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Barrier to green supply chain management: based on the developing countries

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Abstract

In recent years, due to the unreasonable use of natural resources by human beings, the pressure on resources and environment has been increasing, so green management has been focused by enterprises and governments. In order to understand the barriers to the development of green supply chain, this paper focuses on the green development of small and medium-sized enterprises in developing countries. By analyzing the development of green supply chain in recent years, this study points out the barriers faced by the development of green supply chain in developing countries, and puts forward some suggestions to solve these barriers. As an emerging economy, the idea of green supply chain management in developing countries is still immature, and there is a lot of waste of resources. Therefore, this study attempts to analyze the relationship between barriers in green supply chain using the method of Interpretive Structural Modeling(ISM), and divides 22 barriers into six levels. Enterprises are facing difficulties in raising funds and financial difficulties, lack of government support for green supply chain, and the imperfect supervision system of citizens' participation in environmental pollution are the main barriers to the development of green supply chain. In addition, this study can also help decision makers to make development strategies and solve problems in time.

Keywords

Green supply chain, Barriers, ISM's.

1. Introduction

Globally, the increase of extreme weather, the intensification of natural disasters and ecological degradation make the green supply chain management increasingly indispensable. As the direction of supply chain development, green supply chain has become a strategic task for the industrial development of various countries[1]. For example, China, as a developing country, has begun to adjust its economic structure to protect the environment, save energy and reduce emissions. With the cooperation among China's foreign trade organizations and green supply chain participants increasing, the innovation performance of the organizations will be improved[2]. Despite the high initial investments for green supply chain management(GSCM) practices adoption, the benefits, namely energy-saving, waste reduction ,operational efficiency and customer image improvement, can outweigh the costs[3], This also caused the slow development of GSCM. Currently, protecting natural resources, reducing waste and minimizing energy consumption have become the main focus of green supply chain management[4] .Green supply chain management is not only committed to the sustainable development of companies, but also regarded as an important factor for environmental improvement[5]. Hence, many enterprises are implementing green supply chain to improve environmental performance.
Following Maditati et al.(2018)[6], in the present study:First, we focus on industries other than manufacturing, and pay close attention to small and medium-sized enterprises; Second, we

focus on developing countries or low-income countries in terms of countries and regions; Third. The suppliers and other stakeholders are considered. According to Seuring and Gold(2013)[7]:there are few studies about environmental sustainability in developing countries. Henan province of China is in a backward area of green economic development, but it is the key to ecological protection and high-quality development in the Yellow River Basin[8]. As an inland area of China, it has strong research significance, than, this paper takes the Small and medium enterprises (SMEs) in Henan Province as the main reference point. This study examines barriers to green supply chain through expert discussions and literature review, and analyzes the key barriers faced by developing countries in green supply chain. In addition, this study considers the impacts of each barrier on supply chain management through hierarchical clustering analysis. Finally, it discusses the reasons for the barriers so as to solve environmental pollution and other problems.

This study adds new ideas and contents to the barriers to the development of GSCM in emerging economies. At present, China is in the transitional period of green development, and this study will help the government to implement green decision-making so that decision-makers can grasp the main contradictions and make a more accurate assessment. By analyzing the barriers of green supply chain in developing countries, this paper finds out the barriers faced by suppliers in green development, and obtains the key barriers of green supply chain. The results show that enterprises are facing difficulties in raising funds and financial difficulties, lack of government support for green supply chain and the supervision system of citizens' participation in environmental pollution is not perfect is the most important barrier, and it is also considered as the first barrier to be solved.

2. literature review

2.1. Background of GSGM implementation in enterprises

Since the 1990s, companies have become more aware of the need to implement environmental strategies. This change was in part driven by the growing pressure exerted by various stakeholders, namely, clients and governments[9]. In recent years, China's green supply chain management practice is better concentrated in large enterprises, and the implementation level of small and medium-sized enterprises needs to be optimized. In addition, the government began to attach importance to green development, stepped up the pace of promoting green supply chain management, and also promoted enterprises to carry out green supply chain management construction.

Through a series of promotion, The development of green supply chain by leading enterprises is already on a large scale. In the operation of modern enterprises, due to the lack of green supply chain and the increase of residents' awareness of green environmental protection, environmental protection has become the primary goal of enterprise development. Yadlapalli et al.(2018)[10]argued that adopting forms of sustainability in the supply chain has been shown to increase a firm's competitiveness, Mani et al.(2020)[11]found a positive relationship between social sustainability efforts in SME's supply chain and supply chain performance, and environmental performance is positively related to economic performance. The implementation of environmental strategy by small and medium-sized enterprises is also irreversible.

Whether GSCM brings positive or negative economic performance is still controversial, but depending on China's national conditions and development needs, it brings positive economic performance to China. The aim of GSCM is to reduce costs and resource consumption, decreased environmental pollution through green production, improved market share, stronger brand image, and increased economic performance by improving environmental and social performance[12]. The purpose of this article is to assist inland enterprises and governments in

developing countries like China to recognize the importance of green supply chain and identify the barriers to the development of green supply chain, so as to formulate appropriate development strategies, Better develop GSCM.

2.2. barriers to the development of GSCM

Many experts and scholars have discussed the barriers to the implementation of green supply chain. Ghazilla et al.(2015)[13]identified 39 drivers and 64 barriers for small and medium-sized enterprises in Malaysia to implement green production practices, which showed that improving corporate image, competitiveness and product quality are the key drivers, while weak organizational structure, insufficient R&D and design and testing are the key barriers. Tumpat et al.(2019)[14] found that financial constraints, lack of top management commitment, and complexity in supply chain are the most critical barriers for some of the practitioners, and lack of demand from customers for sustainable products, weak government regulatory system, lack of promotion of sustainable products, and technical obstructions are the commonly accepted important barriers towards green supply chain adoption. Kannan and Haq(2007)[15] committed themselves to traditional supply chain management (TSCM) and sustainable supply chain management (SSCM), and identified 13 barriers faced in India fastener manufacturing. Three barriers, namely environmental protection packaging cost, complex design to reduce resource consumption and lack of clarity of sustainability, are the main barriers SSCM faces. Yang and Lin(2020)[16] analyzed the importance of green innovation and supply chain cooperation in the supply chain environment using ISM method and concluded that environmental regulations were the most important barrier. Jayant and Azhar (2014)[17] analyzed 20 barriers of green supply chain development and ISM analysis, and got the barriers of green development of Indian automobile industry, which provided solutions for enterprises. Mathiyazhagan et al.(2013)[18] also analyzed the barriers of GSCM from the starting point of Indian auto parts manufacturing industry. In the analysis of 26 barriers, the supplier barrier is the dominant one. Majumdar and Sinha(2019)[19] concluded through ISM that complexity of green process and system design is an important factor hindering the green development of textiles in Southeast Asia.

Table 1: Literature description of barriers to the development of GSCM

NO.	Source	Research industry and scope	Important barriers
1	Ghazilla et al.(2015) [13]	Small and medium-sized enterprises in Malaysia	Insufficient R&D and design and testing
2	Tumpa et al.(2019) [14]	Textile industry in Bangladesh	less incentives from the government; lack of government regulations and legislative framework
3	Kannan and Haq(2007)[15]	India in fastener manufacturing	Complex design to reduce resource consumption; lack of clarity of sustainability
4	Yang and Lin(2020)[16]	Automobile firm in southwestern China	Environmental regulations
5	Jayant and Azhar(2014)[17]	Indian auto component manufacturing industries	Lack of government support to adopt GSCM

6	Mathiyazhagan et al.(2013)[18]	Indian auto component manufacturing industries	Supplier barrier
7	Majumdar And Sinha(2019)[19]	Southeast Asian countries textile and apparel industry	Complexity of green process and system design

According to Table 1, at present, there are relatively few studies on the barriers to the development of green supply chain, and the literature research direction tends to southeast Asia and other coastal areas, and the main focus is on labor-intensive industries. In addition, most of the research on the development barriers of GSCM tends to point out the main barriers to the development of enterprises, but there is no specific solution, which is also a big gap in the research. In this process, our research provides a new system optimization method for the green development of inland cities. Therefore, this study adopts the method of questionnaire survey combined with ISM and MICMAC. The research blank is filled, and the innovation goal is realized. First, take the inland areas of developing countries as the main research direction, and check the substantive barriers in all directions of enterprise development, and then by providing valuable information to help decision makers to set policy, solve the barriers. Finally realize the good development of green supply chain management.

3. Research method

3.1. Data collection

This paper collectes 25 barriers of small and medium-sized enterprises through literature review barriers. Because this kind of research is all about small and medium-sized enterprises in one industry, which is of low reference, this paper takes the common problems faced by inland enterprises as research barriers, so as to expand the credibility and utilization rate.. Therefore, this paper distributes 30 questionnaires to the managers of leading domestic inland enterprises. The response rate of 73%.Then 52 questionnaires were sent to SMEs, with a response rate of 60%, Respondents are rated by likert scales. For each barrier, there are five options: "strongly agree", "agree", "not necessarily", "disagree" and "strongly disagree", which are expressed as 5, 4, 3, 2 and 1.Then 3 barriers were removed according to the total score, and 22 barriers were finally determined, as shown in Table 2.

Table 1: Three Scheme comparing

NO	barriers	description	source
A1	Enterprises are facing difficulties in raising funds and financial difficulties.	Transportation is inconvenient in inland areas, with many small and medium-sized enterprises, missing financial support.	[20]
A2	Fear of failure	When green supply chain is adopted, there are failure factors, which will cause financial losses and lead enterprises to lose their competitive advantages.	[21] [22]
A3	Lack of commitment from senior management	Top management's commitment usually determines the overall impacts of environmental practices and plans in their supply chain.	[23] [16]
A4	Lack of green suppliers	Green suppliers are very important in industrial implementation and green development	[14] [24]
A5	Lack of communication and cooperation between enterprises	Due to unreasonable enterprise structure, lack of cooperation among organizations and the restriction of information flow hinders the development of GSCM.	[21] [25]

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A6	The supply chain information network is not perfect	The imperfect information network leads enterprises to pursue their own interests, which result in information incompleteness.	[26]
A7	The coordination between management system and logistics operation is poor	The operation of logistics consists of different industries and regions, and there are also different functional departments to operate. For profit-pursuing, each department makes decisions individually, which leads to difficulties in coordination.	[27]
A8	Lack of core competitiveness	Inland areas are underdeveloped in economy, backward in business model and technology, and most enterprises lack core competitiveness.	[17] [28]
A9	Lack of environmental awareness	The production is to meet the needs of consumers, thus sell more products. The consumers' weak awareness of green environment will hinder the enterprises' enthusiasm to implement green supply chain.	[29]
A10	Lack of government support for green supply chain	Governmental interventions play an important role in promoting green manufacturing and building GSCs for enterprises to achieve cleaner production.	[30] [31]
A11	The supervision system of citizens' participation in environmental pollution is not perfect.	As the main force of ecological development, public participation in green supervision system is more conducive to make up for the defects and deficiencies of government supervision. The imperfection of supervision system has also caused the blockage of residents' supervision channels.	[32]
A12	Enterprise chain-jumping amidst competition between supply chains	The behavior of a node enterprise from integration to dissociation or from dissociation to integration of a certain supply chain is called chain jumping. Driven by interests, the enterprise ignores the status quo of suppliers and blindly cooperates. Suppliers refuse to cooperate, thus increasing the risks of enterprises and hindering the needs of green development of enterprises.	[33]
A13	Environmental publicity and education efforts are scarce.	The government's propaganda is insufficient to let consumers understand the green supply chain,and leads them to pursue green enjoyment.	[34] [35]
A14	Ambiguous correlation between emission reduction and economic benefits	The economic benefits of green supply chain management are not quantified systematically, and enterprises cannot see how much economic benefits can be brought by implementing green supply chain. There are worries from enterprises to implement GSCM, which hinders the development of green supply chain.	[36]
A15	The cost of waste disposal is high	Nowadays, the cost and pollution of waste disposal are serious, and high cost is needed to treat it.	[37] [17]
A16	Environmental protection packaging costs high	The environmental protection packaging materials need a large amount of capital and manpower investment, with high upfront capital cost and long recovery cycle.	[38] [31]
A17	High implementation and maintenance costs	The development of China's green supply chain is still in the initial stage, so the implementation cost is relatively high. In addition, the facilities and equipment are in in low level, and a large amount of maintenance costs are needed in the later stage.	[38]

A18	Fear of high investment and low return on investment	The cost of green supply chain is high in the early stage, and some firms think that the development of green supply chain will increase the cost of enterprises and fear the low rate of return in the later stage.	[32] [17]
A19	Less green advertising	Because enterprises lack the awareness of green concept, they invest less in green advertising. However, green advertising will enhance brand value and promote the concept of environmental protection.	[34]
A20	Lack of green leading enterprises and industrial parks	Inland areas have less economic influence, and its financial revenue and scientific and technological achievements are also in a backward position. the development of green industrial parks is slow and the industrial coupling degree of industrial parks is low.	[39]
A21	Lack of technical support and data processing	Science and technology as an important pillar of supply chain development, the imperfect information technology leads to the slow development of supply chain and lack of competitiveness.	[40]
A22	Exclusivity of international green barriers	Green trade barriers have the greatest impact on developing countries, affecting trade exports and hindering the development of suppliers	[41]

3.2. Research method

In order to analyze the development barriers of GSCM in China's inland areas, this paper utilizes ISM combined with MICMAC. Because of the interconnectedness of barriers, it is difficult for policy makers to grasp the key problem when making decisions. ISM, as a modeling technique, is devoted to the ordering of structural relations among various barriers. ISM is a communication tool developed for complex situations, and is also formulated as a mediation channel for complex problems among barriers[42]. It can be applied to various disciplines. For example, Wang et al.[43] analyzed the main contributing factors of ship stranding accident through ISM; Kumar and Dixit[25] employed an ISM and Decision Making Trail and Evaluation Laboratory (DEMATEL) for understanding the hierarchal and contextual relationship structure among the barriers of e-waste management. The steps are shown in Fig 1. MICMAC method combined with the ISM are used to discuss the barriers hindering the development of the main factors, through the driving and dependence power to describe the interaction between disorder state.

4. An interpretive structural modeling (ISM) approach

To establish a structured ISM, first ,the components should be selected, and the context between any two elements should be determined. Kadam and Bandyopadhyay[62] mentioned that ISM gives hierarchical relationship among the constructs of the process/operations, which helps to visualize the structure within a system considering outcomes and enablers. The method of determining the relationship between two factors is implemented in management skills, such as brainstorming, in which experts express their opinions on the relationship between two factors. If opinions differ, experts should explain their understanding one by one, and then the final position is determined according to the voting. By this way, we can find the contextual relationship among barriers. The determined context is shown in Table 3.

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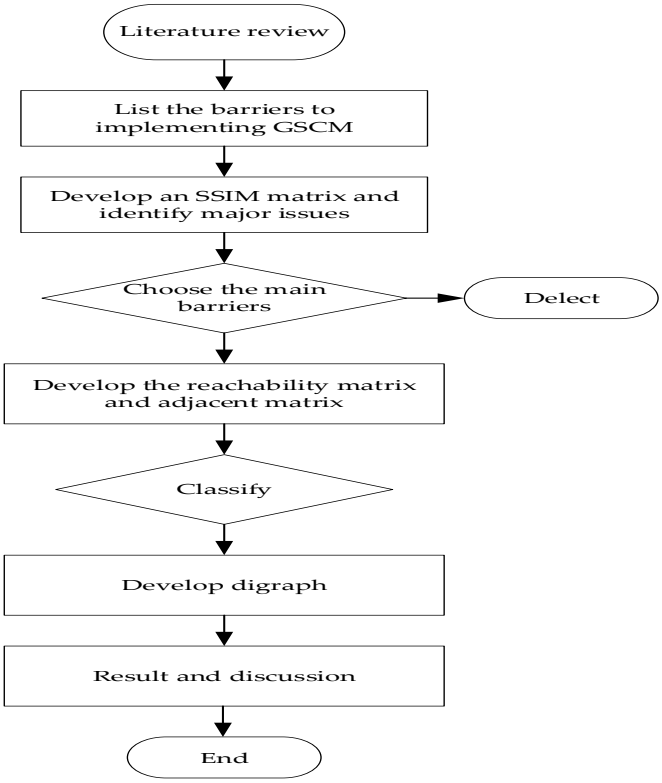

Figure 1: Flow chart for preparing ISM model in the early stage

4.1. Structural self-interaction matrix (SSIM) development

There is a mutual relationship between two variables. The structured self-interaction matrix uses the following four symbols to represent the mutual relations:

(1)V---If element 'Ai' helps to achieve element 'Aj';

(2)A--- If element 'Aj' helps to achieve element 'Ai';

(3)X--- If element 'Ai' and 'Aj' helps to achieve each other.

(4)O--- Element Ai and Aj are not related to each other.

Table 3: Structure Self-interaction Matrix (SSIM)

barrier	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	A12	A13	A14	A15	A16	A17	A18	A19	A20	A21	A22
A1	A	A	O	O	A	O	X	O	O	O	A	O	O	A	O	O	O	A	O	A	O
A2		A	O	A	O	O	V	O	V	O	A	O	X	V	V	V	V	O	O	V	V
A3			V	X	0	O	O	V	V	O	O	V	V	O	O	O	V	O	X	O	V
A4				O	O	O	O	V	V	O	O	V	V	X	O	V	O	O	X	O	O
A5					A	A	V	O	O	O	O	O	V	O	O	V	O	A	A	O	O
A6						A	O	O	O	O	A	O	O	O	O	A	A	O	A	A	A
A7							O	O	O	O	O	O	O	O	A	A	A	O	V	O	A
A8								O	O	O	A	O	O	O	O	O	A	O	O	O	O
A9									X	X	O	X	O	A	O	O	O	O	O	O	O
A10										X	O	X	A	O	O	A	A	O	A	A	O
A11											O	A	A	A	O	O	O	O	A	O	O
A12												X	O	O	O	O	O	O	O	V	V
A13													O	A	O	O	O	X	V	O	O
A14														O	O	O	X	A	A	V	O

A15															O	O	A	O	A	V	O
A16																V	A	O	A	V	A
A17																	A	A	A	V	A
A18																		A	A	V	O
A19																			O	O	O
A20																				O	O
A21																					A

For example, enterprises are afraid of failure because of the difficulty in fund-raising and financial constraints. The relationship between them marked as A; The lack of government support for the green supply chain from the top management, which is marked as V; The interaction between poor environmental publicity and consumers' lack of green awareness and pressure is marked as X; If consumer's lack of awareness of green has nothing to do with pressure, difficulty in raising funds and financial constraints, then it is marked as O.

4.2. Initial reachability matrix

Initial reachability Matrix is established based on SSIM. The relationship between each barrier in SSIM is converted into binary numbers (0,1) to develop accessibility matrix. where 1 indicates that there is a mutual influence or driving relationship between two barriers; and 0 indicates that two barriers do not influence each other's related relationship. The following are some rules of SSIM conversion:

(1)In SSIM, the entry is V, then in the reachability matrix;(i, j) is 1, and (j, i) is 0.

(2)In SSIM, the entry is A, then in reachability matrix; (i, j) is 0, and (j, i) is 1.

(3)In SSIM, the entry is x, then in reachability matrix; (i, j) and (j, i) are both 1.

(4)In SSIM, the entry is O, then in reachability matrix; (i, j) and (j, i) are both 0. The formula (1) is expressed as:

$$Aij = \begin{cases} 1 & AiRAj \quad \underline{R} \quad Ai \text{ and } Aj \text{ have a relationship} \\ 0 & Ai\overline{R}Aj \quad \overline{R} \quad Ai \text{ and } Aj \text{ nonexistence relationship} \end{cases} \tag{1}$$

4.3. Formation of ISM based model

According to the final accessibility matrix, all the influencing factors of barriers are demonstrated, and the reachable and the antecedent set of barriers are formed. C(Ai) is composed of all elements with matrix 1 in Ai row. R(Ai) is composed of all elements with matrix 1 in Aj Column. Elements with the same accessibility and intersection are divided into a set F(Ai). Then, 22 barriers are graded horizontally according to the antecedent set and intersection.

$$C(Ai) = \{Ai | Ai \in A, \quad rij = 1\} \tag{2}$$

$$R(Ai) = \{Ai | Ai \in A, \quad rji = 1\} \tag{3}$$

$$F(Ai) = R(Ai) \cap C(Ai) \tag{4}$$

ISM model is presented by the combination of hierarchical partition table and directed graph, which can clearly know the hierarchical relationship among barriers. The partition in Fig.2 represents the Interpretive Structural Modeling of factors, which depicts the directed graph among barriers to the green supply chains in developing countries, and they can be divided into six levels. Enterprises are facing difficulties in raising funds and financial difficulties(A1), lack of government support for green supply chain(A10) and the supervision system of citizens' participation in environmental pollution is not perfect(A11) as the key barriers to the development of GSCM, are higher-level barriers, which are located at the top of ISM. It can be

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seen that the development of GSCM needs the Co-operation of enterprises, government and citizens.

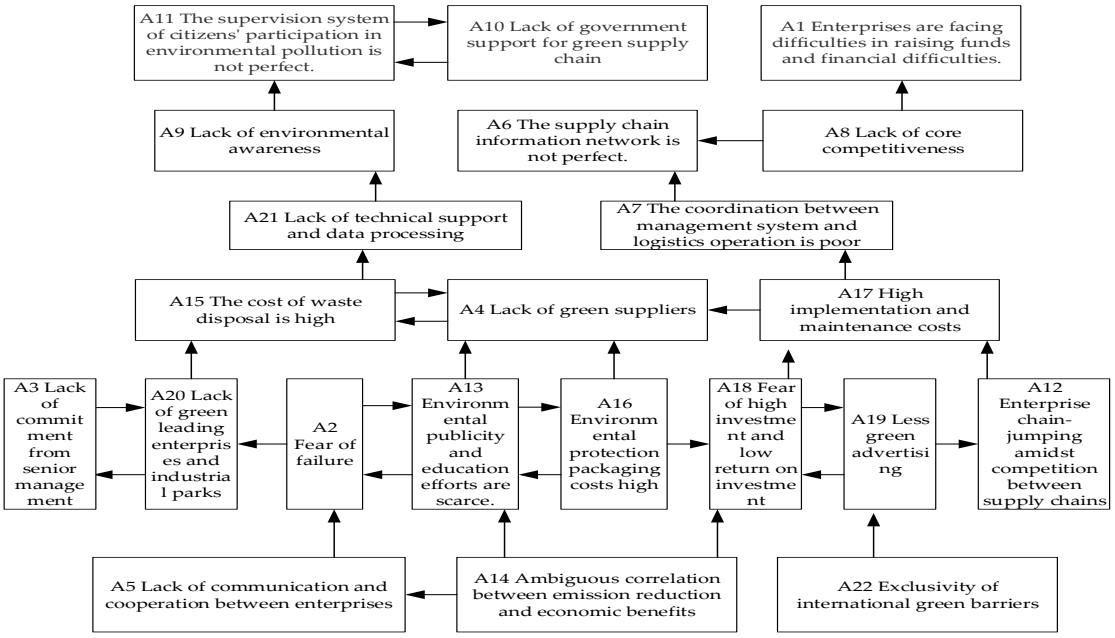

Figure 2: Directed graph of green supply chain barriers

4.4. MICMAC method

The application of the matrix of cross-impact multiple application to classification MICMAC method helps us to understand the project execution matrix multiplication and analyze the multi-sensor interoperability[44].MICMAC mainly displays the identified results of analysis through coordinate orientation. The abscissa represents dependency and the ordinate depicts drivability. Its drive and dependence are determined by the number of elements in the antecedent and reachable set of the final reachable matrix. According to barrier coordinates, it is divided into four parts : spontaneity, linkage, independence and dependence. For example, there are four barriers in quadrant 4, namely, the driving force of the lack of commitment from senior management (A3) is 9, the dependency is 22, the driving force of the enterprise chain-jumping amidst competition between supply chains(A12) is 8, and the dependency is 20. Fear of high investment and low return on investment (A18) and less green advertising(A19), The main purpose of this section is to determine the key enabling factors of driving systems in different categories by evaluating the driving force and dependence of these barriers.

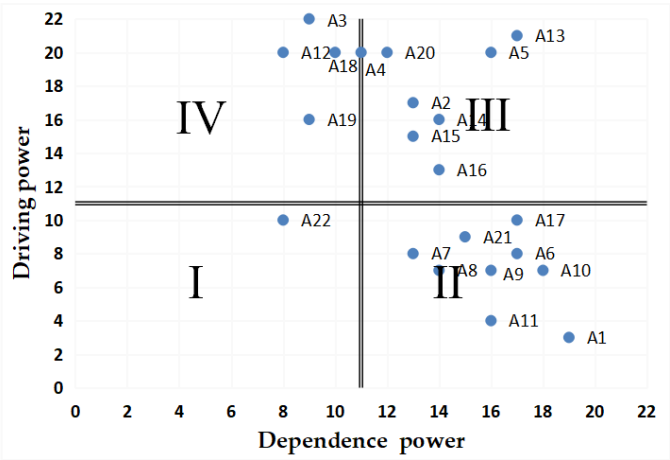

Figure 3: Barrier cluster for GSCM implementation

From Fig.3, the barriers under the first part have weak driving and dependence force, so they are called autonomous enablers. These autonomous enablers will not interfere with the whole

system or be interfered. This study has only one independent factor: exclusivity of international green barriers(A22). Autonomous factors have weak dependence and driving force, which exert relatively minimal impact on the system[13]. Exclusivity of international green barriers(A22) is an international barrier and has less connection with the system.

The barriers under the second part have high dependence power but low driving force, so they are regarded as dependency barriers. Most of these barriers are at the top of the core layer of ISM and can be controlled by its associated barriers, Nevertheless, this article offers some Suggestions.. For example, enterprises are facing difficulties in raising funds and financial difficulties(A1). As the foundation of enterprise operation, financial funds should be given the priority during the enterprise reform. The enterprise lack of core competitiveness(A8), the enterprise must learn to use the modern science and technology, strengthens the information technology development and the application, fosters the enterprise core product.

This category of barriers has high driving as well as dependence power. Barriers belonging to this category are not stable because any step taken on them can affect the system due to feedback effect[45]. Lack of communication and cooperation between enterprises (A5), fear of failure (A2), ambiguous correlation between emission reduction and economic benefits (A14)and others are all between highly driven and dependent clusters. They are also the barriers with the highest research value, because these barriers are unstable, and any actions they take will have an impact on others and will also have a feedback effect on themselves.

As a potential solution to improve environmental performance, green supply chain management is also conducive to the needs of industrial upgrading and information development. According to the discussion in Section 5, lack of communication and cooperation between enterprises(A5), ambiguous correlation between emission reduction and economic benefits(A14), exclusivity of international green barriers(A22), as the bottom of the chart, they are direct factors and will push all other issues forward. For SMEs, the risk of green supply chain is mainly due to insufficient funds and suppliers. so we analyze the driving force and dependency in the study, which implis the complexity of implementing green supply chain. In the study, we find that enterprises and suppliers ignore the green supply chain and the lack of cooperation with green supply chain.

5. Conclusion

In the study, we confirm that GSCM has a positive impact on developing countries. Green development in developing countries is the most important part of green environmental protection. Therefore, GSCM is particularly important in developing countries. Among the 22 barriers considered in this study, the correlation between barriers is analyzed through ISM and MICMAC. In ISM, barriers were divided into six levels. The most important barrier is difficulties in raising funds and financial, lack of government support for green supply chain and the supervision system of citizens' participation in environmental pollution is not perfect. These barriers have less impacts on other barriers and should be addressed firstly. Therefore, this paper argues that enterprises should cooperate with suppliers to enhance their green image. Government should encourage the public to join on green environmental protection. In addition, the small and medium-sized enterprises should be supported to develop green production. From the perspective of long-term development, green supply chain can achieve a win-win situation between economy and environment, lay a foundation for related enterprises and enhance the brand effect of enterprises.

There are several limitations in the study. First, only 22 major barriers were considered. Second, this paper only considers the barriers of supply chain development in inland enterprises of developing countries, which is small in scope and the considerations are not particularly comprehensive. Third, the barriers analyzed in this paper mainly contain barriers of

enterprises. Fourth, it lacks the supplement to the influencing factors and logical relations of green supply chain. Therefore, in our future research, on the one hand, we will explore more variables to study, and on the other hand, we may consider choosing an industrial sector to design a dynamic model. Finally, other analysis methods will be integrated to evaluate and judge green supply chain management from multiple angles.

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