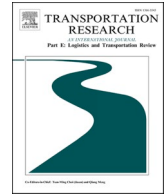




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## How to enhance the effects of the green supply chain management strategy in the organization: A diffusion process perspective

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### ABSTRACT

Although green supply chain management strategy (GSCMS) plays an important role in the development of firms, there is still uncertainty about how to achieve a win–win between environmental and financial performance during the GSCMS diffusion process (e.g., the preparation stage and development stage). Thus, this study firstly examines whether the effects of the GSCMS on firm profits in different diffusion stages vary. Then, we test the moderating effect of the green initiatives (i.e., internal green certification, green cooperation improvement with the suppliers, green recovery with governments and green improvement with customers), operational process and business strategy on the effectiveness of GSCMS during the diffusion process. Based on 140 event samples over a time span of 19 years (i.e., 2001–2018), this study finds that the firms' financial benefits decreased in GSCMS preparation stage and then increased in the development stage. Two green initiatives (i.e., green recovery with governments and green cooperation with suppliers), the differentiation strategy and process standardization, have positive influence on GSCMS diffusing in preparation stage. So, wisely using appropriate green initiatives, operational process and business strategy can mitigate the dark side of GSCMS in short-term and achieve a win–win between environmental and financial performance in the long term. These findings enrich the green supply chain literature and diffusion theory, and provide practical implications for firms to adopt environmental management strategies and offer some guidelines for governments to formulate environment management policies.

### 1. Introduction

The institutions relevant to environmental protection have been continuously issuing some new regulations for environmental protection (Wong et al., 2020), for example, Chinese governments issued environmental protection plan as an important national strategic plan and policy. Also, many global companies such as Apple, Motorola, Pepsi, and Walmart require Chinese manufacturers to develop ISO 14001 environmental management systems and disclose the environmental audit results to the public (Pourjavad and Shahin, 2020). Therefore these manufacturers face huge pressure from their supply chain partners to continuously improve their green performance (Villena and Dhanorkar, 2020). In addition, manufacturers are often under mimetic pressures from competitors to adopt

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similar or more advanced environmental management practices (Yang et al., 2019). Thus, under pressures from the governments, suppliers and competitors, many enterprises have realized the importance and urgency of environmental management and made huge efforts to adopt Green Supply Chain Management Strategy (GSCMS) (Kalyar et al., 2019).

GSCMS is an operational-level strategy, which aims to help companies achieve a win-win situation between financial and environmental performance by conducting a series of environmental management practices over the entire supply chain (Olayeni et al., 2021). Many companies have been successful in improving their performance by conducting GSCMS. For example, General Motors is an American multinational automotive manufacturing company, which reduces its disposal costs about \$12 million by setting up a reusable container program with suppliers (Murray, 2019). Also, some recent studies have demonstrated that GSCMS can help firms improve their performance (Geng et al., 2017). However, such these implications have been challenged by (Liu et al., 2020) that emphasized the investment in green technologies is so large that it may not bring about positive changes in short term. Indeed, some literature argue that the adoption of green strategy has a preparation stage that requires more capital in process innovation and incurs some organizational changes that can serve efficient undertaking of the related activities in this stage (Feng et al., 2022). Arthur D. Little, Inc., which is one of the most famous consultancies in the world, claims that organizations' general profit is often not enough to offset technology and new-process investment at the preparation stage (Juan et al., 2022). Above all, this study examines the effect of GSCMS on firms' financial performance in two stages, i.e. preparation stage and development stage. There is a diffusion process undergoing from the preparation stage and the development stage, where ideas and plans of the green practices of GSCMS are diffused into decisions and activities in daily and operational routines. Based on diffusion theory (Zhang et al., 2019), this study examines how three different organization diffusing aspects of GSCMS (see Fig. 1) i.e. strategy, operational process and green initiatives can improve the diffusion effectiveness of GSCMS (Meqdadi et al., 2020).

Current literature on green supply chain management practices (e.g., Farooque et al., 2022; Wong et al., 2020) are concerned with a number of initiatives including green suppliers certification, direct investment, lean production, green cooperation innovation, customers cooperation, internal environmental management, external green supply chain management, ISO 14001 system certification, investment recovery and ecological design. (Liu et al., 2021) classify these green initiatives into four categories from a supply chain network perspective, i.e., environmental system certification, green cooperation improvement with suppliers, green improvement with customers and green recovery with governments. This classification approach is comprehensive covering a wide range of initiatives from internal processes to external collaboration with stakeholders (i.e. governments, suppliers and customers) and has been widely adopted to facilitate conceptualization in the prior literature. Thus, in our study, based on Liu et al. (2021), we classify our key green initiatives into four categories from supply chain perspective, i.e., internal green supply chain management activities (i.e. green system certification aiming to reduce pollutant generation, emissions and environmental impact from the whole supply chain) and external activities (i.e., green cooperation improvement with suppliers, green recovery with governments and green improvement with customers). These four initiatives comprehensively pertain to an organization's supply chain activities from downstream with suppliers to upstream concerning customers, from internal operations to external governments collaboration.

There are many studies that focus on the effects of these green initiatives on performance outcomes (Song et al., 2022). Some studies relevant to these initiatives indicate that they can enhance their operational performance and financial performance due to green identities among organizations and less energy consumption in the long term (Wong et al., 2020). Other studies found a negative

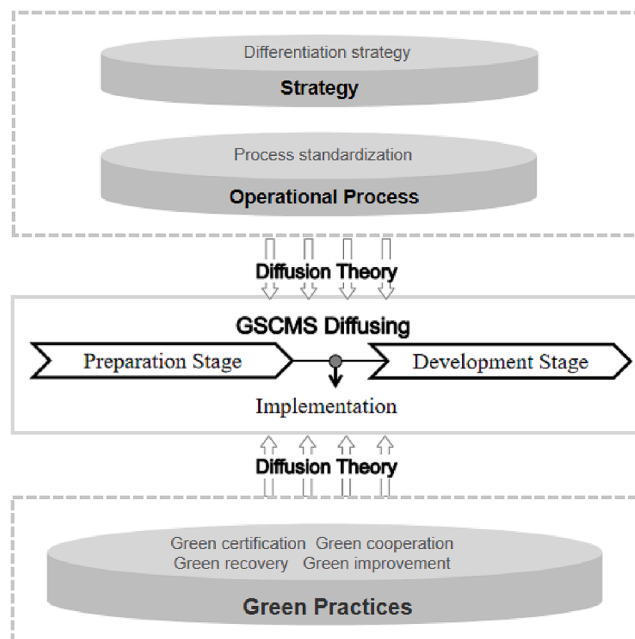


Fig. 1. The system analysis of GSCMS diffusion.

relationship between green practices and corporate financial performance, which are due to the higher cost of applying more environmental-friendly materials and technologies in early stage (Feng et al., 2022). Such mixed results and conclusions could be attributed to the reason that they only focus on the effects of green strategies in a certain stage of implementation by using cross-sectional data. Thus, it is necessary to examine the potential changes in the financial performance of green strategies during the diffusion process and how different organizational factors affect GSCMS implementation in this process.

In addition, strategies and processes are playing an important role in the diffusion process of GSCMS (Xu et al., 2017). The literature on environment management has indicated that there are conflicts between environmental and other strategies such as cost leadership strategy (Tran et al., 2020). Specifically, the cost leadership strategy aims to reduce operational costs and produce products with a low price, but the green strategy always necessitates high investments in technology innovation and high costs on advertising about introducing ecological features of green products to the public in the competitive market (Feng et al., 2022). Besides, operational process could determine the daily routine activities in green strategy diffusion. For example, Hilton company has reduced energy and carbon intensity and has cumulatively saved the equivalent of USD 1 billion by following a standard process (i.e. ISO9000) across all its properties (Elizabeth, 2018). Hence, we also need to examine if the diffusion of green strategy can be facilitated by business strategy and the operational process in order to achieve effective diffusion in the stages during the adoption of GSCMS.

In order to help companies adopt and diffuse green strategy effectively, this study attempts to address the following questions: (1) Does the GSCMS lead to a negative firm performance in the preparation stage and a positive firm performance in the development stage? (2) How different green initiatives (i.e., internal green certification, green cooperation improvement with suppliers, green recovery with governments and green improvement with customers) can facilitate GSCMS diffusion? (3) How can the strategic factor and operational process facilitate the diffusion of GSCMS? Based on the green supply chain management literature and diffusion theory, we posited several relevant hypotheses (see Fig. 2) and then examined them by analyzing the longitudinal data (i.e., 140 samples of events) covering the period from 2001 to 2018. Our findings enrich the green supply chain literature by indicating how different green supply chain management initiatives, the business strategy and the operational process can foster GSCMS diffusion into organizations based on the diffusion theory. Also, we develop specific guidelines to manufacturers and governments on how to accelerate GSCMS diffusion in different contexts.

## 2. Theoretical background

### 2.1. The green supply chain management strategy

Table 1 shows main conclusions about the literature relevant with green supply chain management strategy (GSCMS). The literature indicates that green supply chain management refers to supply chain participants' cooperation in the adoption of green innovation in order to achieve sustainability in the entire product life concerning the products and processes in the supply chain (e.g., material purchasing, product designing, manufacturing, marketing, recycling and re-manufacturing) and reduce the negative environmental impact (Liu et al., 2020), mainly including internal environmental management in the organization (i.e., green training) and external green management with customers and suppliers (e.g., green design, green purchasing and investment recovery) (Liu et al., 2020; Shou et al., 2020). More companies have perceived green supply chain management as an operational level strategy which

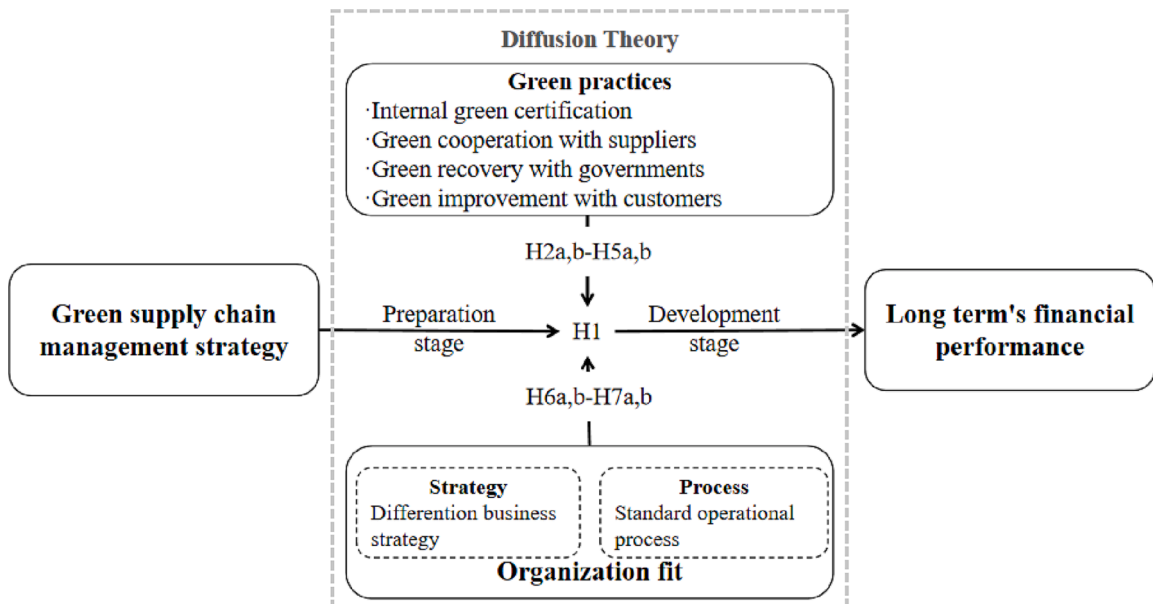


Fig. 2. The conceptual model.

**Table 1**  
The literature about Green Supply Chain Management Strategy.

GSCMS research contents	Main contents	Literature
	Coordination in multiple green supply chain management practices	(Liu et al., 2020; Yang et al., 2019)
	Under pressure from institute theory	(Ahmed and Shafiq, 2022)
	Advanced technology and innovation	(Feng et al., 2022)
	Environmental and finance performance	(Jassim et al., 2020)
GSCMS research method	Empirical research	
	Drivers of GSCMS (i.e. pressure)	(Kalyar et al., 2019)
	Technology with GSCMS (i.e. green exhaustion)	(Esmailian et al., 2020)
	Mathematical research	
	Equilibrium models	(Rebs et al., 2019)
	Multi-criteria decision making	(Bellamy et al., 2020)
	Analytical hierarchy process	

refers to implementing both internal and external green supply chain management initiatives strategically through integrating green initiatives and environmental considerations with corporate-level plans and decisions. This strategy helps companies to achieve the economic, social and environmental benefits by advanced technologies, high efficiency in the coordination and control of logistics, information flow and cash flow (Alexandrou et al., 2022). In this study, we consider the effectiveness of green supply chain management and the relevant moderating factors from a strategic perspective.

The rapid development of green supply chain management has been shown in both empirical and mathematical model research (Rebs et al., 2019; Ahmed and Shafiq, 2022). Empirical studies mainly focus on the drivers of adopting green supply chain management, including regulations, competition and marketing pressure (Yang et al., 2019). Also, some studies emphasized that innovation technologies plays an important role in developing the practices of green supply chain management (Bellamy et al., 2020), which includes block chain, big data and 5G and other technologies (Esmailian et al., 2020; Wu and Chiu, 2015; Li et al., 2022). With regards to studies employing modeling, most of them focus on supply chain network design and suppliers selection for green supply chain management by applying three dominant approaches, i.e. game theory, equilibrium models, multi-criteria decision making and analytical hierarchical process (Bellamy et al., 2020; Lai et al., 2023). Overall, the existing literature have demonstrated some key factors influencing green strategy implementation in the enterprises (Olayeni et al., 2021). However, there are few studies that consider how these factors can influence the efficiency of the diffusion process of GSCMS in different stages. Thus, it is necessary to test which factors could facilitate the diffusion of GSCMS in organizations.

### 2.2. Diffusion theory and green strategy diffusion

Diffusion theory refers to the process that occurs as people or organizations adopt some new things (e.g., new idea, product, technology, practice and philosophy) to create critical value for the company (Del et al., 2021). In the prior studies, diffusion theory indeed has been applied to examine how, why, and at what rate new ideas and technologies diffuse into an organization or across organizations (Del et al., 2021). In recent years, part of literature about diffusion theory has begun to consider whether some organizational factors and practices are complementary to the new things and can facilitate them to create higher values (e.g., Prajogo et al., 2014; Zhang et al., 2019). These diffusion-related factors can be classified as initiative level, operational level and strategic level in organizations and involve different firms' stakeholders (e.g., suppliers, customers and governments) (Choi et al., 2016). In the initiative level, the main factors are related to firms' specific activities (e.g., co-design, joint purchasing and manager support) to make new strategy diffuse smoothly (Meqdadi et al., 2020; Chen and Liang, 2023). In the operations level, the main factors are related to process management (e.g., standard and transparent process) (Chen et al., 2018; Meqdadi et al., 2020). In the strategic level, the main factors are related to business strategy (e.g., mentoring strategy, differentiation strategy, marketing strategy) (Tran et al., 2020; Meqdadi et al., 2020). Thus, in our study, based on the literature of diffusion theory, we consider the factors influencing the green strategy diffusion from three levels (i.e. initiatives, strategy, and process) (see Table 2).

Specifically, GSCMS initiatives pertain to the set of actions to transfer and disseminate environmental management knowledge through the entire supply chain (Zhang et al., 2023). In our study, we classify four main types of GSCMS initiatives (e.g., environmental system certification, green cooperation with suppliers, green recovery with governments and green improvement with customers).

**Table 2**  
Related factors about GSCMS diffusion.

Diffusion Theory	Related factors	GSCMS diffusion related factors
Initiative level	Cooperation with partners (e.g., co-design, joint purchasing and cooperation support)	Environmental system certification; green cooperation with suppliers; green recovery with governments and green improvement with customers
Operational level	Organizational process management (e.g., standard process, transparent process)	Process standardization
Strategic level	Business strategy (e.g., mentoring strategy, differentiation strategy, marketing strategy)	Differentiation strategy

Specifically, environmental system certification refers to the third-party offering monitored systems and control standards for the pollution emission and environmental protection of the whole supply chain. Green cooperation with suppliers refers that firms cooperate with suppliers, to share the costs and benefits from technology innovations (Ahmed and Shafiq, 2022). Green recovery with the governments refers that companies implement recycling materials and products initiatives and establishing recycling system under the governments support through funding and policies (Bellamy et al., 2020; Niu et al., 2022). Green improvement with customers refers that firms' cooperating with the customers are committed to environmental protection by green design, green procurement and volunteer activities relating to environmental protection (Zhu et al., 2017). Thus, we need to examine the effects of four green initiatives (i.e., green certification, green cooperation with suppliers, green recovery with governments and green improvement with customers) on GSCMS diffusion.

Strategy and process management could be considered as strategic or operational level factors facilitating the effect of green supply chain management strategy diffusion (Zhu et al., 2012). GSCMS includes investments in advanced technology and producing green products, which are suitable to the strategic position concerning the use of differentiated products to increase the financial performance for organizations. As one of the major business strategies, the differentiation strategy aims to develop products and services with unique qualities to fulfill customers' desires and allow the company to receive a price premium (Danso et al., 2019). The underlying principles of GSCMS and differentiation strategy are similar in that they pertain to investments and innovations for achieving unique attributes of process and products (Danso et al., 2019). Also, process standardization can be applied to effectively reduce the pollution and waste during the manufacturing process (Jiang et al., 2020). This supports the aim of GSCMS and helps to achieve a balance between environmental performance and financial performance (Ahmed and Shafiq, 2022). Thus, the success of GSCMS diffusion in an organization may be related to business strategies in the form of the differentiation strategy and firms' process management with respect to process standardization.

### 3. Hypotheses development

#### 3.1. GSCMS and financial performance

According to diffusion theory, firms may experience diffusion process of new strategies in deployment stage to adjust their organization structure, business strategy and process (Altaf et al., 2020). Indeed, prior literature on green management proposes that green strategy could experience the diffusion process in organizations (i.e., preparation stage and development stage) (Zhang et al., 2019). Specifically, in the preparation stage, companies need to invest much capital in GSCMS preparation activities (e.g., employee training, purchasing and adjusting new eco-friendly equipment, designing green products), thereby causing a negative impact on companies' finance performance (Duque-Grisales and Aguilera-Caracuel, 2021). In development stage, GSCMS can improve the firms' reputation and operational efficiency by continuously adopting the green practices in the operational process (Danso et al., 2019), thereby enhancing firm performance. Some studies indicate that green strategy has a positive impact on green performance, which in turn has a positive impact on organizations' financial performance (e.g., Chen et al., 2018). Thus, considering the whole diffusion stages (i.e., preparation stage and development stage), we argue that GSCMS has different influences on a firm's financial performance at different stages of the diffusion process, we propose:

H1: GSCMS has different influences on a firm's financial performance at different stages of the diffusion process (i.e. preparation stage and development stage).

#### 3.2. Green initiatives and GSCMS diffusion

##### 3.2.1. Internal environmental system certification with GSCMS diffusion

Environmental system certification (i.e., ISO 14000 family) forces a certified organization to comply with the requirements for the implementation of environmental management systems (Jell-Ojobor and Raha, 2022). In the preparation stage, companies with ISO14000 need to employ many advanced systems and technologies (Jell-Ojobor and Raha, 2022), which reduce the cost of buying new equipment and lay a solid technology foundation for developing GSCMS. In the development stage, the employees and managers experience green training from cross-functional departments before using new technologies (Goebel et al., 2018), and the experience of cooperation and communication among different departments play an important role in the success of green strategy (Feng et al., 2022). Therefore, when companies adopt ISO 14000, they could have laid a solid foundation in green knowledge and technology in the internal organization and have an influence on the organizational compatibility of green strategies. Consequently, we propose:

H2: Firms taking environmental system certification could have a greater influence on GSCMS effectiveness at a) the preparation stage and b) the development stage of the diffusion process.

##### 3.2.2. Green cooperation with suppliers and GSCMS diffusion

In order to cope with the changeable environment regulations and standards set by states and environmental protection institutions, more companies have begun to cooperate with their suppliers to conduct green practices (e.g., co-invest green technologies) (Yu et al., 2020). Such cooperation can reduce the cost of conducting green practices and achieve risk sharing in preparation stage (Yu et al., 2020). This is beneficial to the firms and the whole supply chain in facilitating supply chain partners to build innovation ecosystem and conduct more green innovation (Bellamy et al., 2020). In development stage, their cooperation with suppliers can accelerate knowledge sharing and exchange (e.g., using suppliers' patent with low cost and inviting suppliers to evaluate green design) (Ahmed and Shafiq, 2022), which can reduce the loss of knowledge transformation diffusion (Choi et al., 2022). We predict that the

firms' green cooperation with the suppliers could drive companies to promote green strategy diffusion. Therefore, we propose:

H3: The firms taking green cooperation with suppliers could have a greater influence on GSCMS effectiveness in a) the preparation stage and b) the development stage of the diffusion process.

### 3.2.3. Green recovery with the governments and GSCMS diffusion

Green recovery has become an important initiative of reducing the waste of resources for both the governments and the companies. Governments can be key nodes in developing social network with relevant industries by initiating green recovery activities so as to create a wider cooperation system (Potter and Wilhelm, 2020; Niu et al., 2022), which encourages manufacturers' joint innovation in reducing the waste of material (Ilyas et al., 2020). Also, the governments can update knowledge on professional recycling and advanced environmental protection technologies by setting up an authority agency, which can help companies build a deeper innovation system (Mei et al., 2019). Thus, governments' involvement can help companies learn about environmental regulations and advanced green technologies and monitor the effects of firms' green management implementation, thereby facilitating the diffusion of GSCMS. Hence, we propose:

H4: The firms taking green recovery with governments could have a greater influence on GSCMS effectiveness in a) the preparation stage and b) the development stage of the diffusion process.

### 3.2.4. Green improvement with customers and GSCMS diffusion

To integrate green aspects into the entire product life cycle and improve the customers' satisfaction, manufacturers encourage customers to participate in the Eco-design of products. Most of the environmental pollution of products generates from the preparation stage (e.g., R&D stage) (Bellamy et al., 2020; Burki et al., 2019). So, understanding marketing needs accurately can effectively reduce the cost and waste from companies by frequently adjusting product design at this stage (Gelderman et al., 2021; Han et al., 2023). Customer's preference for green products directly influences manager's environmental awareness in development stage. This benefits implementing green strategies in daily operations (Gualandris et al., 2021) and managers with high green awareness could pay much attention to constructing innovative atmosphere that can fully use human resources and platform resources in the organization to accelerate green product innovation by promoting supply chain ecosystem cooperation (Feng et al., 2022). Hence, we propose:

H5: The firms taking green improvement initiatives with customers could have a greater influence on GSCMS effectiveness in a) the preparation stage and b) the development stage of the diffusion process.

## 3.3. GSCMS diffusion and business strategies

Business strategies always include cost-leadership strategy and differentiation strategy, which companies can use to gain a competitive advantage in the market (Tran et al., 2020). Some studies indicate that the implementation effects of green practices on the firms performances may be influenced by some business strategies (Yang et al., 2019). Cost-leadership strategy focuses on product costs reduction by refining and upgrading existing technological knowledge in the relevant market segments (Leonidou et al., 2017). However, GSCMS emphasizes more on companies cooperating with the suppliers, governments and customers, in order to develop green products, enter new market segments and acquire higher premium benefits (Ahmed and Shafiq, 2022). Thus, cost-leadership strategy should have no influence on the green strategy diffusion. The differentiation strategy aims to develop unique and customized products and services, which can fulfill customers' desires and allow the company to receive a price premium (Mohammadi et al., 2019).

The underlying principle of GSCMS and the differentiation strategy is similar in terms of involving innovation to introduce unique attributes of the process and products. Companies with differentiation strategies tend to invest resources in some innovative projects, technology alliances and patents as their intangible assets, so as to gain a competitive advantage. Under this innovative circumstance, companies are more likely to focus on green innovation and could actively promote green technologies and innovation by integrating them into the relevant organizational practices (Bellamy et al., 2020), thereby accelerating the process of GSCMS diffusion and reducing the negative financial impact of the strategy in the preparation stage. In addition, firms could be willing to adjust their product layout, increase the percentage of green products and occupy the optimal ecological position to achieve green competitive advantages in the development stage (Mei et al., 2019). Thus, we proposed that:

H6: The differentiation strategy could positively moderate the effectiveness of GSCMS in a) the preparation stage and b) the development stage of the diffusion process.

## 3.4. GSCMS diffusion and operational process

The standardization process has received much attention at the operational process level. The standardization process is regarded as a process of reaching an agreement on technical and business specifications that are used consistently across a company (Rahimi et al., 2016). This aimed to reduce variability in business processes across corporate subsidiaries by scaling back hardware infrastructure, reducing the number of interfaces, and decreasing support cost (Bellamy et al., 2020). This is similar to the main targets of sustainable supply chain, i.e. reducing the energy use and waste. GSCMS requires the participation of all members in the supply chain, and a standardized process can help them cooperate better (Bellamy et al., 2020).

Standardization process can reduce the cost and efforts on green strategy in the preparation stage. For instance, Hilton Hotel reduced the cost of time and financial on training employees and implementing organization revolutions to pass the ISO standard about green certification after acquiring ISO9000 certification (Elizabeth, 2018). Also, the standardization process can remove the barriers of

cooperation and reduce the cost of adjusting equipments to adapt the management by using information system during the GSCMS preparation stage (Feng et al., 2022). Thus, the ISO9000 certification can reduce the time and cost to implement green practices (e.g., internal green certification). After this stage, the product innovations can create a competitive advantage in emerging markets by allowing companies to better produce their patented technologies and green products and enhancing corporate green knowledge spillovers and financial performances due to collaborative innovation (Choi et al., 2022).

H7: The standardization process can positively moderate the effect of GSCMS diffusion in a) the preparation stage and b) the development stage of the diffusion process.

## 4. Methods

### 4.1. Research setting

The sample unites in our study are publicly listed Chinese manufacturing firms. Firstly, the Chinese government has implemented various kinds of policies and regulations that encourage businesses to adopt green practices. Also, an increasing number of firms in China have implemented green supply chain management initiatives, and such these listed Chinese firms have issued environmental reports publicly to improve their transparency and reputation (Bellamy et al., 2020). In addition, Chinese manufacturers are facing the pressure from overseas buyers to comply with various international green standards or regulations (Goebel et al., 2018). Thus, the context of Chinese manufacturing firms is suitable for examining the effects of GSCMS.

### 4.2. Data collection

We conducted an event study to explore the impacts of GSCMS on the financial performance and the data was collected from Chinese publicly listed firms from 2001 to 2018. Such longitudinal data was collected from multiple sources. Firstly, based on the literature (Liu et al., 2020), we determined the keywords describing the four green initiatives shown in Table 3, and then consulted relevant practical field experts to confirm the validity of the keywords. Secondly, we collected the announcements of implementations of GSCMS from Factiva and Wisenews. Factiva covers the most comprehensive global business news and publicly listed company announcements. Wisenews is a widely used and famous Chinese news database including over 45,000 sources, providing sufficient and suitable news for our study (Lam et al., 2016). We combined the related news from both databases not only to make sure that we almost covered all companies implementing GSCMS and ensured the information reliability.

Green initiatives include four items, i.e., internal green environmental system certification, green cooperation with suppliers, green recovery with the governments and green improvement with customers. Specifically, based on the definition of green cooperation with suppliers, we used descriptions such as “green procurement”, “propose green environmental protection requirements for suppliers”, “joint development of environmental technologies with suppliers” for the relevant activities or practices. The specific examples of news are as follows: “green procurement and suppliers’ joint action, purchasing and promoting supplier system certification work”; “The initial development of the upstream and downstream, production, research, and domestic and foreign integrated research and development system, built a large platform of industry exchange”; “Yuanwang Valley requires suppliers to develop low-carbon energy-saving products and reduce their carbon footprint, and improve communication and environmental awareness and skills of suppliers through communication, experience sharing and training with suppliers”.

The second activity, green recovery with the governments, is searched by the descriptions such as “green recycling topics cooperated between company activities and governments”, “multi-organizational collaborative green product design”, “introducing knowledge of energy-saving and environmental protection technologies to solve the waste problem with the help of institutions”. For

**Table 3**  
Variables Measurement.

Variables	Description	Key words
<i>Dependent variable</i>		
Firm profitability	Abnormal ROA	Not applicable
<i>Independent variables</i>		
Green cooperation with suppliers	Dummy variable (1, adopt green cooperation with suppliers; 0 others)	“green procurement”, “propose green environmental protection requirements for suppliers”, “joint development of environmental technologies with suppliers”
Green recovery with governments	Dummy variable (1, adopt green recovery with governments; 0 others)	“green recycling topics cooperated between company activities and governments”, “multi-organizational collaborative green product design”, “introducing knowledge of energy-saving and environmental protection technologies to solve the waste problem with the help of institutions”
Green improvement with customers	Dummy variable (1, adopt green improvement with customers; 0 others)	“cooperate with customers and implement green purchasing”, “cleaner production priorities built up through customers cooperation”, “customers have the opportunity to participate in green or volunteer activities.”
Green environmental system certification	Dummy variable (1, firms with ISO14001; 0 others)	The certification of ISO14001
Differentiation strategy	Profit margin	Not applicable
Standardization process	Dummy variable (1, firms with ISO9000; 0 others)	The certification of ISO9000

example, some news reports focusing on the adoption of green recovery with governments is as follows: “Under the government’s support, invest a large amount of fund to implement the construction and transformation of clean production programs and reduce treatment devices, strictly control waste gas pollution, and reduce emissions of waste water and solid waste”; “Under the support of institutions, use biophase deinking technology to make office waste paper a substitute for bleachers”.

For green improvement with customers, we used key subscriptions such as “cooperate with customers and implement green purchasing”, “cleaner production priorities built up through customers cooperation”, “customers have the opportunity to participate in the green or volunteer activities”. The specific news examples are as follows: “Honda has now carried out the projects such as afforestation in Inner Mongolia, corporate environment exhibition hall as well as the environmental protection art activities covering the whole value chain”, “Haier has always transfer the concept of environmental protection and integrated it into its product market research, design, manufacturing, sales and recycling process”.

Finally, we used the implementation of ISO 14001 system as the proxy of green environmental system certification, which was collected from the Chinese certification website (<https://cx.cnca.cn>). ISO 14001 is a green certification emphasizes conduct the green practices in the whole supply chain from initial design to final disposal and covers many internal green activities such as green training, green labor, and a paperless office on a daily basis, so it can be seen as a summary of major internal green activities. With regards to other variables (i.e., industry type, operating income, differentiation strategy and ROA) in this study, they were collected from the China Stock Market and Accounting Research (CSMAR) database and Chinese statistics yearbooks, which provided stock information, annual reports of all properly registered Chinese firms and industry classifications. We mainly focus on the four categories (e.g., Electrical machinery and equipment manufacturing, Computer and electronic equipment manufacturing, Chemical raw materials and products manufacturing, Pharmaceutical manufacturing), they all have relatively high pollution emission. After completing the initial data collection process, we further analyzed the data provided and deleted some public opinion articles. We also confirmed the time span of the implementation of each initiative in these samples and removed some firms implementing multiple green practices at the same considered time span, ensuring that they have no overlap in the entire time span examined. In the end, we collected 140 samples covering the period from 2001 to 2018, including 44 samples on the internal green certification, 30 samples on green cooperation with suppliers, 44 samples on green recovery with the governments and 22 samples on green improvement with customers.

#### 4.3. Variable measurement

In this study, the firm’s adoption of GSCMS initiatives (i.e., green environmental system certification, green cooperation with suppliers, green recovery with the governments and green improvement with customers) are developed from the announcements as discussed above. Standardization process, which is reflected by firms’ adoption of ISO9000, is developed based on the website search. Other variables are measured as follows:

*Firm profitability.* It refers to a firm’s value or profit creation. This study adopts return on asset (ROA) (i.e., dividing net profit (including depreciation, interest and taxes) by total assets) to measure profitability (Bellamy et al., 2020). We used abnormal ROA as the dependent variable for financial performance (instead of labor productivity and sales growth) in the cross-sectional hierarchical regression analysis because it is believed to reflect the overall operational effectiveness of organizations and is consistent with recent studies (Swink and Jacobs, 2012)..

*Differentiation strategy.* It refers to the strategic factors determining an organizational production routine that provides unique services or products to achieve customization (Banker et al., 2014; Banker et al., 2011). The firms with such a strategy commonly need achieve a higher gross profit margin to afford the huge expenses in R&D and advertisements of the unique services or products. Also, such a strategy supports firms to achieve high margins by meeting customers’ personalized requirements. Thus, this study follows the method of Banker et al. (2011) and (Fairfield and Yohn, 2001) to adopt common accounting ratio (i.e., profit margin) as the proxy to reflect the differentiated strategic positioning. Profit margin is calculated by the ratio of net profit over net sales.

*Control variables.* We adopted some control variables, i.e. the firm size and industry types. The firms with a larger size could have larger capital and more experience to adopt GSCMS and could have an obvious influence on the firm profitability. Therefore, we controlled the firm size, which is measured by their sales (Lo et al., 2014). Also, based on the classification for manufacturers of (Li and Lin, 2017), this study classified the manufacturers into the four industries (i.e. Electrical machinery and equipment manufacturing, Computer and electronic equipment manufacturing, Chemical raw materials and products manufacturing, and Pharmaceutical manufacturing). We further classified them into two categories by considering their pollutants emission generated according to the Chinese statistics books, i.e. heavy polluted industry and light polluted industry, to control the possible pollution-related effect on the association between financial performance and green practices implementation. While the light industry is well tolerated in residential or commercial areas, the heavy industry often necessitates carrying out complex chemical processes that tend to have a very high impact on the environment. Heavy industry includes processing of coal, oil, or iron, and production of ships, or large and heavy facilities and equipment, whereas light industry is involved with more consumer-oriented products, such as the manufacturing of furniture, apparels and home appliances. We used a dummy variable to indicate heavy or light industry in our study (Ishikawa, 1983).

#### 4.4. Statistics model

##### 4.4.1. Event study for longitudinal analysis

Event study methodology mainly consists of short-term and long-term event study approaches. The short-term event study emphasizes the influence of an event within a relevant short time window. Whereas some specific consecutive events, e.g., innovation experiences multiple long-time intervals that require a dynamic measurement (Yu et al., 2021). Thus, a long-term event study expands



**Table 4**  
Results of event study.

	Year -2 to year -1			Year -1 to year 0			Year -2 to year 0			Year 0 to year 1		
	N	Median	Percentage	N	Median	Percentage	N	Median	Percentage	N	Median	Percentage
ROA	123	0.0026	47.20%	132	-0.117	40.90%	123	-0.0118	43.90%	136	0.0249	80.15%
Statistic		-0.146	-0.541		-2.396**	-2.002**		-2.065**	-1.262		-6.792***	-6.946***

Noted: Z statistics for Wilcoxon Signed test (Median) and sign test (Percentage).

Percentage indicates the percentage of firms achieving positive abnormal changes in ROA.

\*Note a statistically significant different at 0.1 level ( $P < 0.1$ ).

\*\*Note a statistically significant different at 0.05 level ( $P < 0.05$ ).

\*\*\* Note a statistically significant different at 0.01 level ( $P < 0.01$ ).

the time window to analyze consecutive years which can understand how an event affects firm performance over time. Considering that an environmental event can generate long-term expectations of performance and GSCMS needs a long time to get totally diffused in the organization, we used a long-term event study approach to examine the diffusion effect of this strategy. To determine the window duration, this study first defined the year announcement of GSCMS as the event year (year 0). Based on the study concerning the implementation process of ISO series implementation, firms would take around one year to implement a GSCMS prior to announcement (Lo et al., 2014). We defined year  $-1$  as their first year of preparation. Then, the base year of the event (i.e., the years when firms could not experience the event) is defined as year  $-2$ . As this study focuses on the long-term impact of GSCMS, we attempted to explore abnormal performance changes from the base year to the subsequent two years and decided on a window in the analysis that covered year  $-2$ , year  $-1$ , year 0, and year 1. To better identify the period and financial performance in preparation stage, we identify the abnormal performance of companies ( $-2$  to  $-1$  years,  $-1$  to 0 years and  $-2$  to 0 years). We then tested the performance of years 0 to 1 to observe whether the development stage performed as expected.

Based on prior event studies (e.g., Lo et al., 2014), some comparable control firms need to be formed to match the sampled firms by choosing a similar industry, similar firm size and financial performance in GSCMS implementation year (e.g., year  $-2$ ). Firstly, we followed the regulations of (Swift et al., 2019) to select the firms with a total asset within 50–200% and with a return on asset (ROA) within 90–110% of sampled firms' total assets and ROA as our matched control firms (Wiengarten et al., 2019). Second, when matched firms have similar controlled variables with sampled firms, we attempted to define them to be in the same industry. Finally, the number of matched firms is three times that of sampled firms (Wiengarten et al., 2019). Also, we calculated their abnormal change between sampled firms and control firms. The formula is as follows:

$$AP_{(t+j)} = AS_{(t+j)} - EP_{(t+j)}EP_{(t+j)} = AS_{(t+j-1)} + (CS_{K(t+j)} - CS_{K(t+j-1)})$$

Where  $AP_{(t+j)}$  and  $AS$  are abnormal performance and actual performance of the sampled firm respectively in  $t+j$  year;  $EP_{(t+j)}$  and  $CS_{K(t+j)}$  are expected performance of the sampled firm and the actual performance of the matched control firm in  $t+j$  year.  $t$  is the GSCMS adoption year.  $j$  is the comparison year ( $j = -2, -1, 0, 1$ ). After calculating abnormal change, we used Wilcoxon sign-rank (WSR) test, significant test and paired T test to examine the significance of these abnormal changes.

#### 4.4.2. Hierarchical regression analysis

This study conducted the cross-sectional hierarchical regression analysis to examine the moderating effect of differentiation strategy on the abnormal change. The model is as follows (Lo et al., 2014):

$$AP_K = \beta_0 + \beta_1(IL_k) + \beta_2(FS_k) + \beta_3(IESC_k) + \beta_4(GCS_k) + \beta_5(GRG_k) + \beta_6(GIC_k) + \beta_7(DS_k) + \beta_8(SP_k) + e_k$$

$IL_k$  and  $FS_k$  is the type of industry of the  $k^{\text{th}}$  firm and its firm size;  $IESC_k$ ,  $GCS_k$ ,  $GRG_k$  and  $GIC_k$  indicate the levels of firm adoption Internal environmental system certification, green cooperation with suppliers, green recovery with the governments and green improvement with customers respectively;  $DS_k$  is the differentiation strategy (i.e. the profit of margin of productions of the  $k^{\text{th}}$  firms);  $SP_k$  is the adoption level of standardization process (i.e. ISO9000).

#### 4.5. Analysis of results

We matched these samples with the control samples to compute their abnormal performance and used the WSR and rank test for analyzing the abnormal performance (Wiengarten et al., 2019). The lack of operating data and information for publicly listed sample companies in some periods could cause the difference in the number of samples in different periods. For example, some companies have adopted some green certificates or conducted some green initiatives when they prepared to become publicly listed company, thus there is no information about their financial reports before event years; whereas some companies began to adopt the green practices in recent years, causing a lack of data (e.g., ROA) for future year.

H1 assumed that the green strategy had greatly influenced the firm's profitability. The results shown in Table 4 indicate that in the period from year  $-2$  to year  $-1$ , there is no statistically significant change, whereas the period from adopting GSCMS to issuing the announcement (from year  $-1$  to year 0) has a significantly negative abnormal change, showing that the median of abnormal ROA was  $-1.17\%$ , which was significant at the 5% level, and 40.9% of sample firms experienced positive performance in this period. The cumulative abnormal performance with is declined from year  $-2$  to year 0, in which median abnormal ROA was  $-1.18\%$  and significant at the 5% level, which further indicated that a negative performance exists during the the preparation stage. However, during the period from year 0 to year 1 (i.e., the development stage), there has been a significantly positive abnormal change in ROA. Specifically, the median abnormal ROA change was 2.49%, which was significant at 1% level. In this development period, 80.15% of firms experienced a positive abnormal ROA change. Thus, GSCMS had a negative impact on firms' financial performance during the preparation stage of the diffusion process but can improve firms' profitability in the long run (i.e. during the development stage), supporting H1.

Table 5 shows the correlations between the regression variables, whereas Table 6 presents the regression analysis examining the contextual factors under which GSCMS can be diffused in the firm better. The control models contained the firm- and industry-level factors and the first model indicates the control factors along with GSCMS initiatives (i.e. green environmental system certification, green cooperation with suppliers, green recovery with the governments and green improvement with customers) (H2a,b-H5a,b). The second model added differentiation strategy (H6a,b) and the third model included operation process along with all the other variables (H7a,b). The results showed that firms adopting the practices of green cooperation with suppliers and green recovery with the

**Table 5**  
Results of analysis correlation analysis.

Variables	Mean	S.D	Industry level (IL)	Firm Size (FS)	Internal environmental system certification	Green cooperation with suppliers	Green recovery with governments	Green improvement with customers	Differentiation strategy (DS)	Standardization process (SP)
Industry level (IL)	0.6	0.492	1							
Firm Size (FS)	22.80	1.379	-0.121	1						
Internal environmental system certification (IESC)	0.41	0.493	-0.031	-0.073	1					
Green cooperation with suppliers (GCS)	0.24	0.426	0.148	-0.004	-0.323**	1				
Green recovery with governments (GRG)	0.44	0.498	0.017	-0.07	-0.171*	-0.284**	1			
Green improvement with customers (GIC)	0.19	0.396	-0.095	0.331**	-0.221**	-0.229**	-0.210*	1		
Differentiation strategy (DS)	0.26	0.156	0.200*	-0.083	-0.293**	0.325**	-0.039	-0.05	1	
Standardization process (SP)	0.64	0.483	0.014	-0.083	-0.037	0.071	-0.023	-0.006	-0.07	1

Note: N = 140.

\*Indicates statistically significant at 0.1 level (two-tail).

\*\*Indicates statistically significant at 0.05 level (two-tail).

\*\*\*Indicates statistically significant at 0.01 level (two-tail).

governments, experienced negative financial performance, which was significant at the 5% level and 1% level respectively. Thus, H3a and H4a are supported.

The differentiation strategy has the moderating effect on the effect of GSCMS( $\beta = -0.114, p < 0.05$ ) in preparation stage and also shows that the explanatory power of the abnormal ROA model in preparation stage improved by 3.9% (based on adjusted R-square). Thus, H6a is supported. By contrast, the differentiation strategy negatively influenced the effect of GSCMS in development stage ( $p < 0.05$ ), thus, the result does not support H6b. The standardization process also plays an important role in the effect of GSCMS ( $\beta = -0.03, p < 0.05$ ), and this variable improved the explanatory power of the abnormal ROA model in preparation stage by 2.8% (based on adjusted R-square). So, H7a is supported.

#### 4.6. Robustness check

For robustness test, firstly, this study tested the four green initiatives of GSCMS in the same regression model (see Table 6), which may cause collinearity issues. To address this issue, we re-examined the four green initiatives in the regression mode independently, the results were shown in Table 7. The results indicate that the green cooperation with suppliers and the green recovery with governments are still playing significant roles in GSCMS diffusion in the preparation stage ( $\beta = -0.032, p < 0.1; \beta = -0.024, p < 0.1$ ).

In addition, we take robustness for different industries to confirm whether our conclusions are generalized in different fields. Our samples were comprised by the different industries, namely (1) Electrical machinery and equipment manufacturing, (2) Computer and electronic equipment manufacturing, (3) Chemical raw materials and products manufacturing, and (4) Pharmaceutical manufacturing. We tested the finding robustness by removing the samples of the first three industries separately and conducted tests on potential attrition and sample-selection bias. Firstly, we deleted the samples from the industry of Electrical machinery and equipment manufacturing and run the regression analyses concerning our moderators. The results indicate that the green cooperation with supplier, the green recovery with governments, the differentiation strategy and the standardization process still play a significant role

**Table 6**  
Results of regression analysis.

	Dependent variable abnormal ROA (year - 1 to year 0)				Dependent variable abnormal ROA (year 0 to year 1)			
	Control Model	Model 1	Model 2	Model 3	Control Model	Model 1	Model 2	Model 3
Intercept	-0.113 [-0.953] (0.118)	-0.093 [-0.745] (0.124)	-0.037 [-0.302] (0.124)	0.009 [0.073] (0.124)	0.236 [1.547] (0.152)	0.202 [1.236] (0.163)	0.272 [1.65] (0.165)	0.248 [1.489] (0.167)
Industry level (IL)	0 [-0.021] (0.014)	0.005 [0.32] (0.014)	0.011 [0.744] (0.014)	0.01 [0.682] (0.014)	-0.009 [-1.39] (0.007)	-0.008 [-1.047] (0.007)	-0.009 [-1.293] (0.007)	-0.009 [-1.219] (0.007)
Firm Size (FS)	0.004 [0.726] (0.005)	0.004 [0.8] (0.005)	0.003 [0.588] (0.005)	0.002 [0.387] (0.005)	-0.013 [-0.714] (0.018)	-0.015 [-0.814] (0.019)	-0.008 [-0.406] (0.019)	-0.008 [-0.422] (0.019)
Internal environmental system certification (IESC)		-0.022 [-1.297] (0.017)	-0.029* [-1.753] (0.017)	-0.031* [-1.852] (0.017)		0.004 [0.193] (0.023)	-0.004 [-0.166] (0.023)	-0.003 [-0.13] (0.023)
Green cooperation with suppliers (GCS)		-0.046** [-2.204] (0.021)	-0.037* [-1.778] (0.021)	-0.033 [-1.616] (0.02)		0.014 [0.501] (0.028)	0.023 [0.823] (0.028)	0.021 [0.744] (0.028)
Green recovery with governments (GRG)		-0.031* [-1.872] (0.017)	-0.032* [-1.948] (0.016)	-0.032 [-1.972] (0.016)		-0.009 [-0.429] (0.022)	-0.009 [-0.42] (0.022)	-0.009 [-0.417] (0.022)
Green improvement with customers (GIC)		-0.02 [-1.872] (0.022)	-0.021 [-0.975] (0.021)	-0.02* [-0.931] (0.021)		-0.016 [-0.554] (0.029)	-0.016 [-0.541] (0.029)	-0.016 [-0.558] (0.029)
Differentiation strategy (DS)			-0.114** [-2.452] (0.047)	-0.124*** [-2.7] (0.046)			-0.134** [-2.06] (0.065)	-0.128* [-1.954] (0.066)
Standardization process (SP)				-0.03** [-2.175] (0.014)				0.017 [0.931] (0.019)
R2	0.004	0.048	0.093	0.127	0.017	0.027	0.059	0.065
Adjusted R2	-0.011	0.002	0.041	0.069	0.002	-0.018	0.007	0.006
F-test	0.271	1.052	1.798*	2.212**	1.112	0.597	1.131	1.097
Incremental R2		0.044	0.044	0.034		0.011	0.031	0.006
Incremental F-test		1.441	6.013**	4.732**		0.351	4.242**	0.867

\*Indicates statistically significant at 0.1 level (two-tail).  
 \*\*Indicates statistically significant at 0.05 level (two-tail).  
 \*\*\*Indicates statistically significant at 0.01 level (two-tail).  
 t-Statistics in the bracket; standard error in the parenthesis.  
 N = 140.

**Table 7**  
Robustness Test for green initiatives collinearity.

VARIABLES	Dependent variable abnormal ROA (year - 1 to year 0)				Dependent variable abnormal ROA (year 0 to year 1)			
Industry level (IL)	-0.006	-0.004	-0.009	-0.004	-0.005	-0.006	-0.007	-0.007
	(-0.38)	(-0.26)	(-0.58)	(-0.30)	(-0.28)	(-0.30)	(-0.37)	(-0.35)
Firm Size (FS)	0.008	0.007	0.009	0.008	0	0	0	-0.001
	-1.37	-1.34	-1.52	-1.49	(-0.05)	(-0.07)	(-0.03)	(-0.20)
Internal environmental system certification	-0.012				0.002			
	(-0.78)				-0.08			
Green cooperation with suppliers		-0.032*				0.006		
		(-1.90)				-0.26		
Green recovery with governments			-0.024*				-0.016	
			(-1.66)				(-0.83)	
Green improvement with customers				0.023				-0.025
				-1.25				(-1.04)
Constant	-0.197	-0.188	-0.207	-0.222*	0.027	0.029	0.031	0.056
	(-1.52)	(-1.47)	(-1.61)	(-1.70)	-0.17	-0.18	-0.2	-0.35
R-squared	0.02	0.042	0.036	0.027	0.001	0.001	0.006	0.009

in the effect of GSCMS during the preparation stage ( $\beta = -0.058$ ,  $p < 0.05$ ;  $\beta = -0.034$ ,  $p < 0.1$ ;  $\beta = -0.116$ ,  $p < 0.05$ ;  $\beta = -0.042$ ,  $p < 0.05$ ). The influence of the differentiation strategy in the development stage is also supported. ( $\beta = -0.159$ ,  $p < 0.05$ ). Then, we deleted the samples from the industry of Chemical manufacturing group. The results of all five moderators remain significantly positive ( $\beta = -0.036$ ,  $p < 0.1$ ;  $\beta = -0.030$ ,  $p < 0.1$ ;  $\beta = -0.092$ ,  $p < 0.1$ ;  $\beta = -0.034$ ,  $p < 0.05$ ;  $\beta = -0.111$ ,  $p < 0.1$ ). The results after removing samples from the industry of Pharmaceutical manufacturing group are similar with the two previous tests during the preparation stage ( $\beta = -0.048$ ,  $p < 0.05$ ;  $\beta = -0.043$ ,  $p < 0.05$ ;  $\beta = -0.191$ ,  $p < 0.1$ ;  $\beta = -0.034$ ,  $p < 0.01$ ;  $\beta = -0.111$ ,  $p < 0.1$ ). However, after deleting the samples from the Computer manufacturing group, only the green cooperation with suppliers and the differentiation strategy are significant in the adoption of GSCMS in the preparation stage (respectively,  $\beta = -0.057$ ,  $p < 0.05$ ;  $\beta = -0.085$ ,  $p < 0.1$ ). In addition, the differentiation strategy plays a significant role in the development stage ( $\beta = -0.196$ ,  $p < 0.01$ ). The robustness check results indicate that green cooperation with the suppliers, green recovery with the governments, the differentiation strategy and the standardization process remain the same in other industrial groups, which are consistent with the hypothesis test results in Section 4.5. Therefore, we are confident that the results of our analyses are solid and robust.

## 5. Discussion and conclusion

### 5.1. Discussion

Many studies have demonstrated the relationships between the green supply chain strategies and various performance dimensions (e.g., operational performance and environmental performance) in different industrial settings (Swift et al., 2019). However, their conclusions are inconsistent and mixed, which makes it difficult for practitioners and researchers to obtain actionable guidelines and derive meaningful theoretical implications. For example, some studies have proposed that the green strategies lead to negative financial performance due to the higher cost of more environmental and friendly materials and technologies (Feng et al., 2022). Other studies have emphasized that green strategies can improve financial performance by increasing green performance (e.g., enhanced product utilization and company reputation) (Kalyar et al., 2019). Such mixed findings can be caused by only considering the effects of green strategy in a certain stage of implementation through the use of a cross-sectional data. Thus, in our study, it is necessary to examine the financial performance of green strategies in the different GSCMS development stages over time and which organizational factors can facilitate effects for GSCMS implementation in the different stages.

Our findings indicate that firms with GSCMS could experience financial loss in preparation stage and then improve profitability in development stage, supporting H1. Indeed, Honda has adopted a green strategy and invested 12.61 million dollars to introduce advanced production processes to develop a green production system, leading to a negative impact on the financial performance during the preparation stage in implementing the green strategy (Honda, 2018). Due to the recycling of waste water and the extensive use of solar energy resources after running the green production system, the company significantly reduced operating costs and made profit in the subsequent period (Honda, 2021). As mentioned in our hypothesis, GSCMS implementation requires huge investment and long diffusion time. Firms need to invest more capital in staff training and update hardware, software and other necessary resources (Bellamy et al., 2020). However, with the acquisition of more green knowledge, awareness and experience, firms can easily achieve green manufacturing, reduce resource consumption, recycle waste and produce high quality green products by increasing green innovation (Song and Yu, 2018; Farooque et al., 2022). Thus, the corporate reputation and customers satisfaction can be improved, which can, in turn, bring positive financial performance in the long run.

Also, we find that green practices have different influences on the GSCMS diffusion. Firstly, suppliers can help GSCMS diffusion in the organization. Further, the firm cooperation with suppliers can reduce some green costs through cost sharing contracts, lowering their green improvement cost (Ahmed and Shafiq, 2022). Suppliers also play an important role in helping manufacturing, catering to the strict regulations set by international companies and organizations. They could share knowledge and advanced technologies to help companies better diffuse the green strategy (Ahmed and Shafiq, 2022). Secondly, the green recovery with governments plays an

important role in the diffusion stage of the green strategy. The findings support previous research views that governments involvement could reduce the companies' cost and help companies adopt green practices (Ilyas et al., 2020). Green recovery involves prevention of pollution by the recycling of material and governments could implement green commitment to provide consulting services and industrial clusters in order to improve the companies' green capabilities (Ilyas et al., 2020). Thus, in the preparation stage, the green improvement with customers and green recovery with governments can facilitate GSCMS diffusion. As such, H3a, H4a are supported. However, the knowledge and resources gained from the two previous initiatives have already advanced the green architecture of the company in preparation stage. Therefore, in the development stages, collaboration with suppliers and the governments do not play an important role. So, H3b, H4b are not supported. Contrary to expectations, this study could not find significant evidence to confirm H2a, b and H5a,b. Firstly, The finding of this study indicates that green certification does not affect the diffusion of GSCMS. This can be explained by the fact that green certification is no longer the only criterion for international companies to select a strategic partner. They can more systematically assess the green performance of a potential partner by understanding the green activities undertaken through scrutinizing reports or news concerning ESG, CSR, etc (Ahmed and Shafiq, 2022). Then, it is somewhat surprising but consistent with the previous studies that closing relationships with their customers could not facilitate GSCMS diffusion in the organization (Burki et al., 2019). This could be that the customers lacks the knowledge related to professional product design and process, thus they are difficult to propose useful suggestions on GSCMS in the daily operations.

Also, the results indicate that the differentiation strategy can weaken the negative effect of GSCMS on firms' financial performance in the preparation stage, which supports H6a. The differentiation strategy is perceived as a flexible and innovative manufacturing strategy (Mohammadi et al., 2019). The situation with the differentiation strategy is flexible and innovative. Thus, employees and managers in the firms with the differentiation strategy are willing to pay more attention on green products and process innovation, which enables superior GSCMS effects in the preparation stages. However, in development stage, the differentiation strategy have negative role in the green strategy diffusion. There is a possible reason is that the companies have no enough capital in advancing green activities in differentiated routines. In addition, a standardization process has a positive effect on GSCMS diffusion, supporting H7a. The standardization process (ISO9000) can reduce variability in business processes across corporate subsidiaries. This aims to promote cooperation between different companies. A higher consistency means that the members in the supply chain can cooperate more efficiently to satisfy customers' requirements about green process and products in a rapidly changing market environment. Thus, implementing the standardization process could reduce the obstacles between different organizations and increase the speed of green strategy assimilation in preparation stage. As a result, the green strategy can be routinized in daily operations before formal implementation and the making the standardization process less important in development stage. Thus, H7b cannot be supported.

### 5.2. Theoretical implication

The first theoretical implication is that, this is a pioneering effort to conduct a longitudinal analysis to investigate the impact of GSCMS on firm profitability in preparation and development stages. The findings enrich the green supply chain and environmental management literature and provide evidence for some inconsistent conclusions in the prior studies about the relationship between environmental practices and firm performance. Our study demonstrates that the effectiveness of GSCMS varies over different implementation stages and some organizational factors can be as critical ones to facilitate the diffusion of GSCMS, which is consistent with the proposition that the effectiveness of the green strategy relies on their diffusion and fit with firms' organizational mechanisms (Bellamy et al., 2020).

The second theoretical implication is to extend the application of diffusion theory into green supply chain management. Diffusion theory is mainly used in exploring how the new technology, innovation and practices can assimilate into organizations and which factors can influence employees to accept new things (Zhang et al., 2019). The green strategy can be considered as a business strategy that consists of various green principles and initiatives needed to be diffused into organizations. Thus, this study, based on diffusion theory, proposes three different key aspects (strategy, process and initiatives) to help GSCMS diffuse into organizations smoothly, demonstrating the application of diffusion theory in practical problems within the literature of green supply chain management.

The third theoretical implication is to provide the leverage effect of multiple organization factors in enhancing the implementation of GSCMS in different stages, which supplements the literature relating to GSCMS. Internal system certification achieved can provide more green experience to help organizations to implement a green strategy. Also, green cooperation with suppliers and governments leads to co-investment of green technologies and practices by different stakeholders, thereby reducing the capital pressure and innovation risks. Firms with a differentiation strategy and a standardization process are in a favorable environment for green strategy diffusion. Such findings indicate that these factors can facilitate firms to diffuse the green strategy smoothly into different organizational functions, processes, and activities. These findings imply that firms without such factors in place might suffer an ineffective implementation of GSCMS, providing the explanations about mixed findings of GSCMS implementation in the literature.

### 5.3. Practical implication

Firstly, firms need to be aware that, during the implementation of GSCMS, they inevitably need to go through and experience the preparation stage, in which the economic returns are less satisfactory. The main reason is that firms generally need to invest quite substantial capital and resources in green initiatives (e.g., environmental friendly machines) and configure their operations processes, leading to a decrease in profitability in this period. However, in the subsequent development stage, the initial investments no longer could be needed and the investments' benefits such as improved efficiency, reputation and revenue start to emerge. Thus, we conclude that GSCMS could benefit firms' profitability in the long run. Managers need to recognize the varied financial returns of GSCMS in

different development stages and consider how to facilitate firms to experience the transition from the preparation stage to the implement stage more quickly.

Second, Green initiatives (i.e. environmental system certification, green cooperation with suppliers, green recovery with governments, green improvement with customers), play different roles in the GSCMS diffusion process. In the preparation stage, it's important for a company to focus on cooperating with the suppliers and the governments, both of which can reduce the firm's financial and risk pressure during the GSCMS preparation. In the development stage, these initiatives have limited impacts on the effectiveness of GSCMS. Thus, when companies have to allocate their resources reasonably, they should pay less attention to such green initiatives in the development stage of GSCMS.

In addition, the operational process and the business strategy, as key organizational factors, influence companies' green strategy diffusion. Thus, when companies decide whether they could implement GSCMS, they should consider whether their strategy and the daily operational process match with such strategy. Companies adopting a differentiation strategy are suitable to implement GSCMS because the strategy can enhance the effectiveness of GSCMS in both of its preparation stage and development stage. Also, companies that adopt a standardized process strategy are also suited to implement GSCMS because the strategy helps achieve efficiency and lower operational costs, thereby alleviating firms' financial pressure from the investment for GSCMS.

Finally, based on short-term impacts of the green supply chain strategy in the preparation stage, firms facing a decreasing profitability may discourage to continue implementing GSCMS or consider reducing the relevant investments. Thus, governments should recognize this challenge for firms and provide financial support to relieve firms' economic pressure in this stage. Also, the standardization process can provide a solid foundation for the preparation stage in GSCMS adoption, thus, governments should strategically cover the concept of standardization process in the promotion of GSCMS to companies and provide the necessary support (e.g., consultancy), when firms come across problems in integrating their standardization practices and GSCMS activities.

Managers should first determine whether their own strategies are compatible with GSCMS, i.e., companies adopting a differentiation strategy are suitable to implement GSCMS because this strategy is likely able to improve the effects of GSCMS in companies at both preparation stage and development stage. Furthermore, companies with a standardized process strategy in place are also suitable to implement GSCMS because a standardized process strategy could significantly alleviate the negative impact of investment caused by GSCMS on firms' financial performance. Apart from that, managers should focus on cooperating with suppliers, as such cooperation helps achieve reduction of costs throughout the product life cycle at the product design stage. Finally, managers should pay attention to cooperate with the governments by participating in events concerning recovery of products. For instance, many governments should issue some policies to provide financial support helping companies significantly reduce their early investment in green practices.

#### 5.4. Limitation and future study

There are some limitations to our study. Firstly, the number of samples in each category of GSCMS is not large, although it is a longitudinal study. In the process of data collection, we deleted some overlapping samples because they implemented two or three practices simultaneously in the same year. In addition, we excluded samples with missing data and information. Future studies should increase the sample size over a longer time period. Second, we mainly focus on four initiatives of green supply chain in our study. In the future, the study should explore other green supply chain management practices such as the green technological innovation and the green strategic innovation. Although the study has successfully demonstrated that the diffusion effects between operational initiatives, business strategy and operational process. Future studies should examine other interesting contingent factors, such as organizational culture and structure. In addition, this study only examines the diffusion effect of green strategy. Future studies should include other areas where GSCMS can be adopted. This can help companies to learn how to achieve the green strategy diffusion in the organization.

#### Data availability

Data will be made available on request.

#### CRedit authorship contribution statement

**Yefei Yang:** Conceptualization, Formal analysis, Investigation, Methodology, Validation, Writing – original draft, Writing – review & editing. **Jiayi Chen:** Conceptualization, Formal analysis, Investigation, Methodology, Writing – original draft, Writing – review & editing. **Peter K.C. Lee:** Conceptualization, Formal analysis, Investigation, Methodology, Validation, Writing – original draft, Writing – review & editing. **T.C.E. Cheng:** Conceptualization, Validation, Writing – original draft, Writing – review & editing.

#### Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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## Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.tre.2023.103148>.

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