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Behavioral and technical perspectives of green supply chain management practices: Empirical evidence from an emerging market

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ABSTRACT

Recently, companies in emerging markets have implemented green supply chain management (GSCM) practices to tackle environmental issues. Drawing upon socio-technical systems theory, this study develops a conceptual model suggesting a sequential effect between two distinct categories of GSCM practices, namely behavioral (human and soft aspects) and technical (tangible and hard aspects) practices, on performance. We employ structural equation modeling method to test hypotheses based on survey responses from 200 Chinese manufacturers. The categorization of behavioral and technical GSCM practices and research findings contribute to the GSCM literature. Statistical results demonstrate the complete mediation effect of technical GSCM practices (e.g., green design, green manufacturing and reverse logistics) on the relationship between behavioral GSCM practices (e.g., relationship with customers and suppliers) and organizational performance. Such results recommend that companies in emerging markets should highlight behavioral GSCM practices first and then implement necessary technical GSCM practices to reap economic, environmental and operational performance.

1. Introduction

Green supply chain management (GSCM) practices are management actions implemented by a company across a supply chain to reduce pollution and energy consumption and enhance sustainability in the long term (Zhu et al., 2008). In recent years, to balance economic gains and environmental protection, companies and governments in emerging markets, such as China, have implemented GSCM (Geng et al., 2017; Niu et al., 2019; Tang, 2018; Zhu et al., 2019). The successful implementation of GSCM depends on the combination of practices. The most prevalent components of GSCM are technical and tangible (hard) aspects, such as green design, green manufacturing, and reverse logistics (Green et al., 2012; Luthra et al., 2016; Srivastava, 2007). For many companies in emerging markets, the implementation of GSCM is relatively at the primitive stage while technical aspect has received adequate attention (Kumar et al., 2019; Longoni et al., 2018). These aspects emphasize optimizing processes by adopting techniques to achieve green goals. However, indispensable, non-technical (soft) organizational practices, such as those related to behaviors (e.g., top management commitment, supplier involvement and customer involvement), have been largely neglected by companies in emerging markets (e.g., Brazil, India) in recent years (Jabbour et al., 2017; Kumar et al., 2019). These non-technical or behavioral practices

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may cultivate a supportive environment for organizations to better implement tangible GSCM practices (Paille et al., 2013; Zhu and Geng, 2013). The evidence from the textile industry in China shows that collaborative behaviors across the supply chain may promote the implementation of technical practices such as clean technologies (Shen et al., 2017). Despite the importance of behavioral practices becoming gradually recognized, it still remains unclear what these behavioral practices are and how they affect technical practices and performance (Dubey et al., 2017; Kumar et al., 2019).

The literature with emerging markets as a research context mainly focuses on how different GSCM components affect the performance of related companies (Geng et al., 2017; Golicic and Smith, 2013). This is partially due to the characteristics of emerging markets; the conceptualization and implementation standards are relatively immature, leading to uncertainty surrounding GSCM implementation. Specifically, adequate resources and capabilities are lacking for companies to cope with the transition from a traditional supply chain (operational efficiency-oriented) to a modern supply chain (triple bottom line) (Flynn et al., 2015; Gurca and Ravishankar, 2016). For example, a large number of small and medium-sized enterprises in China are unable to undertake a few necessary environmental improvements such as achieving effective energy and water management (Chen et al., 2017). Furthermore, contextual factors (e.g., low data quality, contract ineffectiveness, and absence of relevant legal institutions) vary among countries, which may hinder the implementation of GSCM in emerging market companies (Choi and Luo, 2019; Shou et al., 2016; Zhou et al., 2016). Therefore, studies on GSCM for emerging markets have obtained mixed results. For example, some related empirical studies on China, India, and Malaysia identified a positive relationship between GSCM practices and performance (Gopal and Thakkar, 2016; Lee et al., 2015; Zhu et al., 2013), whereas others conducted in Malaysia and Thailand did not determine a significant relationship (Eltayeb et al., 2011; Laosirihongthong et al., 2013). Notwithstanding, behavioral and technical GSCM practices may influence each other to promote the performance of companies in emerging markets (Chan et al., 2012; Jabbour et al., 2015; Mitra and Datta, 2014).

The role of behavioral GSCM practices is poorly understood in the emerging market context. As such, researchers called for a comprehensive study on exploring empirical approaches to understand the relationships among behavioral practices, technical practices and performance (e.g., Muduli et al. (2013), Dubey et al. (2017)). This study attempts to classify such behavioral and technical practices based on the literature and examine their effects on performance by using a sample from China. With the implementation of GSCM practices, companies can expect to reduce their negative environmental impact (e.g., saving energy and materials, and reducing emissions) and benefit society by creating a more eco-friendly environment (Ortas et al., 2014). However, relationships between GSCM practices and economic, environmental, and operational performance have yet been examined (Jabbour and de Sousa Jabbour, 2016; Zhu et al., 2012). Following Zhu et al. (2005), this study uses three performance dimensions, namely, economic, environmental, and operational performance to measure the focal company's organizational performance.

To enhance the exploratory power and the connection between research and practice, we develop our theoretical framework learning from the study by Cho et al. (2017) on behavioral and technical quality management. Cho et al. (2017) used an integrated model to examine the effect of behavioral and technical quality management practices on firm performance; the role of behavioral aspects was relatively less understood. Furthermore, in their model, they investigated how behavioral and technical dimensions influence each other. We draw upon socio-technical systems (STS) theory as a response to the call for an increased focus on the behavioral dimension and contribute to the broader application of STS theory in supply chains (Dubey et al., 2017; Kull et al., 2013). In addition, this study also contributes to the GSCM liter ature by simultaneously considering the environmental, economic and operational performance.

This study adopts structural equation modeling (SEM) to examine hypothesized relationships by using survey data collected from 200 manufacturing companies in China. SEM is a popular method for examining hypothesized relationships among latent variables (Byrne, 2016); thus, it is suitable for analyzing relationships among variables within an integrated and theory-driven model with GSCM practices and performance. This study provides insights into how companies improve organizational performance through the two categories of GSCM practices.

2. Literature review and hypotheses development

2.1. Literature review on GSCM practices and STS theory

2.1.1. Behavioral and technical GSCM practices

GSCM practices have been summarized in studies investigating their effects on organizational performance. One study classified these effects into five GSCM practice dimensions, which are referred to in this study. The five GSCM practice dimensions focus on lifecycle supply chain management concerning suppliers, manufacturers, customers, and reverse logistics (Zhu et al., 2008). Specifically, the five dimensions are *internal environmental management*, *green purchasing*, *eco-design*, *customer cooperation with environmental concerns*, and *reverse logistics* (Geng et al., 2017; Zhu et al., 2008). Such categorizations of GSCM practices combine organizational/human resources and technical/methodological aspects. In addition, some subsequent studies have re-categorized the aforementioned dimensions according to their research purposes. For example, Longoni et al. (2018) classified GSCM practices into internal and external aspects, and mainly focused on technical practices such as eco-design, green production, supplier selection, and monitoring. Feng et al. (2018) conceptualized GSCM practices as a single construct, primarily focusing on behavioral practices such as cross-functional cooperation, and cooperation with customers and suppliers. As such, related behavioral and technical GSCM practices are defined in this study.

Following the definitions of behavioral and technical practices in quality management (Cho et al., 2017; Zu, 2009), this study defines behavioral GSCM practices as people-oriented, relationship-driven, and other soft practices (e.g., commitment from management, employee participation, and cooperation with customers and suppliers). Technical GSCM practices are defined as technology-oriented, methodology-driven, and hard practices, including product design, process techniques, reverse logistics, and environmental management systems.

Behavioral (i.e., leadership, relationship, and involvement) practices have received increased attention as being critical prerequisites for the implementation of green technical practices, i.e., green product design, green production, and information technology practices (Chien and Shih, 2007; Luthra et al., 2016). The adoption of these green practices may influence organizational performance (Jabbour et al., 2015). For example, a meta-analysis conducted by Geng et al. (2017) indicated a positive relationship between GSCM practices and performance. To this end, it is likely that both behavioral and technical approaches are necessary for the successful implementation of GSCM practices.

2.1.2. STS theory and GSCM

Organizational theories have been widely applied in GSCM studies for explaining organizational behaviors (Liu et al., 2018). For example, institutional theory was used for analyzing antecedents (drivers, pressures) for organizational GSCM behaviors (e.g., Zhu et al. (2013), Dubey et al. (2015)). Resource-based view was widely applied to explain the relationship between GSCM practices and performance (Choi and Hwang, 2015). Game theory was applied to related issues on organizational decision behaviors for GSCM (e.g., Hafezalkotob (2017)). Besides, system-related theories such as complexity theory and system theory were also used for explaining systematic characterize of GSCM (Liu et al., 2018; Sarkis et al., 2011). Based on discussions from above, the STS theory fits the research objective of this study best.

STS theory was originally used to explain intra-organizational phenomena such as systematic relationships between employee behaviors and work design (Trist and Bamforth, 1951). According to the aforementioned theory, an organization can be considered a socio-technical system consisting of technical and social subsystems (Cooper and Foster, 1971; Manz and Stewart, 1997). The technical subsystem "is consisted of the tools, techniques, devices, methods, procedures and knowledge used by organizational members to acquire inputs, transform inputs into outputs and provide outputs or services to clients or customers", whereas the social subsystem "is comprised of the people who work in the organization and their social interactions with another" (Pasmore, 1988). Thus, system outputs are determined by the two subsystems (Grover et al., 1995).

The literature extends the boundary of STS theory from intra-organizational to inter-organizational, e.g., a supply chain (Choi and Liker, 2002; Kull et al., 2013). Bellamy and Basole (2013) suggested that a supply chain is a complex socio-technical system and that scholars must consider both technical and social concerns. Additionally, STS theory has been used in the field of environmental management. Ruiz-Quintanilla et al. (1996) argued that in terms of reducing pollution, a socio-technical system outperforms a system solely consisting of technical components. Boiral (2009) revealed that combining socio-technical factors (activities, behaviors, and technical systems) produces environmental benefits for organizations. Furthermore, the role of human (behavioral) and technical aspects of environmental management on the relationship between green product development and performance has been discussed, demonstrating that human dimensions must be strengthened and deserve more investment in companies (Jabbour et al., 2015).

Research on STS theory and GSCM practices suggests that technology utilization and organizational involvement are driving forces behind organizational change (Wu et al., 2012). Thus, GSCM studies have established the usefulness and appropriateness of using STS theory to understand GSCM practices. From the perspective of STS theory, behavioral GSCM practices are components of a social subsystem, whereas technical GSCM practices can be categorized as being from a technical subsystem. Behavioral GSCM practices highlight the involvement of supply chain members (top management, employees, suppliers, and customers), which is in line with a social subsystem that reflects people's awareness, attitudes, and behaviors (Manz and Stewart, 1997; Shen et al., 2015; Zu, 2009). Similarly, the technical subsystem is intended to satisfy external environment-related needs through tangible inputs such as technology, processes, and tools (Manz and Stewart, 1997; Shen et al., 2015; Zu, 2009). Technical GSCM practices involve eco-design procedures, manufacturing processes, reverse logistics, and harnessing environmental management tools to meet expectations related to the environment and economy.

STS theory emphasizes the joint optimization of the two subsystems to improve system performance (Pasmore, 1988). The two subsystems should be implemented together rather than applied individually (Ruiz-Quintanilla et al., 1996). STS theory emphasizes the joint optimization of the two subsystems to improve system performance (Pasmore, 1988). The two subsystems should be implemented together rather than applied individually (Ruiz-Quintanilla et al., 1996). Although the literature on STS theory usually puts more emphasis on the social subsystem, there exists a two-way direction between the two subsystems, suggesting that the social subsystem affects or changes the technical subsystem (Zu, 2009) and vice versa (Kull et al., 2013). On the other hand, behavioral practices may cultivate a cooperative environment and culture to support the implementation of technical practices while technical practices can also facilitate the development of behavioral practices. For example, top management support is beneficial for new product development (Jabbour et al., 2015). The application of information technology will facilitate coordination among supply chain members (Liu et al., 2016). Referring to the quality management literature, the relationships between the two GSCM practices are dynamic, which also depends on the stage of GSCM implementation (Cho et al., 2017). Evidence indicates strong interdependent relationships between the social (behavioral) and technical components of GSCM practices in improving organizational performance (De Giovanni and Vinzi, 2012; Li et al., 2016; Luthra et al., 2016). Therefore, according to STS theory, behavioral and technical GSCM practices can influence each other.

2.1.3. Research gaps

From the perspectives of practitioners and researchers in GSCM field, three research gaps are identified:

(1) Although the behavioral dimension is critical for GSCM implementation, most of the companies in emerging markets have

recognized the impact of technical practices on performance (Jabbour et al., 2017, Kumar et al., 2019). A few studies summarized behavioral factors of GSCM, but there is no systematic classification for behavioral and technical practices. This resulted in an inadequate understanding of GSCM (Longoni et al., 2018, Kumar et al., 2019). The importance of behavioral practices was largely neglected.

(2) The two dimensions of GSCM practices function together to affect performance. However, Geng et al. (2017) indicated mixed results on the relationship between GSCM practices and performance in the context of emerging markets. It is necessary to explore how the two dimensions of GSCM practices affect the overall performance (economic, environmental and operational).

(3) There were limited studies systematically discussing how the behavioral dimension affects organizational performance. In particular, scholars called for more empirical studies in this regard (e.g., Muduli et al. (2013), Dubey et al. (2017)). This study develops a theoretical framework to examine the sequential effects of behavioral and technical practices on performance using a Chinese sample of 200 manufacturing companies.

2.2. Hypotheses development

2.2.1. Behavioral GSCM practices and organizational performance

This section discusses how behavioral GSCM practices (internal management support, supplier involvement, and customer involvement) identified in Section 2.1 can improve organizational performance. Numerous studies have suggested that implementing behavioral GSCM practices directly affects organizational performance. For example, organizational citizenship behavior toward the environment (e.g., the eco-initiatives of employees) can be associated with corporate environmental management practices and contribute to organizational environmental performance (Boiral, 2009; Boiral and Paille, 2012). In addition, the commitment of top management to addressing environmental concerns is crucial for the successful implementation of GSCM (Hoejmose et al., 2012; Olugu et al., 2011; Zhu et al., 2013). Furthermore, employee involvement and green training practices may enhance organizational performance (Delmas and Pekovic, 2013; Ruiz-Quintanilla et al., 1996). Govindan et al. (2015) explored the causal relationship between GSCM practices and performance through a case study of the automotive industry, revealing that internal management support can significantly improve performance.

Studies have demonstrated that supplier involvement practices promote the economic, operational, and environmental performance for both suppliers and manufacturers (Jabbour et al., 2017; Yu et al., 2014; Zhu et al., 2013). For example, cooperation with suppliers on green product development improves suppliers' competitive advantage in the market due to customers having increased attention on the green index of products (e.g., environmental footprint) and strengthens buyers' reputation related to green sourcing (Govindan et al., 2015; Vachon and Klassen, 2008). Customer involvement helps companies to better respond to the GSCM requirements of customers and facilitates cooperation on environmental product development and used product recycling (Li et al., 2016; Thun and Muller, 2010). Moreover, it can enhance companies' reputation through transferring green knowledge and providing technical assistance and training support to their partners, which in turn, could be rewarded by more business opportunities (Laari et al., 2016; Luthra et al., 2015).

Behavioral GSCM practices (internal management support and supplier/customer involvement) can positively affect organizational performance. It is likely that when several different behavioral practices are implemented simultaneously, the postulated positive relationship can still hold. Accordingly, this following hypothesis is developed:

H1: *The implementation of behavioral GSCM practices is positively related to organizational performance.*

2.2.2. Technical GSCM practices and organizational performance

In the early stage of GSCM implementation, environmental management was mainly technically driven. At that time, companies tended to only focus on how to reduce pollution in production processes by using technical solutions within such companies (Ruiz-Quintanilla et al., 1996). However, current technically GSCM practices have shifted toward being relevant to (closed-loop) supply chains and include material purchasing, product design, production system control, and used products' disposal (Longoni et al., 2018; Srivastava, 2007). These technical environmental management practices are critical for enhancing organizational performance (Choi and Hwang, 2015; Laosirihongthong et al., 2013). Furthermore, the results from five case studies of automotive industry supply chains have indicated that some technical green practices may have a positive influence on supply chain performance (Azevedo et al., 2011).

Numerous studies have explored the relationship between several technical practices and performance. For example, eco-design incorporates a product lifecycle analysis to reduce environmental impact and boost economic performance through various design activities (Eltayeb et al., 2011). The implementation of green manufacturing practices can help reduce pollution and boost market share by alleviating negative environmental impacts and increasing efficiency (Chien and Shih, 2007). Reverse logistics practices can lead to the saving and reuse of raw materials, energy, and other resources, resulting in improved environmental and economic performance (Lai et al., 2013). Environmental management systems, information systems, and environmental audits are environmental management tools adopted by companies to gain competitive advantages (Chien and Shih, 2007; Daily and Huang, 2001; Green et al., 2012).

In summary, the fundamental targets of technical GSCM practices (reducing environmental impacts across the supply chain and increasing economic value) can be realized through adopting technical GSCM practices. Considering the aforementioned arguments, the following hypothesis is proposed:

H2: *The implementation of technical GSCM practices is positively related to organizational performance.*

2.2.3. Relationship between behavioral and technical GSCM practices for performance improvement

Scholars have called for empirical investigations on the sequential relationship among behavioral practices, technical practices, and performance (Jabbour et al., 2017; Muduli et al., 2013). Thus, in this section, an STS theory-based perspective is taken to propose a mediating relationship between the two categories of GSCM practices and organizational performance in two steps. This study postulates that behavioral practices lead to subsequent technical practices. It is argued that technical practices mediate the relationship between behavioral practices and organizational performance.

In the literature, it is argued that technology adoption is a response to social needs and development (Manz and Stewart, 1997); thus, social attributes (e.g., culture and organizational environment) should be present to facilitate the implementation of technical systems (McIvor and McHugh, 2000; Zu, 2009). Behavioral GSCM practices create a cooperative supply chain environment through internal management support such as commitment from top management and employees, supplier involvement, and customer involvement, which are critical for implementing technical GSCM practices (Cantor et al., 2012; Luthra et al., 2016; Muduli et al., 2013). For example, top management commitment is crucial, which enables the implementation of GSCM practices into daily routines (Hoejmose et al., 2012). Companies benefit from GSCM through designing green products, reducing pollution and waste from production, recycling end-of-life products, and complying with environmental regulations through maintaining an information system and undergoing audits (Longoni et al., 2018; Srivastava, 2007). Daily and Huang (2001) identified human resource practices (i.e., top management support and green training) as being critical for environment management systems (a more technically focused approach) implementation. Jabbour and Santos (2008) revealed that human dimensions are necessary for environmental management and proposed a model to reveal the relationship between the two. Cantor et al. (2013) stated that organizational support from managers and employees has a positive impact on the adoption of environmental management systems and ISO 14001 certification. The relational practices with supply chain partners (e.g., collaboration and information sharing) can trigger technical efforts toward GSCM implementation. For example, collaboration with customers further helps companies to implement technical practices such as eco-design and green packaging (Kumar et al., 2013). Mitra and Datta (2014) demonstrated that collaboration with suppliers has a positive influence on sustainable product design. Therefore, to implement these activities across a supply chain, a focal company must build reliable and cooperative relationships with its suppliers and customers (Dou et al., 2018; Laari et al., 2016). As such, the following hypothesis is proposed:

H3: *The implementation of behavioral GSCM practices is positively related to the implementation of technical GSCM practices.*

Based on the discussion in Section 2.1.2, STS theory suggests a potential mediation effect among behavioral-, technical GSCM practices and organizational performance. As most companies in emerging markets are still at the initial or early stage for implementing GSCM practices, the importance of behavioral practices is neglected (Kumar et al., 2019; Tokar, 2010). The understanding, diffusion, and implementation of technical practices across the supply chain are triggered by human efforts toward behavioral GSCM practices (e.g., supplier and customer involvement) (Daily et al., 2007; Fernandez et al., 2003). Several previous studies from emerging markets explored the sequential effects among elements of behavioral-, technical GSCM practices and performance, respectively. However, to the best of our knowledge, there is no holistic study incorporating all technical, behavioral, and organizational performance based on STS theoretical lens and focusing on emerging markets.

For example, Chan et al. (2012) demonstrated that a sequential effect of internal management support (internal environmental orientation) on technical GSCM practices (e.g., reverse logistics) to trigger improvements of organizational performance. Furthermore, Li et al. (2016) empirically showed that technical practices (green manufacturing and green information systems) fully mediate the effect of internal management support (environmental orientation) on environmental and economic performance, and green product design partially mediates this relationship. Similarly, customer involvement motivates focal companies to engage in technical GSCM practices, thus improving company performance (Wang et al., 2018; Yu et al., 2014). Improved performance from implementing behavioral GSCM practices could be achieved by linking them to appropriate technical practices.

On the basis of the aforementioned discussion, the following hypothesis is presented:

H4: *The implementation of technical GSCM practices positively mediates the relationship between the implementation of behavioral GSCM practices and organizational performance.*

Fig. 1 presents the conceptual framework based on STS theory. It depicts relationships between behavioral and technical GSCM practices and organizational performance.

3. Methodology

3.1. Survey instruments

Data were collected through questionnaires to test the proposed hypotheses. To ensure content validity, we designed measurement instruments using the following two steps.

First, an extensive literature review of studies related to behavioral and technical GSCM practices as well as organizational performance was conducted (see Section 2). The GSCM practice and performance items were derived from previous empirical GSCM

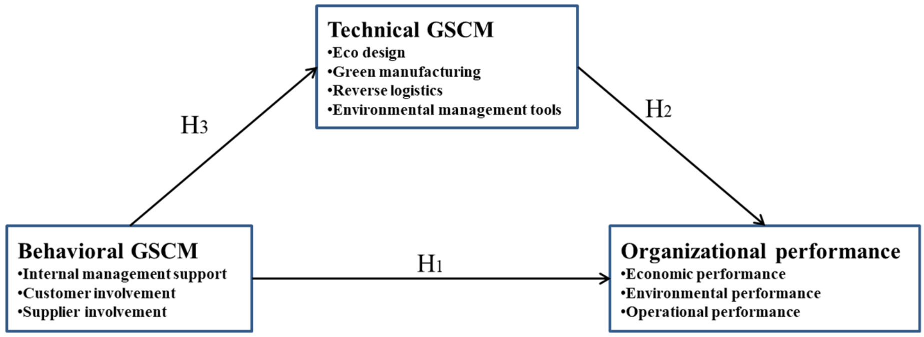


Fig. 1. The proposed model of behavioral GSCM practices, technical GSCM practices, and organizational performance.

studies, e.g., Zhu et al. (2008); Srivastava (2007); Muduli et al. (2013); Govindan et al. (2015). This study employed a 5-point Likert scale to measure the items of GSCM practices in the questionnaire, with 1 being "have not considered it" and 5 being "implemented it successfully". This study measured the performance items by using another 5-point scale, with 1 corresponding to "not at all" and 5 representing "completely". Respondents were asked to tick up one scale for each item of GSCM practices and performance based on the perceived situations of their own companies.

Second, a pilot test was conducted to validate the preliminary questionnaire with the help of eight senior supply chain managers working in manufacturing companies. Subsequently, several rounds of face-to-face discussions among scholars and practitioners helped to refine and confirm these instruments based on the feedback provided.

3.2. Data collection

The targeted respondents in the study were top- or mid-level plant, purchasing, operations, or environment, health, and safety managers in manufacturing companies. Respondents had to be familiar with GSCM practices and corporate performance in their daily work. Anonymity was ensured in answering survey questions and a confidentiality statement was provided to participants.

The data collection process lasted approximately 8 months (May to December 2018). Considering the challenges of random sampling, this study used both snowball and convenience sampling (Melnyk et al., 2012). Snowball sampling began with the selection of an initial respondent who could recommend other potential respondents with knowledge of the theme (green supply chain practice implementation). Convenience sampling was also used; participants were recruited from supply chain workshops held in an international top-five auto manufacturing company with branch headquarters in Shanghai. In these workshops, respondents were top-level managers and came from companies in the Shanghai Association of Small and Medium Enterprises. Following the survey data collection method of Dillman et al. (2014), questionnaires were distributed to potential respondents. Each questionnaire, together with a prepaid return mail envelope, was sent out, and a website link was included in each questionnaire for managers to complete an online survey. In total, two rounds of emails were sent to potential respondents (i.e., a reminder was sent if no response was received). In addition, confusion raised by some respondents were clarified through phone calls. In total, 250 questionnaires were sent out by email and posted online, and 48 hard copies were handed out in workshops. The data collection efforts resulted in responses from 250 companies. Fifty unusable questionnaires (e.g., unfinished and blank questionnaires) were eliminated, and in the end, 200 usable questionnaires were retained (161 responses were collected by return mail and online, and the remaining 39 were hard copies filled in at the workshops).

The sample manufacturing companies are located in 20 provinces in Mainland China, with industry sectors including tire, petrochemical, glass, textile, steel, electronic, and metal product manufacturing. Table 1 presents the descriptive information of survey companies in terms of company size, length of time in business, and ownership type (marker variable).

3.3. Validity of measurements and model fit testing

This study employed confirmatory factor analysis (CFA) to validate the measures of GSCM practices and organizational performance. Tables 2–4 present factor items and their corresponding factor loadings, as determined through factor analysis. All the factor loadings are above 0.5 (range from 0.613 to 0.986). In addition, Cronbach's alpha coefficients for all factors are greater than 0.70, indicating high reliability of each factor (Nunnally and Bernstein, 1978). Table 5 shows bivariate correlations among the variables, mean values, and standard deviations of samples.

This study assessed the goodness-of-fit indices of a model using various metrics. That is, a value in bracket is the acceptance level for each metric, the X^2 per degree of freedom (smaller than 3), comparative fit index (CFI; larger than 0.9), root mean square error of approximation (RMSEA; smaller than 0.08), incremental fit index (larger than 0.9), and Tucker-Lewis coefficient index (TLI; larger than 0.9). Table 6 presents the values of these indices for four measurement models (Behavioral GSCM, Technical GSCM, firm performance and overall model), respectively, all of which are in acceptance ranges. Thus, the measurement model fits the data adequately.

Table 1
Sample distribution.

Category		Sample
Company size [a]	Less than 100	29 (14.5%)
	100–199	32 (16%)
	200–499	46 (23%)
	500–999	38 (19%)
	More than1000	53 (26.5%)
Length of time in business	Less than 3 years	6 (3%)
	3–9 years	45 (22.5%)
	10–19 years	88 (44%)
	20–29 years	45 (22.5%)
	More than 30 years	15 (7.5%)
Firm's ownership	State-owned	27 (13.5%)
	Private	86 (43%)
	Foreign	72 (36%)
	Others	15 (7.5%)

Note: Samples with missing data are not included.
[a] Number of employees.

Table 2
CFA and descriptive analysis of behavioral GSCM practices.

Item description	Mean	SD	Loadings	S.E.[a]	*t*-value	Supporting literature
Internal management support α[b] = 0.898						Green et al. (2012), Muduli et al. (2013), Govindan et al. (2015), Cho et al. (2017)
-Top management commitment to GSCM implementation	3.865	1.310	0.868***	0.093	9.333	
-Achieving common understanding and of GSCM across departments and individuals	4.105	1.209	0.986***	0.084	11.738	
-Green education and training for employees	3.890	1.235	0.769***	0.087	8.839	
Customer involvement α = 0.823						Zhu et al. (2008), Green et al. (2012), Govindan et al. (2015), Laari et al. (2016)
-Coordination with customers to consider environmental issues in the design of products and production process	3.555	1.314	0.773***	0.093	8.312	
-Customers consider environmental factors in suppliers' selection	3.985	1.258	0.818***	0.089	9.191	
-Customers provide technical support and training on environmental protection or energy saving	3.520	1.311	0.747***	0.093	8.032	
Supplier involvement α = 0.961						Zhu et al. (2008), Green et al. (2012), Luthra et al. (2015), Laari et al. (2016), Jabbour et al. (2017)
-Coordination with suppliers to achieve environmental goals	3.510	1.281	0.789***	0.092	8.576	
-Environmental factors are considered in suppliers' selection and evaluation	3.870	1.183	0.962***	0.084	11.452	
-Provide necessary green technologies and training to suppliers	3.160	1.230	0.617***	0.087	7.092	

[a] Standard error.
[b] Cronbach's alpha.
*** $p < .001$.

3.4. Non-response bias and common method variance testing

To examine the non-response bias, we used the *t*-test to determine whether a significant difference exists between the questionnaires collected from early (104) and late (96) responses following the method recommended by a previous study (Armstrong and Overton, 1977). The *t*-test results of mean values for all GSCM practices and performance items demonstrate that no significant difference exists between the groups ($p > 0.05$). Another *t*-test was conducted to determine the difference between the questionnaires from snowball (161) and convenience (39) sampling; no significant difference was observed ($p > 0.05$). Thus non-response bias should not be a problem in this study.

Because most questionnaires in this study were filled by a single respondent (some returned questionnaires indicated that the survey was completed by a group of managers), the research findings may be influenced by common method variance (Podsakoff et al., 2003). This study addressed the common method variance through the following approaches. First, survey questions for GSCM practices and performance were divided into different parts of the questionnaire. Second, all responses were anonymous. Third, a marker-variable technique was employed to test the common method variance (Lindell and Whitney, 2001; Lai et al., 2013; Liu et al., 2016). Company ownership is selected as a marker variable, which is theoretically unrelated to other constructs (Lai et al., 2013). According to two previous studies (Lindell and Whitney, 2001; Liu et al., 2016), the lowest positive correlation (r = 0.036 with

Table 3
CFA and descriptive analysis of technical GSCM practices.

Item description	Mean	SD	Loadings	S.E.[a]	*t*-value	Supporting literature
Eco-design α[b] = 0.821						Zhu et al. (2008), Green et al. (2012), Govindan et al. (2015), Luthra et al. (2016)
-Design of products for fewer consumption of material/ energy	4.335	0.937	0.924***	0.066	14.000	
-Design of products for reuse and recycle of material and/or component parts	4.275	1.012	0.613***	0.072	8.514	
-Design of products to avoid or reduce the use of hazardous products and/or manufacturing process	4.485	0.802	0.841***	0.057	14.754	
Green manufacturing α = 0.855						Zhu et al. (2008), Green et al. (2012), Shen et al. (2015), Luthra et al. (2016)
-Implementation of cleaner production	4.430	0.860	0.716***	0.061	11.738	
-Implementation of total quality environmental management	4.635	0.659	0.908***	0.047	19.319	
-Continuous improvement of production process to lessen environmental impact	4.540	0.742	0.877***	0.053	16.547	
Reverse logistics α = 0.776						Zhu et al. (2008), Luthra et al. (2015), Luthra et al. (2016)
-Reusing/recycling of materials or components or products	4.255	1.107	0.838***	0.078	10.744	
-Remanufacturing of components or products	3.805	1.306	0.739***	0.092	8.033	
Environment management tools α = 0.768						Zhu et al. (2008), Green et al. (2012), Govindan et al. (2015), Shen et al. (2015), Laari et al. (2016)
-Adoption of environment management information system	3.637	1.303	0.614***	0.092	6.674	
-Adoption of environment management standards (ISO14001 certification)	4.370	1.166	0.789***	0.082	9.622	
-Internal environmental audit to ensure that products meet the environmental standards	4.185	1.134	0.783***	0.080	9.788	

[a] Standard error.
[b] Cronbach's alpha.
*** $p < .001$.

Table 4
CFA and descriptive analysis of organizational performance.

Item description	Mean	SD	Loadings	S.E.[a]	*t*-value	Supporting literature
Environmental performance α[b] = 0.882						Zhu et al. (2008), Yang et al. (2013) Luthra et al. (2015), Feng et al. (2018)
-Reduction of air emissions, waste water, solid waste per unit of product	4.010	0.946	0.825***	0.067	12.313	
-Decrease in consumption for hazardous/harmful/toxic materials per unit of product	4.000	1.037	0.923***	0.073	12.592	
-Decrease in frequency for environmental accidents	4.045	1.113	0.817***	0.079	10.342	
-Improvement in a company's environmental situation	4.060	0.960	0.723***	0.068	10.632	
Economic performance α = 0.899						Zhu et al. (2008), Yang et al. (2013) Luthra et al. (2015), Feng et al. (2018)
-Decrease in cost of materials purchasing per unit of product	3.460	1.102	0.768***	0.078	9.846	
-Decrease in cost for energy consumption per unit of product	3.720	0.936	0.871***	0.066	13.197	
-Decrease in fee for waste discharge per unit of product	3.760	0.999	0.814***	0.071	11.465	
-Decrease in fee for waste treatment per unit of product	3.630	0.009	0.774***	0.071	10.901	
Operational performance α = 0.902						Zhu et al. (2008), Luthra et al. (2015), Feng et al. (2018)
-Increase the input and output rate of raw material	3.680	1.011	0.716***	0.071	10.085	
-Increase in product quality	3.950	0.917	0.951***	0.065	14.631	
-Increase efficiency of product line	3.940	0.936	0.942***	0.066	14.273	
-Decrease of inventory levels	3.775	1.005	0.752***	0.071	10.592	

[a] Standard error.
[b] Cronbach's alpha.
*** $p < .001$.

reverse logistics) was used as a proxy to adjust the correlations among these constructs in the model. A comparison of the original and adjusted correlations indicates that all significant correlations are still significant after adjustment (see Table 5). Thus, common method variance is unlikely to unduly influence the results of this study. Fourth, Harman's single factor test using exploratory factor analysis was conducted. Results reveal that the first factor explained only 37.44% of the variance. Finally, a CFA with Harman's single factor test was used to check the difference between models with and without a common latent factor (CLF) (see Figs. A.1 and A.2 in Appendix A for more information) (Podsakoff et al., 2003). The results indicate that no significant difference exists between the two models (the model without a CLF: Chi-square = 846.331, *d.f.* = 419, $p < 0.001$, Normed Chi-square = 2.02, CFI = 0.91, RMSEA = 0.07, and TLI = 0.90; the model with CLF: Chi-square = 692.245 *d.f.* = 387, $p < 0.001$, Normed Chi-square = 1.79, CFI = 0.93, RMSEA = 0.06, and TLI = 0.92). Thus, common method variance should not be a substantial problem.

Table 5
Correlation coefficients and descriptive statistics.

Variables	1	2	3	4	5	6	7	8	9	10	11	12	Mean	SD
Behavioral GSCM														
1 Internal management support	**0.879**	0.641**	0.539**	0.510**	0.507**	0.305**	0.535**	0.354**	0.290**	0.303**	0.390**	0.049	3.90	1.13
2 Customer involvement	0.654**	**0.780**	0.585**	0.487**	0.466**	0.289**	0.525**	0.296**	0.251**	0.333**	0.230**	0.004	3.69	1.11
3 Supplier involvement	0.555**	0.600**	**0.802**	0.364**	0.362**	0.162*	0.371**	0.342**	0.327**	0.359**	0.045	0.012	3.50	1.10
Technical GSCM														
4 Eco-design	0.527**	0.505**	0.387**	**0.804**	0.638**	0.428**	0.425**	0.399**	0.313**	0.398**	0.121+	0.121+	4.37	0.80
5 Green manufacturing	0.525**	0.485**	0.385**	0.651**	**0.838**	0.348**	0.430**	0.407**	0.268**	0.259**	0.123*	0.132+	4.54	0.67
6 Reverse logistics	0.330**	0.315**	0.192**	0.449**	0.371**	**0.790**	0.332**	0.372**	0.337**	0.352**	0.237**	0.067	4.03	1.09
7 Environment management tools	0.552**	0.542**	0.394**	0.446**	0.451**	0.356**	**0.764**	0.387**	0.270**	0.307**	0.369**	0.107	4.08	0.99
Organizational performance														
8 Environmental performance	0.377**	0.321**	0.366**	0.421**	0.428**	0.395**	0.409**	**0.825**	0.601**	0.578**	0.116+	0.110	4.03	0.87
9 Economic performance	0.316**	0.278**	0.351**	0.338**	0.294**	0.361**	0.296**	0.615**	**0.808**	0.728**	0.106	0.024	3.64	0.89
10 Operational performance	0.328**	0.357**	0.382**	0.420**	0.286**	0.375**	0.332**	0.593**	0.738**	**0.847**	0.117+	0.002	3.84	0.85
Control Variables														
11 Company size [a]	0.316**	0.258**	0.079	0.153*	0.155*	0.264**	0.392**	0.148*	0.138	0.149*	–	0.300**	3.27	1.39
12 Length of time in business[b]	0.083	0.040	0.048	0.153*	0.163*	0.101	0.139	0.142*	0.059	0.038	0.325**	–	3.09	0.93
Company ownership (MV)	0.098	0.107	0.051	0.058	0.063	0.036	0.068	0.042	−0.052	0.042	−0.113	0.072		

Note: Pearson correlations.
MV = marker variable; the square root of AVE is represented diagonally, unadjusted correlations are below the diagonal line, and adjusted correlations for the common method are above the diagonal line.
[a] Number of employees (3 = 200–499, 4 = 500–999).
[b] years (3 = 10–19, 4 = 20–29).
+ $p < 0.1$.
* $p < .05$.
** $p < .01$ (two-tailed).

Table 6
Test results of the goodness-of-fit for the measurement model.

Fit index	Behavioral GSCM	Technical GSCM	Firm performance	Overall measure model[e]
Chi-square (X^2)	36.25	65.77	86.11	846.33
Degree of Freedom (d.f.)	22	39	48	419
$X^2/d.f.$	1.65	1.686	1.794	2.02
CFI[a]	0.988	0.976	0.980	0.910
RMSEA[b]	0.057	0.059	0.063	0.070
IFI[c]	0.988	0.976	0.972	0.911
TLI[d]	0.981	0.966	0.980	0.901

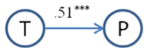
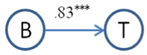
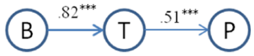
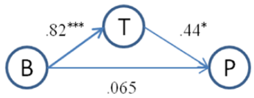
Note:
[a] Comparative fit index.
[b] Root mean square error of approximation.
[c] Incremental fit index.
[d] Tucker-Lewis coefficient index.
[e] All the factors are incorporated.

4. Results

4.1. Results of hypotheses testing

This study employed SEM to test the hypotheses by using IBM AMOS. Three dimensions of behavioral GSCM practices (internal management support, supplier involvement, and customer involvement) were constructed as a second-order behavioral GSCM factor while four dimensions of technical GSCM practices (eco-design, green manufacturing, reverse logistics, and environmental management tools) were constructed as a second-order technical GSCM factor. Furthermore, economic, environmental, and operational performance were constructed as a second-order organizational performance factor. Table 7 summarizes the results of the SEM analysis, depicting the direct link between any two of the three factors (behavioral, technical, and performance). H1, H2, and H3, which propose a direct relationship, are supported. Furthermore, the SEM analysis results also support H4: technical GSCM practices

Table 7
SEM results for hypothesizes.

Hypothesizes purpose	SEM results	R^2	Test results
H1: B has a positive direct effect on P		0.31	supported
H2: T has a positive direct effect on P		0.36	supported
H3: B has a positive direct effect on T		0.73	supported
H4: B has a mediating effect on the relationship between T and P		T:0.74 P:0.38	supported
		T:0.74 P:0.37	

Note: * $p < .05$, ** $p < .01$, *** $p < .001$.
B: behavioral GSCM; T: technical GSCM; P: organizational performance.

positively mediate the relationship between behavioral GSCM practices and organizational performance.

H1 suggests that behavioral GSCM practices are positively related to organizational performance, which is supported by a significant path coefficient of 0.43 (t = 5.75, $p < 0.001$). The direct and positive effect of behavioral GSCM practices and organizational performance becomes non-significant (path coefficient = 0.07, t = 0.40, $p = 0.70$) when the technical GSCM factor is controlled. The direct influence of technical GSCM on organizational performance (path coefficient = 0.44, t = 2.49, $p = 0.013$) and the direct influence of behavioral GSCM on technical GSCM (path coefficient = 0.82 t = 8.47, $p < 0.001$) are still significantly positive. The related results are presented in Fig. 2. These results imply that technical GSCM practices have a full mediating effect on the relationship between behavioral GSCM practices and organizational performance. Therefore, H4 is fully supported. In addition, R^2 values for technical GSCM and performance variables vary between 0.31 and 0.74.

4.2. Post hoc test

Few studies examined whether and how the components of technical GSCM practices affect organizational performance associated with behavioral GSCM practices (Laari et al., 2016; Lee, 2015), i.e., the technical - > behavioral - > performance relationship (hereafter, T- > B- > P). Table 7 details the significantly positive relationships between behavioral and technical GSCM practices. On

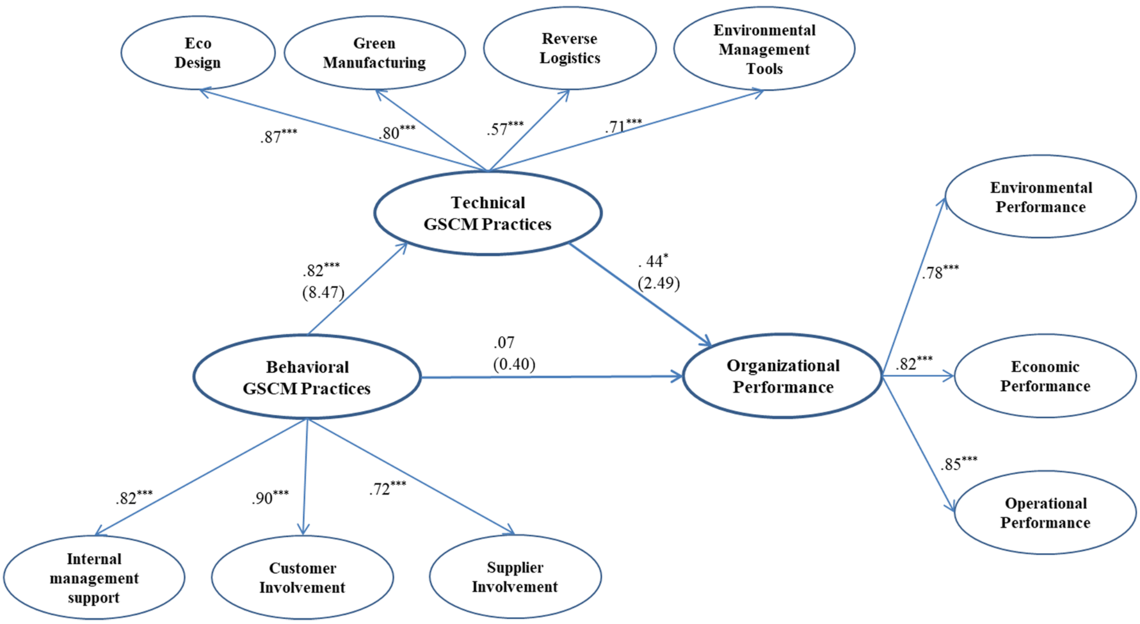
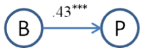
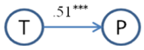
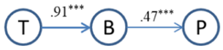
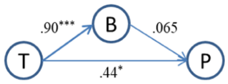


Fig. 2. Mediating effect of technical GSCM practices on the relationship between behavioral GSCM and organizational performance. * $p < .05$, ** $p < .01$, *** $p < .001$; Chi-square = 867.80, *d.f.* = 449, Normed Chi-square = 1.93, CFI = 0.91, RMSEA = 0.07, TLI = 0.9.

Table 8
Post hoc test results.

SEM results	R^2
	0.31
	0.36
	0.73
	B:0.77 P:0.34
	B:0.74 P:0.37

Note: * $p < .05$, ** $p < .01$, *** $p < .001$.
B: behavioral GSCM; T: technical GSCM; P: organizational performance.

the basis of the theorization of B- > T- > P, the soft dimensions of GSCM (i.e., behavioral aspects) provide a basis for technical GSCM practice implementation, but not vice versa (i.e., T- > B- > P). However, it is still worthwhile to examine, statistically, whether behavioral GSCM practices have a mediating effect on technical GSCM practices and performance (T- > B- > P) (see Table 8). The z value is 0.39 (S.E. = 0.148, $p = 0.692$), indicating that behavioral GSCM practices have no significant mediating effect on the technical practices and organizational performance link, which is in line with theoretical assumptions.

5. Discussion

5.1. Theoretical implications

The results of this study have critical theoretical implications. First, this study considers GSCM practices from a behavioral versus technical perspective and theorizes their effects on organizational performance. Generally, the importance of behavioral practices is neglected and companies tend to focus their attention on technical practices in the early stage of GSCM implementation (Ruiz-Quintanilla et al., 1996). However, this study corroborates findings that behavioral GSCM practices are prerequisites for technical GSCM practices, and both practices have positive effects on organizational performance in emerging markets (Chien and Shih, 2007; Geng et al., 2017; Zhu et al., 2005). In addition, results demonstrate that technical GSCM practices have a full mediation effect on the linkage between behavioral GSCM practices and organizational performance, implying that behavioral GSCM practices are infrastructural and have a subsequent positive impact on technical GSCM practices and organizational performance. These results substantiate the STS theory perspective and are in line with, but not restricted to, conventional knowledge that the soft components of GSCM practices, such as top management commitment, supplier relations, and customer cooperation, should be treated as critical practices for facilitating the implementation of technique-focused (hard) GSCM practices (Dubey et al., 2015; Mitra and Datta, 2014; Muduli et al., 2013). Unlike previous works that relied on a few GSCM practices, this study used a more integrated framework of GSCM practices consisting of critical behavioral and technical practices summarized from the literature. As such, the study results suggest a direct relationship between behavioral/technical GSCM practices on performance and contributes to the literature of GSCM by uncovering the mediation effect of technical GSCM practices on the linkage between behavioral GSCM practices and performance. In this regard, the prevalent discussion on the hard (technical) dimensions of GSCM practices should be reconsidered by scholars. Therefore, more research on the behavioral and technical perspectives of GSCM practices is required.

Second, this study contributes to the application of STS theory (Cooper and Foster, 1971; Kull et al., 2013), through its use of a GSCM context. STS theory suggests that social and technical subsystems should be integrated to improve system effectiveness (Pasmore, 1988). In line with the prediction based on STS, this study demonstrates that behavioral GSCM practices enhance the implementation of technical practices and can help companies to reap the benefits of implementing GSCM practices. In previous studies, the two subsystems contributed to a single economic performance indicator (i.e., operational performance). However, this study provides empirical evidence that STS theory influences both environmental and operational performance.

Third, this study contributes to the literature by revealing how behavioral GSCM practices can be affected by technical GSCM practices to achieve superior organizational performance, such as through economic, environmental and operational aspects. Although many studies have explored the relationships between GSCM practices and their performance, few have analyzed three performance metrics simultaneously. Hence, this study provides a more holistic assessment of the effect of behavioral and technical GSCM practices on performance.

5.2. Practical implications

The empirical findings have critical implications for practice regarding how company managers in emerging markets should more effectively implement GSCM practices to reap related benefits. Because SEM analysis results indicate a positive relationship between technical GSCM practices and performance, it is important for managers to continuously invest in technical practices, such as implementing cleaner technology, information systems, and other environmental tools, to improve environmental performance. This is consistent with the fact that gaps exist, in terms of environmental technologies and equipment, between companies from emerging markets and developed countries. This implies that the conventional approach emphasizing the hard dimensions of GSCM practices can still improve organizational performance. As for leading companies in emerging markets, they should stay abreast of companies from developed countries by engaging in more proactive activities and devoting their efforts to technical practices, such as R&D in green technologies or equipment. Small and medium-sized enterprises may involve customers' (e.g., multinational enterprises') GSCM technical practices and obtain support from them. Governments should take steps, such as establishing pilot or demonstration programs, to promote the diffusion of best GSCM practices among companies, especially small and medium-sized enterprises.

Technical practices could be leveraged when behavioral practices are a firm's foundation. This argument implies that advanced technologies or equipment may not necessarily lead to best practices in emerging markets, but best practices depend on contextual and behavioral factors (Khanna, 2014). Empirical evidence from companies in developed countries has shown that behavioral GSCM practices play a strategic role in improving performance (Cho et al., 2017). Considering the difference between emerging markets and developed countries, the results of this study provide a GSCM-based reference for companies in emerging markets. In other words, behavioral GSCM practices implemented in a focal company create a cooperative environment between suppliers and customers to increase their involvement in technical GSCM implementation. In addition, behavioral practices can promote the diffusion of GSCM principles across supply chain partners. To this end, managers should be motivated to implement behavioral practices in order to enjoy the aforementioned benefits. These implications may also be applicable to companies in other emerging markets; their implementation of GSCM could improve performance.

6. Conclusions

This study adopted an STS theory-based perspective to understand the role of behavioral and technical GSCM practices in improving organizational performance among companies in China, a typical country with an emerging economy. Two categories of GSCM practices were explored, and the underlying mechanism of how behavioral versus technical GSCM practices affect organizational performance was elucidated; the mediating role of technical GSCM practices was revealed to affect behavioral GSCM practices and performance. From a managerial perspective, the findings show that managers in emerging market companies should pay more attention to behavioral-oriented GSCM practices and invest more in technical practices. Generally, this study fills research gaps identified in the literature by highlighting the importance of behavioral GSCM practices for organizational performance and uncovering the sequential (mediating) mechanism involving technical practices.

Both the SEM and post hoc analyses support the mediating effect of technical GSCM practices on the relationship between behavioral practices and performance. The results can be interpreted in the context of Chinese manufacturing companies. That is, compared with manufacturing companies in developed countries, Chinese companies lack sophistication in implementing GSCM (Zhu et al., 2017). Many Chinese manufacturing companies are faced with tremendous environmental pressure exerted by the government and their multinational customers. As a result, technical practices alone have been adopted to comply with environmental requirements because they have been considered a "quick" solution to related problems. By contrast, companies in developed countries have begun to focus more on behavioral GSCM practices that endeavor to engage suppliers and customers because their technical practices have reached maturity (Cho et al., 2017). A comparative study using samples from emerging markets and developed countries could be of value. For example, studies should determine whether behavioral GSCM practices have a mediating effect on the relationship between technical GSCM practices and organizational performance using a sample from developed countries.

Similar to other empirical studies, this study is subject to several limitations that provide opportunities for future research. First, the data were collected using surveys. The validity of the reported information within a company seems to be determined by the perceptions of individual respondents. It is ideal to have multiple respondents in a single company. However, it is difficult in practice to obtain the responses of two or more personnel within the same company, although the reliability of data can be enhanced using multiple responses (Flynn et al., 2018). However, this study ensured anonymity in survey distribution and collection as well as explicitly requested respondents to complete survey questions to the best of their ability. Furthermore, experienced senior managers familiar with GSCM practices were requested to fill out the survey. Therefore, the information provided should be reliable. Second, although this study used two popular sampling strategies (snowball and convenience sampling), a risk of limited representation was apparent and it may have affected the interpretation of results. Random sampling is recommended for data collection in GSCM survey studies. Third, this study is in the context of an emerging economy (China), which differs from these developed countries. The effectiveness of behavioral and technical GSCM practices may vary in other macro contextual conditions (e.g., regulatory or policy, industrial infrastructure) and also be affected by contingency of environmental uncertainty. More empirical studies are needed to further understand the influence of contingency on the relationships among behavioral-, technical GSCM practices and organizational performance. Fourth, this study classified GSCM practices into behavioral and technical practices and examined relationships between them and the performance metrics rather than investigating the interrelationships between component factors (e.g., technical component A with behavioral component B). It is even more complicated when GSCM practices are analyzed at the individual practice level in an SEM framework. However, some related discussions can be found in the literature (Zhu et al., 2008, 2013) and can provide a starting point for future research. Finally, considering the development of GSCM is dynamic, future studies could be conducted by collecting time-series data under different research designs ("B- > T- > P" and "T- > B- > P"), and comparing the results from developed countries under the same design.

CRediT authorship contribution statement

Junjun Liu: Data curation, Formal analysis, Writing - original draft, Conceptualization, Methodology, Software. **Houbao Hu:** Investigation, Data curation, Conceptualization. **Xun Tong:** Conceptualization, Methodology, Writing - review & editing. **Qinghua Zhu:** Supervision, Methodology, Validation, Writing - review & editing.

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Appendix A

Figs. A.1 and A.2.

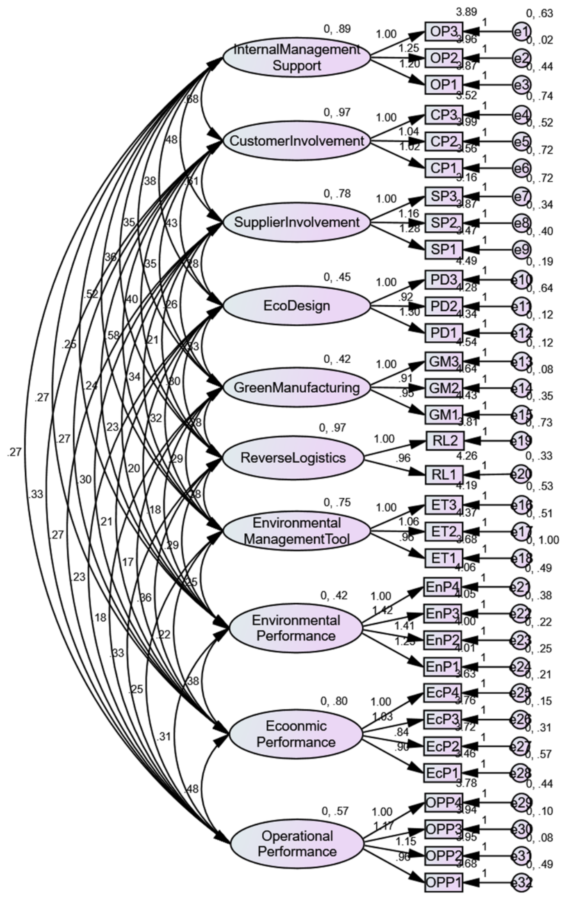

Fig. A1. CFA without common latent factor (Chi-square = 846.331, *d.f.* = 419, $p < 0.001$, Normed Chi-square = 2.02; CFI = 0.91, RMSEA = 0.07, TLI = 0.90).

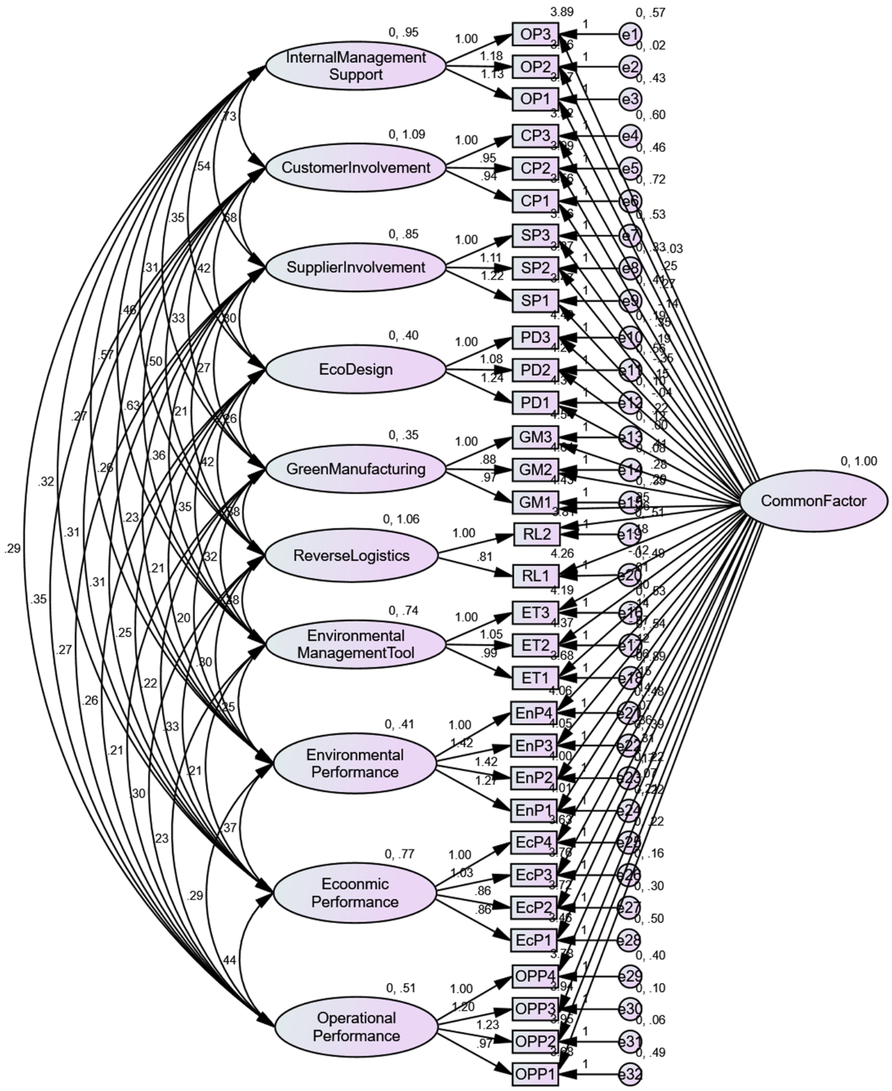

Fig. A2. CFA with common latent factor (Chi-square = 692.245, *d.f.* = 387, $p < 0.001$, Normed Chi-square = 1.79, CFI = 0.93, RMSEA = 0.06, TLI = 0.92).

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