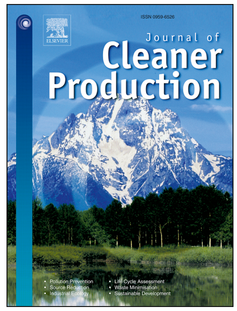


# Sustainable supply chain management practices, supply chain dynamic capabilities, and enterprise performance

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# Sustainable supply chain management practices, supply chain dynamic capabilities, and enterprise performance

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# Sustainable supply chain management practices, supply chain dynamic capabilities, and enterprise performance

**Abstract:** The combination of sustainable supply chain management (SSCM) and dynamic capabilities theory is a fairly young topic, which has attracted great attention from scholars and practitioners recently. This study empirically investigates the impact of SSCM practices on supply chain (SC) dynamic capabilities and enterprise performance (including economic, environmental and social performance) by explicitly focusing on the mediation effect of SC dynamic capabilities on the link between SSCM practices and enterprise performance. Data collected from 209 Chinese manufacturing firms were analyzed using structural equation modeling. The results reveal that SSCM practices have a significant positive effect on SC dynamic capabilities and all three dimensions of performances. Whereas SC dynamic capabilities affect only environmental performance positively, they have no effect on economic performance and social performance. Furthermore our analysis reveals that SC dynamic capabilities partially mediate the relationship between SSCM practices and enterprise performance. Overall, the findings explicate the importance for firms, in particular those operating in developing countries, to reinforce their SC dynamic capabilities and implement effective SSCM practices as an enabler.
**Key words:** Sustainable supply chain management; Supply chain dynamic capabilities; Enterprise performance; Practices

## 1 Introduction

Supply chain management (SCM) has turned out to be one of the main means for firms to control costs and enhance economic performance when facing the more and more competitive market these days. However, with the emerging issues such as environmental protection, firm transparency, employee benefits and security concerns, firms need to transform their supply chain (SC) models. Instead of focusing solely on economic performance, they need to build environmentally friendly supply chains to reach harmony with nature. World leading firms have already launched all kinds of sustainable supply chain management (SSCM) practices to improve their sustainable advantages. For example, Unilever implemented one project named “The Unilever Sustainable Living Plan” in 2010 which had improved the health conditions of nearly one billion people. It reduced the impact on environment and achieved purchasing 100% agriculturally sustainable raw materials and packages(Du, 2012). Apple Inc. promoted supplier supervisory mechanism such as “Apple Supplier Conducting Code” and “Supplier Responsibility Standard”. It made specific requirements on human and working rights, health and safety, environmental impact, managing system and moral conduct[①]. Moreover, the “1+3” supply chain responsibility management project of BASF conveys firm social responsibility throughout supply chain, and help its partners with best examples, expertise, and tailored solutions(Zhang et al., 2008). Based on the research on large number of firms, Accenture found that by establishing sustainable supply chain, firms can not only cut the cost and enhance risk management level, but also explore new income source and increase brand value(Hanifan et al., 2012).

SSCM is based on the combination of sustainable theory and SCM (Masoumik et al., 2012; Ahi and Searcy, 2013; Morali and Searcy, 2013; Signori et al., 2015). At the same time, globalization and digitization post more challenges to modern SCM in terms of complexity and dynamicity, which requires higher level of dynamic capabilities (DC) in supply chain. SSCM and DC are linked through similar environmental and organizational conditions, making the application of DC concepts in the field of SSCM a logical choice (Beske, 2012; 2014; Meinlschmidt et al., 2016). As a result, conducting research on how to improve dynamic capabilities of supply chain to grant firms sustainable competitive advantage in economics, environmental and society based on a deep understanding of the dynamic of supply chain is a highly valuable topic.

Much research on sustainability[②] of supply chain in developed countries has been done to

[①] This information sources from the website of Apple (China), http://www.apple.com/cn/supplier-responsibility/.
[②] At the core of sustainability is the interrelated relationship among the economic, environmental, and social dimensions (Morali & Searcy, 2013).

boost the development of the field (Mustaffa and Potter 2009; Paulraj, 2011; Wolf, 2011; Natalia et al., 2012; Gopalakrishnan et al., 2012; Harms et al., 2013; Shokri et al., 2014; Varsei and Polyakovskiy, 2016). Research focusing on developing countries is still limited as SSCM practices in these countries are relatively underdeveloped (Kim and Min, 2011; Silvestre, 2014; Esfahbodi et al., 2016; Galal and Moneim, 2016). Silvestre (2015) explains that supply chains in developing and emerging economies face more barriers to sustainability than those operating in developed countries. However, improving sustainability of supply chains in developing countries bears significant values to the entire world as these are more developing countries. This paper focuses on China, the largest and fastest developing country in the world. The economy of China is under transformation, and supply-side reform is, without a doubt, one of the hottest topics in China nowadays. It aims at changing the status of excessive supply, waste of resources, unreasonable structures, low quality, and low value-adding products (Xi, 2015). From a micro perspective, it is a good prescription for Chinese firms to survive and thrive as well as a new direction for sustainable development for all industries. The sustainable development of society to a certain degree depends on the sustainable development of supply chain. Therefore, focusing on SSCM is a good starting point for supply-side reform. And our research empirically tests how SSCM can affect the sustainable development of Chinese firms in a positive and sustainable way under the special circumstance of market economy reform. Meanwhile, coupling SSCM and dynamic capabilities theory (Beske, 2012; 2014), this paper also embeds SC dynamic capabilities into the framework and examines whether SC dynamic capability is able to mediate SSCM practices and firm performance.

In the remainder of the paper, a theoretical background is presented and the research hypotheses are developed. Sections describing the methodology, empirical results, and discussion follow. The paper ends with a summary of theoretical contribution, managerial implications, limitations and future research.

# 2 Literature review and hypotheses development

In this section, we will provide some theoretical grounds on the construction of the framework.

## 2.1 Sustainable supply chain management (practices)

Drumwrigh (1994) points out firms should embrace their social responsibilities and not be solely focused on maximizing profits. Social responsibility means that firms have a duty to act in the best interests of their environments and of society as a whole. By introducing environmental and social topics into traditional supply chain management, SSCM extends the realm of traditional idea by taking into consideration the sustainability of economy, environmental and society at the time of designing and optimizing supply chain (Bai and Sarkis, 2010; Gold et al., 2010; Dubey et al., 2016a). Many researchers have tried to define the term SSCM and they overwhelmingly agree that SSCM can be deemed as SCM focusing on maintaining environmental, economic and social stability for long-term sustainable growth (Carter and Rogers, 2008; Seuring and Müller, 2008; Ahi and Searcy, 2013; Beske et al. 2014; Silvestre, 2015; Dubey et al, 2016b). Typically, Seuring and Müller (2008) point out SSCM is the management of material, information and capital flows as well as the cooperation among firms along the supply chain while taking goals from all three dimensions of sustainable development. To distinguish from green SCM, Ahi and Searcy (2013) identify 22 definitions for green SCM and 12 definitions for SSCM and find that the latter is the extension of the former one by extending the environmental dimension into economic and society dimensions as well. Dubey et al. (2016a) make an in-depth analysis of the definitions of SSCM based on literature review and classify them into two broad categories: SSCM as a management philosophy & SSCM as a set of management processes.

SSCM practices comprise a firm’s internal and external practices which are taken to make its supply chain more sustainable in terms of all three dimensions of sustainability (Morali and Searcy, 2013; Paulraj et al., 2015). Firms practicing sustainable supply chain are driven by value and policy to improve their sustainable efficiency. Firms do so by taking measures favoring sustainable development in managing their supply chains. Scholars have done numerous researches on SCM practices. However, little has been done on SSCM practices. Existing literatures mainly use case analysis to discuss the practices from a variety of industry sectors and national settings. For example, Kottala et al. (2013) and Abhiruchi (2014) study the practices in manufacturing and hotel industries in India respectively. Alireza et al. (2014) investigate the fast food industry in UK. Raut et al. (2017) identify 32 critical success factors of motivation for the successful implementation of SSCM practices in Indian oil and gas industries. Furthermore, some researchers use qualitative analysis methods based on literature review to explore the composition of SSCM practices and the best practice (Pagell and Wu, 2009; Hong and Mayco, 2014; Beske et al. 2014; Paulraj et al., 2015; Esfahbodi et al., 2016). Among them, Beske et al. (2014) summarize SSCM practices into five types: strategic orientation, supply chain continuity, collaboration, risk management and pro-activity for sustainability. Paulraj et al. (2015) identify four underlying dimensions of SSCM practices incorporating sustainable product design, process design, and sustainability collaboration with suppliers as well as customers. Similarly, Esfahbodi et al. (2016) focus on four areas (sustainable production, sustainable design, sustainable distribution and investment recovery) in SSCM practices. However, SSCM practices have been inconsistently defined throughout the literature and there has been very little agreement regarding how to measure SSCM practices. This study has attempted to identify the key constituents of implementing SSCM practices. We propose a new classification (five categories) of SSCM practices which take the core practices into account based on the extant literature. These categories are elaborated in the subsequent methodology.

### 2.2 Supply chain dynamic capabilities

Studies show SSCM can stimulate the sustainable development of supply chain in a certain period, which requires certain level of static abilities in supply chain (Zhang, Yang and Bi, 2011; Diabat et al., 2013). However, due to the ever changing environment, these abilities need to be adjusted constantly. Supply chain can only fulfill the market demand only if new abilities are created to improve long term sustainable efficiency. The capability of creating new abilities is essentially the dynamic ability of the enterprise. Teece et al. (1997) define dynamic capabilities as ‘the ability to integrate, build, and reconfigure internal and external competencies to address rapidly-changing environments’. Dynamic capabilities theory is an extension of the resource-based view (RBV). While the RBV emphasizes resource choice, or the selecting of appropriate resources, dynamic capabilities emphasize resource development and renewal (Hitt et al., 2016). Sirmon et al. (2007) explain that resources (tangible and intangible) are bundled to create capabilities. Dynamic capabilities theory is also integrated with RBV to illustrate how to achieve a competitive advantage within the supply chain (Squire et al., 2009).

Supply chain dynamic capability, building on dynamic capabilities theory, is the ability of adjusting supply chain. It is an emerging and popular concept in recent years and yet its essence is difficult to grasp (Defee and Fugate, 2010). Beske (2012) views supply chain as a complex system. He pioneered adopting dynamic capability into supply chain and proposed that supply chain dynamic capability was the desired ability of this complex system to deal with environmental change as well as internal complex relationships. Gimzauskiene et al. (2015) think that supply chain dynamic capability makes organizations more flexible, and therefore can more easily and swiftly adapt to market trend and effectively tackle market volatility, and eventually enable the firm to achieve sustainable competitive advantage in its industry. Supply chain dynamic capability is an abstract concept consists of several sub-capabilities. For example, Beske (2012; 2014) breaks it down into supply chain reconstruction, knowledge evaluation, co-evolvement, flexible supply chain control, and supply chain partner relationship development. Chang (2011) categorizes this ability into integration one and cooperation one. The competitive advantage of a firm is not from one particular sub-capability, but from the combination of all sub-capabilities (Beske, 2014). Hall et al. (2012) also discovers that focusing on sustainable development element independently is unlikely to find a satisfactory solution to sustainable supply chains.

### 2.3 Conceptual framework and hypotheses

Our conceptual framework draws upon previous work in both the sustainable supply chain and dynamic capability literature. From the sustainable supply chain literature, we draw on the work of Suhaiza et al. (2012), Maruf (2013), Norazlan et al. (2014) and Esfahbodi et al. (2016). These studies investigate different kinds of SSCM practices that are undertaken by firms and how these practices affect the economic, environmental and social performance of the firms. From the dynamic capability literature, we draw on the work of Defee and Fugate (2010), Chang (2011), Beske (2012; 2014), Vargas and Mantilla (2014), Masteika and Čepinskis (2015) and Kirci and Seifert (2016). They argue that first, previous research on capabilities has been limited to static capabilities and have largely been firm-centric, which neglect today's evolving supply chain environment. Second, the combination of dynamic capabilities and SCM makes organizations more flexible which creates a competitive advantage for them. In particular, Beske et al. (2012; 2014) clearly acknowledge that SSCM practices are contingent upon dynamic capabilities and that there needs to be an alignment between the two in order to maximize competitive performance. Similarly, Vargas and Mantilla (2014) argue that the dynamic capability construct should be applied in the field of SSCM. Kirci and Seifert (2016) point out dynamic capabilities are the key source of sustainable competitive advantage for companies in SSCM. Since the coupling of SSCM and dynamic capabilities theory mentioned above, investigating the development of sustainable supply chain based on the latter is logical. The purpose of this paper is to examine the link between SSCM practices, SC dynamic capabilities, and enterprise performance, and to develop a model that describes the relationship among these three constructs. Based on the theoretical background presented in this section, we are able to formulate the conceptual framework of this paper. See Figure 1.

INSERT FIGURE 1 ABOUT HERE

In view of the underlying rationale, the following subsections present the detailed hypotheses related to the relationships of the research model.

### 2.3.1 SSCM practices and enterprise performance

A number of studies have investigated the mechanism of how SSCM practices can enhance firm performance. Through surveying 400 Malaysian manufacturing companies, Zailani et al. (2012) demonstrate that SSCM practices (environmental-friendly purchase and sustainable packaging) have a positive effect on sustainable performance, especially from the economic and social perspective. Hasan (2013) studies five typical firms, such as Coca Cola Enterprises and Eastman Chemical Company, and proves the positive impacts of SSCM on environmental and operational performance. Wang and Sarkis (2013) confirm that firms' SSCM activities are positively related to financial performance measured by return on assets and return on equity, and the positive influences can have a time lag of at least two years. Perry et al. (2013) use explorative methods to find the positive impact of SSCM on firm brand as well as social responsibility performance in Scottish cashmere industry. Using mobile industry in India as subjects, Luthra et al. (2014) empirically testify the impact of green supply chain on a firm's environmental, economical, social and operational performance to be positive. Norazlan et al. (2014) find that SSCM, including environmental, technological, culture and risk management, positively affects the health industry in Malaysia. Hsu et al. (2016) study manufacturing companies in emerging economies and find that implementing SSCM can realize positive reverse logistics outcomes and the promotion of competitiveness. Based on the above observations, we hypothesize:

H1 SSCM practice is positively associated with enterprise performance

H1a SSCM practice is positively associated with economic performance

H1b SSCM practice is positively associated with environmental performance

H1c SSCM practice is positively associated with social performance

### 2.3.2 SC dynamic capabilities and enterprise performance

Existing research on dynamic capability has shown its positive effect on firm performance.

Zott (2003), Griffith et al. (2006), and Eriksson (2013) confirm that dynamic capability enables a firm to gain competitive advantage and therefore improve its performance in its industry. Menguc and Barker (2005), Morgan et al. (2009) find similar results of dynamic capability on economic performance.

As supply chain dynamic capability is a relatively new concept, there is only limited research discussing how it affects firm performance. Caniato et al. (2014) focus on luxury industry, and find positive impact through intensive case analysis. Cheng et al. (2014) find that in highly competitive market, excellent dynamic capability can significantly improve the innovative performance and new products of firms. Other researchers analyze this relationship through some specific dimensions. Mentzer (2001) argue that strategic cooperation ability throughout supply chain can help enhance sustainable advantage for every firm in the chain. Jiang (2005) uses comprehensive ability as an important concept of dynamic capability, and finds its positive impact on enhancing sustainable advantage using 300 manufacturing firms in China. Harrison (2002) finds a positive relationship between supply chain coordination ability and firm performance. Using different industries in UK as sample, Bessant (2003) finds a significant impact of supply chain learning ability on supply chain efficiency. Dyer and Hatch (2006) compare the supply chains of US automobile firms with that of Toyota and show that knowledge sharing among supply chain can improve efficiency. Chen (2007) and Wisner et al. (2015) point out the importance of flexibility of supply chain information flow. Lee and Rha (2016) find this flexibility is important to buffer the negative impact from supply chain breakdown and to enhance firm performance. We thus hypothesize:

H2 Supply chain dynamic capability is positively associated with enterprise performance

H2a Supply chain dynamic capability is positively associated with economic performance

H2b Supply chain dynamic capability is positively associated with environmental performance

H2c Supply chain dynamic capability is positively associated with social performance

### 2.3.3 SSCM practices and SC dynamic capability

SSCM practices would bring short term competitive advantage, which in turn would boost further development of dynamic capability (Hall, 2010). Research combing SSCM with dynamic capability is rare, especially so in empirical research. Ramaswany (2000) holds that customer orientation and participation in SSCM practices provide all kinds of information (knowledge) to firms, and to some extent cultivate the dynamic capability, and hence improve firm performance. Handfield and Bechelt (2001) argue that partnership within supply chain can enhance the abilities of quick response and of adapting to the environment, and hence improve ability of reconstruction. Ernst and Kim (2002) qualitatively study knowledge spillover and cultivation of firm capability in global supply chains and show that firms in the chains can gain knowledge and resources from other chain members and hence improve their capability. Prieto and Revilla (2009) study 80 Spanish firms with surveys and find that support and trust of supply chain partner is vital to dynamic capability of firms. Therefore, we hypothesize the following.

H3 Sustainable supply chain management practice is positively associated with supply chain dynamic capability

### 2.3.4 The mediating effect of supply chain dynamic capability

Hazen et al. (2011) propose that SSCM practices per se may not be the source of competitive advantage. Dubey et al. (2016) argue that SSCM may affect the competitiveness of enterprises through mediating linkages. In the resource-based framework, dynamic capabilities can often mediate the enterprise’s resources or activities to improve performance (Lin and Wu, 2014). Kim and Han (2012) find that dynamic learning capability can effectively mediate the influence of sustainability practices on performance. In addition, some scholars dig into the relationships among supplier management, dynamic capability and firm performance, such as Stanley and Wisner (2001), Lin et al. (2005), Kannan and Tan (2005), Nair (2006), Lo et al. (2007), Kaynak and Hartley (2008), and Sroufe and Curkovic (2008). These researchers start from dynamic capability and propose that fine supplier relationship has positive impact on firm production flexibility and product optimization, and therefore enhance firm performance. They confirm the linking effect of dynamic capability between supplier relationship and firm efficiency. We therefore hypothesize:

H4 Supply chain dynamic capability mediates relationships between sustainable supply chain management practice and enterprise performance

H4a Supply chain dynamic capability mediates relationships between sustainable supply chain management practice and economic performance

H4b Supply chain dynamic capability mediates relationships between sustainable supply chain management practice and environmental performance

H4c Supply chain dynamic capability mediates relationships between sustainable supply chain management practice and social performance

In addition, contextual factors such as firm size and industry sector can affect the implementation of SSCM. Zhu et al. (2008) confirm that an organization size has a statistically significant relationship with the adoption of green SCM practices. Vanpoucke et al. (2014) argue that firm size can influence the implementation of environmental practices as larger firms have more available resources and receive greater environmental pressure than smaller firms. Moreover, Zhu and Sarkis (2004) find significant differences among green SCM practices adoption in the power generation, automobile, and electronics. Huang et al. (2015) prove that different sectors from Chinese manufacturing SMEs differ in adoptions of green SCM. Based on the above observations, we hypothesize:

H5 There are differences in the level of implementation of SSCM practices according to the main characteristics of organizations.

H5a There are differences in the level of implementation of SSCM practices according to the size of organizations.

H5b There are differences in the level of implementation of SSCM practices according to the sector of organizations.

# 3 Methodology

## 3.1 Variable measurement and questionnaire design

The survey questionnaire is structured into three sections, namely, SSCM practices, SC dynamic capabilities and enterprise performance. All Measurements used a five-point Likert scale. In order to ensure the reliability and validity of the measurements, we referred to the mature scales developed in the relevant literature. We conducted a pre-test involving 20 respondents (practitioners) who hold senior positions in their organization and possess sufficient knowledge about the organization’s overall supply chain management, and then made some minor alterations to the questionnaire before a formal investigation.

Five dimensions (16 items) for measuring SSCM practices were adopted from the study of Pagell and Wu (2009), Reuter et al. (2010), Raine et al. (2010), Beske et al. (2014), Paulraj et al. (2015), Hendrik and David (2016), and Esfahbodi et al. (2016), including supply chain coordination and trust, supply chain learning, supply chain strategic orientation, supply chain risk management and supply chain continuity. Five dimensions (19 items) for measuring supply chain dynamic capabilities were obtained from Zheng et al. (2011), Shin et al. (2012), Klassen and Vereecke (2012), Ramesh (2014), Beske et al. (2014), Lin et al. (2015), and Meinlschmidt et al. (2016), including knowledge acquisition and absorptive capacity, market oriented perception ability, innovation ability, internal reconstruction ability and social network relationship ability. Enterprise performance mainly measures the changes of enterprises in the operation, market, finance, environmental protection, resource utilization and social responsibility in recent years. It falls into three categories: economic performance, environmental performance and social performance. Thirteen items measured economic performance, all adapted from Lin et al. (2005), Cory (2009), Nazli et al. (2010), and Emilie et al. (2014). Six items measured environmental performance, all adapted from Zhu et al. (2006), Cory (2009), Natalia et al. (2012) and Luthra et al. (2014). Seven items measured social performance, all adapted from Vachon and Mao (2008), Patlitzianas et al. (2008), Adivar (2010), and Tajbakhsh (2015). For details of variable measurement, see Table 2 and the appendix.

### 3.2 Sample data collection

Using the questionnaire, this study collected data from manufacturing companies in the Yangtze River Delta region, which has the most developed manufacturing industry in China. To avoid the biases associated with convenience sampling, we randomly select sample companies from the complete list of manufacturers in Yangtze River Delta. The types of investigated enterprises include private enterprises, state-owned enterprises, foreign-funded enterprises, joint ventures, and collective enterprises. The surveyed enterprises are involved in a wide range of industries such as food and beverage, alcohol and cigarettes, chemicals and petroleum chemical industry, wood and furniture, building materials, rubber and plastic, electronic products and electrical appliances, textiles and apparel, publishing and printing, pharmacy and other. The respondents are mainly personnel engaged in the jobs related to SCM or OM, such as CEO, president, director, manager, supervisor and senior staff. Thus, it is reasonable to expect that the respondents are informative and knowledgeable to answer the survey questionnaire. We issued a total of 483 questionnaires and 220 questionnaires were returned, yielding a response rate of 45.5%. We excluded 11 questionnaires because of incomplete data, thus 209 valid questionnaires were processed for analysis. Details of the companies of the respondents are given in Table 1.

INSERT TABLE 1 ABOUT HERE

Table 1 indicates the distribution of respondent enterprises in terms of industry, enterprise size using employment levels, and annual revenue turnover of the companies. Notice that respondents are mainly from foreign-funded companies and private companies. Enterprise sizes ranged from under 100 to over 1000 employees with about half of the enterprises falling into the relatively large company classification of over 500 employees. Moreover, enterprises established more than 10 years of age and above ￥100 million (￥1 = $USD0.15) in annual revenue account for most of the samples.

## 4 Data analysis and results

### 4.1 Preliminary Analysis

(1) Pre-testing

As mentioned earlier, we conducted a pre-test involving 20 respondents who have SCM or OM experience, and then made some minor alterations to the questionnaire before the formal investigation.

(2) Non-response bias

To test for non-response bias, the Armstrong and Overton (1977) approach was followed. Specifically, a comparison was made between the early (first 25% replies) and late respondents (last 25% replies) to see if they differed in their questionnaire responses. The t-test results indicated no significant difference at $p \leqslant 0.05$, thus non-response bias is not a problem.

(3) Common method bias

Harman’s one factor test with un-rotated principal component analysis of the items was performed to identify common method bias (Cheng, 2011). The result showed that the first factor explaining 30.1% of the overall variance (did not account for the majority of the variance) indicating that the data was not affected by common method bias.

### 4.2 Measurement model

The reliability of the scale in this paper was tested using Cronbach’s alpha (α). Generally, Cronbach's α is best to be greater than 0.7 (Hair et al., 1998). Table 2 lists the calculated Cronbach's α coefficients of the scale using SPSS. It can be seen that the reliability of each measurement index is greater than 0.7, which shows that the scale in this paper has a good reliability.

The validity was assessed by the content validity test and the structural validity test. Because the scale of this paper is based on existing research, it has a good content validity. Construct validity includes convergent validity and discriminant validity. In this paper, confirmatory factor analysis was used to verify the validity of the structure using AMOS. For convergent validity, we can use AMOS to compute the average variance (AVE), if the AVE value is greater than 0.5, the standard load is more than 0.5, and the composite reliability (CR) is more than 0.7, then the scale validity is very high. Table 2 indicates that AVE is more than 0.6, so the scale in this paper has a good convergent validity. For discriminant validity, if the square root of each variable is larger than the correlation coefficient between the variables and the other variables, the AVE has a good discriminant validity. From Table 3, we can find this scale indeed has a good discriminant validity.

INSERT TABLE 2 ABOUT HERE

INSERT TABLE 3 ABOUT HERE

## 4.3 Structural model: structural equation analysis

### 4.3.1 **The goodness of fit test of the model**

In this paper, we use AMOS to analyze the overall model of this study, and draw the results of the overall analysis of the model (see Table 4). The fitness values of these indices are all in the acceptable range by Table 4. So it shows the model is consistent with the actual survey data and the model has good fitness.

INSERT TABLE 4 ABOUT HERE

### 4.3.2 **Path analysis and hypothesis testing of the model**

INSERT FIGURE 2 ABOUT HERE

To assess the model structure, we first examined multi-collinearity using SPSS for the predicting constructs. All constructs in this paper were shown to have a tolerance level of above 0.2 and VIF below 5, indicating non-collinearity. Then we assessed the significance and the relevance of the structural model relationships using AMOS (see Figure 2). We bootstrapped the constructs to examine the significance of the path co-efficiency (see Table 5). The results indicate the p-values of H1a, H1c, H2b and H3 are very significant, p-value (<0.05) of H1b is also significant, so H1a, H1b, H1c, H2b, H3 are verified. The p-values of H2a and H2c are slightly greater than 0.05, which means they are not significant. So H2a and H2c are not supported.

INSERT TABLE 5 ABOUT HERE

We also examined the mediating effect of SC dynamic capacity according to step-by-step guidelines of Zhao et al. (2010). The size of mediating effects was determined by computing the value of variance accounted for (VAF). The results of mediating effect are shown in Table 6. Hence, it is apparent that SC dynamic capabilities partially mediate the relationship between SSCM practices and enterprise performance. The empirical evidence supports our hypothesis (H4a, H4b and H4c) that SSCM practices have an indirect effect (a*b) ($\beta$ = 0.078, 0.359 and 0.110), and direct effect (c) ($\beta$ = 0.53, 0.20 and 0.69) having same directions and are significant with t-statistic > 1.75.

INSERT TABLE 6 ABOUT HERE

Furthermore, to test H5 (H5a, H5b) the non-parametric Kruskal-Wallis test was used. The results indicate that there are significant differences between the levels of implementation of SSCM practices based on organization size and industrial sector of the research firms (H5a and H5b are verified). As shown in Table 7, large organizations present higher levels of implementation of SSCM practices and small organizations present lower levels. According to Table 8, the industrial sector with higher level of implementation of SSCM is “electronic products & electrical appliances”. In this sector only supply chain learning presents low levels of implementation. Therefore, this sector can be considered as the most sustainable. It is followed by pharmacy and “textiles & apparel” sectors, which presented considerable levels of implementation of an extended set of SSCM practices. The two sectors less sustainable are “publishing & printing” and “rubber & plastics”. Another important conclusion is that the SSCM practice with higher levels of implementation in almost all industrial sectors is “supply chain coordination and trust”.

INSERT TABLE 7 ABOUT HERE

INSERT TABLE 8 ABOUT HERE

## 5 Results and discussion

Recent studies have reported many examples of improving enterprise performance through SSCM in several countries (Zailani et al., 2012; Hasan, 2013; Wang and Sarkis (2013); Perry et al., 2013; Luthra et al., 2014; Norazlan et al., 2014; Hsu et al., 2016). Consistent with their findings, this study provides an empirical support for the positive relationship between SSCM practices and enterprise performance based on the investigation of Chinese manufacturers. The influences of implementing SSCM practices have been discussed in the literature review. These benefits vary from operational goals in the tactical level which focus on improving the economic benefits, to strategic values which take longer time to be realized by the firms (Kurnia, 2014). For example, the implementation of SSCM practices can enable firms to maintain leading positions in the sustainability market, to increase market shares, and to improve profits (Paulraj, 2011). In addition to operational benefits, SSCM implementation can generate strategic benefits which enable enterprises to fulfill their responsibilities to society, environment, and other stakeholders

(Hoejmose et al., 2012; Paulraj et al., 2015; Esfahbodi et al., 2016). In particular, under the supply-side reform in China, the implementation of SSCM helps eliminate highly polluting and energy inefficient products through the choice of downstream firms (Yang, 2016). It can facilitate the environmental protection compliance of firms and help firms actively improve their environmental performance. In this way, it can accelerate the transformation and upgrading of Chinese firms in global value chains (Wei and Yang, 2016). Huawei, one of the pioneers in adopting SSCM practices in China, has made enormous efforts and achievements in SSCM: accounting for sustainability in supplier certifying and inspection process, building sharing platform for suppliers, corporation with partners in energy-saving innovation (Liu, 2016).

This study shows that SC dynamic capability has a significant impact on environmental performance, but not on economic and social performance. Esfahbodi et al. (2016) also arrive at a similar conclusion that SSCM in emerging economies results in better environmental performance, but does not necessarily better cost performance. The view that SC dynamic capability positively affects environmental performance has been backed by many researchers (Zhu and Sarkis, 2006; Sharfman, 2008; Green et al. 2012). By enhancing the overall dynamic capability, the activeness and innovativeness of key firms on the chain can be boosted, and their utility of monitoring environment can be achieved. Further, it can enhance the environmental supervision of the entire chain and enhance sustainable performance of firms. As a matter of fact, there have been many successful stories in China recently. For example, backed by Walmart Foundation, Sustainable Development Alliance and its Chinese partners have launched a series of projects to help Chinese firms with overall environmental protection performance and social sustainability performance. Moreover, Winter (2003) argues that insignificant impact of SC dynamic capability on economic performance is due to the costs of ad hoc problem solving. Jeroen (2010) sees sustainability as linked to externalities and deems the impact of sustainable capacities on corporate bottom lines to be negative as they mainly increase costs. Obviously, whether an enterprise achieves sustainable performance is determined by input-output efficiency. Pagell and Wu (2009) argue that firms must gain profits over time while performing well in all aspects of the triple bottom lines. Considering the long response time of SC dynamic capability on economic performance, many manufacturers in emerging economies often struggle to implement SSCM initiatives (Paulraj et al., 2008). Actually, when coupled with economic objectives to develop a long-term strategy, SSCM can actually lead to the highest level of organizational performance (Carter and Rogers, 2008). Similarly, dynamic capabilities in social management might require a much longer time horizon to develop, implement and yield performance benefits than static capabilities (Klassen and Vereecke, 2012). Therefore, SC dynamic capability has no significant impact on social performance.

This study finds significant positive impact of SSCM practice on its dynamic capability. It empirically testify the framework proposed by Beske et al. (2012; 2014). And this result supports the conclusion in Vachon and Klassen (2008) that supply chain learning, a supply chain dynamic capability, is embedded in environmental collaboration with important partners which can positively affect firm performance significantly. As Kim and Han (2012) indicate, firms implementing SSCM usually have stronger supply chain dynamic capability to cope with environmental changes than average firms. Kirci and Seifert (2016) study the “Zero Waste to Disposal” project in Nestle and conclude that the practice of SSCM is governed by its routines and processes which have a significant influence on dynamic capability in supply chain. Our result is also in line with several observations in China that some pioneering firms have enhanced their dynamic capabilities through SSCM practices. For example, China Medical Group, the largest and most competitive group in health industry, has proposed the idea of smart supply chain construction. This is a practice to integrate current available resources and use information technology to achieve viable, controllable, and tractable smart supply chain and achieve dynamic management of the entire chain. This practice makes it possible for firms on the entire chain to work together and achieve joint development in dynamic capability and profit.

Moreover, this study further confirms the mediating effect of supply chain dynamic capabilities in the relationship between SSCM practices and enterprise performance. This is consistent with Defee and Fugate (2010), who show that as a path, supply chain dynamic capability can improve sustainable competitive advantage. This result can provide inspiration to firms because effective implementation of SSCM practices can lead to better SC dynamic capabilities and enhanced enterprise performance. Silvestre (2015) argues that the poor condition of SSCM in developing countries prevent supply chains from learning, innovating (the accumulation of dynamic capabilities), and thus hinder the improvement of sustainability performance. The aforementioned Huawei example which achieved sustainable performance through cultivating excellent dynamic capability with its supply chain partners in SSCM practices can also provide a powerful support for this conclusion.

Finally, this study proves that the implementation level of SSCM practices is different by organizations' size and by industrial sectors. These results are supported by the works of Zhu et al. (2008), Vanpoucke et al. (2014), Zhu & Sarkis (2004) and Huang et al. (2015) which argue that the deployment of green SCM practices differ in firm size or industrial sectors. Therefore, the company level characteristic variables play an important role on the implementation level of SSCM practices.

# 6 Conclusions

## 6.1 Theoretical contributions

The theoretical contributions of this paper are two-fold. First, through the literature review on SSCM, it is found that the theories used by existing SSCM research are not sufficiently solid. (Hoejmose and Adrien-Kirby, 2012; Touboulic and Walker, 2015). In view of the coupling of SSCM and dynamic capabilities theory (Beske et al., 2012; 2014), SC dynamic capability is introduced into the framework of the relationship between SSCM practices and enterprise performance. The combination of the two enriches and deepens the theoretical connotation of each other. Second, in spite of the increasing research on SSCM, there is a paucity of empirical evidence and theoretical reflection on sustainable supply chains in developing and emerging economies (Silvestre, 2015; Esfahbodi et al., 2016). This study is a first attempt to investigate SSCM practices in developing countries. It provides empirical evidence for improving SSCM performance in developing countries. This fills an important research gap as existing research so far has focused on developed countries.

## 6.2 Managerial implications

For business practice, this paper has made several contributions. First, our findings can help firms realize the importance of SSCM and how SSCM practices impact enterprise performance. Enterprises should develop an understanding of the entire supply chain and then communicate and collaborate with its supply chain partners to reach a consensus on sustainable goals in SCM practices. As Julia Schwarzkopf, the supply chain manager of Volkswagen Group, said, without establishing sustainable development at the strategic level, executing related policies of sustainable development in practices is "unsustainable". Second, our findings also show the medium effect of SC dynamic capability in the relationship between SSCM practices and enterprise performance. In recent years, the rapid development of information technology such as Internet Plus, cloud manufacturing, and big data has brought many opportunities to SSCM practices (Soliman, 2014; Cámara, 2015; Khan et al., 2016). Hendrik and David (2016) find the most important execution themes for SSCM are the availability of information and suitable IT via an exploratory Delphi study. Therefore, enterprises should seize the opportunities of information era and focus on using modern information technology to improve SC dynamic capabilities, in order to build a flexible, efficient, and dynamic supply chain to better respond to environmental changes, and ultimately promote their sustainable competitive advantage. Thirdly, our study confirms the importance of building a scientific and comprehensive assessment of supply chain sustainability from the national and industry level, which can help enterprises understand their current practices in the triple bottom line across the supply chain. The developed countries have provided some good examples of popular standards (e.g. Dow Jones Sustainability Index) as a starting point for the firms in developing countries.

## 6.3 Limitations and future research

Despite the theoretical and practical contributions stated above, it is essential to acknowledge limitations of our study that might provide opportunities for future research. First of all, this paper mainly focused on the Yangtze River Delta region in China, which makes our research results less generalizable. A larger sample collection will be a future direction of SSCM research. Secondly, the measure of supply chain dynamic capability is not comprehensive enough because it doesn't contain the ability category of an enterprise's whole operation process. Thus, it is necessary to strengthen the measure of this variable in future research. In addition, supply chain dynamic capabilities emphasize the abilities to combine existing resources and capabilities in the process of coping with environmental changes. In this paper, the new capacities generated by dynamic capabilities are not included in the conceptual framework due to the unknown and unpredictable new capabilities. Therefore, our research framework can be further expanded and improved in the future. Finally, this study indicates that enterprises trying to improve performance in supply chain may increase investment in SSCM and supply chain dynamic capabilities because of the benefits and the incentives. Therefore, enterprise performance may have a reverse influence on SSCM practices and SC dynamic capabilities. Future research can further explore this issue.

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**Tab 1 Respondent profile information (N = 209)**

| Characteristics | Categories | Frequency | Percentage（%） |
|---|---|---|---|
| Industry | Publishing and printing | 10 | 4.78 |
| | Electronic products and electrical appliances | 27 | 12.92 |
| | Textiles and apparel | 15 | 7.18 |
| | Chemical products and petrochemical industry | 21 | 10.05 |
| | Building material | 10 | 4.78 |
| | Metal machinery and Engineering | 33 | 15.79 |
| | Wood and furniture | 8 | 3.83 |
| | Food and beverage, alcohol and cigarettes | 19 | 9.09 |
| | Rubber and plastics | 14 | 6.70 |
| | Pharmacy | 9 | 4.31 |
| | Other | 43 | 20.57 |
| Type of firm | Foreign-funded enterprise | 72 | 34.45 |
| | Private enterprise | 71 | 33.97 |
| | Collective enterprise | 9 | 4.31 |
| | Joint venture | 25 | 11.96 |
| | State-owned enterprise | 28 | 13.40 |
| | Other | 4 | 19.14 |
| Size (Employees) | Less than 100 | 36 | 17.22 |
| | 100-300 | 28 | 13.40 |
| | 301-500 | 36 | 17.22 |
| | 501-1000 | 36 | 17.22 |
| | More than 1000 | 73 | 34.93 |
| Sales volume (Yuan Renminbi, ￥) | Less than 1 million | 10 | 4.78 |
| | 1-10 million | 26 | 12.44 |
| | 10-50 million | 36 | 17.22 |
| | 50-100 million | 41 | 19.62 |
| | More than 100 million | 96 | 45.93 |
| Age of firm | Less than 4 years | 12 | 5.74 |
| | 4-5 years | 17 | 8.13 |
| | 6-10 years | 54 | 25.84 |
| | 11-20 years | 66 | 31.58 |
| | More than 20 | 60 | 28.71 |

**Tab 2 Reliability and convergent validity analysis**

| Measurement index | | | Factor loading | AVE | CR | Cronbach α |
|---|---|---|---|---|---|---|
| Variable | Sub-variable | Items | | | | |
| SSCM practices | Supply chain coordination and trust | 3 | 0.706 | 0.637 | 0.897 | 0.896 |
| | Supply chain learning | 3 | 0.828 | | | |
| | Supply chain strategic orientation | 3 | 0.801 | | | |
| | Supply chain risk management | 4 | 0.809 | | | |
| | Supply chain continuity | 3 | 0.839 | | | |
| SC dynamic capabilities | Knowledge acquisition and absorptive capacity | 4 | 0.548 | 0.622 | 0.889 | 0.883 |
| | Market oriented perception ability | 4 | 0.839 | | | |
| | Innovation ability | 3 | 0.801 | | | |
| | Internal reconstruction ability | 4 | 0.879 | | | |
| | Social network relationship ability | 4 | 0.833 | | | |
| Economic performance | Operation | 4 | 0.699 | 0.616 | 0.827 | 0.822 |
| | Market | 3 | 0.823 | | | |
| | Finance | 6 | 0.826 | | | |
| Environmental performance | Pollution control | 3 | 0.783 | 0.602 | 0.752 | 0.753 |
| | Resource utilization | 3 | 0.770 | | | |
| Social performance | Enterprise perspective | 4 | 0.772 | 0.612 | 0.760 | 0.757 |
| | Employee perspective | 3 | 0.794 | | | |
| The whole scale | The whole reliability | | | 0.947 | | |

**Tab 3 Correlation coefficient matrix and discriminant validity analysis**

| Variable | Mean | Standard deviations | SSCM practices | SC dynamic capabilities | Economic performance | Environmental performance | Social performance |
|---|---|---|---|---|---|---|---|
| SSCM practices | 3.8 | 0.536 | 1 | | | | |
| SC dynamic capabilities | 3.887 | 0.507 | 0.648** | 1 | | | |
| Economic performance | 3.746 | 0.449 | 0.789** | 0.688** | 1 | | |
| Environmental performance | 3.783 | 0.448 | 0.613** | 0.686** | 0.543** | 1 | |
| Social performance | 3.684 | 0.542 | 0.750** | 0.619** | 0.682** | 0.529** | 1 |

Note: **Correlation is significant at the 0.01 level (2-tailed); Diagonal elements are square roots of average variance extracted (AVE)

**Table 4 The goodness of fit of the model**

| Fitting index | CMIN/DF | GFI | AGFI | NFI | IFI | CFI | RMR | RMSEA |
|---|---|---|---|---|---|---|---|---|
| Evaluation criterion | <3 | >0.9 | >0.8 | >0.9 | >0.9 | >0.9 | <0.05 | <0.08 |
| Test value | 2.748 | 0.905 | 0.818 | 0.912 | 0.921 | 0.920 | 0.014 | 0.072 |

**Tab 5 Results for structural model evaluation**

| Hypothesis | Path direction | Path coefficient | P value | Result |
|---|---|---|---|---|
| H1a | SSCM practices→Economic performance | 0.53 | *** | Pass |
| H1b | SSCM practices→Environmental performance | 0.20 | 0.010 | Pass |
| H1c | SSCM practices→Social performance | 0.69 | *** | Pass |
| H2a | SC dynamic capabilities→Economic performance | 0.17 | 0.059 | Not Pass |
| H2b | SC dynamic capabilities→Environmental performance | 0.78 | *** | Pass |
| H2c | SC dynamic capabilities→Social performance | 0.24 | 0.068 | Not Pass |
| H3 | SSCM practices→SC dynamic capabilities | 0.46 | *** | Pass |

**Tab 6 Results for mediating effect**

| | Path | Direct path coefficients (β) | | | Indirect effect | | | Total effect | VAF | Mediation type |
|---|---|---|---|---|---|---|---|---|---|---|
| | | a | b | c | a*b | se | t-stat | | | |
| H4a | SSCM practices→SCDC→ Economic performance | 0.46 | 0.17 | 0.53 | 0.078 | 0.044 | 5.846 | 0.608 | 0.674 | Partial |
| H4b | SSCM practices→SCDC→ Environmental performance | 0.46 | 0.78 | 0.20 | 0.359 | 0.056 | 7.832 | 0.559 | 0.515 | Partial |
| H4c | SSCM practices→SCDC→ Social performance | 0.46 | 0.24 | 0.69 | 0.110 | 0.063 | 3.917 | 0.800 | 0.589 | Partial |

**Tab 7 SSCM practices implementation level by organizations' size**

| Organization size / SSCM practices | Less than 100 | 100-300 | 301-500 | 501-1000 | More than 1000 |
|---|---|---|---|---|---|
| Supply chain coordination and trust | 3.9 | 4.0 | 4.2 | 4.3 | 4.5 |
| Supply chain learning | 3.3 | 3.4 | 3.5 | 3.7 | 3.8 |
| Supply chain strategic orientation | 3.5 | 3.9 | 4.1 | 4.2 | 4.4 |
| Supply chain risk management | 3.6 | 3.7 | 3.9 | 4.1 | 4.3 |
| Supply chain continuity | 3.4 | 3.5 | 3.6 | 4.0 | 4.1 |
| Note: The values represent the mean answers with regard to the level of implementation of SSCM practices on a 5 point Likert scale. | | | | | |

**Tab 8 SSCM practices implementation level by industrial sector**

| SSCM practices / Industrial sectors | Supply chain coordination and trust | Supply chain learning | Supply chain strategic orientation | Supply chain risk management | Supply chain continuity |
|---|---|---|---|---|---|
| Publishing and printing | 3.8 | 3.0 | 3.3 | 3.3 | 3.1 |
| Electronic products and electrical appliances | 4.5 | 3.8 | 4.3 | 4.2 | 4.1 |
| Textiles and apparel | 4.2 | 3.6 | 4.1 | 4.0 | 3.8 |
| Chemical products and petrochemical industry | 3.9 | 3.4 | 3.9 | 3.8 | 3.6 |
| Building material | 4.1 | 3.5 | 4.0 | 4.0 | 3.9 |
| Metal machinery and Engineering | 4.0 | 3.4 | 3.9 | 3.9 | 3.8 |
| Wood and furniture | 4.1 | 3.7 | 4.2 | 4.2 | 4.1 |
| Food and beverage, alcohol and cigarettes | 4.0 | 3.5 | 4.0 | 4.0 | 4.0 |
| Rubber and plastics | 3.9 | 3.2 | 3.6 | 3.5 | 3.3 |
| Pharmacy | 4.3 | 3.6 | 4.2 | 4.1 | 3.9 |
| Other | 4.1 | 3.5 | 4.0 | 3.9 | 4.0 |
| Note: The values represent the mean answers with regard to the level of implementation of SSCM practices on a 5 point Likert scale. | | | | | |

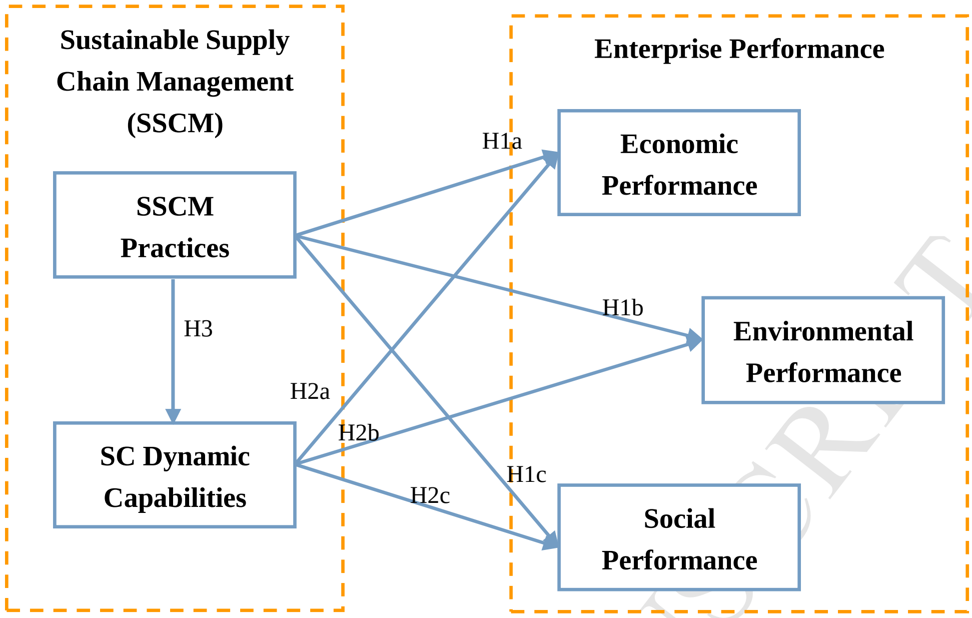


**Figure 1 Conceptual framework**

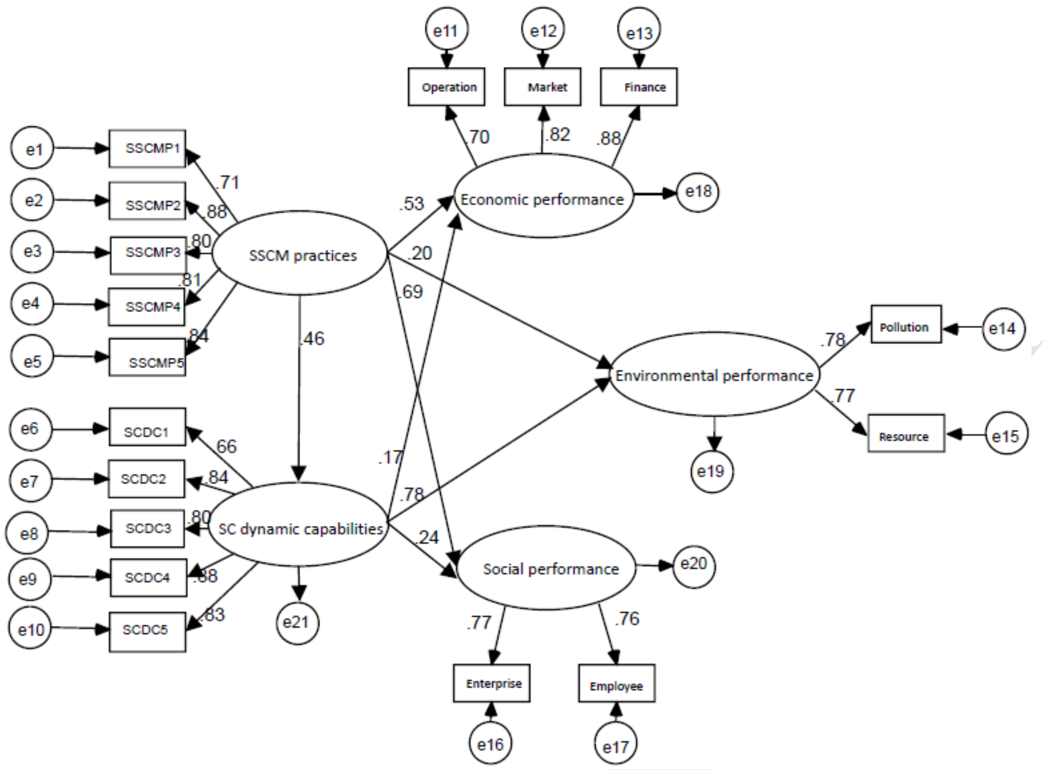


Fig 2 Structural equation model