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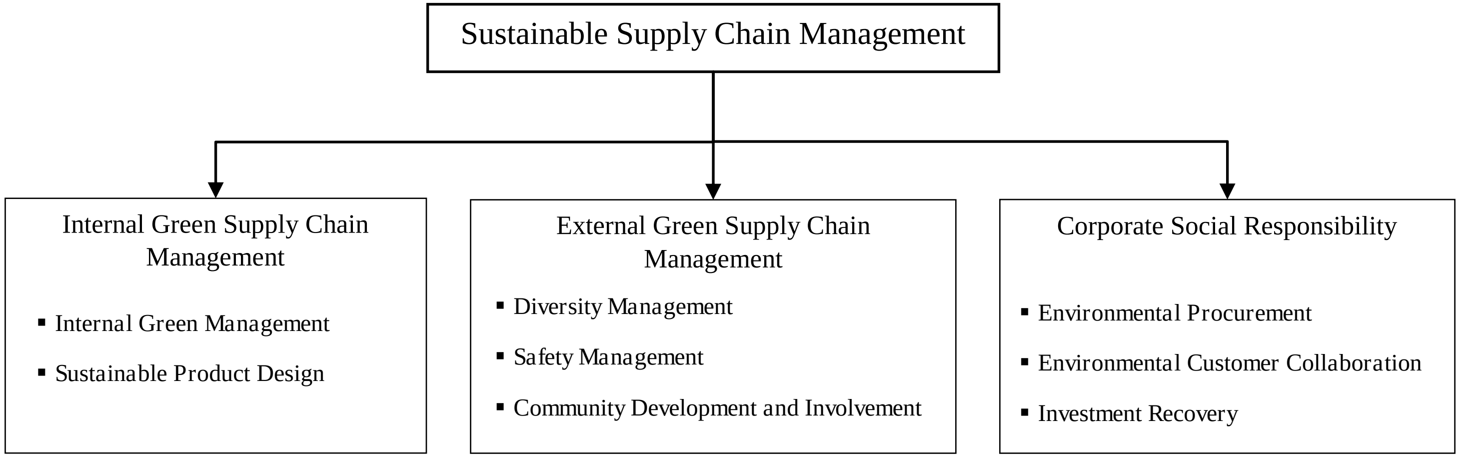
Graphic Abstract



Sustainable Supply Chain Management:

Confirmation of a higher-order model

Abstract

Drawing from the research of green supply chain management and corporate social responsibility, this research proposes a hierarchical structure of sustainable supply chain management and develops a multi-item measurement scale to reflect the specific management practices of sustainable supply chain management. In this research, sustainable supply chain management is operationalised as a third-order factor reflected by three second-order factors, namely external green supply chain management, internal green supply chain management and corporate social responsibility. Utilising a rigorous, multi-step scale development method and data from 293 Chinese manufacturers, this research validates a 31-item measurement scale and approve the proposed third-order structure. The results confirm the multidimensionality of sustainable supply chain management, which suggests that it is necessary for the future researches to consider both environmental and social aspects. The valid measurement scales provide managers with a "to do list" to make the specific business decisions to achieve sustainable development in the supply chain.

Key Words: Sustainable Supply Chain; Scale Development; Sustainable Development; Survey

1. Introduction

In today's business environment, as well as competing on cost and profitability, organisations have a new focus on sustainability (Tseng, 2013). Many studies suggest that companies with a "sustainability culture" perform better in the long run than other companies (Pagell and Wu, 2009, Lin et al., 2016). Certainly, sustainability is regarded as a key ingredient of competitive advantage. Recent researches indicate that the need for firms to be sustainable is due to pressure from stakeholders, such as government, customers and wider society (Sharfman et al., 1997; Christmann and Taylor, 2001; Zhu et al., 2007). For instance, in 2011, Greenpeace identified Apple as the "least green" technology company because of the substantial energy consumption incurred by its cloud data service (Carus, 2011). Then Apple has implemented a series of green management programs to reconstruct the business model towards sustainable consumption and production (Apple, 2015). Recently, Apple announced that 93% of its facilities are running on green energy (Kokalitcheva, 2016). This improvement regarding sustainable management of Apple has been recognised by the market and by society (Hardcastle, 2016).

In China as elsewhere, manufacturers have started to consider how to make their businesses more sustainable, so as to respond to environmental regulations put in place by the government, the increasingly educated society and competitors, and their international customers (Govindan et al., 2014). Moreover, in China, tremendous economic growth has resulted in a precarious ecological situation (Zhu and Sarkis, 2007; Yardley, 2005), which reinforces the awareness of the need for sustainability. According to Zhang et al. (2002), Zhang and Wen (2008), China should implement a strategy of low resource consumption and stable and sustained economic growth. However, the research on the sustainable supply chain in developing countries such as China is not extensive, and it is still a new concept (Zhu et al., 2008). Managers still lack holistic guidance on business decision making to deal with the sustainability issues in the current highly competitive business environment.

Over the last decade, researchers have attempted to extend the boundary of sustainable development into the area of supply chain management (SCM), to investigate sustainable supply chain management (SSCM) (Pagell and Wu, 2009; Tseng et al., 2015; Tseng and Chiu, 2013). Based on the triple bottom line (TBL) standard, it is increasingly clear that SSCM should deal with both environmental and social issues (Kleindorfer et al., 2005; Corbett and Klassen, 2006; Tseng et al., 2008). However, while an increasing number of firms are starting to adopt indicators such as environment, health and safety and social factors to measure the sustainability of production (Tseng, 2013; Tseng et al., 2008; Tseng and Lin, 2009), most focus on the environmental dimension (Seuring and Muller, 2008). Researchers are keen to identify the best practices for improving environmental performance. There are two main research directions, namely examining the impact of existing management systems on companies' environmental performance, and conceptualising new environmental management practices (Pagell and Wu, 2009). For example, King and Lenox (2001) explore the linkage between lean production, measured by the adoption of ISO 9000, and environmental performance. On the other hand, Zhu et al. (2008b) developed a significant measurement scale of Green Supply Chain Management (GSCM). Most recently, Esfahbodi et al. (2016) have empirically tested the relationship between SSCM practices and organisational performance according to two perspectives – environmental performance and cost performance. However, their model of SSCM is still a modification of the existing GSCM practices, which focus solely on the environmental dimension. Compared with the research of green/environmental issues, there is very little SSCM literature that considers social aspects (Seuring and Muller, 2008). Indeed, Kleindorfer et al. (2005) argue that the current studies of SSCM have ignored the social component of sustainability. Among the few exceptions, some authors have adopted four categories of the social pillar of responsibility, namely Labour Practices, Human Rights, Society and Product Responsibility, to develop social assessment indicators (Jorgensen et al., 2008). To the best of our knowledge, there is limited empirical research that consolidates social and environmental aspects in the investigation of SSCM. The current study mainly argues that SSCM should have a multidimensional consideration that not only focuses on environmental aspects or social aspects individually. In order to close the research gap, this research aims to answer the following questions: Research Question 1: Does SSCM empirically comprise the environmental and social dimensions? Research Question 2: How to measure SSCM?

This research aims to conceptualise and validate the constructs of SSCM in the context of the Chinese manufacturing industry. Drawing upon insights from the literature of GSCM and CSR, this research synthesises a holistic structure of the SSCM and provides a measurement scale for practitioners and for future research. Based on the findings of an extensive literature review and structured interviews with experienced academics and practitioners, SSCM is modelled as a third-order construct. A rigorous scale development process was employed, which has been widely adopted in the literature (such as Shah and Ward, 2007; Cao and Zhang, 2010; Oliveira and Roth, 2012), to validate the proposed structure of SSCM. This proposed structure establishes the key management practices that determine SSCM attributes of three crucial dimensions, namely external GSCM, internal GSCM and CSR.

The current research contributes to SSCM literature by establishing a holistic framework which includes both environmental aspect and social aspect. Using the large-sample from Chinese manufacturers and rigorous measurement development method, this research also contributes SSCM practices the empirically supported measurement scales. Practically, according to the higher-order structure, managers can clearly identify the area need to be improved for achieving sustainable development in the supply chain. Specifically, the validated higher-order model could help managers to recognise the similarity and differences of the management practices under the systematic structure. In addition, the validated measurement indicators can serve as the checklist to assist practitioners in applying the related actions of SSCM in practice.

In the following sections, scale development process for SSCM is presented. In Section 2, this research describes the theoretical background of SSCM and gives the associated hypotheses in the proposed structural model. Section 3 presents the details of the scale development process. That section also provides the data analysis for the measurement model, including the results of content validity, unidimensionality, construct reliability and discriminant validity. Also, Section 3 presents the structural equation modelling (SEM) analysis of the hierarchical structure of SSCM. Section 4 discusses the managerial implications of the study while conclusions and recommendations for future research are given in Section 5.

2. Literature Review

Although the debate regarding sustainable supply chain management (SSCM) is still ongoing, there is general agreement as to some key definitions. Sustainability is regarded as a normative notion of how human beings should treat the natural environment, and of how they carry responsibility for one another and future generations (Kates et al., 2001; Clark and Dickson, 2003; Clark, 2007). Evolved from the concept of sustainability, sustainable development is not only the top agenda of many governments (Tan et al., 2014) but now being widely discussed in policy research (Swart and Raes, 2007; Jordan, 2008) and business management research (Hall et al., 2010; Steurer et al., 2005). Specifically, sustainable development is "*a development that meets the needs of the present without compromising the ability of future generations to meet their needs*" (WCED, 1987). Embracing the concepts of sustainability and sustainable development, SSCM has grown out of the traditional context of supply chain management (SCM), which aims at managing the supply chain relationship and the flow of materials and information to maximise operational performance and the profitability of the supply chain (Lummus and Vokurka, 1999; Li et al., 2006; Mentzer et al., 2001).

Compared with SCM, SSCM has multiple dimensions, and is not focused solely on profits (Seuring and Muller, 2008; Jennings and Zandbergen, 1995; Gladwin et al., 1995). Seuring and Muller (2008) state that a truly sustainable supply chain can produce long-term profitability without harming natural or social systems. The triple bottom line standard is used to operationalise the performance of a sustainable supply chain, which includes economic, environmental and social dimensions (Carter and Rogers, 2008). Thus the term SSCM has been defined by Carter and Rogers (2008, p. 368) as *"the strategic, transparent integration and achievement of an organization's social, environmental, and economic goals in the systemic coordination of key inter-organizational business processes for improving the long-term economic performance of the individual company and its supply chains"*.

Building upon the GSCM and CSR research in the supply chain context, this research provides a new measurement scale that evaluates eight synergistic management practices. More specifically, this research views SSCM as a holistic and multidimensional construct that is measured by the following eight management practices from different disciplines: 1. Sustainable Product Design (SPD); 2. Environmental Procurement (EP); 3. Environmental Customer Collaboration (ECC); 4. Internal Green Management (IGM); 5. Investment Recovery (IR); 6. Diversity Management (DM); 7. Community Development and Involvement (CDI); 8. Safety Management (SM).

In order to explain the hierarchical structure of the concept, SSCM is operationalised as a third-order construct. According to Oliveira and Roth (2012), the notion of third-order construct is very useful to describe complex phenomena, and it is widely adopted in the marketing literature (Brady and Cronin, 2001; Ko and Pastore, 2005; Ranjan and Read, 2014). The individual practices are represented by the indicators (i.e. questionnaire items), and the first-order management practices are measured by these related indicators. Based on the similarities of the first-order management practices (i.e. dimensions), the second-order practices bundles are conceptualised. As Zhu et al. (2008b) and Jabbour et al. (2014) have already validated the second-order structure of the GSCM, it is necessary to extend the concept of SSCM into a higher-order structure. According to the definition of SSCM and the triple bottom line standard, this research considers that SSCM is a multidimensional concept that considers both environmental and social issues. Accordingly, in the following sections, hypothesised structure of SSCM is developed with the hypotheses of its sub-dimensions from H1 to H3.

2.1 External GSCM

This research categorises GSCM into the external aspect and the internal aspect, based on the "*organisational boundary of a manufacturer"* (Zhu et al., 2013, p. 107). Zhu et al. (2013) argue that external GSCM refers to those practices that require a certain level of external cooperation with stakeholders and suppliers or customers. In this research, external GSCM can be defined as "*the environmental management practices that manage the cooperation with supply chain partners or stakeholders for the environmental objectives and solutions*" (Vachon and Klassen, 2008; Zhu et al., 2008a; De Giovanni, 2012; Zhu et al., 2013). In other words, the external GSCM reflects the collaborative implementation of sustainable practices in the supply chain in order to achieve environmental goals (Vachon and Klassen, 2008; De Giovanni, 2012). Typically, the focus of external GSCM is in collaboration with the supply chain partners (i.e. suppliers, second-tier suppliers and customers) to reduce the negative environmental impacts of processes and products (Geffen and Rothenberg, 2000; De Giovanni, 2012). Drawing from the research model of Zhu et al. (2013), the external GSCM is associated with the management practice bundles, which consist of SSM, SCC, and IR. Because the focus of external GSCM is consistent with the environmental dimension of TBL, the following hypothesis is proposed:

H1: External GSCM positively reflects the SSCM

EP, or green purchasing, is an important dimension of the external GSCM and focuses on the upstream suppliers. According to Nagel (2000), environmental key concepts, such as eco-labels, the avoidance of environmentally hazardous substances, the recyclability of supply materials and the environmental responsibility of suppliers, together provide the contents of EP. Certification and collaboration are two key elements in this dimension (Pagell and Wu, 2009). For example, in the automobile industry, some big enterprises, such as Ford, GM, and Toyota, have required their Chinese suppliers to be certified with ISO 4000 (Zhu et al., 2007). It should be noted that EP is not confined to cooperation with direct suppliers but also considers the environmental responsibility of second-tier suppliers. This research adopts the notion of Zsidisin and Siferd (2001, p. 69), to define EP as "*the set of purchasing policies held, actions taken, and supplier relationships formed in response to concerns associated with the natural environment*". Consistent with previous research, EP is regarded as a critical component of the GSCM implementation (Min and Galle, 1997; Zhu et al., 2008a; Zhu et al., 2013). Due to its externally focused characteristics, this research hypothesises that:

H1a: EP positively reflects external GSCM

Like EP, ECC is an external environmental management practice, but one that focuses on the collaboration between the focal company and customers. It involves cooperating with the customers to environmentally manage the production, the flow of materials and maximise the use of logistics resource in the distribution process. According to Vachon and Klassen (2008), environmental collaboration requires a close supply chain relationship to planning and establish the objectives for environmental performance. A large customer company will usually expect its suppliers to have better environmental performance. Therefore, suppliers have great motivation to cooperate with the customer regarding the environmental requirements (GEMI, 2001; Zhu et al., 2008a). To achieve the environmental objectives, ECC normally includes the supply chain joint activities regarding cleaner production, green packaging and logistics resources maximisation. Vachon and Klassen (2008) find that ECC can lead to the better quality performance of the supply chain. In addition, ECC is found to be positively associated with environmental performance (Zhu et al., 2013). Empirically, previous researches have confirmed that ECC is a crucial dimension of GSCM (Zhu et al., 2008b). Moreover, combined with the practices of green purchasing (i.e. EP), the practices of ECC are also conceptualised as elements of external GSCM (Zhu and Sarkis, 2004; Zhu et al., 2008a).

H1b: ECC positively reflects external GSCM

IR is an emerging environmental management approach used in both developed countries (Tibben-Lembke, 2004) and developing countries (Zhu et al., 2008c) to achieve a closed-loop supply chain (CLSC). The practices of IR are developed from the concept of reverse logistics (RL), a process that takes back previously shipped products or components from the point-of-consumption for possible recycling, re manufacturing, or disposal (Lai et al., 2013). In addition to the reuse or recycling of unused or end-of-life products, RL should also consider the sale of surplus products and assets (Zhu et al., 2008b). In this research, IR is defined as the "*management practices that recover and recapture the value of unused or end-of-life assets through sales of excess inventories, scrap and used materials, excess capital equipment and refurbished products"* (Esfahbodi et al., 2016; Zhu et al., 2008b). Zhu et al. (2007) find that the positive impacts of IR on both environmental and economic performance are statistically significant. According to Zsidisin and Hendrick (1998), the enterprises of developed countries have widely considered IR as a critical aspect of GSCM (Zhu et al., 2008c). Using the data from Chinese manufacturers, Zhu et al. (2008b) also confirm that IR is one of the dimensions of GSCM. Because IR might require a certain level of customer cooperation, it could be regarded as an externally focused management practice.

H1c: IR positively reflects external GSCM

2.2 Internal GSCM

While external GSCM refers to management practices related to inter-organisational issues, internal GSCM focuses on improving the internal operations to achieve better environmental outcomes (Zhu et al., 2013). It aims at achieving the firm's specific internal targets, as established by the management team or imposed by company policies (Rao, 2002, Wu and Dunn, 1995). Thus, the internal GSCM practices reflect the organisation's capability to adopt a sustainable strategy aimed at reducing the negative environmental impact of its own operations, for example in terms of commitment from senior managers, cross-functional cooperation and eco-design (Rao, 2002, Walton et al., 1998, Bowen et al., 2001). Internal GSCM is defined as *"the practices that can be implemented and managed independently by individual manufacturers with the purpose of improving environmental performance"* (Zhu et al., 2013, p. 107). It has an environmental focus, which is consistent with the environmental dimension of the sustainable TBL.

H2: Internal GSCM positively reflects SSCM

In order to proceed with the implementation of GSCM practices such as EP, IR, GD and ECC, it is necessary for an organisation to ensure commitment from the top and mid-level management on the adoption of environmental sustainability as a strategic imperative (Green et al., 2012). If the company is to achieve environmental excellence, top management must be totally committed to the implementation of the environmental practice (Rice, 2003; Zsidisin and Siferd, 2001; Green et al., 2012). Therefore, the green commitment of the management team should be a key element of IGM. In addition, IGM is related to key concepts such as regulation, training, and cross-functional cooperation within an organisation (Zhu et al., 2007; Zhu et al., 2013; Zhu and Sarkis, 2004). In this research, IGM is defined *as the practice of improving environmental excellence internally through management commitment, employee training, organisational regulation and cross-functional collaborations*. In the Chinese context, IGM is regarded as one of the most important GSCM practices and has received particular attention from managers (Zhu and Sarkis, 2004). Following the classification of Zhu et al. (2013), this research posits that:

H2a: IGM positively reflects internal GSCM

A number of environmental management studies have indicated the importance of SPD or eco-design. Zhu et al. (2007) argue that green product design is the one of the most significant dimensions of sustainable production. Typically, SPD is about designing the product to be environmentally friendly and recyclable, for example by using greener materials and reducing the consumption of energy and resources (Min and Galle, 2001). Eco-design, also known as "Design for the Environment," can be defined as "*the systematic integration of environmental consideration into product and process design*" (Canada, 2003; Knight and Jenkins, 2009). In the context of an emerging market like China, if local enterprise plans to establish a supply relationship with foreign customers, it might be required to integrate eco-design into its operations (Zhu et al., 2015; Zhu et al., 2007). According to Eltayeb et al. (2011), eco-design is an internally focused GSCM practice that enhances the environmental attributes of the products with little cooperation or interaction with external parties. Therefore, SPD can be regarded as a dimension of internal GSCM:

H2b: SPD positively reflects internal GSCM

2.3 Corporate Social Responsibility

According to Seuring and Muller (2008), apart from the economic and environmental aspects of organisational activities or actions, SSCM should also consider the social aspects. A growing body of research indicates that SSCM does focus on improving both environmental and social performance of firms in the supply chain context (Schaltegger and Burritt, 2014; Amann et al., 2014; Harms et al., 2013). Nevertheless, there is very limited research that integrates the management practices with regard to social aspects into the framework of SSCM. Moreover, Carter and Easton (2011) also urge the recognition of the interrelationships among topics such as environment, diversity, human rights and safety. These topics are key to conceptualising a holistic view of CSR and to understanding sustainability in the context of supply chain management (Carter and Rogers, 2004; Carter and Easton, 2011). Currently, companies are beginning to extend their CSR from internal production to their supply chain partners (Cruz and Wakolbinger, 2008; Emmelhainz and Adams, 1999; Kolk and Tudder, 2002). In this research, CSR is defined as *"meeting the economic, legal, ethical and discretionary responsibilities expected by society"* (Carroll, 1979; Carroll, 1991; Carter and Jennings, 2004). According to Chi (2011), the adoption of CSR activities is helpful for enterprises to establish a sustainable supply chain in the long term.

H3: CSR positively reflects SSCM

Managing diversity issues is a critical direction of CSR research. Kacperczyk (2009) finds that the corporate attention to diversity can positively influence long-term shareholder value. In particular, purchasing from minority/women-owned business enterprises (MWBE) is conceptualised as an important element of purchasing diversity (Carter and Jennings, 2004; Dollinger et al., 1991; Carter et al., 1999). Inoue and Lee (2011) provide a more holistic view, whereby diversity can be measured by the extent of the appointment of women and minority (WM) executives, the promotion of WM and contracting with MWBE suppliers. Furthermore, the Kinder, Lydenburg, Domini (KLD) rate, a major method to measure CSR, also includes the consideration of diversity issues (Kacperczyk, 2009; Inoue and Lee, 2011; Berman et al., 1999).

H3a: DM positively reflects CSR

According to Carter and Rogers (2004), CSR also encompasses the dimension of safety considerations. Under the concept of CSR with regard to supply chain functions, precautions to ensure employees' health and safety, and safety in warehousing and production, are vitally important activities (Ciliberti et al., 2008; Tekin et al., 2015). Wu et al. (2015) find that prominent international contractors give high priority to occupational health and safety in the CSR key benchmarking framework. Moreover, Saunders et al. (2015) use safety as a proxy for social sustainability factors, which is consistent with the social dimension of the TBL. Consequently, it is hypothesised that:

H3b: SM positively reflects CSR

The inclusion of CDI in CSR is supported by the social contract theory. According to Gray et al. (1996), a society can be described as a series of social contracts between members of society and society itself. There are two kinds of the social contract: macrosocial contracts and microsocial contracts (Donaldson and Dunfee, 1999). Macrosocial contracts refer to a social expectation that commercial companies can provide support to their local community while microsocial contracts are specific forms of social involvement (Moir, 2001). Through a thorough investigation of 115 companies, the CCPA (2000) found that three-quarters of the companies supported community development and that involvement is key to business sustainability. Moreover, the great majority of companies in the CCPA (2000) study regarded CDI as a form of CSR and as associated with long-term commercial outcomes. Therefore, the following hypothesis is developed:

H3c: CDI positively reflects CSR

3. Method

3.1. Generating Questionnaire Items

The research purposes of this research are to develop the hierarchical structure of the SSCM and to verify a reliable and valid scale to measure the concept of SSCM. According to Shah and Ward (2007), a rigorous and comprehensive scale development process is presented in this section. The details of each step in the process are provided in Figure 1. Based on a comprehensive literature review and comments from an expert panel, this research aimed to generate items that accurately reflect the proposed constructs, thus ensuring content validity (Li et al. 2005). Therefore, the process of item generation comprised two steps. First, the previous literature on GSCM and CSR in the supply chain context were reviewed. From this, the study obtained the theoretical insights to compile the initial list of potential items.

Second, structured interviews with an expert panel, consisting of three academics and three practitioners, followed by a Q-sort procedure was conducted to assess the content validity of the questionnaire items within the initial list. This research began by conducting structured interviews with one academic and one practitioner to review carefully the definition of each proposed construct and to clarify the wording or address redundancy problems for each question item. Then, a different pair of manager and academic was asked to finish the sorting task of "item-to-factor" (Menor and Roth, 2007). According to Moore and Benbasat (1991), the idea behind the Q-sort measure is to have experts act as judges and sort the items into several groups, with each group corresponding to a dimension based on an agreement between judges. In this research, three measure indices were adopted to conduct the content validity test: a) inter-judge agreement percentage, b) item placement ratio (i.e. hit ratio) and c) application of Cohen's kappa (k) test. Specifically, the inter-judge agreement percentage is the number of items that expert judges agree to place into a certain category divided by the whole item pool (i.e. the total number of indicators). According to Hardesty and Bearden (2004), the threshold value for inter-judge agreement is from 60% to 75%. The hit ratio is the number of *"items that are correctly sorted into the intended theoretical category divided by twice the total number of items"* (Cao and Zhang, 2011, p. 168). Although there is no established standard to determine a "good" level of hit ratio (Moore and Benbasat, 1991), generally speaking, a hit ratio of 70% would be accepted (Moore and Benbasat, 1991, Stratman and Roth, 2002). The third measure index, Cohen's kappa (k) indicates the index of beyond chance agreement among the judges of the expert panel (Armenakis et al., 2007, Stratman and Roth, 2002, Cohen, 1960). The results of the Q-sort measurement tests are available from the authors. Then, the final pair of academic and practitioner were responsible for reviewing and modifying the items adopted in the first two rounds of content validity confirmation. After following this process, 37 question items were sent out as the pilot study for the exploratory analysis.

3.2. Establishing the Questionnaire

The aim of this stage was to produce a well written and clear questionnaire. As suggested by Hinkin (1995), the researcher should give consideration to format issues, including the "use of negative wordings," "number of items within a construct" and "justification of Likert scale." In this research, each of the constructs has more than four measurement items. Our respondents were asked to measure their level of agreement for each of the construct items on a 7-point Likert scale (i.e. strongly disagree to agree strongly).

As our target respondents are Chinese managers, our questionnaire is in two versions: one in Chinese[1] and one in English. Therefore, the process of translation is critical for our research. Following Brislin (1980), this research adopted the backward translation process to ensure the accuracy of the questionnaire presented to our target respondents. Once the questionnaire had been finalised, two Chinese academics were invited to help us fine-tune the wording and the structure of our questionnaire.

[1] The Chinese version questionnaire was further divided into two different written styles – Simplified Chinese and Traditional Chinese.

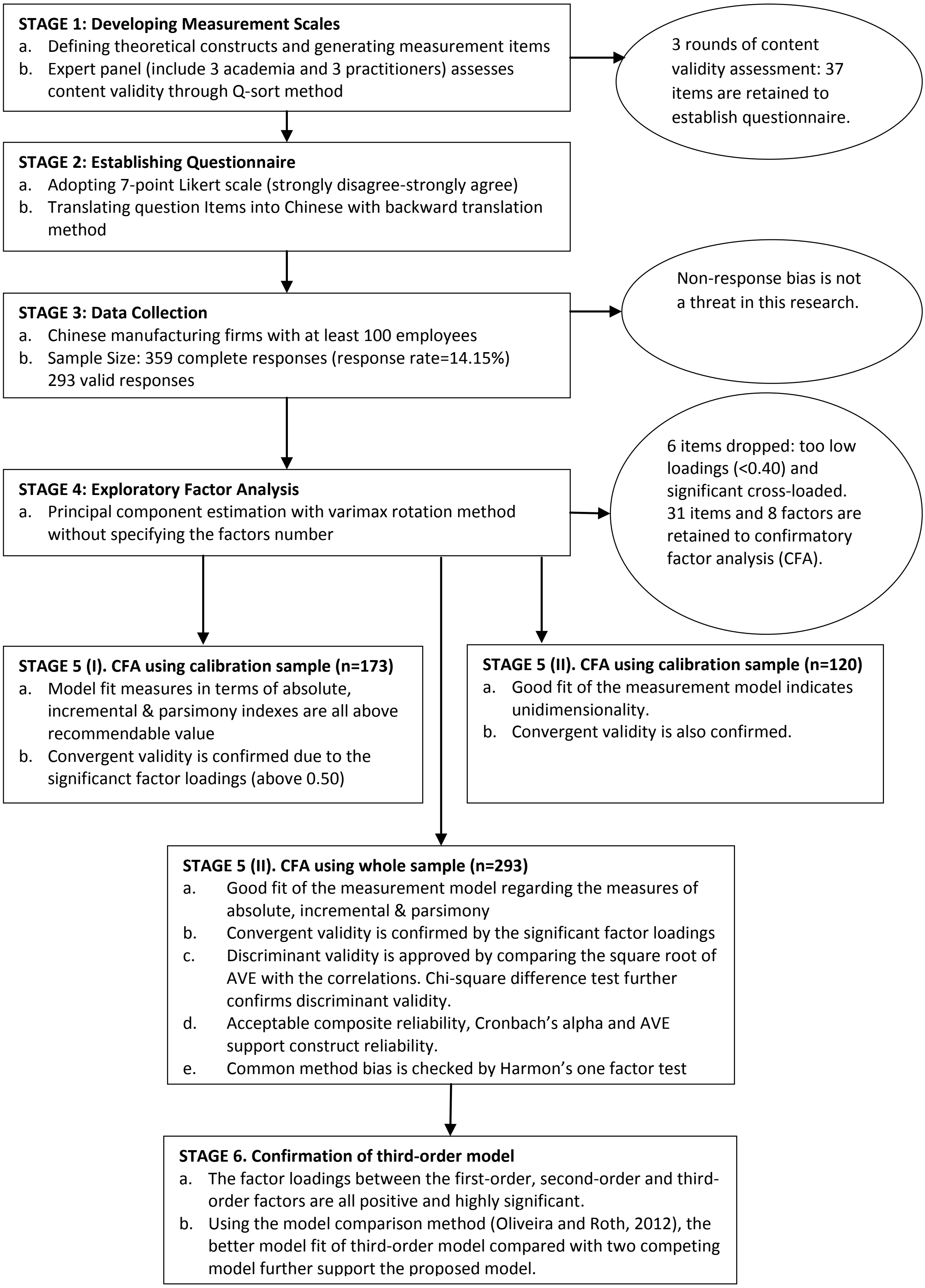


Figure 1. Scale development Structure
Developed from the work of Oliveira and Roth (2012) and Shah and Ward (2007)

3.3. Data Collection

To obtain practical insights of SSCM, this research targeted the respondents as practitioners with related knowledge and experience of manufacturing industry (SIC 20-39). Because SSCM focuses on the corporation's practices with both suppliers and customers, the research unit was narrowed to the focal manufacturers of a supply chain. In addition, given that previous literature argues that bigger firms are more likely to achieve SSCM, this research adhered to an important criterion whereby respondents must have at least 100 employees in their company (Shah and Ward, 2007). A Chinese business marketing and consultancy firm was employed to assist the administration of the formulated survey instrument. After refining the original mail-list by eliminating entries with incomplete records (such as lack of job title or valid email address), our dataset contained 2537 valid potential samples. Employing a two-round data collection process, this research began by sending out 2537 online surveys via email with an appropriate cover letter; then, two weeks later, researchers followed up this initial contact with phone and email reminders. According to Cao and Zhang (2011), the web-based survey is an efficient method to collect responses. Finally, 359 completed responses were received, representing a 14.15 percent response rate. After removing responses that were invalid because the time taken to answer was too short (i.e. less than seven mins to complete the questionnaire[2]), or data were missing, 293 of the completed responses were suitable to be analysed. The demographic information of our respondents and the results of non-response bias test are provided in Table 1. Due to the relatively low response rate compared with other survey-based research, our sample might contain non-response bias (Frohlich, 2002). Therefore, the X^2 difference test is conducted to assess the difference between first-wave and second-wave respondents in terms of company size, regions and job titles. The non-significant results of the X^2 difference test indicate that non-response bias was not a threat to our sample.

	Number of firms	First-wave frequency (n=143)	Second wave frequency (n=150)	Chi-square test for non-response bias	Total Percentage (%)
The Position of Respondent					
CEO	3	2	1	$X^2 = 4.698$ df = 4 p = 0.320	1.0
Vice President/Director	51	21	30		17.4
Purchasing Director	176	94	82		60.1
Supply Chain Manager	57	23	34		19.5
Others	6	3	3		2.0
Firm Size (Number of Employees)					
$100-299$	54	23	31	$X^2 = 3.759$ df = 2 p = 0.153	18.4
$300-2000$	176	94	82		60.1
> 2000	63	26	37		21.5
Company Base Region					
North China	67	35	32	$X^2 = 5.895$ df = 6 p = 0.435	22.9
Northeast China	13	7	6		4.4
Eastern China	91	40	51		31.1
Central China	18	11	7		6.1
South China	61	34	27		20.8
Southwest China	30	11	19		10.2
Northwest China	13	5	8		4.4

Table 1. Profile of the respondents (n = 293)

[2] In general, it should take respondents 7- 9 mins to complete the questionnaire.

4. Results

4.1. Exploratory Factor Analysis (EFA)

Before assessing the measurement model, in order to obtain an overall picture of the factors structure for the 37 items, EFA was conducted. This is also a method to evaluate the unidimensionality (Zhao et al., 2008). Three criteria were adopted in EFA to purify the indicators: a) factor loading should be above 0.30, b) Eigenvalue should be above 0.10, and c) the variance of the measurement items extracted by the factors should be greater than 50% (Chen and Paulraj, 2004; Zhao et al., 2008). Moreover, if an indicator is loaded on more than one factor and the difference between the factor loadings for the "cross-loaded" indicator is less than one, the cross-loading problem should be considered (Kathuria, 2000). This research applies the principle component method to estimate the EFA model with varimax rotation method, without specifying the number of factors. Three items are dropped (i.e. EP4, ECC4, and IGM2) due to the significant cross loading. Another three factors (i.e. IGM3, SPD1, and SM1) are eliminated due to the percentage of variance of the items extracted in commonality being smaller than 0.50. The result of Kaiser-Meyer-Olkin test was 0.941, which is greater than the recommended value of 0.60 (Worthington and Whittaker, 2006), and thus indicates the sample adequacy for conducting the EFA. Finally, the eight-factor solution was retained for the CFA analysis (Appendix B).

4.2. Confirmatory Factor Analysis

To verify the 31 items remaining from EFA, this research applies confirmatory factor analysis (CFA) using AMOS v22. A covariance matrix model of these items with maximum likelihood estimation is employed. Specifically, the eight dimensions' measurement scales were checked with regard to (1) unidimensionality, (2) reliability, (3) convergent validity, (4) discriminant validity and (5) third-order construct validity. To improve the model fitness to an acceptable level, this research adopts the iterative method and drop the question items with standardised factor loading lower than 0.50 (Cao and Zhang, 2011, Hair et al., 2006). According to Cao and Zhang (2010), the model modification (i.e. dropping unreliable items) should be continued until all of the reliability and validity tests are confirmed.

To indicate how well a particular item measures a latent variable, the convergent validity is assessed by the significance of *t*-value of each indicator. If the indicators significantly load their representative factors with *t*-value above 2.58 and *p*-value significant at 0.01 level, the test provides evidence of convergent validity. The results of EFA have already upheld the presence of unidimensionality. In this stage, this research used the measurement model fit indices to assess the unidimensionality further (Cao and Zhang, 2011; Menor and Roth, 2007; Hair et al., 2006). Three types of fit indices are evaluated, namely overall model fit (i.e. absolute measures), model comparison (i.e. relative fit measures) and model parsimony (i.e. parsimony fit measures) (Schumacker and Lomax, 1996). According to Shah and Ward (2007, p. 795), these model fit indices help to answer the question *"how well do the relationships estimated by the model match the observed data?"* The result of three dimensions of fit indices with recommended cut-off values is reported in the following sections.

Three types of indices are also adopted to assessed the construct reliability, namely composite reliability (p_c), Cronbach's alpha (α) and average extracted variance (AVE). In order to ensure the construct reliability, the rule of thumb for Cronbach's alpha and composite reliability should be greater than 0.70 (Nunnally, 1978). However, Hair et al. (2006) argue that the Cronbach's alpha is still acceptable when the value is below 0.7 but above 0.6. In this stage, IMB SPSS v22 is adopted to check the construct reliability. If the AVE is above 0.5, the internal consistency of the latent variable is also achieved (Shah and Ward, 2007; Hair et al., 2006).

Discriminant validity is defined as "*the extent to which independent assessment methods diverge in their measurement of different traits (ideally, these values should demonstrate minimal convergence)*" (Byrne, 2013, p. 275). To assess the discriminant validity, this research compares the construct correlations with the square root of the AVE (Fornell and Larcker, 1981). If the square root of AVE for each construct is greater than the correlation between that construct and the other constructs, the result indicates discriminant validity (Flynn et al., 2010; Fornell and Larcker, 1981). A pairwise CFA method using X^2 difference test is also adopted to assess the discriminant validity (Anderson and Gerbing, 1988; Zhu et al., 2008b). For each possible pair of the model, a model comparison is undertaken, comparing the paired factor model with a one-factor model. If the X^2 difference between the two models is significant, discriminant validity is confirmed.

Following the CFA procedure suggested by Hausman et al. (2002) and Shah and Ward (2007), the "split-sample" approach is applied to test and refine the measurement model. The whole sample (n=293) is randomly divided into two sub-datasets, the calibration sample (n=173) and a validation sample (n=120). Both sample sizes meet the minimum requirements of statistical power analysis (0.80 statistical power with 406 degrees of freedom and significant at the level of 0.05) (MacCallum et al., 1996; Shah and Ward, 2007). According to Shah and Ward (2007), the convergent validity and unidimensionality are assessed in all three samples (i.e. calibration, validation and whole sample), while the discriminant validity, construct reliability and validation of third-order structure are evaluated in the entire sample only.

Finally, this research uses the model competition method to validate our third-order factor – SSCM (Oliveira and Roth, 2012). A second-order reflective model (i.e. where SSCM is treated as a second-order factor) and a formative model of dimensions of SSCM (Figure 3) are assessed to compete with the third-order model (i.e. the hypothesised model) regarding the model fitness (Goncalves, 2013; Oliveira and Roth, 2012). Moreover, to further validate the proposed hierarchical structure of SSCM (Figure 2), the standardised factor loading between the first-order, second-order and third-order factors should be above 0.5 with significant *t*-value, as required by the convergent validity test.

4.2.1 CFA analysis for the calibration sample

As shown in Appendix C, the standardised factor loadings are all above 0.60, thus above the cut-off value of 0.50, and their corresponding *t*-values are all greater than 8.00, significant at the 0.001 level. Therefore, the convergent validity is confirmed in the calibration sample (n=173). Also, the value of variance explained (i.e. R^2) of indicators ranges from 0.369 to 0.769. For the measurement model with the calibration sample, three dimensions of the model fit indices are demonstrated to have an excellent fit (Table 2). First, regarding the overall model fit indices: NNFI=0.954, CFI=0.960, and IFI=0.961, which exceed the number of good model fit (i.e. 0.90). Moreover, the values of RMSEA, normed X^2, PNFI and RMR all indicate excellent fit of the measurement model in the calibration sample. Furthermore, there are no absolute standardised residuals exceeding $|2.58|$ and all the modification indices are below 0.10. In summary, the unidimensionality of the measurement model in the calibration sample is ensured (Shah and Ward, 2007).

4.2.2 CFA test for the validation sample

To assess the measurement scales for the validation sample, the same CFA approaches is applied as for the calibration sample. The standardised factor loadings and their t-values are lower than the associated numbers in the calibration sample but still exceed the cut-off value. Therefore, the measurement model of the validation sample indicates convergent validity (Column 5 in Appendix C). The model fit indices for the validation model are provided in Table 2. Notably, the normed X^2, RMSEA, RMR and IFI meet the "rules of thumb" for a good model fit. The scores of CFI and NNFI are slightly lower than the recommended values, but they are still reasonable (Segars and Grover, 1998). In addition, there are four absolute standardised residuals$>|2.58|$, representing a proportion of 0.8%[3] (4 out of 465). All the modification indices are below 20. Therefore, the validation sample also indicates that the measurement model has a good fit. According to Shah and Ward (2007), the CFA results for these two samples (i.e. calibration and validation) indicate "invariance of form".[4]

Indices	Shorthand	Calibration Sample (n=173)	Validation Sample (n=120)	Whole Sample (n=293)	Rule of thumb
Absolute					
Chi-square Test (degree of freedom)	$X^2(d.f.)$	518.761(406)	535.860(406)	554.28(406)	NA
Root mean square error of approximation	RMSEA	0.040	0.052	0.035	≤ 0.08
RMSEA, 90% confidence interval	/	(0.029; 0.050)	(0.039; 0.063)	(0.028; 0.042)	(0; 0.08)
p value H_0: close fit ($RMSEA \leq 0.05$)	/	0.948	0.393	0.98	≥ 0.05
Standardised root means square residual	RMR	0.061	0.076	0.052	≤ 0.10
Comparative fit					
Non-Normed fit index	NNFI	0.954	0.885	0.959	≥ 0.90
Incremental fit index	IFI	0.961	0.904	0.964	≥ 0.90
Comparative fit index	CFI	0.960	0.899	0.964	≥ 0.90
Parsimonious fit					
Normed Chi-square	$X^2/\,d.f.$	1.278	1.320	1.365	≤ 0.30
Parsimony normed fit index	PNFI	0.735	0.606	0.767	≥ 0.70

Table 2. Model fit indices (Shah and Goldstein, 2006; Schreiber et al., 2006)

4.2.3 CFA test for the whole sample

For the entire sample, the unidimensionality and convergent validity are assessed using the same approach as for the two sub-datasets; also, the discriminant validity and construct reliability are examined. As shown in Appendix C, the standardised path coefficient between the indicators and latent variables ranges from 0.614 to 0.836, and their t-values are significant at the level of 0.001. Therefore, the convergent validity is confirmed. Furthermore, the unidimensionality of the whole sample is also confirmed, because of the excellent model fitness (Table 2). There are no absolute standardised residuals greater than $|2.58|$ moreover, the modification indices are all below 0.20.

Because all $\boldsymbol{p_c}$ are greater than 0.75 and all $\boldsymbol{\alpha}$ exceed the recommended value of 0.70, the reliability for all eight latent variables is confirmed. With the exception of Safety Consideration, the AVE values of the other seven constructs are greater than the cut-off values (i.e. 0.50). Furthermore, Table 3 shows that the square roots of AVE (bold numbers in diagonal) are greater than the correlations among the constructs (off-diagonal values). The results provide evidence to confirm good discriminant validity. The pairwise CFA model comparison tests is also examined. The pairwise CFA models for every latent variables are first built. Then the pairwise CFA models are compared with the single factor model (i.e. the measurement items from each pairwise model are forced to be

[3] A value of $|2.58|$ lying in the extreme 5% of the distribution.

[4] Where there is invariance of form, "using the same mapping of manifest variables to latent variables in two sub-samples is appropriate" (Shah and Ward, 2007, p. 798).

measured in a single latent variable). As shown in Table 3, the significant results of all 28 pairwise X^2 difference tests demonstrate discriminant validity (Anderson and Gerbing, 1988;, Zhu et al., 2008b).

		p_c[a]	α[b]	Items	AVE	SM	SPD	EP	CDI	ECC	IGM	DM	IR
1	SM	0.772	0.772	4	0.459	**0.678**	94.36	123	108.75	152.566	148.683	133.41	147.946
2	SPD	0.795	0.794	3	0.564	0.610[c]	**0.751**	108.38	127.26	119.308	80.253	184.869	140.684
3	EP	0.844	0.842	4	0.576	0.517	0.679	**0.759**	193.043	128.074	158.236	323.674	202.312
4	CDI	0.838	0.836	5	0.509	0.614	0.624	0.635	**0.714**	197.144	229.551	234.855	200.994
5	ECC	0.836	0.834	3	0.631	0.485	0.644	0.707	0.569	**0.794**	120.943	261.019	172.048
6	IGM	0.822	0.819	4	0.536	0.464	0.726	0.642	0.531	0.696	**0.732**	189.678	172.153
7	DM	0.841	0.839	4	0.569	0.560	0.482	0.440	0.559	0.452	0.599	**0.754**	225.115
8	IR	0.800	0.797	4	0.502	0.427	0.580	0.541	0.532	0.587	0.584	0.477	**0.709**

Note: a. Composite reliability for the latent variable is denoted as p_c.
b. The Cronbach's alpha is denoted as α.
c. The lower triangle shows the correlation.
d. The upper triangle shows the X^2 difference between the pairwise factor model and single factor model. All X^2 difference test with 1-degree freedom, so if X^2>11, the p-value is significant at 0.001 level.

Table 3. Construct Reliability and Discriminant Validity

4.3 Common Method Bias

Based on Podsakoff et al. (2003), the common method bias might be a potential problem of this research because the questionnaire uses the seven-point Likert scale and single informants from each organisation. There are two characteristics of common method bias: *"1. Only a single factor emerges from the factor analysis and 2. One general factor accounts for the majority of the covariance among measures"* (Podsakoff et al., 2003, p. 889). To check for this problem, two statistical tests are checked. First, Harman's single-factor-test reveals that the first factor of the total of eight extracted factors with Eigenvalue above one explains only 35.20% of the total variance. Since this is not the majority of the total explained variance of 61.05%, it can claim that the common method bias is not a concern in this research. To further conduct Harman's single factor test, an additional CFA is applied. The model fit indices of the single factor model (X^2/df = 3.868, NNFI = 0.675, CFI = 0.696, and RMSEA = 0.099) are worse than the recommended values. Hence, the unacceptable model indices of the single factor model also indicate that the common method bias is not a threat.

4.4 Third-order Model Validation

Indices	Shorthand	Hypothesised Model (n=293)	Competing Model 1 (n=293)	Competing Model 2 (n=293)
Chi-square Test (degree of freedom)	$X^2(d.f.)$	589.153(423)	611.821(426)	1519.769(457)
Root mean square error of approximation	RMSEA	0.037	0.039	0.089
Standardised root mean square residual	RMR	0.057	0.062	0.336
Non-normed fit index	NNFI	0.955	0.951	0.724
Incremental fit index	IFI	0.960	0.955	0.748
Comparative fit index	CFI	0.959	0.955	0.746
Normed Chi-square	$X^2/\ d.f.$	1.393	1.436	3.326
Parsimony normed fit index	PNFI	0.793	0.792	0.622

Table 4. Model Fit Indices for Third-order Model Validation

To further confirm the empirical results of the third-order structure, the model comparison method is adopted. Two models are assessed to compare with the hypothesised models – 1. SSCM modelled as a reflective second-order model, and 2. A formative model of dimensions of SSCM (Figure 3). First, although the model fit indices of competing model 1 (i.e. SSCM as a second-order factor) indicate a good fit, the hypothesised model (i.e. SSCM as a third-order factor) shows a better overall fit (Table 4). Second, competing model 2 (i.e. formative model) shows poor results of model fitness with normed $X^2 = 3.326 > 3$; NNFI = 0.724$<$0.8; CFI = 0.746$<$0.8; and IFI = 0.748$<$0.8. In summary, the hypothesised model illustrates a better picture of the SSCM than the two competing models. Therefore, this research can conclude that the hypothesised model (i.e. third-order model) is further supported (Oliveira and Roth, 2012).

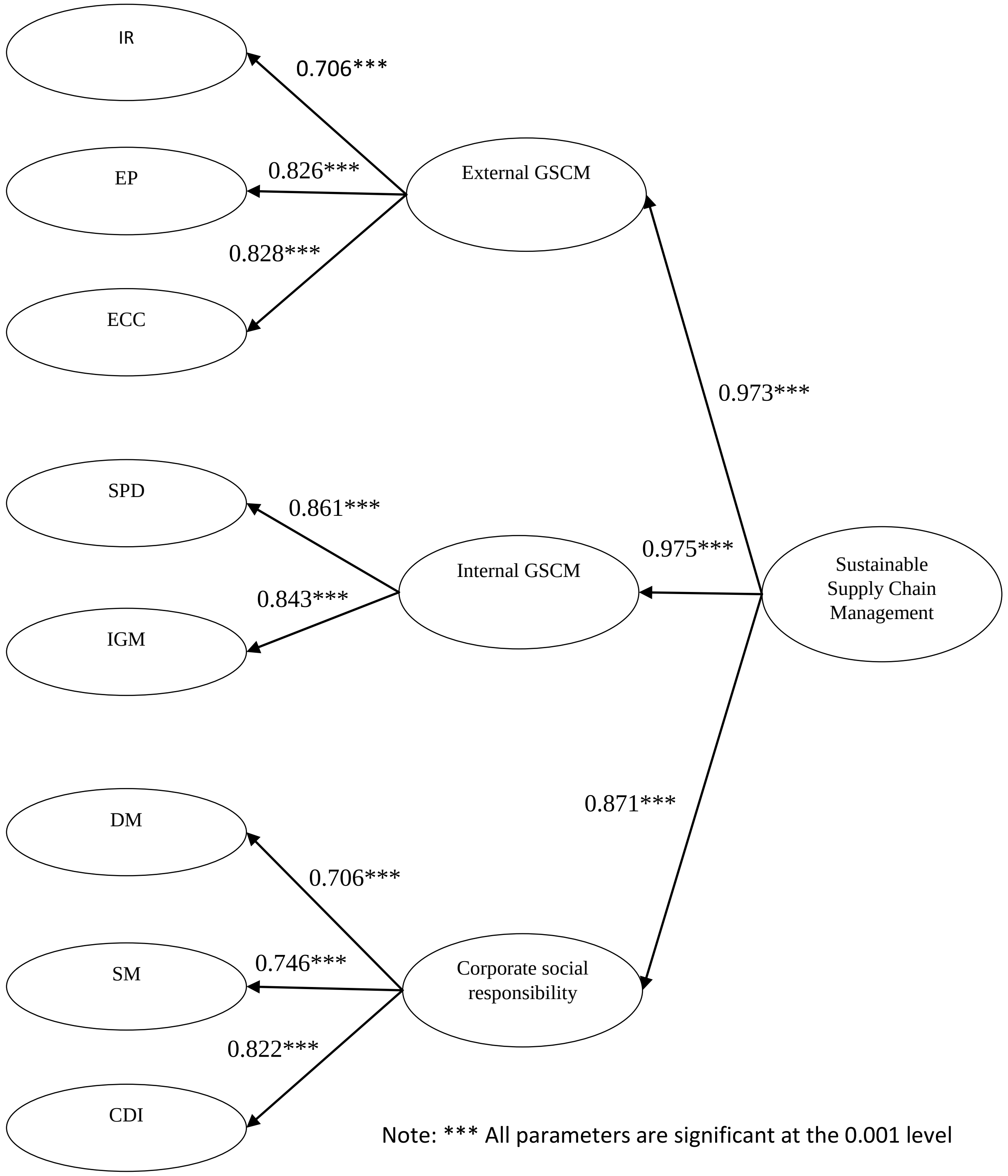


Figure 2. Third-order Model

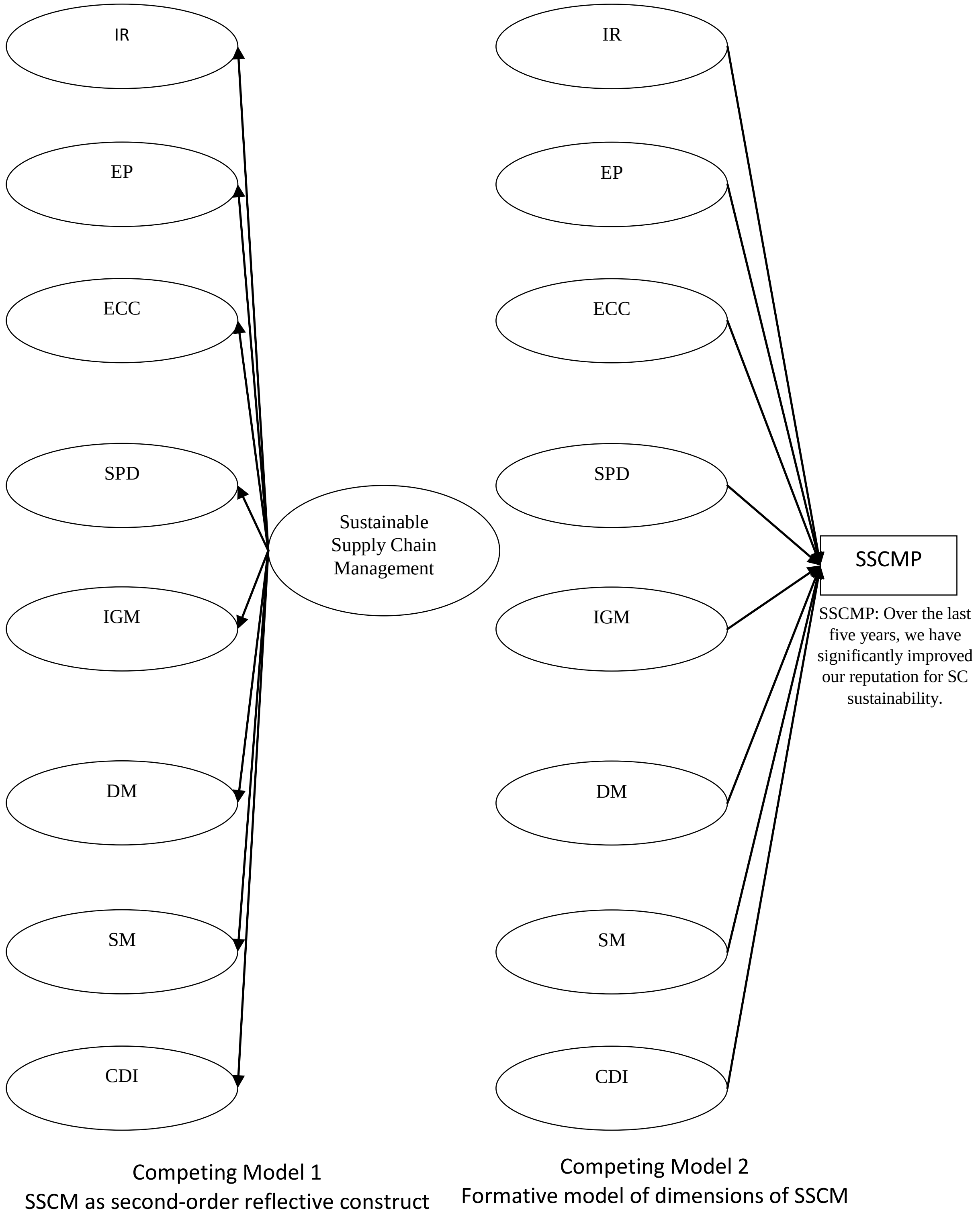


Figure 3. Competing Models

5. Discussion

The conventional view of SSCM emphasises the implementation of efficient management practices to deal with environmental problems (Carter and Easton, 2011; Seuring and Muller, 2008). More recent literature in the field highlights the necessity of the social component in the SSCM framework, based on the insights from sustainable TBL (Tseng et al., 2015). Do socially responsible management practices also reflect a dimension of SSCM? In order to address this question, it is necessary to first identify a valid measurement structure for SSCM. Utilising a large-scale survey of Chinese manufacturing managers, this research goes beyond the traditional, environmentally-focused, view of SSCM, to refine and empirically validate a multidimensional measure schema for SSCM that considers both environmental and social issues.

According to the definitions of SSCM provided by Seuring and Muller (2008) and Carter and Easton (2011), 31 practices (i.e. Items/indicators) are identified to compose the hierarchical structure of SSCM. Utilising a classical scale development process, the selected items are generated into eight first-order factors, namely SPD, EP, ECC, IGM, IR, DM, SM and CDI. Drawing from the CSR and GSCM research, of the eight factors found in scale development process, this research proposes that three (i.e. EP, ECC, IR) reflect the external GSCM, two measures (i.e. IGM, SPD) reflect the internal GSCM and three evaluate the CSR (i.e. DM, SM, CDI).

Through confirming the validity and reliability of the constructs, this research has established a set of credible measurement scales for implementing SSCM practices. Specifically, adopting the split sample testing method, the measurement models show adequate overall fit for both the calibration sample and the validation sample. Moreover, in the measurement model, the eight first-order factors established in this research are significantly and positively correlated with each other (i.e. $p<0.001$). The result provides initial support for the integrated nature of SSCM, which suggests that managers should consider the dual aspects of sustainable development (i.e. environment and social). According to Shah (2002), highly inter-correlated management practices could assist practitioners to recognise the close relationships among the SSCM practices and at the same time to discern their differences. To confirm the third-order structure of SSCM, the model comparison method is adopted (Oliveira and Roth, 2012). Using the SEM method, this research finds that both the reflective models (i.e. third-order and second-order models) have an acceptable model fit, while the formative model has a poor fit. Compared with the second-order model, the proposed third-order model shows a better fit and all estimated parameters are highly significant. The possible implications of these results are twofold. First, the multi-layer model of SSCM provides a more complementary and synergistic approach for managers to achieve sustainability in their supply chain. The presence of the third-order structure provides a more easily interpretable model to understand the mechanism of SSCM. The SSCM implementation should be multifaceted, not limited to a single aspect or a single factor. Second, both social and environmental aspects should be considered in the implementation of the SSCM practices, which is consistent with the prevailing view in SSCM research (Carter and Easton, 2011; Seuring and Muller, 2008; Tseng, 2013).

6. Conclusion

In summary, this research focuses exclusively on conceptualising the factors of SSCM and developing a holistic model to implement the SSCM. Using the SEM method and data of Chinese manufacturers, the structural hypotheses (i.e. H1 – H3) raised in the proposed model was empirically verified. Based on the significant results, all of the hypotheses are supported. This research provides empirical evidence of the multidimensionality in SSCM, which should consider both social and environmental issues. The empirical analysis of the third-order model is among the first efforts to examine the multidimensionality in SSCM that not limit the investigation of SSCM to the environmental dimension.

There are several contributions from the empirical analysis. First, the definition and valid measurement of the individual first-order factors can help managers to address the questions *“What is SSCM?”* and *“How should SSCM be implemented?”* in their business decision making. Specifically, the questionnaire items used in this research offer a set of quantifying and benchmarking tools for achieving SSCM. That is, the questionnaire items and individual factors could help managers to undertake the suggested activities or actions and direct their attention to particular areas. Second, the analysis of the higher-order model enables managers to understand the SSCM implementation in a structured way. As the debate regarding SSCM has continued, various so-called “sustainable management practices” have emerged in the literature over the last decade. The third-order model proposed in this research reveals the similarities and differences between these practices. By abstracting the three dimensions of SSCM, namely external GSCM, internal GSCM and CSR in SSCM, the research findings provide practitioners insights on identifying the critical areas in order to improve their business decisions to achieve the goal of sustainable development.

This research also suffers several limitations, and further research is necessary. First, because the current business environment is characterised as highly uncertain, the use of cross-sectional data in this research might provide only a snapshot of the best practices in SSCM. In order to document the causal processes of how SSCM practices evolve over time, a suggestion for the future research is to adopt longitudinal study. Second, this research only establishes and approve the measurement of SSCM. Whether this higher-order structure of SSCM has a complementary effect on organisational sustainable performance (i.e. TBL) remains an open question for future research. Moreover, future study can use the constructs with the validated items in this research to examine the inter-relationship between different concepts. For example, using the existing constructs, future research could address the question of *“can internal GSCM improve external GSCM or CSR?* Third, although the proposed model is empirically validated, the structure of the SSCM might not be same for the companies with different size, industries or innovation levels. This research suggests future research to investigate the impact of various contextual factors on the proposed model. Fourth, the applicability of the findings of this research is limited to the Chinese manufacturers. Future studies should also address the potential issues raised by the data collected from a single informant and a single nation, in this case, China. Although China is currently known as the world’s factory, the generalisability of the SSCM structure is still in doubt. A recommendation for future research is to extend the applicability of the current findings to different country contexts. For instance, it would be a good idea to compare the SSCM model in an emerging country and a developed country. Finally, the verified SSCM practices are only starting points. Our third-order structure with three main second-order dimensions has outlined the key areas (i.e. external GSCM, internal GSCM and CSR) that need further research. A future study could adopt alternative research methods, such as cross-firm case study, to explore more management practices or to refine the management practices under the three main dimensions of SSCM, which have approved in this research.

Appendix A

The respondents were asked to indicate the extent to which they agree or disagree with each statement as applicable to their firm: 1 = strongly disagree – 7 = strongly agree. Items that noted with "*" were deleted in data analysis.

Variables and Items	**Citations**
Sustainable Product Design	Veleva and Ellenbecker (2001); Zhu et al. (2005); Zhu et al. (2008b); Zhu et al. (2015)
SPD2: We are continually improving the design of our production process to reduce consumption of material and energy.	
SPD3: We are continually improving the design of our products to use more recycled materials.	
SPD4: We are continually improving the design of our products to avoid or reduce the use of hazardous products.	
SPD1*: We do not consider the biodegradability of the materials used in our products. (reverse coded)	
Environmental Procurement	Zhu et al. (2004); Zhu et al. (2005); Zhu et al. (2008b) IBM (2016)
EP1: Our major suppliers have ISO 14000 certification.	
EP2: We have close cooperation with our suppliers regarding the environmental objectives.	
EP3: We strive to prevent first-tier suppliers from transferring responsibility for environmentally sensitive operations to unqualified companies.	
EP5: We evaluate the environmentally-friendly practice of second-tier suppliers.	
EP4*: We regularly conduct environmental audit for suppliers' internal management.	
Environmental Customer Collaboration	Zhu et al. (2008b); Green et al. (2012)
ECC1: We have close cooperation with customers to achieve cleaner production.	
ECC2: We have close cooperation with customers to develop environmentally-friendly packaging.	
ECC3: We have close cooperation with customers to maximise the use of logistics resources.	
ECC4*: We have close cooperation with customers to reduce energy use during product transportation.	
Internal Green Management	Veleva and Ellenbecker (2001); Zhu et al. (2005); Zhu et al. (2008b); Green et al. (2012)
IGM1: The management team (e.g. senior managers and middle-level managers) of our company are committed to applying green supply chain management practices.	
IGM4: Our company has cross-functional cooperation to achieve environmental improvement.	
IGM5: Environmental compliance and auditing programs are regularly conducted in our company.	
IGM6: The green manufacturing training for our employees has increased over the last three years.	
IGM2*: Our company has a comprehensive environmental management system.	
IGM3*: The workplaces are designed to minimise continuously, or eliminate, physical, chemical, biological, and ergonomic hazards.	
Investment Recovery	Zhu et al. (2005); Zhu et al. (2008b); Green et al. (2012)
IR1: We aim to sell the excess inventories/materials.	
IR2: We aim to sell the scrap and used materials.	
IR3: We aim to sell the excess capital equipment.	
IR4: We aim to sell the refurbished products.	
Diversity Management	Carters and Jennings (2004)
DM1: Minority/Women-owned business enterprise suppliers have equal opportunity to become our partners.	
DM2: All workers have equal opportunity for promotion (i.e. no difference regarding gender, nationality).	
DM3: Minority/women workers have equal opportunity of employment with us.	
DM4: There is no difference in salary between women/minority and men/majority workers.	
Community Development and Involvement	Veleva and Ellenbecker (2001); Carter and Jennings (2004); Zhu et al. (2016)
CDI1: We strive to improve employment opportunities for the local community.	
CDI2: We strive to create wealth and income for the local community.	
CDI3: We continuously promote community education and cultural development.	
CDI4: Our employees often volunteer for local charities.	
CDI5: We are involved in local community development plans.	
Safety Management	Carters and Jennings (2004); Zhu et al. (2016)
SM2: Ensuring warehousing safety is essential to us.	
SM3: We consistently promote the importance of safe production in the value chain.	
SM4: Safety is a priority of our working plan.	
SM5: We guarantee the health and safety of our staff at work.	

SM1*: We always provide safety trainings to our employees.	

Appendix B: Exploratory Factor Analysis

	Factor Loadings							
	CDI	DM	IR	IGM	EP	SM	ECC	SPD
CDI1	**0.806**	0.076	0.139	0.091	0.110	0.040	0.041	0.101
CDI2	**0.722**	0.070	0.134	0.120	0.192	0.233	0.134	0.010
CDI5	**0.696**	0.192	0.040	0.165	-0.014	0.129	0.123	0.204
CDI3	**0.674**	0.190	0.223	-0.040	0.242	0.145	0.130	0.097
CDI4	**0.554**	0.234	0.091	0.155	0.125	0.174	0.197	0.320
DM1	0.059	**0.805**	0.094	0.149	0.104	0.158	0.074	-0.039
DM4	0.156	**0.766**	0.133	0.180	0.047	0.044	0.004	0.202
DM3	0.195	**0.737**	0.112	0.114	0.030	0.092	0.186	0.183
DM2	0.193	**0.705**	0.141	0.161	0.219	0.244	0.053	0.004
IR2	0.080	0.157	**0.755**	0.192	0.165	0.103	-0.012	0.090
IR1	0.095	0.054	**0.749**	0.180	0.122	0.065	0.193	0.207
IR4	0.210	0.077	**0.730**	0.124	0.052	0.017	0.093	-0.001
IR3	0.131	0.219	**0.640**	-0.038	0.142	0.141	0.265	0.212
IGM1	0.149	0.140	0.166	**0.785**	0.186	0.063	0.076	0.118
IGM6	0.058	0.243	0.099	**0.714**	0.221	0.121	0.148	0.152
IGM4	0.137	0.158	0.200	**0.612**	0.024	0.119	0.239	0.322
IGM5	0.125	0.195	0.127	**0.609**	0.170	0.016	0.331	0.186
EP2	0.152	0.121	0.154	0.133	**0.782**	0.088	0.192	0.093
EP1	0.219	0.087	0.118	0.298	**0.663**	0.050	0.127	0.263
EP3	0.074	0.142	0.171	0.141	**0.653**	0.286	0.207	0.187
EP5	0.272	0.099	0.125	0.132	**0.532**	0.120	0.312	0.243
SM2	0.055	0.046	0.099	0.134	0.246	**0.792**	-0.018	0.013
SM3	0.210	0.109	0.096	-0.005	0.010	**0.705**	0.247	0.056
SM5	0.171	0.230	0.011	0.022	0.123	**0.655**	0.228	0.212
SM4	0.198	0.221	0.089	0.142	0.021	**0.628**	-0.066	0.341
ECC3	0.097	0.178	0.198	0.202	0.219	0.139	**0.738**	0.133
ECC1	0.154	0.109	0.208	0.237	0.267	0.045	**0.732**	0.148
ECC6	0.244	0.013	0.095	0.191	0.179	0.187	**0.700**	0.152
SPD5	0.138	0.108	0.147	0.190	0.203	0.178	0.138	**0.735**
SPD4	0.257	0.072	0.154	0.205	0.188	0.092	0.137	**0.670**
SPD6	0.122	0.120	0.152	0.223	0.213	0.181	0.174	**0.667**
Eigenvalue	3.115	2.880	2.592	2.570	2.472	2.470	2.393	2.343
Total Variance Explained	67.21%							

Appendix C. Measurement Model for the Calibration, Validation and Whole sample

Indicator	Latent Variable	Calibration Sample (n=173)		Validation Sample (n=120)		Whole Sample (n=293)	
		$\beta(C.R.)$[a]	R^2	$\beta(C.R.)$[a]	R^2	$\beta(C.R.)$[a]	R^2
SPD2	SPD	0.758(-)[b]	0.575	0.685(-)	0.47	0.724(-)	0.514
SPD3	SPD	0.823(10.481)	0.677	0.685(6.150)	0.469	0.771(11.752)	0.377
SPD4	SPD	0.766(9.783)	0.586	0.736(6.465)	0.541	0.758(11.588)	0.476
EP3	EP	0.803(-)	0.645	0.763(-)	0.582	0.794(-)	0.519
EP2	EP	0.723(9.845)	0.523	0.664(6.991)	0.441	0.702(12.132)	0.561
EP1	EP	0.744(10.193)	0.554	0.731(7.731)	0.534	0.742(12.924)	0.608
EP5	EP	0.821(11.420)	0.674	0.741(7.839)	0.549	0.793(13.932)	0.524
CDI1	CDI	0.69(-)	0.476	0.724(-)	0.525	0.708(-)	0.664
CDI5	CDI	0.721(8.442)	0.52	0.679(6.771)	0.461	0.693(10.697)	0.48
CDI2	CDI	0.729(8.527)	0.532	0.743(7.363)	0.552	0.732(11.242)	0.498
CDI3	CDI	0.709(8.313)	0.503	0.749(7.413)	0.56	0.728(11.189)	0.53
CDI4	CDI	0.756(8.800)	0.572	0.617(6.182)	0.381	0.706(10.881)	0.536
ECC3	ECC	0.849(-)	0.722	0.734(-)	0.538	0.815(-)	0.401
ECC1	ECC	0.877(13.740)	0.769	0.762(7.715)	0.581	0.836(14.938)	0.624
ECC2	ECC	0.786(11.911)	0.618	0.57(5.571)	0.325	0.728(12.880)	0.495
IGM1	IGM	0.759(-)	0.577	0.695(-)	0.484	0.743(-)	0.534
IGM6	IGM	0.746(9.647)	0.557	0.724(6.705)	0.524	0.742(11.937)	0.542
IGM4	IGM	0.76(9.837)	0.577	0.634(5.998)	0.401	0.72(11.585)	0.426
IGM5	IGM	0.772(10.001)	0.596	0.666(6.262)	0.443	0.724(11.648)	0.564
DM1	DM	0.74(-)	0.547	0.743(-)	0.552	0.749(-)	0.501
DM2	DM	0.844(10.700)	0.712	0.533(4.908)	0.284	0.78(12.55)	0.629
DM3	DM	0.753(9.563)	0.566	0.696(4.019)	0.484	0.736(11.851)	0.55
DM4	DM	0.794(10.099)	0.631	0.621(5.587)	0.386	0.751(12.079)	0.493
SM4	SM	0.783(-)	0.613	0.553(-)	0.305	0.69(-)	0.595
SM3	SM	0.68(8.500)	0.462	0.594(4.526)	0.353	0.653(9.327)	0.575
SM5	SM	0.715(8.946)	0.512	0.731(4.998)	0.535	0.73(10.146)	0.524
SM2	SM	0.64(9.091)	0.41	0.634(4.697)	0.402	0.633(9.091)	0.63
IR4	IR	0.607(-)	0.369	0.615(-)	0.378	0.614(-)	0.699
IR2	IR	0.753(9.341)	0.567	0.591(5.015)	0.35	0.717(9.341)	0.552
IR3	IR	0.781(9.225)	0.61	0.551(4.754)	0.304	0.703(9.225)	0.53
IR1	IR	0.822(9.872)	0.676	0.73(5.739)	0.533	0.79(9.872)	0.551

Note: a. Standardised factor loading is denoted as β and t-value is denoted as C.R.
b. This regression weight was fixed as 1.0

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