Renewable and Sustainable Energy Reviews 55 (2016) 1301–1312

Contents lists available at ScienceDirect

Renewable and Sustainable Energy Reviews

journal homepage: www.elsevier.com/locate/rser

A framework for supply chain sustainability in service industry with Confirmatory Factor Analysis

Matloub Hussain [a], Mehmood Khan [a], Raid Al-Aomar [b,*]

[a] College of Business Administration (COBA), Abu Dhabi University, P.O. Box 59911, Abu Dhabi, United Arab Emirates
[b] College of Engineering, Abu Dhabi University, P.O. Box 59911, Abu Dhabi, United Arab Emirates

ARTICLE INFO

Available online 14 August 2015

Keywords:
Supply chain management
Sustainability
Service industry
Factor analysis

ABSTRACT

Supply chain sustainability has attracted less attention in the Arab world compared to the western countries. There is dearth in existing research on this topic, particularly in service organizations, and techniques of sustainability are in the development stages compared to manufacturing companies. The typical challenge that is faced by organizations in this regard is how to be productive and profitable while being sustainable. This study identifies and consolidates various relevant factors to develop a Sustainable Supply Chain Management (SSCM) construct conducive to service supply chains. To this end, a comprehensive framework of sustainability measurement has been developed through successive stages of data collection, analysis and refinement. Data has been collected from major service companies in the Abu Dhabi area. The outcome of this research is a set of reliable, valid and *unidimensional* first order measurements that can be subsequently used in conceptualization and measurement of the sustainability of supply chains in service industries. This contributes to the continuing research of supply chain sustainability and provides supply chain managers with a practical approach for measuring and implementing sustainability practices across service supply chains.

Contents

* Corresponding author. Tel.: +971 50 943 7057.
E-mail addresses: Matloub.Hussain@adu.ac.ae (M. Hussain), Mehmood.Khan@adu.ac.ae (M. Khan), raid.alaomar@adu.ac.ae (R. Al-Aomar).

http://dx.doi.org/10.1016/j.rser.2015.07.097
1364-0321/

1. Introduction

A supply chain is often viewed as a network of critical links that connects organizations (stakeholders) together and links each organization's inputs to its outputs. As defined by Bowersox et al. [1], the supply chain refers to all those activities associated with the transformation and flow of goods and services, including money and information flows, from the sources of materials to end users. Supply chain management (SCM) includes all programs, initiatives, and management activities that aim at effectively running, controlling and improving supply chain operations. The main components of a supply chain are common in both manufacturing and service industries. Fig. 1 depicts the main components of a service supply chain. Details of supply chain components and functions can be found in [2].

The new global reality that has emerged from the latest economic crisis has called for supply chains to be more lean and cost effective. In addition, and due to stricter regulations and increased community, legislatives, and consumer pressures, companies need to effectively integrate sustainability initiatives and programs into their regular logistics and supply chain operations. The integration of sustainability with SCM (i.e., SSCM) is, therefore, increasingly emphasized in almost all industries through the collaboration of all stakeholders including regulators, suppliers and customers. SSCM aims to deliver quality products and services across the supply chain while increasing effectiveness, reducing waste and costs, and being environmentally responsible. Effective supplier and customer management play a key role in the seamless flow of supplies and services/products particularly in service supply chains.

Sustainability in services supply chains is increasingly seen as essential to delivering long-term profitable services and products that positively reflect on societies. However, the sustainability interaction with services is different from that with manufacturing. This is basically due to the structural differences between a product-based (manufacturing) supply chain and a service-based supply chain. Unlike manufacturing, services supply chains are often characterized with high customer involvements, less structured processing, and intangible products that may not be standardized or stored. Sustainability initiatives are, therefore, more product and process oriented in manufacturing (i.e., reducing byproducts, pollution, and waste along the life cycle of the products). For example, sustainability in the IT industry focuses on the carbon footprint of manufacturing technology/process and recycling products such as PCs, laptops, mobile phones and other electronic devices. On the other hand, there is relatively less focus on product and process in services where fewer reverse logistics are used and the focus is more on the environmental impacts, social impacts, and the corporate green policy and environmental standards. This can be observed in various service industries such as banking, healthcare, tourism, airlines, hospitality, entertainment and education.

Still, however, there is an overlap between manufacturing and service supply chains with several common elements. In some cases, services are provided along with the physical products such as product support and customer service. Some other services have separate supply chains such as government services, healthcare, airlines and education. Generally speaking, almost all service organizations in both public and private sectors are increasingly adopting recycling practices and sponsoring social and environmental projects and initiatives.

SSCM is a relatively new concept in the service sector. The challenge is similar to that in manufacturing companies: reducing environmental and social impacts while improving the bottom line. This is particularly important to service supply chains in the Arab world and the Middle East where the service sector represents the major contributor to local economies, especially in the Gulf region. The sustainability of both manufacturing and service supply chains in the Gulf countries and in Abu Dhabi, in particular, is attracting more attention from regulators, companies and academia. However, there is a lack of studies that assess the extent and the impact of implementing sustainability practices and initiatives in supply chains. The issue is even more evident in the supply chain of service organizations. For example, steel and aluminum producers and big construction companies are bound to develop a yearly sustainability report to outline their green initiatives and social responsibility. On the contrary, service companies do not have such obligation. Thus, the objectives of this paper are as follows:

1. To propose a comprehensive framework of sustainability in service supply chains.
2. To introduce first order Confirmatory Factor Analysis (CFA) model of the proposed framework.
3. To test and validate CFA model in service supply chains of Abu Dhabi.

The structure of this paper is as follows. Section 2 provides a brief literature review of relevant research while section 3 explains the proposed research methodology. Section 4 presents the data collection and results analysis. Section 5 discusses results and findings and Section 6 presents implications, concluding remarks, and directions for future research.

2. Literature review

The literature on supply chain sustainability has mostly focused on environmental impacts while some researchers have put together the environmental, economic and social impacts to form the widely known triple bottom line [3]. Herva and Roca [4] added institutional impact to this methodology while Ilskog [5] recommended measuring technical impact. Linton et al. [6] argued that sustainability in supply chains should be moved from optimization of environmental factors to consideration of the entire supply chain, i.e. production, consumption, customer service, and disposal of products. They posed a number of questions for the future of supply chains, such as (a) type of resources to be used, (b) level of pollution, (c) extent of renewable resources, (d) use of technology, and (e) the role of government policies in achieving a competitive rank in sustainability.

Seuring and Müller [7] acknowledged the growing significance of sustainability in supply chain literature. They reviewed 191 articles from 1994 to 2007 and categorized them into (a) supplier management and (b) supply chain management for sustainable products. They offered a conceptual framework for studying the relationship between

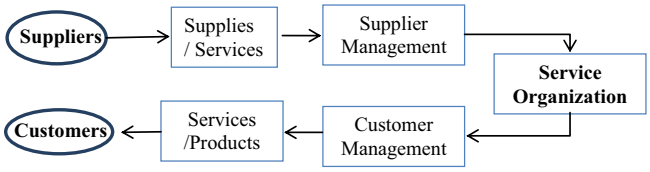

Fig. 1. The main components in a service supply chain.

stakeholders in a supply chain to improve its performance and avoid the risks involved. They claimed that the outcomes of their conceptual framework will depend on the knowledge, experience and mindset of the researchers or research groups. Roca and Searcy [8] analyzed 94 corporate reports to identify 585 different sustainability indicators used in Canadian firms. These reports spanned various corporate sectors in Canada and covered indicators ranging from customer satisfaction through emission levels, waste generation, and water consumption. They found that all these indicators were evenly distributed along the triple bottom line while 31 of those corporates were using the indicators identified explicitly by the Global Reporting Initiative (GRI). This set of indicators can act as a baseline for further research in sustainability measurement and could be used to advance the current trends in sustainability measurement in public and private sectors.

Mori and Christodoulou [9] reviewed the requirements for the City Sustainability Index (CSI) based on a number of indices such as ecological footprint, human development, and genuine progress. These indices spanned the triple bottom line of social, economic and environmental aspects. The CSI is vital for comparing the sustainability performance of cities across the world and it can help authorities set a guideline for accomplishing their sustainability endeavors.

Ahi and Searcy [10] identified 22 definitions of green supply chain management and 12 definitions for SSCM through a systematic literature review. They tried to identify convergence and divergence among the definitions presented under the two notions. For this analysis, they used a number of dimensions in business sustainability (i.e., economic, environmental, social, and long-term focuses) and SCM (i.e., flow, coordination, stakeholder relationship, and efficiency). Further reviews on supply chain sustainability can be found in Srivastava [11], Seuring and Müller [7], Mollenkopf et al. [12], Gold et al. [13], Carter and Easton [14], and Sarkis et al. [15].

2.1. Sustainability practices in manufacturing supply chains

A recent trend in assessing sustainability and its components in manufacturing supply chains is using product and process footprints such as economic footprint (EF), carbon footprint (CF), enviromental footprint (EnF), and social footprint (SF). For example, Sundarakani et al. [16] used analytical and finite difference methods to approximate a three-dimensional carbon footprint model in a manufacturing supply chain. They argued that the major constituents of carbon emissions in a supply chain are the use of technology and energy as well as policies pertaining to inventory, trade and shipment. Čuček et al. [17] presented an overview of several of these footprints and showed that they were not yet standardized. They also presented the tools used for evaluating these footprints and concluded that these tools lacked consistency. Thus, they suggested a composite footprint that provided a systematic and integrated measurement of a number of different footprints.

Another practice in manufacuring supply chains is developing indices to measure sustainability. For example, Gaussin et al. [18] developed a standard measure/index of sustainability that is straightforward, efficient yet comprehensive. They surveyed a number of existing approaches and methodologies that are utilized to assess sustainability in the manufacturing environment. They recommended future research directions to obtain an ideal sustainability index. This index would encapsulate various dimensions of sustainability attributed across the lifecycle of a product through its design and manufacturing. Similarly, Neves and Leal [19] analyzed 10 energy-and-climate-action-plans to propose a framework of eighteen energy-sustainability-indicators. These indicators of sustainability initiatives were mainly meant for benchmarking through ranking, used for diagnosis rather than monitoring, and fail to provide a comprehensive assessment of the overall impact of energy-use.

Another practice in this regard is to focus sustainability studies on the supply chains of certain industries. For example, Mayyas et al. [20] reviewed the various studies on sustainability in the automative industry. They categorized these studies into life-cycle assessment, end-of-life perspective, design, and material selection studies. Jawahir et al. [21] also highlighted that other than the economic, social and environmental factors, the major elements that contribute to design for sustainability are: manufacturability, remanufacturability and functionality.

Studies of supply chain sustainability acrosss multiple industries are still limited. For example, Zailani et al. [22] studied the impact of environmental purchasing and sustainable packaging on sustainable supply chain performance in 400 manufacturing firms in Malaysia. They developed an empirical questionnaire and divided the results in four categories, i.e. environmental, economic, social and operational. They found that environmental purchasing has a positive effect on economic, social and operational outcomes, whereas sustainable packaging has a positive effect on environmental, economic and social outcomes. Zailani et al. [23] proposed an ecological design for describing the relationship of the environmental performance of a manufacturing firm with government regulations/incentives as well as customer pressure. They used Structual Equation Modeling (SEM) and Confirmatory Factor Analysis (CFA) to assess the scales and the relationship among different latent variables. Similarly, Zhu et al. [24] attempted to study the differences between industrial development and environmental protection in a number of manufacturing firms in China.

Other studies are focused on developing frameworks and models for assessing sustainability in manufacturing supply chains. For example, Sarkis [25] focused on how green aspects can serve forming a decision framework to gain competitive advantage in a supply chain. Seuring [26] advocated the fact that only a little has been done to model sustainable supply chains quantitatively. He presented a review of the existing research on quantitative models in sustainable supply chains and laid directions for future research. He reviewed a number of modeling techniques such as equilibrium models, multi-objective optimization, and Analytical Hierarchy Process (AHP). Similarly, Brandenburg et al. [27] evaluated the developments in the quantitative models of sustainability in forward supply chains. They reviewed 134 selected articles in six journals in the last two decades, and found that most of the research used AHP, Analytical Network Process (ANP), and Life Cycle Analysis (LCA) for multiple criteria decision making. Pedrazzoli et al. [28] presented a supply chain simulation tool that takes into account the specificity of mass customized markets. Moreover, this tool is integrated with a sustainable assessment engine that allows the user to configure the entire supply chain in a lifecycle perspective.

2.2. Sustainability practices in service supply chains

As mentioned earlier, this is a relatively new area of sustainability research and with limited number of studies and literature. For example, Hasan [29] examined the relationship between sustainable supply chain practices and operational/environmental performance. He devised a framework for this study and validated

Table 1
Summary of SSCM literature review.

Research	Triple bottom line	Literature review	Design of a framework	Sustainability indicators	Manufacturing	Service
Ahi and Searcy [10]	X	X				
Branderburg et al. [27]		X		X		
Brindley and Oxborrow [31]				X		X
Carter and Jennings [37]			X	X		X
Carter and Easton [14]	X	X	X			X
Chan et al. [38]				X	X	X
Chen et al. [32]				X		X
Čuček et al. [17]		X		X	X	
Gaussin et al. [18]		X		X	X	
Gold et al. [13]	X			X	X	X
Govindan et al. [39]		X		X	X	X
Grimm et al. [36]				X		X
Hacking and Guthrie [3]	X		X	X		
Hasan [29]			X		X	X
Herva and Roca [4]		X		X		
Ilskog [5]				X		X
Jawahir et al. [21]			X		X	
Kuo et al. [30]				X		X
Li et al. [40]				X		X
Linton et al. [6]					X	X
Mayyas et al. [20]	X	X			X	X
Mollenkopf et al. [12]				X	X	X
Mori and Christodoulou [9]	X			X		
Neves and Leal [19]			X	X	X	
Roca and Searcy [8]	X			X	X	
Sarkis [25]			X		X	
Sarkis et al. [15]		X			X	X
Seuring [26]		X			X	
Seuring and Müller [7]		X	X			X
Srivastava [11]		X		X		
Sundarakani et al. [34]	X		X		X	X
Sundarakani et al. [16]			X	X	X	
Zailani et al. [23]				X	X	
Zailani et al. [22]	X			X	X	
Zhu et al. [24]				X	X	

it through case studies in a number of service and manufacturing firms. The study found that sustainable supply chain practices have a significant impact on the environmental performance of both manufacturing and service firms.

Kuo et al. [30] developed an empirical model to study the impact of pressure, strategy, uncertainty, internal management and external management on sustainable service supply chain practices in Taiwan and Vietnam. Their hypotheses proved that all the five factors have a prominent impact on the SSCM in the corporates in both countries though the level of impact may be different. Brindley and Oxborrow [31] emphasized the need for aligning the green practices in marketing to sustainability objectives. They demonstrated this through a case study at a university in the UK. The study also outlined the importance of reverse information flow and intermediaries in this context.

Chen et al. [32] deployed the Theory of Planned Behavior (TPB) to study sustainability practice in more than 500 dining services at USA-based colleges and universities. They analyzed how personal attitudes (personal norms, PN) and pressure from administration and students (subjective norm, SN) influence sustainable behaviors. They used Exploratory Factor Analysis (EFA) to group the indicators for various latent variables and used CFA and SEM to investigate the developed model.

Jänicke [33] demonstrated the concept of the ecological modernization theory that postulates how environmental problems can be tackled by ecological innovations in the form of technological, organizational and operational innovations. They validated the measurement of their constructs through CFA and showed that their models for ESCC (environmental-oriented supply chain cooperation) and CE (cyclic economy) practices fit the data acceptability. Working along the same lines, Sundarakani et al. [34] highlighted the importance of restructuring supply chain architecture to reduce carbon emissions in the light of economic, social and environmental goals.

Finally, some studies have analyzed the sustainability of service supply chains by focusing on the green practices of suppliers. For example, Govindan et al. [35] performed a review of research on evaluating suppliers in the light of their green practices. They found that researchers have mostly focused on supliers' environmental management systems. Similarly, Grimm et al. [36] studied two food supply chains and identified fourteen critical success factors in managing sub-supplier relationship. They classified these success factors as (a) focal firm-related, (b) relationship-related, (c) supply chain partner-related, and (d) context-related factors.

Table 1 summarizes the span of the literature on sustainable supply chains for the last few years. This highlights the significance of the subject and the growing interest among researchers to further explore every aspect of sustainability in the supply chain context. The table catgeorizes the focus of the surveyed literature into triple-bottom-line, literature survey, framework development, and the development of sustainability indicators. The table then categorizes the context of surveyed literature into service and manufacturing supply chains. It is evident that most researchers have focused on reviewing the different dimensions that have been studied in the past two decades. The three cornerstones of sustainability, i.e. environmental, economic, and social aspects (i.e., the triple-bottom-line) have been the prime focus in the literature on sustainability. Some studies simply presented an extensive literature review on the subject along with a framework and/or indicators of development.

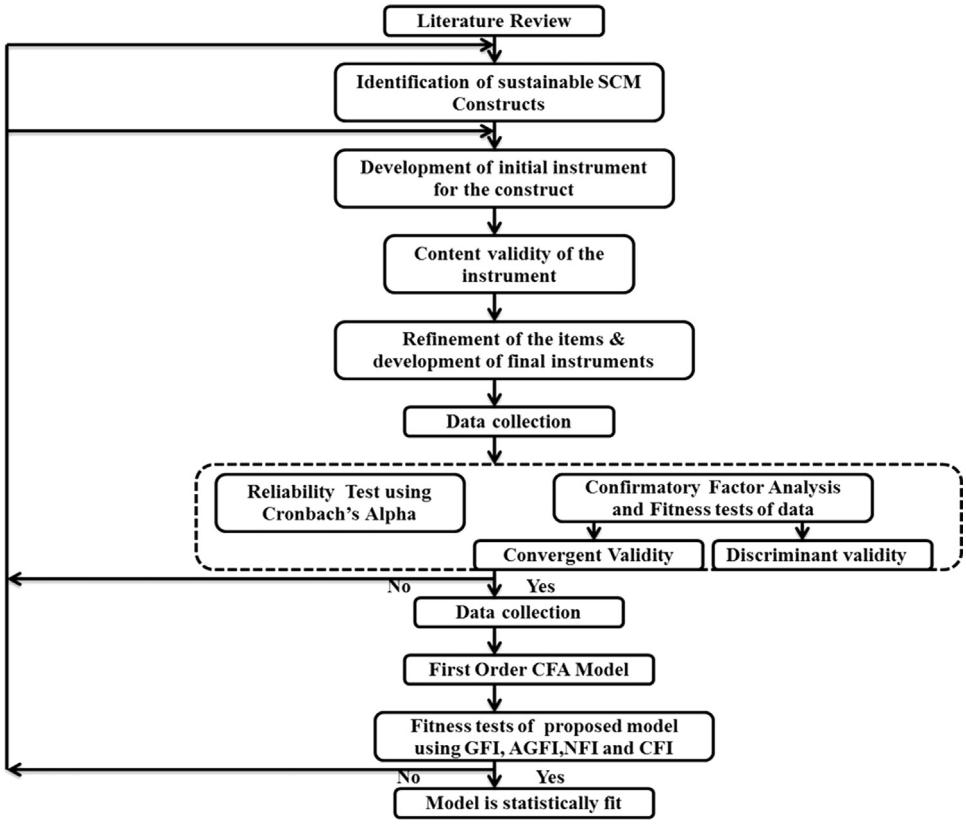

Fig. 2. Research plan.

Table 2
Company categorization (Source: the new SME definition).

Enterprise category	Annual work unit (AWU)	Annual turnover
Large	≥ 250	≥ €50 million
Medium	< 250	≤ €50 million
Small	< 50	≤ €10 million

Fig. 3. Framework of service supply chain sustainability.

2.3. Study contribution

As shown in Table 1, several studies have identified different indicators of sustainability but little attention has been given to formulating a comprhensive framework for measuring the impact of these indicators on the performance of supply chains. Although the literature contains a good number of articles studying the performance measures of manufacturing organizations, not much attention has been paid to exploring the respective indicators in the service industry. Most of the previous research on sustainability focuses on manufacturing companies while the concepts and techniques of sustainability in service supply chains are yet to be explored. Thus, sustainability measurement in the service sector is a fertile field to be explored.

Therefore, this paper builds on the reviewed literature of SSCM and attempts to contribute to the research gaps by introducing a comprehensive research framework for investigating and assessing sustainability across the supply chains in the service companies in Abu Dhabi. The review of existing research on quantitative models in sustainable supply chains has also helped in developing a research framework to analyze the sustainability of service supply chains, setting the research instrument, and selecting the data analysis method. Data has been collecteted from the main banks, hospitals and airline companies in Abu Dhabi. The research instrument has been validated initially by senior supply chain/operations managers of service companies in Abu Dhabi. The validity and reliability of the proposed instrument has been tested using different statistical techniques and the *unidemensionality* of the items in the scale has been measured through Confirmatory

Factor Analysis (CFA). Finally, a *first order* CFA model has been developed using *Standardized Regression Coefficients* and *Correlation* among Latent Variables.

3. Research methodology

The key research goal in this study is to assess the extent and outcomes of implementing sustainability actions and initiatives within the supply chains of selected service companies in Abu Dhabi. To achieve this research goal, a comprehensive research methodology has been developed. The proposed research plan is shown in Fig. 2. The research methodology includes the research design, survey design and distribution, and an analysis of collected data using descriptive statistics factor analysis and latent variable model development.

The study plan is developed based on an empirical study of selected service companies in Abu Dhabi area. Primary data is collected through a survey distributed to a sample of selected companies (the population frame is service companies in Abu Dhabi, and the unit of analysis is an individual company). The secondary data in the study is obtained from an extensive literature review of supply chain sustainability. For data analysis, CFA technique is used. CFA is a statistical technique used to verify the factor structure of a set of observed variables. CFA allows the researcher to test the hypothesis that a relationship exists between the observed variables and their underlying latent constructs. A software tool (AMOS 16) has been used for CFA analysis.

3.1. Research design

Li et al. [37] mentioned that supply chain practices are being well observed in large as opposed to small companies. Therefore, this study is focused on collecting information and data from large service companies of Abu Dhabi. The size of the companies was determined by the number of employees. As explained by the European Commission (Table 2), small companies have less than 50 employees, medium companies have more than 50 and less than 250, and large companies have at least 250 employees. To observe consistency, a sample was first taken using the same criteria (e.g., the similarity of operations, industrial sectors, and corporate cultures of large companies).

3.2. Survey instrument

The survey instrument is divided into five sections with a total of 25 indicators. Section 1 of the instrument deals with the general information of the selected company while the remaining four sections are related to the four sustainability aspects of the supply chain (Environment Management, Social Responsibility, Health, Safety and Risk Management, and Customer Management). These four sections, which are selected based on an extensive literature review, represent a comprehensive construct of the latent variables. Each latent variable is measured using a set of associated indicators. These indicators are used to measure the sustainable practices in the service supply chain. Fig. 3 shows the sustainability framework of service supply chains.

As shown in Fig. 3, the framework of service supply chain sustainability has been developed to consist of four dimensions. Broadly speaking, sustainable development is often described as containing multiple dimensions – environmental, social and economic issues. There is a series of related literature that supports these dimensions of supply chain sustainability (e.g., Srivastava [11]; Seuring and Müller [7]; Mollenkopf et al. [12]; Gold et al. [13]; Carter and Easton [14]; Sarkis et al. [15]). In many of these reviews, Environmental Management (EM) has been identified as a key parameter (latent variable) for investigating sustainable practices in green supply chains. The second important latent variable for SSCM is “Social Responsibility”. Nowadays, supply chains are typically under pressure to improve their social standards [38]. Among the lines of research on SSCM are the management of risk, health and safety which are also receiving growing attention (e.g., Kleindorfer and Saad [39]; Tang [40]; Manuj and Mentzer [41]). Literature clearly shows that a well-designed risk-oriented SCM can put companies in a privileged position to deliver sustainable and reliable long-term benefits to all stakeholders in the value chain. Finally, supply chains should embrace customer service to attract new customers while, at the same time, taking advantage of opportunities to meet, or even exceed, the expectations of existing supply chain customers [42].

In order to verify the findings from the literature review, all of the survey items related to the environment, society, health and safety, and customer management were initially validated (content validity) by three supply chain managers working in the service sector. It is, therefore, believed that this process is deemed necessary to suit the sustainability measurements in the context of Abu Dhabi service sector supply chains. The target respondents of the survey were requested to indicate, using a five-point Likert scale (1=strongly disagree, 2=disagree, 3=neutral, 4=agree and 5=strongly agree), the extent to which they perceived their companies implementing each of the four dimensions of sustainable SCM practices, underpinned by the 18 questionnaire items for measurement.

Table 3
Profile of the respondents and their organizations.

	Frequency	Percentage
Nature of organization		
Banks	65	39
Airlines	51	30
Hospitals	53	31
Total	169	100
Type of organization		
Project Based	12	7
Traditional	157	93
Total	169	100
Management level		
Middle Management	100	59
Top Management	69	41
Total	169	100
No. of employees		
Less than 500	0	0
Between 500 and 1000	5	3
Greater than 1000	164	97
Total	169	100
Total annual revenue in million AED		
Less than 10	0	0
Between 10 and 50	6	4
More than 50	163	96
Total	169	100
Ownership		
Local Body	169	100
Foreign Body	0	0
Mix of Both	0	0
Total	169	100

4. Data collection, analysis and results

The survey instrument was emailed to 550 respondents belonging to managements of banks, airlines and hospitals in Abu Dhabi. These service companies were randomly selected from the Abu Dhabi

Commercial Directory, using the criteria mentioned in Table 2. The survey results were tabulated, summarized, and analyzed statistically to answer the underlying research question. Out of 550 surveys emailed to the selected companies, only 9 emails were undeliverable and within a two-week period, 176 responses were received. Seven responses were found incomplete and were hence excluded from the analysis. The remaining 169 responses were considered for the analysis, which is a judicious sample size for this study, where at least 50 responses are required to attain credible results [43].

4.1. Descriptive statistics

Table 3 presents the profile of respondents and their companies. The table shows that the surveyed organizations are categorized as banks, airlines and hospitals. The majority of these companies (93%) are typical service organizations and only 7% organizations are project-based. This indicates that the survey has been conducted in typical established companies since projects based organizations do not aggressively pursue the phenomenon of sustainability. Results also show that 59% of the respondents belong to middle management levels and the remaining 41% to top management. This highlights the fact that the respondents were experienced in their organizations and had the essential prior knowledge of sustainability and supply chains. It should be noticed that respondents tend to pay lesser attention, increase speed of their responses or simply get fatigued, as they progress through the questionnaire. There are other possibilities such as the lack of knowledge, sensitivity and/or ambiguity of a question that make the responses questionable. This would ultimately affect the reliability of data in general and outcomes of the research in particular. To minimize this impact, it was ensured that (i) the length of the questionnaire is limited, (ii) the text in each is simple and straightforward and (iii) the survey is responded by middle and senior managers.

In terms of company size, 97% of the respondents indicated that their companies had more than 1000 employees while 3% respondents indicated that their companies had 500–1000 employees. Thus, all surveyed companies are considered to be large organizations. This can also be seen from the total annual revenue of each company where 96% reported a total annual revenue of more than 50 million AED while 4% reported a total annual revenue of 10–50 million AED. After a discussion with the top managers of two companies, researchers found that this contradiction in responses

Table 4
Results of the reliability test.

	No. of items	Cronbach's alpha
Environmental Management	4	0.759
Corporate Social Responsibility	3	0.824
Health, Safety and Risk Management	4	0.711
Customer Management	7	0.828

Table 6
Scale validity analysis.

Factors	Convergent validity	Discriminant validity
Environmental Management	0.99	0.49
Corporate Social Responsibility	1.00	0.51
Health, Safety and Risk Management	0.96	0.47
Customer Management	0.97	0.58

Table 5
Assessment of goodness-of-fit statistics for confirmatory factor analysis.

Factors and indicators	CFI	Factor loading	R^2	GFI
A. Environmental Management	1.00			0.99
EM1. The organization management system is in compliance with applicable environmental laws and regulations.		0.57	0.33	
EM2. The organization has up-to-date ISO 14001 or any other certification.		0.61	0.37	
EM3. The environmental policies, practices and expectations are communicated to all employees and suppliers in local or appropriate languages.		0.76	0.57	
EM4. The employees are trained on relevant environmental targets.		0.76	0.58	
	1.00			1.00
B. Social Responsibility				
CSR1. The organization has a written corporate responsibility policy or statement of commitment that defines its approach to labor, health, and safety standards.		0.69	0.48	
CSR2. The organization has a management system in place, or is developing one, to maintain relations with community stakeholders.		0.82	0.67	
CSR3. The organization's performance management system is in compliance with applicable social laws and regulations.		0.84	0.70	
C. Health, Safety and Risk Management	0.98			0.98
HSM1. The organization has got written procedures for the safe storage, use and disposal of each hazardous material in language (s) workers understand.		0.55	0.30	
HSM 2. The organization has a written emergency response plan and fire evacuation procedure.		0.77	0.59	
B6.The organization frequently conducts an emergency drill.		0.63	0.40	
HSM 3. The organization has got well-stocked, unlocked first aid stations at every different site.		0.56	0.31	
D. Customer Management				
	0.95			0.96
CM1. The organization has a customer service vision in place.		0.51	0.26	
CM2. The organization has defined key customer segment(s) based on criteria such as demographics, life-stage, preferences, age, gender, etc.		0.48	0.23	
CM3. The organization collects customer data at various touch points.		0.74	0.55	
CM4. The organization engages its customers in activities such as survey, focus groups, interviews, etc.		0.76	0.59	
CM5. The organization has defined communication standards and protocols.		0.60	0.36	
CM6. The organization uses multiple channels (internet, kiosk, mobile devices or other innovative channels) to deliver its services.		0.48	0.23	
CM.7. The customers/staff can access the same up-to-date customer information through different channels.		0.79	0.63	

Note: All factor loadings were significant at $p < 0.001$.

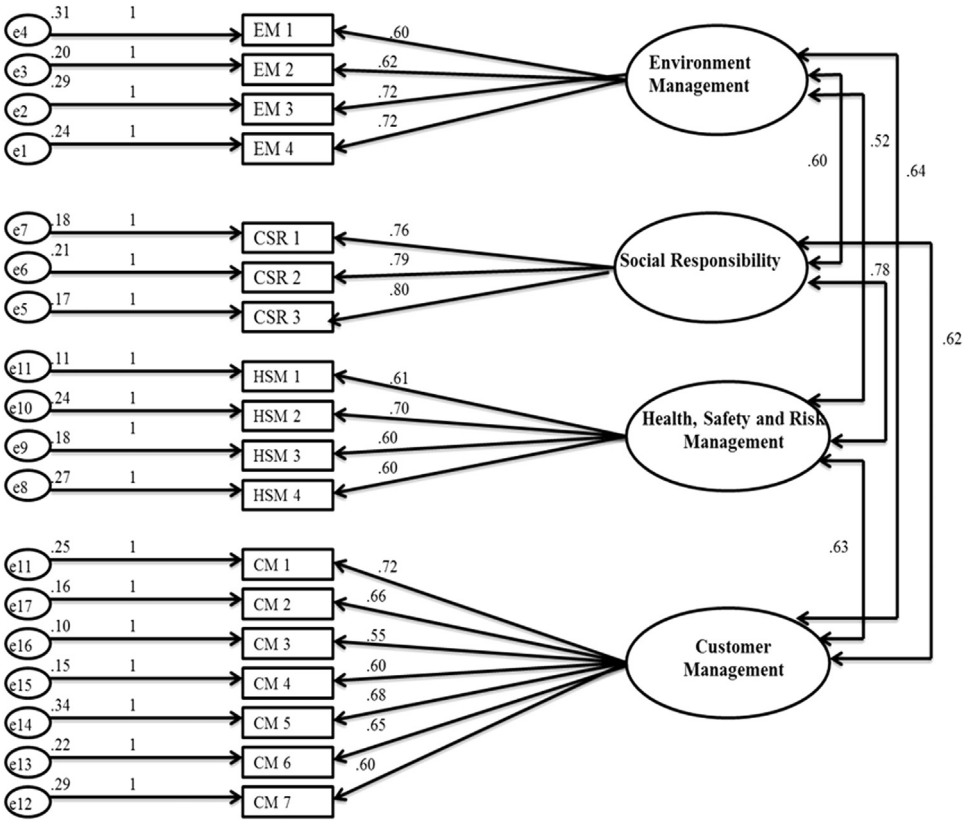

Fig. 4. Proposed latent variable model.

Table 7
Summary statistics of model fitness indices.

Fit index	Suggested values	Observed values
Chi-square/degrees of freedom	≤ 3.00	2.29
GFI	≤ 0.90	0.90
AGFI	≤ 0.80	0.82
NFI	≤ 0.90	0.94
CFI	≤ 0.90	0.95

could be attributed to a "lack of communication". Finally, results show that all the organizations studied in this research are locally owned.

4.2. Validity and reliability testing

The degree of consistency of a measure is referred to as its reliability. The reliability coefficient, Cronbach's α [44], is generally used to test the reliability of a scale. αvalues of 0.70 or greater are deemed to be indicative of good scale reliability [45]. This reliability test was, therefore, applied to the data collected from the 169 surveys. As can be seen from the results of Table 4, Cronbach's α for the four latent variables of SSCM model range from 0.711 to 0.828. These results suggest that the theoretical constructs exhibit good psychometric properties.

4.3. Unidimensionality

Unidimensionality measures the extent to which the items in a scale measure the same construct [46]. CFA is used to assess how well the observed variables, i.e., measurement items, reflect unobserved or latent variables in the studied construct. A CFA was conducted for each of the four constructs to determine whether the 18 indicators have adequately measured the construct they were allocated to. Empirical evidence in CFA (and SEM in general) is generally assessed using criteria such as the comparative fit index (CFI), squared multiple correlations (R^2), the significance of parameter estimates (factor loading), and goodness-of-fit statistic (GFI). Table 5 summarizes the results of these tests.

The CFI compares a proposed model with the null model assuming that there are no relationships between the measures. A CFI value that is greater than 0.90 indicates an acceptable fit to the data [47]. It can be seen from the results of Table 4 that CFI values for four latent variables range from 0.95 to 1.00, which suggests very good model fitness. Squared multiple correlations (analogous to R^2) indicate the percentage of variance in an indicator explained by a certain factor. Table 5 also confirms that the factors loading, which are the standardized regression weights, are satisfactorily high and statistically significant (values range from 0.48 to 0.82). The GFI calculates the proportion of variance that is accounted for by the estimated population covariance [48]. An omnibus cut-off point of 0.90 has been recommended for the GFI [49]. The obtained GFI values range from 0.96 to 1.00, which is an acceptable range. Table 5 also shows that the relevant squared multiple correlations (R^2) are adequately large, ranging from 0.23 to 0.70. This confirms that a significant degree of calculated variable's variance is provided by its latent construct. Hence, all of the four constructs have good fit and thus are *unidimensional.*

4.4. Convergent validity

Convergent validity can be evaluated by the use of the Bentler–Bonett's Normed Fit Index (NFI). This index provides the degree to

which the different approaches to measure a construct generates the same results [50]. According to a generally accepted principle, the NFI values of 0.90 or above are considered as a satisfactory fit index [47]. An examination of Table 6 shows that the values of NFI are greater than 0.90, and, therefore, signify a strong convergent validity of constructs. This provides evidence that all four items are related to the same construct.

4.5. Discriminant validity

Discriminant validity is the degree to which different latent constructs and their indicators can be distinguished from the other constructs and their indicators [51]. For calculating the discriminant validity, we can have a comparison of Cronbach's alpha of a latent construct to its mean correlations with other model latent variables. If the alpha value of a latent construct is adequately higher than the mean of its correlations with other variables, then there is a signal of discriminant validity [52]. Table 6 shows that the difference between Cronbach's alpha value of every latent scale and the mean correlation of each latent scale with the other scales is sufficiently high and this provides the evidence that the scale does not correlate with other conceptually distinct constructs.

4.6. Latent variable model analysis

As mentioned earlier environment management, social responsibility, health and safety management, and customer management are specified as a priori parameters to measure sustainable practices in service supply chains. AMOS 16 software has been used to develop a *First-Order CFA Model* and to examine the relationship among these four factors. The proposed latent variable model is shown in Fig. 4. The path coefficients connecting the items to the factors in Fig. 4 represent the *factor loadings* and may also be interpreted as standardized regression coefficients.

The correlations among the four latent factors are also depicted in Fig. 4. The residual variance terms for each item are also shown. An analysis of Fig. 4 shows that all four factors are correlated. Five model fit indices (χ^2/df, GFI, AGFI, NFI, and CFI) are employed to test the fitness of the proposed model (further details can be found in Sila and Ebrahimpour [53], Jung and Wang [54], and Fotopoulos et al. [55]). A summary of goodness-of-fit indices for this model is displayed in Table 7. The table shows that all the goodness-of-fit statistics are in the acceptable range.

5. Discussion of findings and results

This study intended to develop and validate a framework and an instrument for exploring and assessing sustainability in service supply chains. Through extensive literature review, four latent variables (Environment management, Social responsibility, Health, safety and risk management, and Customer management) were identified as the primary indicators of sustainability in service organizations. Similar to existing research, the initial focus of the study was on the two main dimensions of the triple-bottom-line model (environmnetal and social). However, the economic aspect in a typical manufacturing setup is replaced by two dimensions in the service context: customer management, and health, safety, and risk management. Such dimensions are found to be more appealing to service organizations.

Eighteen associated indicators for these four latent variables were developed after consultation with the supply chain managers of the selected service companies. After distributing the survey, 169 responses were received from the middle and top managements of banks, airlines and hospitals in Abu Dhabi. The reliability of the instrument has been measured through *Cronbach's* α, and *unidemsionality* has been measured through the CFA technique. The CFA outcomes revealed that all four proposed latent variables adequately measure the constructs. CFI, GFI and squared multiple correlation tests confirmed that the four constructs have good fit and are *unidimensional. Convergent Validity* was evaluated to check the degree to which the different approaches to measure the construct generated the same results and *Discriminant Validity* was evaluated to confirm that scale did not correlate to other conceptually distinct constructs. The construct of SSCM practices implementation appears to adequately fit with the collected empirical data.

The first order CFA model provided insights into the construct of SSCM practices implementation and its relationships with the underlying factors. In the proposed model, it has been found that all the latent variables of the model are positively and strongly correlated to each other. The highest correlation (0.78) has been observed between social responsibility and health, safety and risk. This is quite intuitive as there has been a growing concern that links social responsibility of major corporates to their practices in health and safety (i.e., occupational health and safety). This demonstrates how an organization performs on moral and ethical grounds as it brings business values along and aids to sustainability.

The second important correlation is observed (0.64) between environment management and customer management. This is also another emerging trend in the service sector in which consumers are becoming more and more aware of the benefits of environment-friendly services (e.g., eco-hotels, green services, etc.). This makes the attentiveness of corporates to green practices a key indicator of their strong commitment to better customer relationship.

The next highest correlation is observed between social responsibility and customer management (0.62). This suggests that customers' perception about the performance of an organization is an indicator of its responsibility towards its customer base in particular, and the environment in general. Besides, effective relationship with customers is widely becoming a priority initiative of contemporary executives who view these valuable relationships to be vital for their competitive advantage. As shown in Fig. 4, the other three correlations are also positive and important.

In conclusion, the construct of SSCM practices implementation appears to adequately fit the data collected. In model testing, the proposed first-order model has provided an acceptable fit with positive correlation amongst latent variables. The CFA analysis model provides insights into the construct of SSCM practices implementation and its relationships with the underlying factors. The items and the factors of the construct provide direct and actionable information on SSCM practices implementation in service organizations. Also, the conceptualization of the construct at higher levels, e.g., beyond first-order level, is expected to provide managers with an opportunity to observe SSCM practices implementation at a higher level of abstraction beyond the individual items and factors.

6. Conclusions, limitations, and directions for future research

SSCM has emerged as an important new standard for enterprises to achieve the objectives of enhanced profits and market share. Through sustainability, companies ensure compliance with laws and regulations and support international standards for sustainable operations. To this end, companies are increasingly taking actions that result in better social, economic and environmental impacts. Societies also expect such initiatives from leading firms as public awareness of sustainability and its economic benefits is growing. Thus, by managing and seeking to improve sustainability measures throughout the supply chains, companies not only act in their own interests but also protect the interests of stakeholders and society.

Previous research on sustainability has focused on manufacturing supply chains and limited studies have addressed the supply chain sustainability in services. This paper has first presented a literature review on the sustainability of supply chains with a focus on service organizations. The paper has then assessed the extent of implementing sustainability practices in the supply chain of service companies in Abu Dhabi. Based on such analysis, the paper has developed and validated a construct for the implementation of SSCM practices in service organizations. This was attained through successive stages of data collection, measurement analysis, and refinement. The outcome is a set of reliable, valid and *unidimensional* first-order measurements that can be subsequently used in conceptualization and measuring sustainability in service industries. The measurement items used in the scale for evaluating SSCM were classified into four dimensions: environment management, social responsibility, health and safety and risk management, and customer management. The validity and reliability of the measurement scale for evaluating the different aspects of sustainability were tested using CFA. Findings provide evidence to support the claim that the used instrument is valid as a practical framework for implementing green and agile supply chains. This contributes to the ongoing research on SSCM and gives supply chain managers and designers a practical approach to measure and implement sustainability across service supply chains.

Although the results in this study are only from a limited sample, significant relationships from this data indicate that the findings are essentially robust. Besides, the data was obtained from a number of different service providers which can support the generalization of the results for the overall service industry. This paper has also provided a number of implications for practitioners and the researchers especially in Middle East and North Africa (MENA) region. These implications include, but are not limited to, the following:

a. It enables service supply chain managers to conceptualize and design their network, ranging from suppliers to customers, with sustainability perspective as opposed to the traditional relationship between the tiers in a service supply chain.
b. It entices researchers and academics to explore constructs of significance in coordinating service supply chains.
c. It can act as a base model for the development of a comprehensive benchmark to assess the performance of the fast growing service industry. Such benchmark would also be beneficial for regulatory authorities.
d. As management principles and theories associated with sustainable supply chains continue to advance, the proposed framework fulfills the needs for additional investigations and critical analysis for a better understanding of this field.
e. Service supply chains in the Arab world and the Middle East, where the service sector represents the major contributor to local economies, are getting pressures from the regulators to submit their yearly sustainability reports and outline their green practices and social responsibility. Towards that end, supply chain managers and practitioners in these services companies can evidently benefit from this research.

However, this study has several limitations and can only be considered as a pilot study to explore the extent of SSCM practices in service industries in Abu Dhabi. Study findings and results are based on the collected data from the 169 service companies which is a relatively small group of respondents compared to the size of the service sector in Abu Dhabi and the Gulf region. Similarly, different company sizes might result in different strategies of SSCM. Also, the research did not consider the relationship among some or all of the factors that might impact SSCM. Rather, the study focused solely on discovering the influence each factor has on SSCM. In addition, these factors were investigated only in Abu Dhabi companies, so the results may possibly vary in different countries even though they are geographically close. Still, the findings of this study are relevant to both researchers and managers in the field of sustainable supply chain management.

More focus of the future research needs to be placed on the supply chain of service industries, and not just manufacturing. Future research directions include collecting more data and conducting more analysis to establish a valid comparison between countries on how SSCM practices may impact the overall economy of a country. An analysis of SSCM practices applied to different Asian countries may provide a broader spectrum. Future research should also focus on developing second and third order factor analysis models of SSCM by incorporating the measurement scales for SSCM practices. Finally, further research needs to address outcomes analysis (i.e., correlation between identified sustainability factors and their operational and economic performance measures).

Acknowledgment

The researchers would like to thank the students who helped in distributing the survey, the managers who took the time to fill in the survey, and the service companies in Abu Dhabi who gave us the chance to assess the sustainability practices of their supply chains.

Appendix

A. General Information					
1 Name of organization					
2 The organization is	(i) Project based organization	(*ii*)Traditional organization			
3 Contact name and title					
4 You are serving in this firm as a part of	(*i*) Middle Management	(*ii*) Top Management			
5 Total number of employees at the organization	(*i*) Less than 500	(*ii*) Between 500 and 1000	(*iii*) More than 1000		
6 Total annual revenue in million AED	(*i*) Less than 10	(*ii*) Between 10 and 50	(*iii*) More than 50		
7 The ownership of the organization is a	(*i*) Local body	(*ii*) Foreign body	(*iii*) A mix of both		
*Please select "**one**" response to each of the following questions:*					
B. Environmental Management	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
8 The organization management system is in compliance with applicable environmental laws and regulations.					
9 The organization has up-to-date ISO 14001 or any other certification.					
10 The environmental policies, practices, and expectations are communicated to all employees and suppliers in local or appropriate languages.					
11 The employees are trained on relevant environmental targets.					
C. Social Responsibility	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
12 The organization has a written corporate responsibility policy or statement of commitment that defines its approach to social responsibility standards.					
13 The organization has a management system in place, or is it developing one, to maintain relations with community stakeholders					
14 The organization performance management system is in compliance with applicable social laws and regulation.					
D. Health, Safety and Risk Management	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
15 The organization has got written procedures for the safe storage, use, and disposal of each hazardous material in language(s) workers understand.					
16 The organization has a written emergency response plan and fire evacuation procedure.					
17 The organization frequently conducts an emergency drill.					
18 The organization has got well-stocked, unlocked first aid stations at every different site.					
E. Customer Management	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
19 The organization has a customer service vision in place.					
20 The organization has defined key customer segment(s) based on criteria such as demographics, life-stage, preferences, age, gender, etc.					
21 The organization collects customer data at various touch points.					
22 The organization engages its customers in activities such as survey, focus groups, interviews etc.					
23 The organization has defined communication standards and protocols.					
24 The organization uses multiple channels (internet, kiosk, mobile devices or other innovative channels) to deliver its services.					
25 The customers/staff can access the same up-to-date customer information through different channels.					

References

[1] Bowersox DJ, Closs DJ, Cooper MB. Supply chain logistics management. New York: McGraw-Hill; 2002.
[2] Fredendall LD, Hill E. Basics of supply chain management. CRC Press; 2000.
[3] Hacking T, Guthrie P. A framework for clarifying the meaning of Triple Bottom-Line, Integrated, and Sustainability Assessment. Environ Imp Assess Rev 2008;28:73–89.
[4] Herva M, Roca E. Review of combined approaches and multi-criteria analysis for corporate environmental evaluation. J Clean Prod 2013;39:355–71.
[5] Ilskog E. Indicators for assessment of rural electrification—an approach for the comparison of apples and pears. Energy Policy 2008;36:2665–73.
[6] Linton JD, Klassen R, Jayaraman V. Sustainable supply chains: an introduction. J Oper Manag 2007;25:1075–82.
[7] Seuring S, Müller M. From a literature review to a conceptual framework for sustainable supply chain management. J Clean Prod 2008;16:1699–710.
[8] Roca LC, Searcy C. An analysis of indicators disclosed in corporate sustainability reports. J Clean Prod 2012;20:103–18.
[9] Mori K, Christodoulou A. Review of sustainability indices and indicators: towards a new City Sustainability Index (CSI). Environ Impact Assess Rev 2012;32:94–106.
[10] Ahi P, Searcy C. A comparative literature analysis of definitions for green and sustainable supply chain management. J Clean Prod 2013;52:329–41.
[11] Srivastava SK. Green supply-chain management: a state-of-the-art literature review. Int J Manag Rev 2007;9:53–80.
[12] Mollenkopf D, Stolze H, Tate WL, Ueltschy M. Green, lean, and global supply chains. Int J Phys Dist Logist Manag 2010;40:14–41.
[13] Gold S, Seuring S, Beske P. Sustainable supply chain management and inter-organizational resources: a literature review. Corp Soc Resp Environ Manag 2010;17:230–45.
[14] Carter CR, Easton PL. Sustainable supply chain management: evolution and future directions. Int J Phys Dist Logist Manag 2011;41:46–62.
[15] Sarkis J, Zhu Q, Lai K. An organizational theoretic review of green supply chain management literature. Int J Prod Econ 2011;130:1–15.
[16] Sundarakani B, De Souza R, Goh M, Wagner SM, Manikandan S. Modeling carbon footprints across the supply chain. Int J Prod Econ 2010;128:43–50.
[17] Čuček L, Klemeš JJ, Kravanja Z. A review of footprint analysis tools for monitoring impacts on sustainability. J Clean Prod 2012;34:9–20.
[18] Gaussin M, Hu G, Abolghasem S, Basu S, Shankar MR, Bidanda B. Assessing the environmental footprint of manufactured products: a survey of current literature. Int J Prod Econ 2013;146:515–23.
[19] Neves AR, Leal V. Energy sustainability indicators for local energy planning: review of current practices and derivation of a new framework. Renew Sustain Energy Rev 2010;14:2723–35.
[20] Mayyas A, Qattawi A, Omar M, Shan D. Design for sustainability in automotive industry: a comprehensive review. Renew Sustain Energy Rev 2012;16:1845–62.
[21] Jawahir I, Rouch K, Dillon O, Holloway L, Hall A. Design for sustainability (DFS): new challenges in developing and implementing a curriculum for next generation design and manufacturing engineers. Int J Eng Educ 2007;23:1053.
[22] Zailani S, Jeyaraman K, Vengadasan G, Premkumar R. Sustainable supply chain management (SSCM) in Malaysia: a survey. Int J Prod Econ 2012;140:330–40.
[23] Zailani SHM, Eltayeb TK, Hsu C, Tan KC. The impact of external institutional drivers and internal strategy on environmental performance. Int J Oper Prod Manag 2012;32:721–45.
[24] Zhu Q, Geng Y, Lai K. Circular economy practices among Chinese manufacturers varying in environmental-oriented supply chain cooperation and the performance implications. J Environ Manag. 2010;91:1324–31.
[25] Sarkis J. A strategic decision framework for green supply chain management. J Clean Prod 2003;11:397–409.
[26] Seuring S. A review of modeling approaches for sustainable supply chain management. Decis Support Syst 2013;54:1513–20.
[27] Brandenburg M, Govindan K, Sarkis J, Seuring S. Quantitative models for sustainable supply chain management: developments and directions. Eur J Oper Res 2014;233:299–312.
[28] Pedrazzoli P, Alge M, Bettoni A, Canetta L. Modeling and simulation tool for sustainable MC supply chain design and assessment. In: Advances in production management systems. Competitive manufacturing for innovative products and services. Springer; 2013. p. 342–9.
[29] Hasan M. Sustainable supply chain management practices and operational performance. Am J Ind Bus Manag 2013;3:42–8.
[30] Kuo TC, Chen GY, Dang HT, Chiu M, Hsu C. The adoption of sustainable supply chain management practices in Taiwan and Vietnam. J Eng Technol Manag. 2013.
[31] Brindley C, Oxborrow L. Aligning the sustainable supply chain to green marketing needs: a case study. Ind Mark Manag 2013.
[32] Chen CR, Gregoire MB, Arendt S, Shelley MC. College and university dining services administrators' intention to adopt sustainable practices: results from US institutions. Int J Sustain High Educ 2011;12:145–62.
[33] Jänicke M. Ecological modernisation: new perspectives. J Clean Prod 2008;16:557–65.
[34] Sundarakani B, de Souza R, Goh M, Van Over D, Manikandan S , Koh SL. A sustainable green supply chain for globally integrated networks. In: Enterprise networks and logistics for agile manufacturing. Springer; 2010. p 191–206.
[35] Govindan K, Azevedo SG, Carvalho H, Cruz-Machado V. Impact of supply chain management practices on sustainability. J Clean Prod 2014;85:212–25.
[36] Grimm JH, Hofstetter JS, Sarkis J. Critical factors for sub-supplier management: a sustainable food supply chains perspective. Int J Prod Econ 2013.
[37] Li S, Ragu-Nathan B, Ragu-Nathan T, Subba Rao S. The impact of supply chain management practices on competitive advantage and organizational performance. Omega 2006;34:107–24.
[38] Carter CR, Jennings MM. Logistics social responsibility: an integrative framework. J Bus Logist 2002;23:145–80.
[39] Kleindorfer PR, Saad GH. Managing disruption risks in supply chains. Prod Oper Manag 2005;14:53–68.
[40] Tang CS. Perspectives in supply chain risk management. Int J Prod Econ 2006;103:451–88.
[41] Manuj I, Mentzer JT. Global supply chain risk management strategies. Int J Phys Dist Log Manag 2008;38:192–223.
[42] Chan HK, He H, Wang WY. Green marketing and its impact on supply chain management in industrial markets. Ind Market Manag 2012;41:557–62.
[43] Hair J, Black W, Babin B, Anderson R, Tatham R. Multivariate data analysis. Pearson Education; 2006.
[44] Cronbach LJ. Coefficient alpha and the internal structure of tests. Psychometrika 1951;16:297–334.
[45] O'Leary-Kelly SW, Vokurka J. R. The empirical assessment of construct validity. J Oper Manag 1998;16:387–405.
[46] Venkatraman N. The concept of fit in strategy research: toward verbal and statistical correspondence. Acad Manag Rev 1989;14:423–44.
[47] Bentler PM. On the fit of models to covariances and methodology to the Bulletin. Psychol Bull 1992;112:400.
[48] Tabachnick BG, Fidell L. Using multivariate statistics: international edition. Pearson; 2012.
[49] Shevlin M, Miles JN. Effects of sample size, model specification and factor loadings on the GFI in confirmatory factor analysis. Personal Individ Differ 1998;25:85–90.
[50] Ahire SL. An empirical investigation of quality management in small firms. Prod Invest Manag J 1996;37:44–50.
[51] Bagozzi RP, Yi Y, Phillips LW. Assessing construct validity in organizational research. Admin Sci Q 1991;36:421–58.
[52] Ghiselli EE, Campbell JP, Zedeck S. Measurement theory for the behavioral sciences. San Francisco: WH Freeman; 1981.
[53] Sila I, Ebrahimpour M. Critical linkages among TQM factors and business results. Int J Oper Prod Manag 2005;25:1123–55.
[54] Jung JY, Wang YJ. Relationship between total quality management (TQM) and continuous improvement of international project management (CIIPM). Technovation 2006;26:716–22.
[55] Fotopoulos CV, Psomas EL. The structural relationships between TQM factors and organizational performance. TQM J 2010;22:539–52.