Sustainable Development
Sust. Dev. **25**, 559–579 (2017)
Published online 17 February 2017 in Wiley Online Library
(wileyonlinelibrary.com) **DOI:** 10.1002/sd.1678

Investigating the Influential Factors of Sustainable Supply Chain Management, Using Two Asian Countries as Examples

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ABSTRACT

Sustainable supply chain management (SSCM) is increasingly followed by academia and industry. Although some companies have shown their success in implementing SSCM practices, many are still hesitant – that is, certain challenges to SSCM operation still exist. The focus of this study was to identify the influential factors of SSCM practices from both the conceptual and practical perspectives. A verified SSCM questionnaire was conducted to investigate the differences of the influential factors between Taiwan and Vietnam, and to explore the regional phenomenon of SSCM implementation. The result could be used to support the argument of related literature that pressure, strategy, uncertainty, internal management and external management could be the influential factors of the success/failure of the SSCM adoption. Local practices of sustainability in Taiwan and Vietnam were addressed and discussed in this study. Future study might survey other Asian countries to examine the international difference. Copyright © 2017 John Wiley & Sons, Ltd and ERP Environment

Received 5 February 2015; revised 6 November 2016; accepted 14 November 2016

Keywords: sustainable supply chain management; questionnaire; Taiwan; Vietnam

Introduction

DRIVEN BY REGULATION, MARKETING AND PUBLIC FACTORS, SUSTAINABILITY HAS BECOME AN INCREASING CONCERN for companies of all sizes and across a wide range of industries (Seuring *et al.*, 2008). Since the 1990s, governments and corporations have spent decades debating the necessity and impacts of adopting sustainability in industries (Bontoux and Bengtsson, 2015; Fiksel, 2003; Renner, 2008; Renner

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and Worldwatch Institute, 1991). For example, the Kyoto Protocol was signed in 1997 and became effective in 2005. The protocol's first commitment period started in 2008 and ended in 2012, but failed to reduce greenhouse gases emissions as expected (Clark, 2012; Gelis, 2015; Haya, 2012). Although the second commitment was then extended from 2012 to 2020, the Kyoto Protocol still faces resistance from the developed countries. However, there is hope for the situation to be reversed. The struggle of getting a consensus among countries seems to improve gradually. Getting 177 nations to sign the Paris Agreement at the Earth Day 2016 to keep on controlling the global warming and carbon outputs starting 2020 is a tremendous success for sustainability. It illustrates that most countries around the world have steadily embraced green ideas after 20 years of raising public awareness.

Currently, with the rising concern for the environment, many enterprises' business strategies have moved from the local or internal optimization of sustainability to the integrated operations of upstream and downstream suppliers (Kleindorfer and Saad, 2005). This kind of strategy or evolving concept leads to flourishing progress of the sustainable supply chain. As a result, sustainability and supply chain management (SCM) are unceasingly merging and becoming increasingly important to various industries.

However, the adoption of sustainability from the concept to the practical implementation of supply chain is still immature in many fields. One of the root causes is that the subject involves the convergence of multiple disciplines, where challenges and issues arise (Linton *et al.*, 2007). Many companies, at the beginning, were driven to adopt sustainability in their supply chain because of regulations, public pressure, potential marketing advantages, cost reduction or long-term profitability. Though the top managers understand more about sustainability, they may be more hesitant to implement it because of unfamiliar challenges and unknown risks.

What are these challenges or risks from industrial perspectives? For instance, defining the goal of a sustainability supply chain is not an easy job. Short-term goals such as creating sufficient and instant benefits might sharply conflict with long-term ones, e.g. long-lasting efforts to improve the lives of the next generations (WCED, 1987). Another example is that the up-to-date implementation of sustainable supply chain requires lots of operating resources, time-consuming negotiation and external cooperation with the upstream and downstream. Third, thorough investigation on the potential impacts of sustainability in aspects such as finance and profit are inevitable for every company. Fourth, the complicated relations between sustainability and SCM go beyond just economic considerations and the way in which people understand and implement practices with only limited knowledge, experience and tools (Filho, 2004; Zhu *et al.*, 2008a, 2008b). Therefore, in order to solve the concerns or challenges of sustainable supply chain management (SSCM), researchers have argued that extrapolating SSCM influential factors from industries is an essential step for SSCM adoption (Gold *et al.*, 2010; Liu *et al.*, 2012b; Sajjad *et al.*, 2015).

SSCM could be defined as 'the strategic business integration of supply chain to minimize the risks from the economic, social and environmental perspectives in the system coordination, and to maximize the corporate values including the shareholders' value' (Rodríguez *et al.*, 2016; Seuring and Müller, 2008a; Tseng *et al.*, 2008; Vermeulen and Seuring, 2009; Wang *et al.*, 2014). Therefore, sustainability is referred to as the triple bottom line (TBL) (Elkington, 1997), where the economic, social and environmental dimensions of business are simultaneously taken into account (Formentini and Taticchi, 2016). An integrated consideration of the above three facets forms the foundation of this study to evaluate the stimuli of SSCM.

In this study, we defined the influential factors of SSCM as (i) the essential factors that would have significant impacts to the success/failure of SSCM implementation and (ii) the critical motivators for companies that have not decided to embrace it. Accordingly, one of the purposes in this study was to integrate the influential models of SSCM from conceptual perspectives to support the validation of its influential factors for implementation.

In investigating the influential factors of SSCM, two developing countries in Asia were compared in terms of sustainable supply chain: Vietnam, a rapidly growing country with an emerging agrarian economy, and Taiwan, a stable developing country with an industry-based economy. Vietnam has maintained its steady progress in terms of the nation's growth and wealth for the last two decades. The environmental and socio-economic effects of industrialization have transformed Vietnam promptly. According to the General Statistics Office of Vietnam (GSOV, 2016), with the increasing amount of investments, Vietnam's economy, where GDP contributions from manufacturing and service industries were 33% and 39% respectively in the past, is swiftly moving from agriculture-based towards manufacturing and service industries. On the other hand, the manufacturing and service industries of Taiwan contribute 30% and 68.5% of GDP (DGBAS, 2016). The major reason for comparing the two countries was because of the blossoming connections in the economy, the culture and the society between Taiwan and Vietnam in recent

DOI: 10.1002/sd

years. The geographical distance between them is close and convenient for transportation. According to the statistics report from Taipei Economic and Cultural Office (TECO) in Ho Chi Minh City of Vietnam, Taiwan was ranked in fifth place of Vietnam's investors and trading partners in 2014 (TECO, 2015).

In brief, this research aims to investigate SSCM from both the theoretical and practical perspectives to develop appropriate influential factors of SSCM, and to identify the gaps in current practices between two Asian countries. An expert survey and a quantitative analysis between Taiwan and Vietnam based on the SSCM model were conducted. The questions to be answered in this research were as listed below.

1 What is the conceptual model of SSCM as it relates to current practice?
2 What are the influential factors for adopting SSCM in practice?
3 Does any difference of the influential factors of SSCM exist between Taiwan and Vietnam?

The SCM and SSCM Practice in Taiwan and Vietnam

SCM in Vietnam and Taiwan

The growing Vietnam economy, relying on its exports, has generally faced internal challenges reflected by competition in its industries. Hoa (2016) urged that Vietnam needed to improve its logistics and supply chain management to continuously contribute to the development of its economy. The majority of logistics service providers were at the level of second and third party logistics (2PL and 3PL). Integrated logistics (4PL) or supply chain management were limited by the competence and service network (Hoa, 2016). Currently, Vietnam still has many gaps to fill in terms of the infrastructure, the supply chain maturity and the development of its national business policy. For example, cluster development and industrial policy are still scarce in the private business sector. The transportation infrastructure becomes a constraint, which keeps businesses landlocked because of rising transport costs and the limited capacity of the seaport management and coastal trade. Therefore, among Vietnam's long-term strategies for industries, SCM is viewed as one of their primary concerns.

Taiwan, one of the industrialized countries in Asia, invests lots of resources in applying advanced technology. It plays an important role predominantly in the global supply chain of the computer and semiconductor industries, a double-edged sword, which makes Taiwan 'vulnerable to the impact of the global business cycle due to the nature of electronics and IT sectors' (Liu and Shih, 2013). Also, due to offshoring of its manufacturing business to reduce the labor cost and tariffs, the economy of Taiwan has faced slow growth rate and flat incomes. Dominated by the intermediate and capital goods producers, Taiwanese enterprises focus mostly on 'raising the efficiency of production processes, rather than on developing key technology or researching the end-user market' (Liu and Shih, 2013); without 'value-added' or key technologies to stay competitive, Taiwan's position as a key supplier of major brands within the global supply chain is gradually eroding (Chen, 2016; Liu and Shih, 2013). Now, Taiwan is also facing the 'red supply chain' challenge from China and other emerging economies with the advantages of cheaper labor and better regional economic integration such as free trade agreements.

Based on the ranking of the Logistics Performance Index (LPI) in Table 1, Taiwan was in 19th place and Vietnam was 48th (LPI, 2014). The LPI ranking includes the evaluation of infrastructure, international shipments, logistics competence and so on. From the supply chain perspective, Vietnam has more natural resources and more available labor than Taiwan, and Vietnam's top competitiveness is its low manufacturing cost. With the increasing

Country	LPI rank	LPI score	Customs	Infrastructure	International shipments	Logistics competence	Tracking and tracing	Timeliness
Taiwan	19	3.72	3.55	3.64	3.71	3.6	3.79	4.02
Vietnam	48	3.15	2.81	3.11	3.22	3.09	3.19	3.49

Table 1. Ranking of the LPI

DOI: 10.1002/sd

international cooperation between Taiwan and Vietnam, their supply chain networks are growing as well. Trading goods such as agricultural products and daily necessities annually have helped build their solid international relationship.

An Overview of SSCM in Vietnam and Taiwan

A survey conducted by the Aberdeen Group (2009) found that the major initiatives of implementing sustainability for companies were the desires to promote environmental and social stewardship, to improve corporate reputation and to boost competitive advantage. Although there is no specific regulation to push industries to adopt CSR or sustainable management in the country, SSCM has recently been highlighted and considered for implementation in many large scale companies in Vietnam because of the demand of their global customers.

Vietnam has been considered as one of the most rapidly developing countries in the world, with a track record of SSCM implementation for over 10 years. The International Finance Corporation (IFC) and State Securities Commission of Vietnam have published the *Sustainability Reporting Handbook for Vietnamese Companies* as a guideline to assist the listed companies (IFC, 2013). Since 2005, the CSR Award of Vietnam has raised the industrial awareness of sustainable development and has promoted local companies such as Vietnam Rubber Group (VRG), Corporation for Financing and Promoting Technology (FPT) and Tin Nghia for their sustainable contributions.

For instance, VRG has collaborated with its suppliers and subsidiaries to renovate the waste water treatment systems of their latex processing plants. The group has urged installation of air filter systems at driers to minimize air pollution to meet local requirements as well. Their treatment facilities are located at a safe distance from residential areas to eliminate environmental impacts on the local community. VRG has progressively received ISO14000 certification for its factories, and is building its ISO14067 standard for the carbon trace of products. Phuoc Hoa Rubber Joint Stock Company and VRG Khai Hoan Joint Stock Company, the members of the VRG, are working on their green label process to enhance their competitiveness in the market (VRG, 2013).

Being one of the IT leaders in Vietnam, FPT has been practicing CSR since it integrated the concepts into its development strategy in 2010. The company had cooperated with its supplier to build its IT service center, which has won an award for Excellence in Design for Greater Efficiencies by the World Bank for making 20% savings in energy, water consumption and the use of materials. For the social perspective, since 1999, the FPT young talent center (FYT) was founded to provide training programs to improve knowledge and soft skills of Vietnam's talented young people in which they could fully develop, become successful and contribute to national prosperity (FPT, 2016). The company has also adopted the sustainability concepts in their ERP and SCM systems to meet the sustainable requirements of the customers and the suppliers.

The international requirements of sustainability brought significant impacts to the global competitiveness of Taiwan. Take Taiwan Semiconductor Manufacturing Company (TSMC), the bellwether in the semiconductor industry, as an example. TSMC has generally managed its own sustainable supply chain based on its risk management strategies (TSMC, 2012). Their concerns of risk management included suppliers' risk management, geographical risk, risk management of natural disasters, interruption of information systems and so on. In 2011, TSMC had surveyed its 56 critical suppliers in various areas as well as transport companies and logistics services, which included more than 90% of its total supplier expenses, to manage the risks.

TSMC was one of the earliest companies to begin implementing green building to promote all new properties following the standards of the Taiwan Ecology, Energy Saving, Waste Reduction, and Health (EEWH) rating system since 2006. It also introduced the green campus development policy in 2010 to improve the efficiency of their green buildings, and to succeed along with preserving the natural environment. Through the efforts of sustainability, TSMC has been named as the group leader of the semiconductor and the semiconductor equipment industries by the Dow Jones Sustainability Indices (DJSI) for a third consecutive year (TSMC, 2016).

Another Taiwan example of SSCM is Acer. In 2010, Acer's carbon disclosure project (CDP), through its supply chain program, was one of the most successful SSCM practices at Taiwan. Acer also participates in the Electronic Industry Citizenship Coalition (EICC) carbon reporting system. In the same year, several suppliers were invited to engage in carbon information response work on a smaller scale. This system is similar in content to the CDP questionnaire, and the database is mutually accessible to all parties, which enables Acer to stay abreast of supplier greenhouse gas (GHG) management. In order to communicate with their suppliers and to enhance their capability

DOI: 10.1002/sd

to respond to sustainability issues, the company has kept holding the annual supplier CSR communication meetings. With all these dedicated efforts, Acer has strengthened its competence among the supply chain in terms of environment and social responsibility (Acer, 2016).

Based on the SSCM cases of Vietnam and Taiwan, we found that the two countries are influenced simultaneously by the trend of sustainability. Table 2 presents the Sustainable Society Index of Taiwan and Vietnam (SSI, 2016). Currently, with respect to the sustainability, the supply chain risk is one of the leading causes of business volatility. Ritter and Schooler (2004) had studied the supply chain resilience index for each country. Table 3 shows three major indices of Taiwan and Vietnam in 2015. Vietnam had better performance in the areas of exposure to natural hazards and quality of natural hazard risk management.

Literature Review

The term 'sustainable' has become a catchword in the 21st century. If 'sustainable' or 'sustainability' is used as a keyword to search the literature, more than 40 000 articles could be found in related topics (Larson *et al*., 2011). The meaning of 'sustainable' management, defined or paraphrased from several sources (Valiela *et al*., 2000), reflects the need for humans to live on the income from nature's capital rather than on the capital itself. To achieve the standards of sustainability, companies are obliged to ensure that environmental burden is not created or social standard violated (Seuring and Müller, 2008b). Sustainability thus maintains a delicate balance between sustainable development and the use of natural resources, including fuel, food, land and water (Dincer and Rosen, 2007). Pope *et al*. (2004) argued the idea that sustainability depends on 'three pillars', environment, society and economy, which is also known as the triple bottom line (TBL).

	Human wellbeing					Environmental wellbeing					Economic wellbeing				
	2006	2008	2010	2012	2014	2006	2008	2010	2012	2014	2006	2008	2010	2012	2014
Taiwan	17	20	20	21	24	145	144	139	140	141	33	37	50	42	26
Vietnam	70	62	67	64	65	64	62	67	67	66	59	66	69	72	62
United States	40	40	39	43	40	136	137	135	131	139	39	44	72	120	96

Table 2. SSI of Taiwan and Vietnam (SSI, 2016)
*The ranking includes 151 countries, and a lower number means better ranking.

Index	Sub-index	Vietnam	Taiwan
Economic	GDP per capita	92	41
	Political risk	55	32
	Oil intensity	107	100
Risk quality	Exposure to natural hazard	48	111
	Quality of natural hazard risk management	96	109
	Quality of fire risk management	61	17
Supply chain	Control of corruption	91	38
	Infrastructure	105	25
	Local supplier quality	89	11

Table 3. Supply Chain Resilience Index of Taiwan and Vietnam (2015)
*Scores are fixed on a scale of 0 to 100 with 0 representing the lowest resilience and 100 being the highest resilience.

DOI: 10.1002/sd

SSCM originates from both the sustainability and SCM literatures, and involves a broadened approach to SCM. An organized summary of the works on SSCM is presented in Table 4. Gupta and Palsule-Desai (2011) defined SSCM as a set of managerial practices comprising the following factors: environmental impact, value chain stages and a multi-faceted perspective covering the entire product life cycle. Carter and Rogers (2008) considered SSCM as the strategic, transparent integration and achievement of an organization's social, environmental and economic goals into the systemic coordination of key inter-organizational business processes for improving the long-term economic performance of the individual company and its supply chains.

At a broader level, sustainability integrates social, environmental and economic issues. Li *et al.* (2014) pointed out that the core of SSCM is the comprehensive consideration of economic, environmental and social performance. Deeper cooperation among supply chain partners leads to achievement of long-term strategic goals and non-imitative attributes. Carter and Mol (2006) stated that Asian countries have heavily emphasized sustainability despite the interpretation difference on corporate social responsibility as well as sustainability between the Eastern and Western worlds.

The industrialization of many Asian nations along with the rapidly rising levels of water, air and land pollution have raised concerns about the unsustainability of current growth patterns. Beske, Land, and Seuring (2013) claimed that the aspects of SCM for sustainability should include strategic orientation, continuity, collaboration, risk management and proactivity. Ahi and Searcy (2013) argued that the key characteristics of SSCM come from two perspectives of business: sustainability (economic, environmental, social, stakeholder, volunteer, resilience and long term) and SCM (flow, coordination, stakeholder, relationship, value, efficiency and performance). Teuteberg and Wittstruck (2010) proposed the 'House of Sustainable Supply Chain' that integrates sustainable supply chain strategy, IT alignment, organization culture, risks, compliance management, standards and regulations to improve the performance of the environment, economy and society. Giunipero *et al.* (2012) summarized the major themes in the sustainability literature and categorized their time frame as follows. Since compliance with government regulation in the 1960s, people started to integrate sustainability into business in the 1970s. During the 1980s, corporations embraced sustainability and focused on environmental and resource consequences of products and processes, and later incorporated sustainability to provide competitive advantages in the 1990s. Right after the millennium, people took more proactive approaches toward sustainability and realized the value of sustainability as a strategic goal in the supply chain.

Categories	Associated activity	Authors
Sustainable supply chain integration	✓ Multi-dimensional integration of SSCM ✓ Implementation of barrier analysis in SSCM ✓ Forward and reverse supply chain integration ✓ Improvement of key performance indicators (resource usage and environmental impacts) ✓ Resource management	Henry and Kato (2011) Liu *et al.* (2012a) de la Fuente *et al.* (2010) Kuo *et al.* (2012) Seuring and Müller (2008b)
Information sharing	✓ Risk reduction ✓ Competitive advantage creation and maintenance	Kuo (2013) Kuo and Chu (2013)
Customer service and customer relationship	✓ Analysis of green marketing effects on the supply chain ✓ Competitiveness analysis ✓ Social responsibility cooperation	Chan *et al.* (2012) Kim *et al.* (2011)
Sustainable supplier relationship	✓ Disaster chain management ✓ Environmental risk management ✓ Carbon chain reduction ✓ Collaborative design	Büyüközkan and Çifçi (2011) Foerstl *et al.* (2010) Kuo and Chu (2013)
Innovation	✓ New business model development ✓ Environmentally superior products development	Zhu *et al.* (2012) Lin *et al.* (2010) Kuo and Wang (2012)

Table 4. Relevant studies on SSCM

DOI: 10.1002/sd

The Conceptual Model and Influential Factors of SSCM

In this study, there were three major research questions. The first and second ones were 'What is the conceptual model of SSCM as it relates to current practice?' and 'What are the influential factors for adopting SSCM in practice?', In the following sections, we define the conceptual model and the influential factors of SSCM to answer the above two questions.

The Conceptual Model

In this study, the model of the influential factors for an enterprise to adopt SSCM was constructed as in Figure 1 based on the prior framework (Baumann *et al.*, 2002; Carter and Rogers, 2008), literature reviews and industrial practices. All practitioners in SSCM have their roles in procurement, production, distribution and disposal of the product. While facing pressure from stakeholders, such as administration, consumers, competitors, the media, non-government organizations (NGOs) and so on, an organization that considers adopting SSCM must reformulate its business strategies to fulfill its sustainable goals and the stakeholders' demands. The business strategies should have connected with both internal and external management of the organization. Moreover, various kinds of uncertainty and risk that are affected by strategies, pressures and other issues should be taken into account simultaneously. In brief, the concept comprised five major considerations: pressure, strategy, uncertainty and internal and external management. We named these five aspects in the SSCM model the influential factors of SSCM.

Following the development of the conceptual model for SSCM in practice, a corresponding SSCM questionnaire was designed to confirm the construct validity of the model and the five influential factors. We conducted the survey in both Vietnam and Taiwan to investigate their transnational differences and to answer the third question of the study. The purposes of the survey were twofold: (1) to confirm the influential factors to adopt SSCM practices and (2) to identify the differences between two Asian countries. The details of the contents of the survey that included the five influential factors are defined and listed in the following section.

The Five Influential Factors of SSCM

Literature about the five influential factors or the driving forces of SSCM is shown in Table 5. During the developing phase of the survey, the details of the relevant factors listed in Table 5 were reviewed thoroughly and had been integrated to the questionnaire. In addition to the debates of organizational strategy, internal and external management being highlighted in many studies, Teuteberg and Wittstruck (2010) and Büyüközkan and Çifçi (2011) took the considerations of pressure and uncertainty as the key characteristics of SSCM practice. In this study, we named the key aspects or characteristics of SSCM the influential factors. However, the industrial practice of SSCM adoption

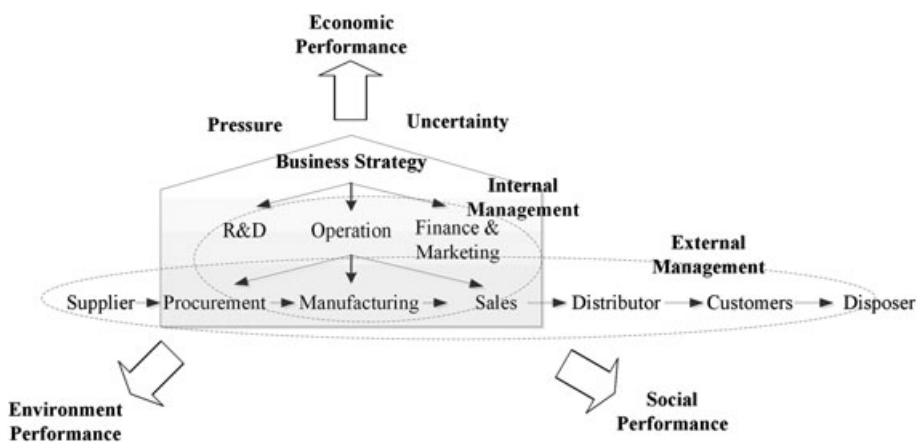

Figure 1. The model of influential factors for SSCM adoption

DOI: 10.1002/sd

The influential factors of SSCM		Strategy	Pressure	Internal management	External management	Uncertainty
		Strategy Orientation Knowledge Commitment	Law Standard Regulation Stakeholder Compliance	Culture Innovation Flexibility Quality Speed Training Continuity Efficiency	Collaboration Stakeholder Communication Training Value Performance	RiskDisaster
Beske *et al.* (2013)	The aspects of SCM for sustainability include strategic orientation, continuity, collaboration, risk management and proactivity.	*		*	*	*
Ahi and Searcy (2013)	The characteristics of SSCM in SCM include flow, coordination, stakeholders, relationships, value, efficiency and performance.		*	*	*	
Teuteberg and Wittstruck (2010)	Includes sustainable supply chain strategy, IT alignment, organization culture, risks and compliance management, and laws, standards and regulations to improve the performance in environmental, economic and social areas.	*	*	*	*	*
Li *et al.* (2014)	The influencing factors in supply chain sustainability governance include internal members (capabilities of supplier, centrality of the focal company), transaction (density of supply chain, complexity of transactions) and external stakeholders (consumer demands, government regulation, information disclosure of NGO).		*	*	*	
Büyüközkan and Çifçi (2011)	The key practices for a sustainable SC include price strategy, SC logistics network, inventory management, accuracy of supply and demand forecasts, life cycle management, supplier management, flexible and cleaner technology, delivery performance, usage of effective systems and tools, environmental management system, green innovation, environmental product design, environmental activity capability, efficient handling and storage, eco-friendly transportation, reverse logistics, collaboration with partners, employee practices, outsourcing, stakeholders' rights, and monitoring and maintenance.	*	*	*	*	*
Seuring and Müller (2008b)	The triggers for SSCM include supplier evaluation for risks and performance, pressure and incentives, and sustainable products.			*	*	*
Ageron *et al.* (2012)	A model for sustainable supply management includes barriers, reasons, greening, performance criteria, benefits and motivation, managerial approaches and characteristics of suppliers.	*		*	*	

(Continue)

The influential factors of SSCM		Strategy	Pressure	Internal management	External management	Uncertainty
		Strategy Orientation Knowledge Commitment	Law Standard Regulation Stakeholder Compliance	Culture Innovation Flexibility Quality Speed Training Continuity Efficiency	Collaboration Stakeholder Communication Training Value Performance	RiskDisaster
Grimm *et al.* (2014)	Critical factors for SSCM include internal factors (costs, lack of financial resources, investment reluctance, lack of competences and skills, lack of personnel commitment, training, top management support), external factors (lack of power, stakeholder partnerships, stakeholder pressures, e.g. regulatory incentives, NGO pressures or customer demands), and others: lack of commitment and trust between supply chain partners, lack of supplier competences, lack of information and transparency, cultural and language differences and geographical distance.	*	*	*	*	
Gupta and Palsule-Desai (2011)	Strategic considerations (organizational strategy, supply chain strategy and structure, marketing strategy), decisions at functional interfaces (product design and product life cycle, pricing and valuation of returns, forecasting, information provision and value of information), regulation and government policies (extended producer responsibility, cap and trade programs, integrative models and decision support tools).	*	*	*		
Filho (2004)	Lists global constraints to and/or opportunities for SC in the TBL: non-taxable barriers, conflicts among SC sectors, inclusion of small and medium size producers, access to information, labor specialty, production management and organization, technical assistance, capital/credit, bio-economic efficiency of the production system, attendance to market niches, degraded pasture or pasture in the process of degradation, environmental degradation, infrastructure of the segments in the chain, traceability, certification and meat and hide quality.	*		*	*	
Giunipero *et al.* (2012)	Drivers of sustainability: involvement of top management, government regulation, financial benefits, competitive advantage, ISO certification,	*	*	*		

(Continue)

The influential factors of SSCM		Strategy	Pressure	Internal management	External management	Uncertainty
		Strategy Orientation Knowledge Commitment	Law Standard Regulation Stakeholder Compliance	Culture Innovation Flexibility Quality Speed Training Continuity Efficiency	Collaboration Stakeholder Communication Training Value Performance	RiskDisaster
	customer demand. Barriers to sustainability: lack of consensus at the CEO level, costs of sustainability and economic conditions, lack of sustainability standards and appropriate regulations, misalignment of short-term and long-term strategic goals.					
Codron *et al.* (2014)	It includes general (market structures, technology, institution and consumer preferences) and safety specific (public regulation, private regulation, co-regulation and consumer NGO activism).		*	*	*	
Liu *et al.* (2012b)	It is indicated that Chinese companies are still at a preliminary stage of GSCM practices. The external pressures are from regulatory, domestic clients, competitors, communities and foreign customers. The internal factors are support of top managers and company's learning capacity.			*	*	

Table 5. Summary of the influential factors or driving forces from SSCM studies

and comparison of these key factors in Asian countries has not been investigated systematically yet, especially in developing ones. In the following, details of the influential factors are briefly explained.

Pressure

With the environmental aggravation, the public have put more pressure on businesses, forcing them to improve the environmental and resource consequences of their products and processes in recent decades. Generally, the pressure comes from the stakeholders of an enterprise. Stakeholders include government, customers, competitors, the media, NGOs and financial supporters. For sustainability, stakeholders might push organizations toward compliance with the regulations and standards of supply chain activities in the three primary facets of sustainability: economic, environmental and social. From the economic perspective, the pressure could be viewed in terms of quality, efficiency and effectiveness. Based on the standpoint of environmental conservation, the pressure could be viewed as the extent of emissions, natural resource utilization, waste and recycling. On the social side, the pressure could be viewed in terms of health and safety, effect on employees and effect of noise emissions. Furthermore, the issues regarding pressure to adopt SSCM include not only the preceding three standpoints, but also the pressure to choose alternative suppliers and methods. In our SSCM questionnaire, six questions were attributed to the pressure factor.

Strategy

A well-planned strategy may lead companies on a more positive track that enhances their competitive edge with fewer risks. Conversely, a badly planned strategy might push a company in a wrong direction and incur significant costs. Although no easy way exists to measure the evolving capacity of top managers in adopting SSCM, some indirect factors could still be utilized to clarify the scope of strategy implementation. Based on the literature review, the content of sustainable strategy should include top managers' commitment, responsibility of the whole supply chain, R&D activities, a key performance indicator (KPI) system, incentives and motivation of the enterprise. Strategies that could evoke employees' awareness about the long-term benefits of changes and best practices should be included as well.

Internal Management

When an organization adopts SSCM, one of the barriers is the lack of knowledge of the internal management system. The organizational awareness, confidence, knowledge and priorities within a company can affect its own SSCM practices. Generally, internal management of SSCM comprises managing the process of continuous improvement, minimizing environmental impacts and enhancing efficiency. Knowing how to provide information transparency, to meet customers' needs and to establish a culture of continuous learning are also essential issues of internal management. This may be accomplished by leveling capacities to match supply and demand, by designing and maintaining the infrastructure according to ecological standards and by ensuring flexible use of infrastructure.

External Management

External management is the essential influential factor in practical SSCM adoption and is strongly correlated with outer pressure. It usually consists of the relationships of suppliers, communication and stakeholders in practice, and the involvement of stakeholder communication with expertise and innovations. Issues such as tracking and monitoring practices following regulatory developments, monitoring government's policies and competitors' initiatives and redesigning relationships with customers and stakeholders are strongly associated with the effectiveness of external management. Ways to eliminate trade-offs or conflicts between regulations and effective supply chain performance should be considered as well.

Uncertainty (Risk)

The inherent uncertainty associated with companies that implement SSCM could be investigated by defining the risks impacting a company's goals and the ways of simplifying plans and processes. The considerations of uncertainty involve having sufficient knowledge of the whole supply chain, minimizing risks, preventing risks and so on. Once a suitable framework is determined to fit a particular organization, knowledge about risks could be reinforced by cooperating with others externally and by dealing with risks rooted in social and environmental impacts and at the same time realizing that risks are constantly evolving.

DOI: 10.1002/sd

Based on the preceding introduction of the five influential factors of SSCM adoption in the proposed conceptual model, we developed a specific questionnaire to examine their importance. In short, as shown in Table 6, the questionnaire included a total of 53 questions: six for pressure, 10 for strategy, 18 for internal management, nine for external management and 10 for uncertainty. Based on a series of initial interviews with experts from different companies and research organizations, respondents were asked to respond to the importance of the specific statements on a seven-point Likert scale ranging from 'strongly disagree' to 'strongly agree'.

Data Collection and Analysis

Data Collection

The survey of SSCM was conducted in Taiwan and Vietnam, through either a face-to-face approach or an online survey. We designed the questionnaire based on the five influential factors of the conceptual model as introduced in the previous section and Table 6. The questionnaire comprised a total of 53 questions and it was presented in Chinese, Vietnamese and English for the subjects' preference. The translation was proofread by the bilingual researchers to prevent misinterpretation.

There were a total of 151 valid responses to the survey. The nationalities of the subjects were Taiwanese, 47%, and Vietnamese, 53%. These respondents were experts in SSCM from either research institutes, 29%, or industry, 71%. For the industry respondents, 59% came from manufacturing business and 41% were service providers with management positions in departments such as supply, purchasing, quality, sales, finances, R&D etc. Most participants were acquainted with related fields of SCM. Considering the work experience of the sample pool, 32% of the respondents had more than 10 years' experience related to SSCM; 37% between five and 10 years; 28% either less than five years or did not respond.

Reliability and Validity

We used Cronbach's alpha to prove the reliability of the SSCM questionnaire. The reliability of the overall framework and the five SSCM factors were all evaluated to ensure they meet the common acceptance level of reliability of 0.70. Based on the results in Table 7, the Cronbach's alpha value of the overall framework was 0.98 and the five influential factors ranged from 0.95 to 0.88. It was noted that the reliability of the questionnaire was supported from the analysis. Furthermore, we conducted the confirmatory factor analysis (CFA) to evaluate the convergent validity of the survey in Table 7. The variation of the five influential factors and the overall framework were all explained more than 50% by their first common factor after rotations with the quartimax method. In short, the result showed us that both the reliability and the validity of the survey were adequate and we could use the feedbacks of the questionnaire for further evaluation.

It should be noted that the CFA results for strategy and internal management were above the validity standard, 50%, but lower than expected. The reason might be the diversities between different industries made the questionnaire more difficult to reach the respondents' consensus ideas even though the questionnaire involved plenty of questions.

Analysis Results

The means of each influential factor for Taiwan and Vietnam are shown in Table 8 and Figure 2. Since a Likert seven-point scale was used in this study, we defined 4.0 (neutral point) as the standard level accordingly to evaluate the agreement of importance of the five major factors. The averages of the five influential factors in total were all close to or higher than 5.50. The result confirmed the magnitude of the importance of the five influential factors with their corresponding ranking for adopting SSCM into practice.

The rankings of the influential factors of SSCM between Taiwan and Vietnam were not too much different. Overall, uncertainty was ranked as the top issue with the highest score, 5.82, among the five factors, followed by internal

DOI: 10.1002/sd

Pressure for adopting SSCM in your organization (or representative organization) involves
1. Economic pressure in terms of quality, efficiency and effectiveness
2. Environmental pressure in terms of emissions, natural resources utilization, waste and recycling
3. Social pressure in terms of health and safety, effect on employees and effect of noise emissions
4. Pressure to search and choose better supplier solutions
5. Pressure to enhance organizational management
6. Pressure to develop good measures and methods in practice

Strategy for adopting SSCM in your organization (or representative organization) involves
1. Learn from failures and spread related knowledge
2. Increase the responsibility of the supply chain managers
3. Establish a dedicated organization to train and motivate employees
4. Conduct SSCM research and development
5. Ask for the participation of supply chain managers and executives in the early phase
6. Manage the uncertainty of sustainability in the supply chain
7. Investigate the cause–effect relationships between industrial trends and supply chain
8. Develop KPI for SSCM
9. Provide incentives to motivate stakeholders
10. Convince employees of the long-term benefits of SSCM implementation

Internal management for adopting SSCM in your organization (or representative organization) involves
1. Process of continuous improvement
2. Process of enhancing efficiency and minimizing environmental impact
3. Customizing tangible and intangible products/services to improve customers' satisfaction
4. Customer relationship management
5. Implementing product life-cycle management (PLM)
6. Using the 'Design for SSCM' concept
7. Evaluating and controlling the impact of varieties of product components
8. Defining and collecting knowledge in relevant fields
9. Transforming implicit knowledge to explicit ones, enabling information transparency via info. Tech.
10. Enhancing departmental communication
11. Establishing a lifelong learning culture
12. Improving location of facilities in the supply chain network
13. Leveling the capacities based on supply and demand
14. Designing and maintaining facilities to meet ecological standards
15. Assuring the flexible usage of facilities
16. Commitments of top management
17. Employee involvement and participation
18. Building a professional team for SSCM

External management for adopting SSCM in your organization (or representative organization) involves
1. Defining the impacts to stakeholders
2. Defining and evaluating primary stakeholders
3. Stakeholder relationship management
4. Addressing expertise and innovation to stakeholders
5. Stakeholder communication and involvement via focus groups, formal review meetings, websites with open forums, multi-stakeholder networks, newsletters etc.
6. Conform top management commitment with the economic and social concerns of stakeholders
7. Mitigating the trade-off or conflict between regulation and supply chain performance
8. Screen government policies and legislation developments
9. Monitor competitors' initiatives

Uncertainty/risk management for adopting SSCM in your organization (or representative organization) involves
1. Defining the risks relevant to the business
2. Evaluating the simplicity of every plan and process to be adopted by the organization
3. Ensuring sufficient information on the entire supply chain

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DOI: 10.1002/sd

4. Analyzing risk in context before undertaking a particular practice
5. Assuring strong and consistent leadership from top management
6. Understanding stakeholders' points of view
7. Establishing a flexible framework for the organization
8. Enhancing risk knowledge via benchmarking or cooperation with outsiders
9. Dealing with the relevant social and environment impacts
10. Understanding that risks would change continually

Table 6. Brief listing of the SSCM questionnaire

Influential factors	No of questions	ReliabilityCronbach's alpha	CFAVariation explained (1st factor) (%)
Pressure	6	0.88	63.83
Strategy	10	0.92	57.34
Internal management	18	0.95	53.43
External management	9	0.92	62.45
Uncertainty	10	0.95	70.10
Overall	53	0.98	51.04

Table 7. Results of the reliability and confirmatory factor analysis (CFA)

Influential factor	Total (100%)			Taiwan (47%)			Vietnam (53%)			*T* test	
	Rank	Mean	SD	Rank	Mean	SD	Rank	Mean	SD	F	*p* value
Pressure	5	5.50	0.96	4	5.24	1.15	5	5.73	0.69	10.221	0.002
Strategy	4	5.53	0.92	5	5.23	1.17	4	5.79	0.49	26.669	<0.000
Internal management	2	5.73	0.80	1	5.42	1.03	2	6.00	0.34	51.962	<0.000
External management	3	5.63	0.85	3	5.31	1.06	3	5.91	0.48	24.117	<0.000
Uncertainty	1	5.82	0.96	2	5.36	1.16	1	6.23	0.45	37.198	<0.000

Table 8. The comparison of the five influential factors between Taiwan and Vietnam
Likert seven-point scales: 1, strongly disagree; 7, strongly agree.

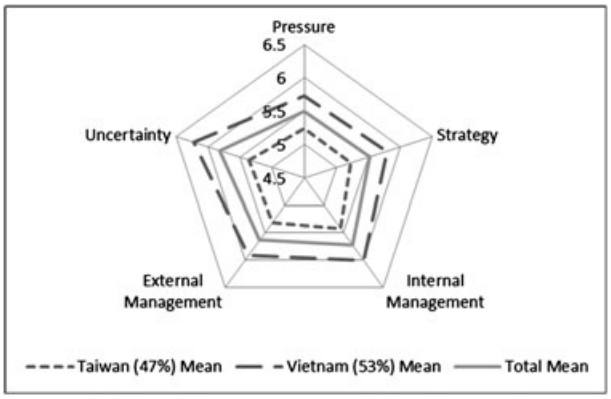

Figure 2. The averages of the five influential factors of SSCM

DOI: 10.1002/sd

management and external management. The finding highlighted the effectiveness of defining and managing risks based on a company's long-term vision. The importance of defining uncertainty/risks in SSCM and to ensure the knowledge for developing the supply chain framework was considered as the highest priority while conducting SSCM from the survey subjects' perspectives. The results provided solid evidence to support our conceptual model of SSCM, even though some significant differences existed between Taiwan and Vietnam.

The differences of means among those five factors between Taiwan and Vietnam ranged from 0.49 to 0.87. An independent sample *t* test was performed to evaluate if there is any significant difference between Taiwan and Vietnam. The brief results of the *t* test are listed in Table 8 as well. Our subjects' perceptions of the importance of the five influential factors between the two countries were all significant at the 0.01 level. According to Figure 2, even though the plot shapes of the five factors were similar for Taiwan and Vietnam, the magnitudes of importance were somewhat different. Using the overall ranking as an example, the ranking sequence of Vietnam was uncertainty, internal management, external management, strategy and pressure in descending order. Respondents from Taiwan, however, considered internal management was more important than uncertainty. It should be noted that the standard deviation of Taiwan's respondents was higher than Vietnam's. This implies that the Taiwanese subjects' opinions were more divergent than Vietnamese.

We also conducted the Pearson correlation analysis to evaluate the overall conditions and the differences between those two countries. For Taiwan, the relationships among five influential factors were all considered as highly correlated ($r > 0.7$) except that between pressure and uncertainty (see Table 9). On the other hand, Vietnam showed only medium correlation ($0.3 > r > 0.7$) among the five factors in general. It should be noted that the consistent differences of the averages, order of importance and correlations of the five factors showed the national differences in culture, economy and customer consumption habits between the two countries, and the effects of these issues will be debated later in the discussion section.

Overall speaking, these five influential factors were highly correlated with each other, as most of the correlation coefficients were higher than 0.7. This result not only indicates the significant interaction among the factors but also demonstrates the necessity to consider them together in SSCM practice. In summary, the five factors, strategy, pressure, internal management, external management and uncertainty, of the conceptual model were proved to be the influential factors for adopting SSCM practice.

	Strategy	Pressure	Internal mgmt	External mgmt	Uncertainty
Strategy	1				
Pressure	0.791[1]**	1			
	0.641[2]**				
	0.768[3]**				
Internal mgmt.	0.871[1]**	0.822[1]**	1		
	0.552[2]**	0.657[2]**			
	0.843[3]**	0.787[3]**			
External mgmt	0.832[1]**	0.791[1]**	0.867[1]**	1	
	0.581[2]**	0.584[2]**	0.613[2]**		
	0.810[3]**	0.757[3]**	0.847[3]**		
Uncertainty	0.773[1]**	0.675[1]**	0.867[1]**	0.815[1]**	1
	0.407[2]**	0.475[2]**	0.487[2]**	0.527[2]**	
	0.746[3]**	0.654[3]**	0.843[3]**	0.798[3]**	

Table 9. The correlation of the five influential factors
[1]Taiwan;
[2]Vietnam;
[3]total.
**Correlation is significant at the 0.01 level (two tailed).

DOI: 10.1002/sd

Discussion (Managerial Implication)

With the global competition of business becoming fierce, various companies face not only economic survival issues, but also human rights and environmental problems. For the SSCM practices, a company needs to fulfill the requirements of environmental performance, social responsibility and economic contribution (Chardine-Baumann and Botta-Genoulaz, 2014). Besides integrating previous literature to qualitatively highlight the five influential factors, strategy, pressure, internal management, external management and risk, for SSCM adoption, the results of this study quantitatively verified the importance of these five driving forces for enterprises considering SSCM practices. Experts from both industry and academia were aware of the need to spend significant amount of resources (budget and effort) to achieve sustainable goals, even though some were still reluctant to implement SSCM practices because of uncertainty or unclear strategies. For internal management, companies need to adjust product customization to address consumers' needs and manage products (tangible and intangible product/services) in terms of actively managing product life cycles. Additionally, taking stakeholders' strategy and pressure into account is proven to be an important issue during the SSCM implementation. The detailed discussion of the five influential factors is summarized as follows.

1 *Pressure is the trigger to implement SSCM*. Based on the mean score of the survey, the importance of pressure may be considered as the lowest of the five influential factors by the SSCM experts. The argument is that the pressures of adopting sustainability concepts from public, administration or customers are quite clear and easy to respond to in comparison with the other four factors. The actual challenges of SSCM implementation for industries are more associated with uncertainty and internal management: these two factors were ranked at the top. So far, details of SSCM practices are still vague in many fields even though we do have regulations or ISO standards to follow; companies have to rely on their past experience or look for benchmarks from others. This phenomenon is reflected by the scores of the analysis results.

In terms of practices, the SSCM in Taiwan is better than in Vietnam. The reason is that the Financial Supervisory Commission (FSC) in Taiwan not only increases the responsibility for internal control at listed companies but has also required listed food processing companies, financial services companies, chemical industry companies and companies with more than NTD$10 billion (the same currency applies hereafter) of paid-in capital to compile corporate social responsibility reports (referred to as CSR reports) since 2014. This statute has forced many Taiwan companies to adopt concepts of sustainability deliberately in their daily operations and to increase their social responsibilities. Furthermore, it helps not only in enhancing the direct business-to-consumer (B2C) relationship but also in reviving the trust for listed companies in these categories among consumers and firms in the supply chains.

Nevertheless, although pressure might not be the most important factor to affect the success/failure of SSCM adoption, pressure may be the jump-starting force for enterprises to do this. Many companies are forced or motivated to begin SSCM practices simply due to enforcement or attention from legislature, media, NGOs or the public. For instance, although Vietnam has not regulated or enforced sustainable practices yet, the public seems to have raised their attention to the environment significantly. Vietnam just had one of their largest environmental disasters caused, ironically, by a Taiwan-owned steel factory, which discharged a combination of chemicals into the ocean. The Vietnam administration struggled against the strong protest from the public and media at the beginning, but eventually fined the company to take responsibility to compensate for the mess (Paddock, 2016). This is a good example that demonstrates that the public in Vietnam have raised green issues and forced both the administration and industry to make adjustments.

2 *Strategy is the foundation of successful SSCM*. The case of strategy is similar to that of pressure. After receiving a considerable amount of pressure regarding sustainability as the trigger, companies have to set up their long-term strategy, for example promising substantial resources for investment to adopt SSCM. This kind of commitment is seen as an easy way to alleviate the external pressure.

However, it should be noted that strategy is at the core of SSCM success since all of the practices and resources of an organization stem from it. All successful tactics – management or business model – require an accurate strategy

DOI: 10.1002/sd

and full support from the top management. Different enterprises might have different strategies for sustainability: supply chain management strategy, sustainable products development strategy, new business model strategy, sustainable transport strategy and sustainable innovative strategy (Janssen and Moors, 2013). Kumar and Christodoulopoulou (2014) stated that the strategy of sustainability will directly influence a firm's performance. Our study supported this argument. However, the results showed the respondents from Taiwan and Vietnam both agreed that strategy's importance to the success of SSCM adoption is only similar to that of pressure.

3 *Internal and external management are the daily practices of SSCM*. After the launch of the strategy, some companies may postpone their implementation because they are incapable of transforming the ideas or concepts of SSCM into daily practice or work process. For instance, no guarantee exists that two organizations utilizing the same SSCM strategy will employ the same method or system to assure the success of sustainability. Uncertainty aggravates the difficulty of finding standard ways to conduct either internal or external practice as well. Our results showed that the correlation between internal management and uncertainty was more obvious than the others, and the respondents might raise a bit more concern on internal than external management overall. Overall, from the viewpoint of an organization, internal management usually holds higher controllability than external. This phenomenon might reveal that current SSCM has not yet established or reached universal management practices; therefore, every company has to keep modifying their own ways to adopt SSCM. It should be noted that, although external and internal groups or 'stakeholders' would keep putting pressures on companies to solve environmental concerns (Zhu *et al*., 2013), these stakeholders might have different opinions about the procedures or the methods to meet SSCM practices. Generally, the internal practices subsequently facilitate extension to adopt external practices (Zhu *et al*., 2010).
4 *Uncertainty is the most concerning or difficult factor of SSCM*. According to Hall and Martin (2005) and Hall *et al*. (2011), there are four related types of uncertainty: technological uncertainty, commercial uncertainty, organizational uncertainty and social uncertainty. Moreover, supply chain risks might include both direct and indirect risks. Direct risk is embodied in the product attributes – value for the buyer, quality, price and performance. Indirect risk includes loss of brand image and value and violations of property rights. Lintukangas *et al*. (2016) summarized supply risks as including conflict of property rights, damage in company reputation, unsatisfactory quality of purchases, rise of purchasing price and costs, and outsourcing of critical activities.

In our survey, uncertainty was considered the most important or demanding factor among all five influential factors. This is consistent with the actual challenge in global business practices. All international business have to comply with a multitude of governmental regulations or industrial standards that may keep evolving continuously. The commercial environment and public opinion may also shift rapidly. In today's business practice, sustainability or environmental issues usually take a backseat to profit because companies have to strive to make a profit in intense competition. A formidable challenge may exist for the top management to accept the strategy of sustainability with the long-term commitment and resource allocation.

Our analysis has pointed out that pressure, strategy and internal management have strong effects on the SSCM adoption; however, based on our country-to-country comparison, these factors showed different levels of influence on the success of SSCM. All the five factors were shown to be at a higher level in Vietnam than in Taiwan, and the *t* test of all five factors indicated a significant difference concerning the importance or implementation of SSCM practices between the two countries.

This might be because Taiwan companies have confronted global SSCM challenges and administrative pressures more directly and for longer than those in Vietnam. Although Vietnam started implementing their Renovation (Doi Moi) policy in 1986 with the goal of creating a 'socialist-oriented market economy', the country has to wait till the last decade to have sufficient investment to enhance its economics and industrial capability. Vietnam is relatively attractive to foreign investors and manufacturers because of the low cost and plentiful labor. It has recently been a focus of interest for international business. Till now, many international companies in Vietnam are founded by or contracted with overseas corporations to provide essential resources or to do outsourcing work. The pressures from stakeholders might be taken over by their mother companies or upstream. Vietnam's industry is having the most rapid growth period at present; the struggle and challenges between economic growth and environment sacrifice have no easy solutions for them yet. The novelty of SSCM to Vietnam's industries might be similar to that of the Internet of Things (IoT) or Industry 4.0 to Taiwan.

DOI: 10.1002/sd

On the other hand, most listed companies in Taiwan had started building their own SSCM practices even before the obligation of publishing CSR reports. In many countries, the pace of legislation to meet global trends is usually slower than the industry. Because the domestic demands in Taiwan would not support the purpose of continuous growth for many industries, Taiwan companies are forced to adopt SSCM to fulfill the worldwide demands of sustainability, especially the relevant standards of the EU, to expand their international business. Recently, due to the pressures from the global clients and the legislative CSR requirements in Taiwan, most companies have accepted the sustainable concepts for a long period of time. Major industries in Taiwan might have discussed and reached SSCM issues for years.

In short, the Taiwanese respondents might like to address less the importance of the five influential factors of SSCM, since it is not a fresh topic to the industries in Taiwan but more like daily practice already.

Conclusions

Literature review and the preliminary interviews with SSCM experts helped us consolidate the conceptual model to local practices. Our study indicated that the five influential factors of SSCM are important from both the academic and the industrial perspectives. The results of the survey attested to the concurrence of the influential factors in the literature review, and proved that the five influential factors of our SSCM model are prominent in the organizational practices in both Taiwan and Vietnam. This answered the first and second research questions we delivered in the introduction. Another valuable contribution of this study is the utilization of the industrial and the administrative cases from Vietnam and Taiwan to explicate the quantitative differences of the SSCM survey, which also answered the third question of this study.

It was concluded that the social, economic and environmental pressures from stakeholders such as the public or the administration and the eagerness to meet rigorous green standards in some areas are still the critical motivators for SSCM adoption. We advocated that practical research and professional training in SSCM should be involved from the beginning phase of a company's SSCM implementation because of the uncertainty or risks of SSCM employment, the deficiency of the latest SSCM knowledge and the specific characteristics of every corporation.

This research was an investigation of the challenges or difficulties of successful SSCM practice and some limitations are acknowledged to exist. The findings from this study are relevant to both researchers and managers in the field of SSCM, but data were collected from a relatively small group of respondents. Furthermore, this research did not consider the relationship among some or all of the factors that might affect SSCM; rather, it focused solely on discovering the influence that each factor has on SSCM. In addition, these factors were only investigated in Taiwan and Vietnam, so the results might possibly vary in other countries even if they are geographically close. Finally, different company scales might result in different SSCM strategies. More data and analyses are required to establish a valid comparison between countries on how SSCM practices may affect the overall economy of a country.

Since SSCM would be affected enormously by the local public, the administration and the domestic environment, local studies of SSCM adoption are essential to profoundly understand the factors that could lead to the success/failure of SSCM. In future research, an investigation of SSCM practices applied to different Asian countries may offer a broader spectrum. Surveying different countries may produce different results. Similar local studies could provide both academia and industry with a wide-ranging understanding of how to implement global SSCM in local business.

References

Aberdeen Group. 2009. The ROI of Sustainability: Making the Business Case. www.aberdeen.com [December 2016].

Acer. 2016. http://www.acer-group.com/public/Sustainability/supply/system.htm [December 2016].

Ageron B, Gunasekaran A, Spalanzani A 2012. Sustainable supply management: an empirical study. *International Journal of Production Economics* **140**(1): 168–182.

Ahi P, Searcy C 2013. A comparative literature analysis of definitions for green and sustainable supply chain management. *Journal of Cleaner Production* **52**(1): 329–341.
Baumann H, Boons F, Bragd A 2002. Mapping the green product development field: engineering, policy and business perspectives. *Journal of Cleaner Production* **10**: 409–425.
Beske P, Land A, Seuring SM 2013. Sustainable supply chain management practices and dynamic capabilities in the food industry: a critical analysis of the literature. *International Journal of Production Economics* **152**: 131–143.
Bontoux L, Bengtsson D 2015. 2035 Paths towards a sustainable EU economy Sustainable transitions and the potential of eco-innovation for jobs and economic development in EU eco-industries 2035. European Commission: Luxembourg. DOI: 10.2760/80294. https://eeas.europa.eu/sites/eeas/files/2035_path-towards-a-sustainable-eu-economy.pdf [15 August 2015].
Büyüközkan G, Çifçi G 2011. A novel fuzzy multi-criteria decision framework for sustainable supplier selection with incomplete information. *Computers in Industry* **62**(2): 164–174.
Carter CR, Rogers DS 2008. A framework of sustainable supply chain management: moving toward new theory. *International Journal of Physical Distribution and Logistics Management* **38**(5): 360–387.
Carter NT, Mol APJ 2006. China and the environment: domestic and transnational dynamics of a future hegemon. *Environmental Politics* **15**(2): 331–345.
Chan HK, He H, Wang WYC 2012. Green marketing and its impact on supply chain management in industrial markets. *Industrial Marketing Management* **41**(1): 557–562.
Chardine-Baumann E, Botta-Genoulaz V 2014. A framework for sustainable performance assessment of supply chain management practices. *Computers and Industrial Engineering* **76**: 138–147.
Chen T-J 2016. Supply Chain Positioning and Innovation: Taiwan's Challenge. Paper presented at the Mega-Regionalism – New Challenges for Trade and Innovation workshop. East-West Center: Honolulu, Hawaii, USA.
Clark D. 2012. Has the Kyoto protocol made any difference to carbon emissions? *The Guardian*. https://www.theguardian.com/environment/blog/2012/nov/26/kyoto-protocol-carbon-emissions [15 August 2015].
Codron J-M, Adanacioğlu H, Aubert M, Bouhsina Z, Mekki AAE, Rousset S, et al. 2014. The role of market forces and food safety institutions in the adoption of sustainable farming practices: the case of the fresh tomato export sector in Morocco and Turkey. *Food Policy* **49**(1): 268–280.
Corporation for Financing and Promoting Technology (FPT). 2016. https://fpt.com.vn/en/about-us/corporate-social-responsibilites [December 2016].
de la Fuente MV, Ros L, Ortiz A 2010. Enterprise modelling methodology for forward and reverse supply chain flows integration. *Computers in Industry* **61**(7): 702–710.
Dincer I, Rosen MA 2007. Energetic, exergetic, environmental, and sustainability aspects of thermal energy storage systems. *Thermal Energy Storage for Sustainable Energy Consumption* **234**: 23–46.
Directorate General of Budget, Accounting and Statistics (DGBAS) 2016. Statistical Yearbook of the Republic of China 2014, DGBAS, Executive Yuan: Republic of China.
Elkington J 1997. Cannibals with Forks. The Triple Bottom Line of 21st Century Business, Capstone: Oxford.
Fiksel J 2003. Designing resilient, sustainable systems. *Environmental Science and Technology* **37**(23): 5330–5339.
Filho KF 2004. Supply chain approach to sustainable beef production from a Brazilian perspective. *Livestock Production Science* **90**: 53–61.
Foerstl K, Reuter C, Hartmann E, Blome C 2010. Managing supplier sustainability risks in a dynamically changing environment – sustainable supplier management in the chemical industry. *Journal of Purchasing and Supply Management* **16**(2): 118–130.
Formentini M, Taticchi P 2016. Corporate sustainability approaches and governance mechanisms in sustainable supply chain management. *Journal of Cleaner Production* **112**(3): 1920–1933. DOI:10.1016/j.jclepro.2014.12.072.
Gelis S. 2015. Kyoto Protocol, 10 years later: did deal to combat greenhouse emissions work and what of its future? *National Post* 14 February.
General Statistics Office of Vietnam (GSOV) 2016. Statistical Yearbook of Vietnam 2014, GSOV: Ha Noi.
Giunipero LC, Hooker RE, Denslow D 2012. Purchasing and supply management sustainability: drivers and barriers. *Journal of Purchasing and Supply Management* **18**(4): 258–269.
Gold S, Seuring S, Beske P 2010. Sustainable supply chain management and inter-organizational resource: a literature review. *Corporate Social Responsibility and Environmental Management* **17**(4): 230–245.
Grimm JH, Hofstetter JS, Sarkis J 2014. Critical factors for sub-supplier management: a sustainable food supply chains perspective. *International Journal of Production Economics* **152**: 159–173.
Gupta S, Palsule-Desai O 2011. Sustainable supply chain management: review and research opportunities. *IIMB Management Review* **23**: 234–245.
Hall JK, Martin MJC 2005. Disruptive technologies, stakeholders and the innovation value-added chain: a framework for evaluating radical technology development. *R&D Management* **35**(3): 273–284.
Hall J, Matos S, Silvestre B, Martin M 2011. Managing technological and social uncertainties of innovation: the evolution of Brazilian energy and agriculture. *Technological Forecasting and Social Change* **78**(7): 1147–1157.
Haya B. 2012. Failed Mechanism: How the CDM is Subsidizing Hydro Developers and Harming the Kyoto Protocol. International Rivers: Berkeley.
Henry M, Kato Y 2011. An assessment framework based on social perspectives and Analytic Hierarchy Process: a case study on sustainability in the Japanese concrete industry. *Journal of Engineering and Technology Management* **28**(4): 300–316.
Hoa HTT 2016. Effective logistics and supply chain management as essential solutions to increase competitive capability of Vietnam goods in knowledge economy. Proceeding of Management Challenges in the 21st Century, 2011.
International Finance Corporation (IFC). 2013. Sustainability Reporting Handbook for Vietnamese Companies. http://www.ifc.org/wps/wcm/connect/topics_ext_content/ifc_external_corporate_site/ifc+sustainability/learning+and+adapting/knowledge+products/publications/publications_handbook_vietnam-sus [December 2016].

Janssen M, Moors EHM 2013. Caring for healthcare entrepreneurs – towards successful entrepreneurial strategies for sustainable innovations in Dutch healthcare. *Technological Forecasting and Social Change* **80**(7): 1360–1374.
Kim KH, Jeon BJ, Jung HS, Lu W, Jones J 2011. Effective employment brand equity through sustainable competitive advantage, marketing strategy, and corporate image. *Journal of Business Research* **64**(11): 1207–1211.
Kleindorfer PR, Saad GH 2005. Managing disruption risks in supply chains. *Production and Operations Management* **14**(1): 53–68.
Kumar V, Christodoulopoulou A 2014. Sustainability and branding: an integrated perspective. *Industrial Marketing Management* **43**(1): 6–15.
Kuo TC 2013. The construction of a collaborative framework in support of low carbon product design. *Robotics and Computer Integrated Manufacturing* **29**: 174–183.
Kuo TC, Chu CH 2013. Risk management of hazardous substances in selection of green suppliers. *International Journal of Precision Engineering and Manufacturing* **14**(6): 1057–1063.
Kuo TC, Hsu CW, Ku KC, Chen PS, Lin CH 2012. A collaborative model for controlling the green supply network in the motorcycle industry. *Advanced Engineering Informatics* **26**: 941–950.
Kuo TC, Wang ML 2012. The optimization of maintenance service level to support the product service system. *International Journal of Production Research* **50**: 6691–6708.
Larson DL, Mao LP, Quiram G, Sharpe L, Stark R, Sugita S, Weiler A 2011. A framework for sustainable invasive species management: environmental, social, and economic objectives. *Journal of Environmental Management* **92**(1): 14–22.
Li Y, Zhao X, Shi D, Li X 2014. Governance of sustainable supply chains in the fast fashion industry. *European Management Journal* **32**(5): 823–836.
Lin Y, Wang Y, Yu C 2010. Investigating the drivers of the innovation in channel integration and supply chain performance: a strategy orientated perspective. *International Journal of Production Economics* **127**(2): 320–332.
Linton JD, Klassen R, Jayaraman V 2007. Sustainable supply chains: an introduction. *Journal of Operation Management* **25**(6): 1075–1082.
Lintukangas K, Kähkönen A-K, Ritala P 2016. Supply risks as drivers of green supply management adoption. *Journal of Cleaner Production* **112**: 1901–1909. DOI: 10.1016/j.jclepro.2014.10.089 [6 November 2014].
Liu D-N, Shih H-T 2013. The Transformation of Taiwan's Status Within the Production and Supply Chain in Asia. The Brookings Institution: Washington, DC.
Liu S, Kasturiratne D, Moizer J 2012a. A hub-and-spoke model for multi-dimensional integration of green marketing and sustainable supply chain management. *Industrial Marketing Management* **41**(4): 581–588.
Liu X, Yang J, Qu S, Wang L, Shishime T, Bao C 2012b. Sustainable production: practices and determinant factors of green supply chain management of Chinese companies. *Business Strategy and the Environment* **21**(1): 1–16. DOI:10.1002/bse.705.
Logistics Performance Index (LPI). 2014. Global Rankings 2014. http://lpi.worldbank.org/international/global/2014
Paddock RC. 2016. Taiwan-owned steel factory caused toxic spill, Vietnam says. *The New York Times* 30 June. http://www.nytimes.com/2016/07/01/world/asia/vietnam-formosa-ha-tinh-steel.html?_r=0
Pope J, Annandale D, Morrison-Saunders A 2004. Conceptualizing sustainability assessment. *Environmental Impact Assessment Review* **24**(6): 595–616.
Renner M 2008. Michael Renner with Worldwatch Institute on Green Jobs Trends/Interviewer: D. Hitchcock, Hartford, CT: ISSP Insight. International Society of Sustainability Professionals.
Renner M, Worldwatch Institute 1991. Jobs in a Sustainable Economy, Worldwatch Institute: Washington, DC.
Ritter FE, Schooler LJ 2004. The learning curve. In International Encyclopedia of the Social and Behavioral Sciences **2001**: 8602–8605. Elsevier Science: New York.
Rodríguez JA, Giménez C, Arenas D 2016. Cooperative initiatives with NGOs in socially sustainable supply chains: how is inter-organizational fit achieved? *Journal of Cleaner Production* **137**: 516–526.
Sajjad A, Eweje G, Tappin D 2015. Sustainable supply chain management: motivators and barriers. *Business Strategy and the Environment* **24**(7): 643–655. DOI:10.1002/bse.1898.
Seuring S, Müller M 2008a. Core issues in sustainable supply chain management – a Delphi study. *Business Strategy and the Environment* **17**: 455–466.
Seuring S, Müller M 2008b. From a literature review to a conceptual framework for sustainable supply chain management. *Journal of Cleaner Production* **16**(15): 1699–1710.
Seuring S, Sarkis J, Muller M, Rao P 2008. Sustainability and supply chain management – an introduction to the special issue. *Journal of Cleaner Production* **16**(15): 1545–1551.
Sustainable Society Index (SSI). 2016. Sustainable Society Index. http://www.ssfindex.com/results-2014/ranking-all-countries/ [December 2016].
Taipei Economic and Cultural Office (TECO) 2015. Report of Economic, Trading and Investment Environment in Vietnam, TECO: Ho Chi Minh.
Teuteberg F, Wittstruck D 2010. A Systematic Review of Sustainable Supply Chain Management Research. Paper presented at MKWI 2010. Georg-August-Universität Göttingen: Göttingen.
Tseng ML, Wu WW, Lin YH, Liao CH 2008. An exploration of relationships between environmental practice and manufacturing performance using the PLS path modeling. *WSEAS Transactions on Environment and Development* **4**: 487–502.
Taiwan Semiconductor Manufacturing Company (TSMC). 2012. http://www.tsmc.com/english/csr/collaborates_with_suppliers.htm [December 2016].
Taiwan Semiconductor Manufacturing Company (TSMC). 2016. http://www.tsmc.com/english/csr/index.htm [December 2016].
Valiela I, Tomasky G, Hauxwell J, Cole M, Cebrian J, Kroeger K 2000. Operationalizing sustainability: management and risk assessment of land-derived nitrogen loads to shallow estuaries. *Ecological Applications* **10**(4): 1006–1023.

Vermeulen WJV, Seuring S 2009. Sustainability through the market – the impacts of sustainable supply chain management: introduction. *Sustainable Development* **17**: 269–273.

Vietnam Rubber Group (VRG). 2013. By Exercising Good CSR, Businesses Will Develop Sustainably and Build Competitive Advantage! http://www.vnrubbergroup.com/en/news_e_detail.php?id=8926 [December 2016].

Wang X, Chan KH, White L 2014. A comprehensive decision support model for the evaluation of eco-designs. *Journal of the Operational Research Society* **65**: 917–934.

World Commission on Environment and Development (WCED) 1987. Report of the World Commission on Environment and Development: Our Common Future. Oxford University Press: Oxford, United Kingdom.

Zhu Q, Geng Y, Fujita T, Hashimoto S 2010. Green supply chain management in leading manufacturers: case studies in Japanese large companies. *Management Research Review* **33**(4): 380–392.

Zhu Q, Sarkis J, Cordeiro JJ, Lai KH 2008a. Firm-level correlates of emergent green supply chain management practices in the Chinese context. *Omega* **36**(4): 577–591.

Zhu Q, Sarkis J, Lai KH 2008b. Green supply chain management implications for 'closing the loop'. *Transportation Research Part E* **44**(1): 1–18.

Zhu Q, Sarkis J, K-h L 2012. Green supply chain management innovation diffusion and its relationship to organizational improvement: an ecological modernization perspective. *Journal of Engineering and Technology Management* **29**(1): 168–185.

Zhu Q, Sarkis J, Lai K-H 2013. Institutional-based antecedents and performance outcomes of internal and external green supply chain management practices. *Journal of Purchasing and Supply Management* **19**(2): 106–117.