ECONOMICS & MANAGEMENT

Exploring the Decisive Attributesof Supply Chain Planning under Uncertainty

Ming-Lang Tseng[1*], Ru-Jen Lin[1], Huynh Le Thuy-Vy[1], Anthony SF Chiu[2]

[1]*Department of Business Administration, Lunghwa University of Science and Technology, Taiwan*
[2]*Department of Industrial Engineering, De La Salle University, Manila, Philippines*

Abstract: In recent years, many firms have recognized supply chain planning (SCP) as an important issue in doing business. In the electronic industry, it plays a significant role in firm's performance. Nevertheless, a comprehensive understanding of SCP is yet to be established. Hence, the objective of this study is exploring the decisive attributes of SCP under uncertainty. By providing the aspects such as information quality, procedural quality, alignment quality and information sharing, this study contributes to determine the critical criteria which affect on SCP and thereby firm's performance and competitive advantage. The fuzzy set theory and a decision making trial and evaluation laboratory are applied. The findings indicate that the driving aspects are information quality and procedural quality that are elements impacting on alignment quality and also contributing information sharing. This study also shows that to achieve efficiency in SCP and improve their performance, firms should focus on complete and adequate of the information exchanges as well as cooperation to plan and execute a strategy for doing business.

Keywords: Supply chain planning, fuzzy set theory, decision making trial and evaluation laboratory are applied, DEMATEL

1. Introduction

Electronic is one of the largest industry in the manufacturing sector which has been more expanded and the development of it contributes a significant part of Taiwan's economy (Jing et al., 2010). Along with the rapid growth, the firm have to face with many challenges such as constant innovation product and change market demand, which lead this industry become to the most competitive business. In an intensely competitive environment, addressing production and distribution issues through supply chain planning (SCP) efforts to increase the competitive advantages (Alam, 1996). Hence, SCP is important strategic activities for firm to make production and distribution decisions in the current business environment that to decide on suitable, quality of suppliers, partners and thereby improving the performance (Che, 2012).

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* Email: tsengminglang@gmail.com

In the literature, SCP becomes a great interest due to the impact on improving the overall competitiveness of economic potential of firms (Jun et al., 2004). Raman & Watson (2004) stated that firms may struggle even more in order to manage and respond to the complexity of markets and suppliers due to the increased competition and globalization create new opportunities as well as challenges and fostering further differentiation within the firm. SCP helps to minimize unsuitable the administration of supply and demand facing through integration, which is expected to bring a highly differentiation for firm (Braunscheidel& Suresh, 2009; Oliva & Watson, 2011).Although SCP is an important issue and numerous studies suggest that it is positively associated with firm performance (Griffin & Hauser, 1996). However, few prior studies have been done on SCP and then lacking of a comprehensive understanding in the literature (Malhotra & Sharma, 2002; Pagell, 2004). To make up the deficiency, it is essential to explore the decisive attribute which impact on SCP under uncertainty and then two study questions are as follows:

- What are the decisive aspects of SCP under uncertainty?
- What is the influence degree of examined criteria of SCP?

This study provides the aspects such as information, procedural, alignment quality and information sharing. Moreover, this study also contributes the determine the decisive attribute which effect on SCP and thereby enhancing firm's performance and competitive advantage. To survive in the economy, supply chain partners need to improve their competitive advantages by information sharing (Du, 2007). Information sharing significantly contributes in reducing supply chain costs, improving partner relationships, increasing material flow, enabling faster delivery and improving order fulfillment rate; thus, enhancing the achievement of competitive advantage (Chandra et al., 2007; Zhou, 2007). Numerous prior studies agree that information sharing is a key driver of effective

and efficient SCP by speeding up the information flow (Li et al., 2006). Recent studies have focused on the benefits associated with information sharing for firm in the supply chain, not many previousstudies investigated the specific impact of this attribute on SCP (Chen, 2003; Guo, 2006). Hence, this study utilize information sharing to explore about SCP.

With the study's objective to achieve the SCP efficiency, it is essential to have an analysis to identify the interrelationships among the attributes. The relevant information is verified from the expert committees. However, the experts' preferences are uncertain and hesitating which is difficult to assign exact numerical values to describe, fuzzy set theory assess is needed to handle with this problem (Chang et al., 1998; Chen &Chiou, 1999; Tseng, 2010). A decision making trial and evaluation laboratory (DEMATEL) is proposed to evaluate the criteria based on the relationships between the cause and effect (Wu, 2012; Lin, 2013). Fuzzy DEMATEL is a method which is able to consider the condition of the fuzziness and handle with flexibly with fuzziness situation (Wu, 2008). Therefore, by applying fuzzy DEMATEL, this study identify the critical attribute that improving SCP to achieve competitive advantages and development for firm's performance.

The remainder of this study is organized as follows. Section 2 introduces the concept of SCP and proposal method. This sector presents a brief theory background of SCP and demonstrates the method that is applied in this study. In Section 3, to mention about the industrial background, data collection and measurement of aspect and criteria. Section 4 presents the method Fuzzy set theory and DEMATEL and the results also are discussed in details in this section. The section 5 presents the theoretical and managerial implications. The last section summary the conclusions, contributions, limitations and future studies.

2. Literature review

This section reviews the literature related SCP. Then the proposed analytical method is also presented. This subsection review underlined the specific areas: supply chain planning and the proposed method.

2.1. Supply chain planning

Engelen et al. (2012) defined that SCP is a process of interaction and collaboration among planning functions. The interaction refers to the structured of planning activities, such as use and exchange of information; while, collaboration is the unstructured, affective nature of interrelationship. To be more specific, SCPtypically involves facilitating communication among different functions include work together, common understanding, common vision, share resources and achieve goals (Troy et al. 2008). These functions recognize their interdependence and the need to cooperate for the benefit of firm by a direct information transfer between functions and improve communication links through SCP (Olson et al., 2001, Frishammar and Hörte, 2005). Turkulainen and Ketokivi (2011) developed a detailed understanding of the effects of SCP on performance from the point of view of information processing. When the SCP is high, the firm works as a unified wholeto transfer, process, interpret and exploit information across functions.

Many studies used the SCP as a tool to deal with firms problems. Shabani et al. (2014) used for a forest biomass power plant under supply uncertainty. While, Zamarripa et al. (2012) improved SCP in a competitive supply chains environment. However, the literature still unclear and lack of understand which attributes are driving a successful SCP (Turkulainen&Ketokivi, 2011). It seems that by using information process, SCP has the impact on firm's performance. Lin et al. (2015) found that information sharing played key role to increase the performance. Furthermore, the quality of SCP is highly appreciated with frequency (Lievens&Moenaert, 2000). Oliva

and Waston (2011) showed that 3 aspects that drive the planning performance are information, procedural, and alignment quality. Hence, this study uses the 4 aspects to explore the SCP.

Hall and Saygin (2012) stated information sharing is the data transfer process among firms and trading partners which improve the SCP and firms performance. The process classifies the critical and proprietary information is communicated to one's supply chain partner(Mentzer et al., 2000).The shared information needs to be presented clearly and can be easily understood by the partners (Cantor &Macdonald, 2009). The condition to achieve a best information sharing is the information has to accompany with the strong requirements for collaboration. By allowing trading partners to collaboratively manage the flow of decision making activities in a way to improve decision quality, the firms increase the interrelationships among parties (Lee et al., 2000; Lee &Whang, 2000).

Oliva and Waston (2011) defined information quality evaluated the information before used in decision making, both in content and in form. By sharing the trustworthy information, firms balanced the high quality planning activities to enhance the overall firm's performance (Zhou et al. 2014). Furthermore, information quality is an important determinant of the usefulness of the information system. There are 5 characteristic are used to make the SCP become useful in this study: timeliness, accuracy, completeness, adequacy, and reliability suggested by Li et al. (2005). The more information quality is maintained, the better SCP is attained (Zailani&Rajagopal, 2006).

After having a good information quality, the SCP using procedural quality to guarantee the shared information gave to departments are fair to improve the performance evaluations (Leventhal, 1980). Cohen and Spector (2001) showed that procedural quality focus on the partners' opportunities to the right of ideas freely communication, to complain firm decisions and to redesign organizational

procedures via supervisors. The performance evaluations is most likely to be perceived as fair when the supervisors have the allowance to detailed information about the planning activities used and perceive them as highly relevant, and when the performance evaluation is conducted uniformly and without bias among partners through procedural quality (Bellavance et al. 2013).

Oliva andWaston (2011) stated that alignment quality is the degree of synchronization of planning activity in SCP includes organizational and functional goals to enhance the performance. To achieve a successful alignment quality, firm need to collaborate with trading partners to plan and execute the conception of new products and services for ultimate customers, plan and execute pricing, promotion, and distribution strategies for the sale of products and services to ultimate customers(Ho et al., 2002; Chen &Paulraj, 2004; Keefe, 2008). However, Green et al. (2012) stated that alignment quality in the reality is difficult to achieve because the standard to determine the ultimate customer of the supply chain values and to effectively communicate changing customer needs to all supply chain partners.

2.2. *The proposed analytical method*

In previous studies, SCP under uncertainty have been discussed by several papers (Hung, 2011). Peidro et al. (2009), for example, proposed a fuzzy mixed-integer linear programming model which considers supply, demand and process uncertainties in SCP. The study suggested that the fuzzy formulation is more suitable than deterministic methods in solving with SCP which is difficult to obtain precise or certain information, and needed to be modeled by triangular fuzzy numbers. In addition, Liang and Cheng (2009) addressed an integrating manufacturing distribution planning decision problem with multi-product and multi-time period in supply chains by using a fuzzy multi-objective linear programming model with the consideration of time value of money for

each of the operating cost categories in an uncertain environment. The method is applied with the purpose at minimizing total costs and total delivery time in association with inventory levels, available machine capacity and labor levels at each source, market demand and available warehouse space at each destination, and total budget constraints.

However, the lacking and unqualified information could be obstacles. Dealing with uncertainty data, the fuzzy DEMATEL may suit to this study since lots of researches have been using this method to overcome the uncertainty data. The proposed method demonstrates the interrelationships among criteria to examine on each criteria used fuzzy numbers and analyzes the criteria importance by evaluating values to DEMATEL. Tseng et al. (2012) extended the DEMATEL to integrate service quality and employee performance evaluation under uncertainty. Lin (2013) using fuzzy DEMATEL to evaluate the green SCM practices. Hence, with the objective of this study, integrating the fuzzy set theory and DEMATEL are utilized to assess the interactions among the criteria and explore the determinant attribute of SCP under uncertainty.

3. Method

This section utilized an empirical example from the Taiwanese electronics industry to illustrate the approach. This section include in two subsections, firstly this section mention about industrial background and data collection. The measurement is demonstrated in the second part.

3.1. *Industry background and data collection*

The electronic in Taiwan has been the most dynamic industry in manufacturing in the last decade. This industry has been a driving force in Taiwan's economic development and moved from developing to developed country status (Jing et al., 2010). Along with the global trend and supported by the governments under regulations of encouragement, this industry

substantially grown up in Taiwan and become the most competitive business and then SCP is evaluated efforts to increase the competitive advantages and firm performance (Che, 2012). Due to having a significant influence on improving the competitiveness of firm, SPC problems is identified as the large concern in firm-wide. These problems related to synchronizing multiple activities in the firm from procurement of the raw materials to distribution of the final product to customers (Jun et al., 2004). For instance, one of the SCP problems is that the different participant partners in supply chain may not operate with the same level of information. Some may possess more information, while other may possess less information; this may lead to the information inaccurate and inadequate. Therefore, it is essential for firm to recognize the decisive attributes of SCP that supports for the firm's competitiveness and provide the recommendations for top management to lead to superior performance.

Therefore, to explore decisive attribute of SCP with 4 aspects, the data is collected from the Taiwan electronic industry and interviewed the experts. To achieve decision goal, the appropriate information is collected from the expert committees who have experience in SCP in this industry. This study applied the Fuzzy DEMATEL method to evaluate attribute. The experts are asked to evaluate the interrelationship of each criterion using four scores in linguistic term and coding by corresponding triangular fuzzy numbers (TFNs), which ranged from no important to very high important. The TFNs is as follow: 1 (no important) (0, 0.1, 0.3), 2 (very low important) (0.1, 0.3, 0.5), 3 (low important) (0.3, 0.5, 0.7), 4 (high important) (0.5, 0.7, 0.9), and 5 (very high important) (0.7, 0.9, 1.0). The results of analyses may contribute by the recommendation to identifying the critical criteria for improving performance and enhancing the competitive advantages of electronic industry in Taiwan.

3.2. Proposed of SCP measure

The table 1 presents a list of attribute. The construct SCP was measured through 4 aspects information quality, procedural quality, alignment quality and information sharing and twenty one criteria.

Information quality measures the degree to which a process enables the information used for decision making to be appropriatefor the decision maker and the decision. Chopra and Meindl (2012) suggested that information shared among supply chain partners must be accurate, accessible in a timely manner and correct. Li et al. (2005) measured information quality by timeliness, accuracy, completeness, adequacy, and reliability. Information quality is an important determinant of the usefulness of the information system. Sum et al. (1995) found that information accuracy is critical in affecting operational efficiency. This study measures information quality on 5criteria is adopted from study of Li et al. (2005) and Monczka et al. (1998). They are (C1) Information exchange between trading partners and firm is timely, (C2) Information exchange between trading partners and firm is accurate, (C3) Information exchange between trading partners and firm is complete, (C4) Information exchange between trading partners and firm is adequate, (C5) Information exchange between trading partners and firm is reliable.

Procedural quality means the level to which a process continuously assurance that the rules used to confirm information and to make decisions within across functions (Simon and Newell, 1972; March and Simon, 1993). Procedural quality of the planning process refers to the appropriateness and the soundness of the rules of inference and judgment used for developing and validating the plans. Procedural quality can suffer from undue influence from the incentive landscape, since incentives and priorities can bias the rules of inference used in the assessment of a plan's validity. This study measures information quality on 5 criteria is adopted from Luo (2007). They are (C6) To make the process fair required regulations and structuring activities have been carried out,

(C7) Planning organizational and management activities are fair, (C8) Sharing of administrative information and sources used in process is dependent upon certain rules, (C9) Execution and inspection of the contracts related to process are carried out in a fair manner, (C10) Decisions related to process are explicitly defined and implemented.

Alignment quality refer to the degree to which a process make sure that the firm goals and functional goals are supported and the resulting actions are synchronized (Sahin& Robinson, 2002; Bendoly& Jacobs, 2004). The items in the alignment measurement scale are based upon the necessity to align, integrate, and coordinate marketing processes (Natarajan &Weinrauch, 1990; Min &Mentzer, 2000; Ho et al., 2002). This study measures alignment quality on 4 criteria. (C11) Firm work with supply chain partners to plan and execute the conception of new products and services, (C12) Firm work with supply chain partners to plan and execute a pricing strategy for the sale of products and services, (C13) Firm work with supply chain partners to plan and execute a promotion strategy for the sale of products and

services, (C14) Firm work with supply chain partners to plan and execute a distribution strategy for the sale of products and services.

Information sharing refers to the extent to which important and exclusive information is communicated to supply chain partner (Monczka et al., 1998). Supply chain partners who exchange information regularly are able to work as a single entity. Together, they understand the needs of the end customer better and thus respond to market change quicker. This study measures information sharing on 7 criteria. They are (C15) Firm share the proprietary information with trading partners, (C16) Firm inform trading partners in advance of changing needs, (C17) Trading partners share proprietary information with firm, (C18) Trading partners keep firm fully informed about issues that affect the business, (C19) Trading partners share business knowledge of core business processes with firm, (C20) Firm and trading partners exchange information that helps establishment of business planning, (C21) Firm and trading partners keep each other informed about events or changes that may affect the other partners.

Table1. Aspects and Criteria

Aspect		Criteria	Reference
Information quality	C1	Information exchange between trading partners and firm is timely	Chopra and Meindl (2012); Li et al. (2005); McGowan (1998); Sum et al. (1995)
	C2	Information exchange between trading partners and firm is accurate	
	C3	Information exchange between trading partners and firm is complete	
	C4	Information exchange between trading partners and firm is adequate	
	C5	Information exchange between trading partners and firm is reliable	
Procedural quality	C6	To make the process fair required regulations and structuring activities have been carried out.	March and Simon, 1993; Simon and Newell, 1972; Luo (2007); Bendoly& Jacobs (2004)
	C7	Planning organizational and management activities are fair	
	C8	Sharing of administrative information and sources used in process is dependent upon certain rules.	
	C9	Execution and inspection of the contracts related to process are carried out in a fair manner.	

Aspect		Criteria	Reference
	C10	Decisions related to process are explicitly defined and implemented.	
Alignment quality	C11	Firm work with supply chain partners to plan and execute the conception of new products and services	Sahin & Robinson (2002); Ho et al. (2002); Min & Mentzer (2000); Natarajan & Weinrauch (1990)
	C12	Firm work with supply chain partners to plan and execute a pricing strategy for the sale of products and services	
	C13	Firm work with supply chain partners to plan and execute a promotion strategy for the sale of products and services	
	C14	Firm work with supply chain partners to plan and execute a distribution strategy for the sale of products and services	
Information sharing	C15	Firm share the proprietary information with trading partners	Monczka et al. (1998);
	C16	Firm inform trading partners in advance of changing needs	
	C17	Trading partners share proprietary information with firm	
	C18	Trading partners keep firm fully informed about issues that affect the business	
	C19	Trading partners share business knowledge of core business processes with firm	
	C20	Firm and trading partners exchange information that helps establishment of business planning	
	C21	Firm and trading partners keep each other informed about events or changes that may affect the other partners	

4. Results

This section is to introduce the fuzzy set theory andDEMATEL method that applies in this study and finding out some results.

4.1. Fuzzy set theory

The linguistic performance of each attribute was based on a scale of 1-5 with TFNs, the performance of the attribute proportional to the soccer. The Fuzzy set theory questionnaires were delivered to experts. Data collection were converted into TFNs. After that, the fuzzy assessments are defuzzified and aggregated values. The original 4 aspects and twenty onecriteria were adopted and presented in Table 1.Table 2 presented the results of fuzzy set theory.

4.2. Dematel

4.2.1 The driving and dependence power of aspects

Table 3 gives the driving and dependence power for aspects. This analysis is conducted to investigate driving power and dependence power of the aspects, namely, Information quality (AS1), Procedural quality (AS2), Alignment quality (AS3), and information sharing (AS4). While the horizontal axis "driving power", represents the aspect's driving power, the vertical axis "dependence power" represents the dependence power. The aspects, therefore, are classified into the cause and effect based upon this analysis. Driving group includes AS2 and AS1. Dependence group contains AS3 and AS4.

Table 2. The resultof Fuzzy set theory

	AS1	AS2	AS3	AS4	Xl	Xm	Xr	Xls	Xrs	Xij	Zij	Wij
AS1	(0.5,0.7, 0.9)	(0.3,0.5, 0.7)	(0.0,0.1, 0.3)	(0.3,0.5, 0.7)	0.375	0.325	0.275	0.342	0.289	0.326	0.361	1.083
AS2	(0.5,0.7, 0.9)	(0.3,0.5, 0.7)	(0.3,0.5, 0.7)	(0.5,0.7, 0.9)	0.375	0.325	0.275	0.342	0.289	0.326	0.361	1.525
AS3	(0.1,0.3, 0.5)	(0.1,0.3, 0.5)	(0.3,0.5, 0.7)	(0.1,0.3, 0.5)	-0.025	-0.075	-0.125	-0.079	-0.132	-0.072	0.043	0.447
AS4	(0.1,0.3, 0.5)	(0.1,0.3, 0.5)	(0.3,0.5, 0.7)	(0.0,0.1, 0.3)	-0.025	-0.075	-0.125	-0.079	-0.132	-0.072	0.043	0.288

Table 3. Driving-dependence power of aspects

	D	R	Driving power	Dependence power
AS1	0.97	0.87	1.84	0.11
AS2	1.74	0.37	2.10	1.37
AS3	0.65	0.87	1.53	-0.22
AS4	0.59	1.84	2.43	-1.25

Figure 1 presented that Procedural quality (AS2) has the highest "dependence power" score with 1.37 that means AS2 get more impact on the whole system of SCP. Besides, the result shows that the degree of influential

impact D of AS2 is 1.74 ranked in the top four among all cause others. Hence, AS2 has significant impact on other aspects. Ingeneral, AS2 is a main aspect that gets more performance in the SCP. The second highest "dependence power" score of AS1 is positive, which suggests that AS1 is a group cause aspect of the whole system. AS1 has power to improve the system. Alignment quality (AS3) and Information sharing (AS4) is an effect factor with "dependence power" as -0.22 and -1.25 that below zero. It means that AS3 and AS4 is just affected by other system.
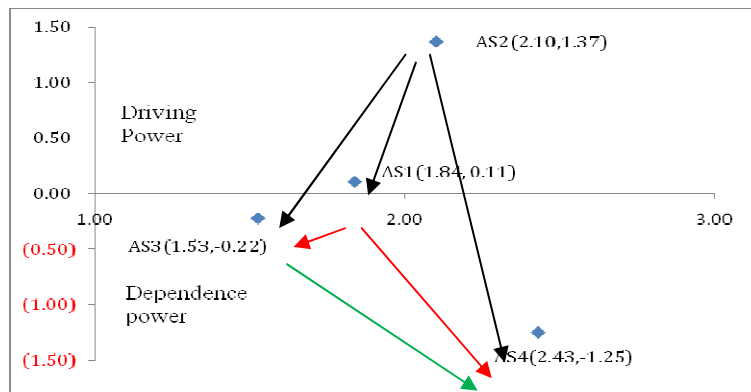

Figure 1. Driving-dependence power diagram.

4.2.2 The causeinterrelationship of criteria

Table 4 gives the DEMATEL initial direct relation matrix for criteria. The empirical data is obtained from each individual expert assessment to normalize the assessment data. The linguistic information converts the TFNs

into crisp value is the computed crisp values.Table 5 shows the total relation matrix for criteria.The crisp value of SCP criteria from the fuzzy assessment is composed of the initial direct relation matrix. and obtained the normalized direct relation matrix.

Table 4. DEMATEL initial direct relation matrix

	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13	C14	C15	C16	C17	C18	C19	C20	C21
C1	0.000	0.045	0.040	0.039	0.042	0.040	0.039	0.041	0.041	0.040	0.041	0.042	0.039	0.042	0.048	0.040	0.043	0.042	0.040	0.043	0.040
C2	0.042	0.000	0.044	0.042	0.046	0.045	0.043	0.044	0.043	0.044	0.044	0.045	0.043	0.045	0.050	0.044	0.047	0.048	0.044	0.046	0.044
C3	0.045	0.050	0.000	0.046	0.048	0.047	0.043	0.047	0.046	0.046	0.047	0.048	0.045	0.047	0.052	0.046	0.048	0.050	0.046	0.048	0.047
C4	0.047	0.052	0.047	0.000	0.051	0.052	0.047	0.049	0.047	0.049	0.048	0.049	0.047	0.049	0.052	0.048	0.050	0.053	0.047	0.050	0.047
C5	0.040	0.046	0.044	0.040	0.000	0.044	0.043	0.044	0.044	0.044	0.044	0.045	0.043	0.043	0.052	0.046	0.047	0.045	0.043	0.048	0.044
C6	0.047	0.058	0.048	0.046	0.058	0.000	0.047	0.050	0.048	0.050	0.049	0.050	0.048	0.045	0.054	0.050	0.054	0.054	0.047	0.053	0.046
C7	0.045	0.052	0.045	0.044	0.051	0.047	0.000	0.045	0.043	0.044	0.046	0.047	0.044	0.044	0.048	0.045	0.046	0.050	0.043	0.047	0.046
C8	0.043	0.054	0.050	0.040	0.057	0.044	0.042	0.000	0.043	0.046	0.044	0.046	0.042	0.040	0.049	0.044	0.048	0.047	0.044	0.046	0.047
C9	0.041	0.050	0.044	0.037	0.054	0.044	0.040	0.038	0.000	0.041	0.040	0.042	0.043	0.036	0.045	0.040	0.043	0.043	0.040	0.044	0.041
C10	0.045	0.055	0.048	0.047	0.056	0.048	0.045	0.045	0.047	0.000	0.045	0.046	0.045	0.042	0.044	0.046	0.050	0.049	0.046	0.047	0.048
C11	0.044	0.057	0.050	0.046	0.049	0.046	0.044	0.047	0.044	0.046	0.000	0.044	0.044	0.039	0.042	0.046	0.048	0.050	0.045	0.048	0.046
C12	0.037	0.046	0.041	0.036	0.040	0.041	0.036	0.036	0.035	0.040	0.036	0.000	0.035	0.033	0.035	0.037	0.040	0.040	0.035	0.038	0.038
C13	0.045	0.055	0.051	0.046	0.051	0.048	0.046	0.049	0.046	0.051	0.051	0.049	0.000	0.045	0.052	0.051	0.049	0.053	0.047	0.050	0.047
C14	0.040	0.042	0.044	0.040	0.048	0.044	0.039	0.042	0.044	0.044	0.043	0.041	0.041	0.000	0.042	0.042	0.049	0.041	0.040	0.045	0.040
C15	0.043	0.051	0.046	0.045	0.048	0.046	0.043	0.043	0.044	0.045	0.044	0.046	0.043	0.043	0.000	0.045	0.051	0.049	0.042	0.049	0.045
C16	0.035	0.040	0.043	0.040	0.044	0.038	0.038	0.042	0.039	0.040	0.040	0.041	0.040	0.035	0.040	0.000	0.044	0.042	0.040	0.041	0.037
C17	0.043	0.045	0.044	0.042	0.046	0.045	0.043	0.044	0.042	0.043	0.043	0.044	0.041	0.040	0.046	0.043	0.000	0.048	0.043	0.047	0.040
C18	0.045	0.045	0.047	0.045	0.047	0.046	0.043	0.045	0.045	0.045	0.044	0.046	0.044	0.045	0.048	0.045	0.047	0.000	0.044	0.044	0.046
C19	0.037	0.046	0.039	0.040	0.041	0.043	0.038	0.045	0.038	0.043	0.040	0.040	0.038	0.040	0.044	0.039	0.046	0.040	0.000	0.041	0.039
C20	0.042	0.044	0.042	0.042	0.045	0.043	0.040	0.044	0.040	0.041	0.043	0.036	0.040	0.041	0.043	0.041	0.044	0.043	0.041	0.000	0.041
C21	0.046	0.043	0.038	0.039	0.040	0.043	0.037	0.039	0.038	0.041	0.041	0.039	0.037	0.039	0.040	0.042	0.040	0.042	0.039	0.040	0.000

Table 5. Total DEMATEL relation matrix

Criteria	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13	C14	C15	C16	C17	C18	C19	C20	C21
C1	0.301	0.385	0.354	0.334	0.378	0.353	0.333	0.351	0.342	0.349	0.346	0.352	0.336	0.336	0.372	0.349	0.370	0.368	0.341	0.364	0.345
C2	0.363	0.367	0.382	0.359	0.406	0.380	0.358	0.377	0.367	0.376	0.372	0.378	0.361	0.361	0.398	0.375	0.397	0.397	0.366	0.390	0.371
C3	0.384	0.435	0.359	0.381	0.429	0.401	0.376	0.398	0.388	0.396	0.393	0.399	0.381	0.381	0.419	0.396	0.418	0.419	0.387	0.412	0.393
C4	0.399	0.452	0.418	0.350	0.447	0.420	0.393	0.413	0.402	0.413	0.409	0.415	0.396	0.396	0.434	0.412	0.435	0.435	0.401	0.428	0.407
C5	0.361	0.410	0.381	0.356	0.361	0.379	0.357	0.376	0.366	0.375	0.371	0.377	0.360	0.358	0.399	0.376	0.397	0.393	0.365	0.391	0.371
C6	0.405	0.464	0.425	0.399	0.459	0.377	0.399	0.420	0.409	0.419	0.415	0.421	0.403	0.397	0.441	0.419	0.444	0.443	0.406	0.437	0.412
C7	0.378	0.429	0.394	0.372	0.424	0.394	0.328	0.389	0.378	0.388	0.385	0.391	0.373	0.371	0.408	0.388	0.409	0.411	0.377	0.404	0.385
C8	0.373	0.428	0.396	0.365	0.425	0.388	0.366	0.343	0.375	0.387	0.381	0.388	0.368	0.365	0.406	0.384	0.408	0.405	0.375	0.400	0.383
C9	0.346	0.396	0.365	0.338	0.395	0.363	0.340	0.355	0.309	0.357	0.352	0.358	0.345	0.336	0.376	0.355	0.376	0.375	0.347	0.372	0.353
C10	0.384	0.440	0.405	0.381	0.436	0.403	0.378	0.397	0.389	0.353	0.392	0.398	0.381	0.376	0.413	0.396	0.420	0.418	0.386	0.411	0.394
C11	0.378	0.435	0.400	0.375	0.423	0.394	0.371	0.392	0.380	0.390	0.343	0.389	0.374	0.367	0.404	0.39	0.412	0.412	0.380	0.405	0.386
C12	0.312	0.357	0.330	0.307	0.348	0.327	0.305	0.321	0.312	0.323	0.317	0.286	0.308	0.303	0.333	0.321	0.340	0.339	0.311	0.333	0.319
C13	0.398	0.455	0.422	0.394	0.446	0.417	0.392	0.414	0.401	0.415	0.411	0.414	0.351	0.392	0.434	0.414	0.434	0.436	0.401	0.428	0.407
C14	0.347	0.392	0.368	0.344	0.393	0.365	0.341	0.361	0.353	0.361	0.357	0.360	0.346	0.304	0.376	0.359	0.385	0.376	0.350	0.376	0.355
C15	0.370	0.423	0.391	0.368	0.416	0.388	0.365	0.383	0.374	0.383	0.380	0.386	0.368	0.366	0.357	0.383	0.408	0.405	0.371	0.401	0.379
C16	0.323	0.367	0.346	0.324	0.367	0.339	0.321	0.340	0.329	0.337	0.335	0.339	0.325	0.319	0.352	0.299	0.358	0.355	0.329	0.350	0.331
C17	0.356	0.401	0.373	0.351	0.397	0.372	0.351	0.368	0.358	0.366	0.363	0.369	0.351	0.348	0.386	0.366	0.344	0.388	0.357	0.383	0.360
C18	0.370	0.415	0.389	0.366	0.412	0.387	0.363	0.382	0.373	0.382	0.377	0.384	0.367	0.365	0.401	0.381	0.402	0.356	0.372	0.394	0.378
C19	0.333	0.382	0.350	0.332	0.373	0.352	0.328	0.351	0.336	0.349	0.342	0.347	0.331	0.331	0.364	0.344	0.369	0.362	0.299	0.358	0.341
C20	0.344	0.387	0.360	0.340	0.384	0.359	0.337	0.357	0.345	0.353	0.352	0.349	0.34	0.339	0.371	0.353	0.374	0.371	0.345	0.326	0.350
C21	0.336	0.373	0.344	0.325	0.366	0.346	0.323	0.340	0.331	0.341	0.338	0.340	0.325	0.325	0.355	0.341	0.358	0.358	0.331	0.352	0.298

Table 6 presents prominence and relation axis for the cause and effect group. The horizontal axis vector named "cause" is made by adding D to R, which reveals the importance of criterion. Similarly, the vertical axis named "effect" is made by subtracting D from R, which may criteria into a cause group. If the "effect" is negative, the criteria are grouped into the effect group. Therefore, the cause and effect diagram can be acquired by mapping the dataset of the (cause, effect), providing valuable insight for problem solving. The criteria were used to construct the cause diagram and interrelationships as shown in Figure 2

Table 6. Prominence and relation axis for the cause and effect group

|	D	R	Cause	Effect
C1	7.36	7.56	14.92	-0.20
C2	7.90	8.59	16.49	-0.69
C3	8.35	7.95	16.30	0.40
C4	8.67	7.46	16.13	1.21
C5	7.88	8.48	16.36	-0.60
C6	8.81	7.91	16.72	0.90
C7	8.18	7.42	15.60	0.76
C8	8.11	7.83	15.94	0.28
C9	7.51	7.62	15.13	-0.11
C10	8.35	7.81	16.19	0.51
C11	8.20	7.73	15.93	0.47
C12	6.75	7.84	14.59	-1.09
C13	8.68	7.49	16.17	1.19
C14	7.57	7.44	15.01	0.13
C15	8.07	8.20	16.27	-0.13
C16	7.08	7.80	14.88	-0.72
C17	7.71	8.26	15.97	-0.55
C18	8.02	8.22	16.24	-0.20
C19	7.27	7.60	14.87	-0.33
C20	7.44	8.12	15.56	-0.68
C21	7.15	7.72	14.87	-0.57
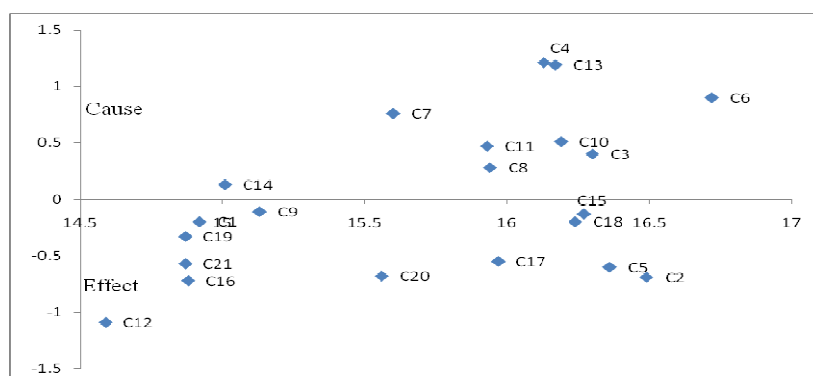
Figure 2. The cause and effect diagram.

As a result of the DEMATEL in the Figure 2 showed that twenty one criteria divided into cause and effect group. There are nine criteria belong to cause group. They are Information exchange between trading partners and firm is adequate (C4), Firm work with supply chain partners to plan and execute a promotion strategy for the sale of products and services (C13), In order to make the process fair required regulations and structuring activities have been carried out (C6), Planning organizational and management activities are fair (C7), Decisions related to process are explicitly defined and implemented (C10), Firm work with supply chain partners to plan and execute the conception of new products and services (C11), Sharing of administrative information and sources used in process is dependent upon certain rules (C8), Information exchange between trading partners and firm is complete (C3), Firm work with supply chain partners to plan and execute a distribution strategy for the sale of products and services (C14).

In the other hand, there are twelve criteria are put in the effect group. Firm share the proprietary information with trading partners (C15), Execution and inspection of the contracts related to process are carried out in a fair manner (C9), Information exchange between trading partners and firm is timely (C1), Trading partners keep firm fully informed about issues that affect the business (C18), Trading partners share business knowledge of core business processes with firm (C19), Trading partners share proprietary information with firm (C17), Firm and trading partners keep each other informed about events or changes that may affect the other partners (C21), Firm inform trading partners in advance of changing needs (C16), Firm and trading partners exchange information that helpsestablishment of business planning(C20), Information exchange between trading partners and firm is accurate (C2), Information exchange between trading partners and firm is reliable (C5), Firm work with supply chain partners to plan and

execute a pricing strategy for the sale of products and services (C12).

In summary, information exchange between trading partners and firm is adequate (C4) is very important criterion in the cause group as it highest "effect" score with 1.21.Besides that, table 6 show that the degree of influence impact D is the also highest with 8.81 mean and the degree of "effect"is ranked top three among all criteria. Hence, (C6) has a significant in cause group that impact on other criteria. In this study, (C14) is located in cause group with low Prominence and Relation, hence, plan and execute a distribution strategy for the sale of products and services as the follow up criterion needs to be considered in electronic industry. In effect group, there are many independent criterions include (C1), (12), (16), (19), (21) that have less interaction with SCP but firms need to pay intention and remove which is unnecessary. In addition, (C2), (C5), (C15), (C17), (C18), (C20) are located in effect group with "cause" and low "effect" as these criteria must be concentrated and improved. Nonetheless, the improvement needs to go through others criteria.

5. Theoretical and managerial implications

This section presents theoretical contributions which relate to literature of SCP and providing managerial implications for practice.

5.1. Theoretical Implications

This study contributes to the literature by providing evidence in proving that firm's sustainability may improve through the efficient of SCP. Moreover, to explore the decisive attribute of SCP, this study indicated that the cause aspect are information quality and procedural quality are elements that impacting on alignment quality and also contributing information sharing.

Procedural quality is found that plays a significant role in SCP that is identified in the decision making process of firm. This aspect

assists firm in the strategic decision making process that related to process are explicitly defined and implemented as well as facilitate the acceptance of certain rules and avoid unfair regulations. Information quality is also found that a driving aspect in SCP since with the assurance of the timely, reliability, adequate as well as the accuracy of information importantly contributes to reduce cost in planning process, this lead to the efficient in SCP. The finding of this study is similar the research of McGowan (1998), this study also asserted thatonly when the information is high quality, readily accessible, accurate and relevant, would the information system be perceived useful and the several transaction costs such as information gathering, negotiation, and monitoring cost can be reduced. Therefore, having better information quality may motivate firms to implement effective supply chain and improved business performance (Zhou and Benton, 2007; Vickery et al., 2003).

While Alignment quality and Information sharing shows as the independent aspect which has less interaction with other aspects. However, Zhao (2002) and Lee et al. (2000) give evidence of the impact of information sharing on inventory reduction and cost reduction. Moreover, Fawcett et al. (2007) have found that information sharing influence on SCP. In SCP, members may attain perfect information about themselves, but might not have such perfect information about the other members. Uncertainties may arise as a result of this lack of information about other members. If the members have the ability and willingness to share information with other members, uncertainties can be significantly reduced. Moreover, Yu et al. (2001) and Lee (2004) stated that the bullwhip effect may be caused by the lack of information and the flow of information within supply chain members leading to a centralized system with much less uncertainties may significantly reduce or even eliminate the negative impact of this effect. Moreover, Yu et al. (2001) and Lee (2004) stated that having some effects may be caused

by the lack of information. The flow of information within supply chain members leading to a centralized system with much less uncertainties may significantly reduce). Therefore to improve the information sharing and alignment quality, firm need to enhance the decisive aspect information quality and procedural quality.

5.2. Managerial implications

The aim of this study is exploring the decisive attributes of SCP in Taiwan electronic industry. By using fuzzy DEMATEL, the study provide manager an overview of SCP in through twenty one criteria. Decision-making is identified as solving several issues that the electronic industry is facing based on the cause and effect results of the diagram, thereby improving firm performance and increasing competitive advantage. This study used the fuzzy DEMATEL method to analyze and offer an indicator to the Taiwan electronic industry. The results of this study showed that the firms should concentrate on some critical criteria to improve the SCP.

Based on the analysis results, several management implications are observed and determine that electronics firms should control and focus on the cause group in advance. Hence, to improve SCP, firm should concentrate on the cause group, especially for the criterion located in the driving aspects area to maximize the performance improvement with limited resources. The criteria in the cause group imply the meaning of the influencing criteria, and the effect group criteria denote the meaning of the influenced criteria. Hence, this study advises that considering improvements in the cause criteria via driving aspects when seeking the best approach for firm.

Information exchange between trading partners and firm is complete. Forms of communication need to block strong cohesion between firm with partners to ensure the exchange process is accurate and secure. Focusing on the completion of the exchange

information system could prevent the loss of power in the supply chains (Li et al. 2005). To perform this process a complete way, between firm should have a common system for sharing information is updated continuously. With this system,firm capture the process of work from its parts in the supply chain. For example, when using a shared information system complete, the information be transferred from the headquarter firm to subsidiaries quickly and be responsive, for the synchronization of information is critical to the smooth link performance than ensuring the productivity of work. The manager after receiving information from the headquarter firm to transmit information to the department so that employees grasp the objectives and work. Since the exchange of information is completed.

Information exchange between trading partners and firm is adequate. Besides the complete, information exchanged should adequate between trading partners. The accuracy of the shared information is the best practice to obtain the best SCM solution (Alvarez, 1994). Full information exchange enough help firm and partners learn the process of implementing the work of the party. Based on the information provided, the partners are easier to control the progress of work ahead of schedule. The provision of adequate communication between the parts of firm have contributed very important, the departments have to be linked together the support together to complete objectives. More importantly, provide full information also helps trading partners and other firm more confidence in the work process.

To make the process fair required regulations and structuring activities have been carried out. Regulations and structuring activities need to be raised and discussed to get the unification between the parties. This aims to create fairness of the process and create harmony between associated firms. Regulations ensure that the partners capture the powers of work with the purpose to improve the quality. In addition, firms have to response for itself

when do not followed the rules. Operational structure helps firms capture their share of work in the supply chain to make the synchronization of operational processes. This is helpful for managers to understand the target and achieve it easier. Their managers know what to do, how and where to exercise their powers in order not to abuse their powers. For example, if the logistics department, managers must complete tasks and ensure the products transportation is safety, in addition contact to the manufacturer to guarantee the department always have goods.

Planning organizational and management activities are fair. The fairness is influenced by both perceptions of process and outcome and that a fair process can enhance acceptance of the outcome (Gross, 2007). Among the parts of the firm are to have the chief to manage the work. The department manager under the direction of a general manager, the manager should have the intelligent operations management and equity to create unified harmony between departments. Collect the general idea is to create a plan for firms with high concurrence. This is necessary because if the standard parts have no connection and unity, the work schedule is delayed and reduced work efficiency and impact significantly on the chain link. Specifically, in the electronics, the new product is launched should have the sympathy of the parts. For example, product research department given that the new material can improve product yield cost savings. But parts production suggests that this idea is not feasible to make wasted costs. To have a fair and detailed plans the manager need experiment by trying new products to generate equity research department and not to waste production ideas. It also halted the trial product if the product is not feasible.

Sharing of administrative information and sources used in process is dependent upon certain rules. The sharing of administrative information to help firms in the chain link could more flexible in order to make decisions and use their resources. It must also ensure that no abuse under certain rules. If overused cause an

imbalance between the parts together, reducing work efficiency. The user should have a specialized division of resources results in a transparent and close to, the division of resources must use the information to the relevant department. Specifically, firms should have a joint financial fund to give the plan to develop products or recruit staff for the department. Financial funds must be used based on the consent of the parties concerned on the basis of certain rules. In addition to transparency, these funds also need flexibility in order not to lose time and slow the progress of work.

Decisions related to process are explicitly defined and implemented. The decision must be consensus before making implementation. For instance, when making a new strategy for the product, the decision with highest rate among parties about the production, advertising strategy and the distribution in detail. Once agreed the opinion, the parties perform their specific tasks one of the best and also the right to exchange the workflow to ensure that other parts capture information in the most obvious way. In this way, the chain links are held together better and work efficiency is improved.

Firm work with supply chain partners to plan and execute the conception of new products and services. This must be discussed not specific to the situation that conflicts between new products and new services with existing products in order to limit the cost of losses. When the new product is arrived, the firm have to calculate inventory status or the imbalance between products, new services are developed to ensure that the interests of the best customers and providers the service. Headquarter should have some incentive programs for firms in the supply chain to encourage the productivity. The pricing for products and strategies for new products is important, the price may be the biggest obstacle, but if the product is worth its value create the loyal for customers. The advertising and customer services help customers sympathetic to products and firms. Green et al

(2012) showed that marketer work with the trading partners to conceive of new products and services and to execute integrated pricing, promotion, and distribution strategies that bring value for and communicate value to customers.

6. Conclusions

The electronics industry has been continuously developed and contributed a significant part of Taiwan's economy. In the rapid growth, firm has to face with many challenges due to the complex market and competitive. Thereby, SCP has been regarded as an important strategic activity for firm doing in the business environment. This study used the fuzzy DEMATEL method to explore the decisive attribute of SCP under uncertainty. The aspects are presented as information quality, procedural quality, alignment quality and information sharing and twenty one criteria, which belonging to 4 aspects. By using fuzzy DEMATEL method, the interrelationships among proposed criteria are explored.

The aim of this study is to explore the decisive attribute of SCP under uncertainty. This study confirms that information quality, procedural quality that impact on alignment quality and information sharing. Based on the analysis results, in order to improve SCP, electronics firms should control and focus on the cause group in advance. In more detail, critical criteria in the cause group are the information exchange between trading partners and firm is adequate and complete, the firm work with supply chain partners to plan and execute the conception of new products and services as well as the promotion strategy for the sale of products and services. In order to make the process fair, required regulations and structuring activities have been carried out. Due to the electronic industry is considered as the most competitive industry, firm need to focus on the mentioned criteria to achieve the efficient of SCP.

This study contributes the literature in SCP by exploring attributes under uncertainty. This

study enriches SCP literature by confirming that information quality, procedural quality, the alignment quality and information sharing among firms in supply chain. Moreover, this study also contributes the interrelationship among attributes of SCP.the finding help manager determine the critical criteria, thereby enhance the effectiveness of SCP and improve firm performance. Additionally, the exchange information between parties and departments among firms is the most important.

This study is not without its limitation that future studies need to have further examination. First, this study is focused on the electronic industry in Taiwan, so the further studies can mention other industries in Taiwan or other countries and compare with this study. Second, this study was conducted using existed literature to explore decisive factor of SCP under uncertainty, thus, the set of criteria may not comprehensive. Finally, this study applies the fuzzy DEMATEL to implement the evaluation of criteria through individual rather than a full-fledged industrial survey. Hence, future researches can use different methods to identify more criteria to justify the SCP.

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