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Aligning supply chain strategy with corporate environmental strategy: A contingency approach

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ABSTRACT

Environmental sustainability is driving firms to extend their green effort across their supply chain. However, the literature has not thoroughly examined the multiple relationships among supply chain (SC) strategy, corporate environmental (CE) strategy, and firm performance. As such, this paper, adopts an alignment perspective to empirically examine the complex links between four SC strategies and four CE strategies on 172 manufacturing firms in Taiwan. Using profile deviation analysis, it is found that overall an SC strategy when properly aligned with a CE strategy leads to improved firm performance. Specifically, a risk-hedging SC strategy should be aligned with a defensive CE strategy to yield improved firm performance. Likewise, a responsive SC strategy should be aligned with an accommodative CE strategy, and an agile SC strategy with a proactive CE strategy.

1. Introduction

Environmental sustainability drives firms to not only develop corporate environmental proactivity but also to move toward green/sustainable supply chain management (Aragon-Correa and Rubio-López, 2007; Seuring and Müller, 2008). Already, firms have adopted environmental friendly practices such as environmental purchasing (Green et al., 1996), green supply (Bowen et al., 2001), green supply chain management (GSCM) (Zhu and Sarkis, 2004), and sustainable logistics strategies (Kumar and Putnam, 2008).

Research (Carter and Rogers, 2008; Molina-Azorín et al., 2009) suggests that proactive green initiatives yield competitiveness, economic benefits, better corporate social responsibility, and sustainability. However, the implementation of environmental management involves numerous actors in the supply chain, which may lead to managerial challenges related to broader organizational complexities (Vachon and Klassen, 2008), high transaction costs, supply risk, and effective control over suppliers and implementation (Simpson and Power, 2005). These different outcomes could be due to the fact that sustainability broadens supply chain management to a wider and integrated perspective rather than a uni-dimensional and dichotomous view (Linton et al., 2007; Seuring and Müller, 2008).

According to Linton et al. (2007), sustainability changes existing practices and creates new production and management systems. As such, it is difficult for firms to achieve a balance between the traditional efficiency based performance and environmental benefits, which in turn influences green management at the business and functional levels (Handfield et al., 2005; Mollenkopf et al., 2010). To mitigate the environmental risks arising from supply chain uncertainties and other issues, new analytical tools, performance metrics, and frameworks to are needed address the environmental issues in the supply chain (Fabbe-Costes et al., 2011; Handfield et al., 2005; Simpson and Power, 2005). However reengineering the supply chain under such a complex and uncertain context is a challenge. Bielak et al. (2007), in a survey of 391 CEOs, report that competing strategic priorities and the lack of recognition from financial markets are the main impediments when implementing integrated approaches to sustainability. They also indicate that it is difficult to manage a sustainable supply chain operating under different national regulations and social norms. Thus, two research questions arise: (1) what is the effective management of the multiple relationships between supply chain management and the environment, and (2) how does the deviation of the strategies from the ideal affect the overall firm performance.

Mollenkopf et al. (2010) urge that research should address how firms could implement green, lean, and global supply chain strategies concurrently to provide effective decision making across the supply chain. Further, Monczka and Petersen (2012) suggest that environmentally sustainable supply chain management is an integrated strategy which must align closely with and support

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business strategy in response to a changing marketplace. In the context of aligning goals for both efficiency and the environment, it is critical for firms to understand the unique needs of each strategy, and develop new capabilities to strategically integrate sustainability into the Supply Chain (SC) strategy and effectively manage the complex relations underlying these two strategies. Accordingly, this study adopts an alignment or fit perspective to examine the relationships between SC strategy and corporate environmental (CE) strategy, and the influence of the degree of alignment of these two strategies on performance enhancement.

Already, a significant amount of strategic alignment studies exists in the environmental management and green supply chain management literature. For instance, based on both moderation and mediation models, organizational factors and business circumstances are employed in discussing the environmental-performance linkage, e.g. industrial growth (Russo and Fouts, 1997), complementary assets (Christmann, 2000), business circumstances (González-Benito and González-Benito, 2005), and firm resources (López-Gamero et al., 2009). Further, research (e.g. Kocabasoglu et al., 2007; Wu et al., 2012; Zhu and Sarkis, 2004) has identified that factors such as production principles, willingness to take risk, and institutional pressures have moderating effects on green/reverse supply chain management. In contrast, some studies suggest that environmental practices have mediated impacts on green supply and manufacturing competitiveness (e.g. Bowen et al., 2001; Yang et al., 2010). Nevertheless, these studies mostly examine the relationships among the variables using the reductionist approach, which may not fully explain the interdependencies among the research constructs (Umanath, 2003). Besides, there is a dearth of research on the alignment effects of supply chain uncertainty and environmental strategy selection. Our paper borrows from the IS literature and adopts the profile deviation approach (Venkatraman, 1989). In this approach, alignment is conceptualized as the adherence to an external profile of an ideal type. In short, an ideal alignment scenario is deduced from theory and the deviations from this ideal state (usually measured empirically) are computed for further analysis.

This paper makes the following contributions. First, we adopt a novel methodological innovation as profile deviation analysis is relatively new to the environmental and supply chain field (Chen et al., 2011; Sun et al., 2009). Second, this study empirically examines the alignment impact of SC strategy and CE strategy on firm performance. Alignment in this study suggests that a firm's choice of a CE strategy fits its SC strategy. Greater alignment is viewed as a highly internal consistency of the activities that implement the numerous attributes of SC and CE strategies. From a managerial perspective, the alignment concept provides firms with a useful and systematic tool for considering SC and CE strategies simultaneously and then making holistic decisions within the firm and across the supply chain. Combined, an alignment of two distinct strategy streams under a profile deviation approach allows for effective decision making on environmental resource allocation in a supply chain context. This is unique to the field and is consistent with the multi-dimensional and holistic perspective of sustainable supply chain management. Thus, a high degree of adherence to the ideal profiles of SC and CE strategies improves firm performance. The third contribution is to provide a research agenda that systematically addresses SC and CE strategies to explain the possible benefits on performance. In doing so, this paper contributes to the literature by providing a unified theoretical lens to examine the complex network relationships and interactions of the different domains related to supply chain, sustainability, strategy, and performance. This will lend new insights into the theory and practice of SC and CE strategies.

The rest of the paper is organized as follows. Section 2 first provides the theoretical background on the alignment concept and the ideal profiles of the SC and CE strategies, and then introduces the research model and hypotheses. Section 3 describes the research method, followed by a presentation of the results in Section 4. Section 5 provides a discussion of the findings, implications, and limitations and some directions for future research.

2. Theoretial background and hypotheses

We first discuss the alignment concept, the four ideal profiles for SC strategy, and the four ideal profiles for CE strategy, and then develop the research hypotheses.

2.1. Alignment concept

According to Nadler and Tushman (1980), alignment is the adjustment of one component in relation to another component so that the arrangement leads to an optimal consequence of the relationship between the components. Kaplan and Norton (2006) define strategic alignment as the internal consistency of the activities that implement the different attributes of strategy. The concept of alignment or fit is essential in a process of change in strategy formulation. As suggested by Miles and Snow (1984:12), "the process of achieving fit begins, conceptually at least, by aligning the company to its marketplace … this process of alignment defines the company's strategy." Moreover, Venkatraman (1989) identifies six perspectives of alignment: moderation, mediation, matching, gestalt, profile deviation, and covariation. So far, only the moderation and mediation models are commonly used in the environmental and supply chain management research.

Though conceptualized in the context of strategy research, the alignment concept is also applicable to other disciplines. For instance, the environmental management literature provides the implications of the selection and interaction approaches in examining the relationship between environmental practices and performance (e.g. Christmann, 2000; González-Benito and González-Benito, 2005; López-Gamero et al., 2009). Also, there are some studies which address alignment under the mediated and moderated perspectives in the context of green/reverse supply chain management (Bowen et al., 2001; Kocabasoglu et al., 2007; Wu et al., 2012; Yang et al., 2010; Zhu and Sarkis, 2004). These papers however examine alignment from a bivariate rather than from a holistic perspective.

Alignment is the underlying conceptual theme for this study. Specifically, this study uses alignment under a profile deviation perspective to examine the links between the SC and CE strategies. Profile deviation is defined as the internal consistency of multiple contingencies (Drazin and Van de Ven, 1985). The higher the degree of adherence to an ideal multidimensional profile the better the performance. Deviations from this profile will result in negative performance (Venkatraman, 1989). Thus, the basic idea is that the SC and CE strategies should be aligned to enhance firm performance (e.g. Sabherwal and Chan, 2001). Following Lee (2002), this study applies four SC strategies types under two SC uncertainty attributes, and four CE strategies types under three environmental management attributes.

2.2. SC strategy ideal profiles

Given the concept of match between the type of product and the type of supply chain, Fisher (1997) categorizes supply chains as either efficient or responsive. Alternatively, lean and agile supply chains are used (e.g. Mason-Jones et al., 2000), with lean supply chains being physically efficient, and agile supply chains being responsive. Further, through the supply chain uncertainty

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landscape, Lee (2002) classifies supply chains strategies as efficient, risk-hedging, responsive, and agile. We will use this taxonomy.

Following Lee (2002), this study adopts demand and supply uncertainties as the attributes to categorize the SC strategies. The demand uncertainty attribute is the unpredictability of the demand for a product, due to the quantity demanded, and product variety (Christopher and Towill, 2000; Fisher, 1997; Lee, 2002). The supply uncertainty attribute refers to characteristics of the procurement process and possesses a number of sub-attributes including quality, buying, and delivery. We follow Lee's (2002, p. 114) classification (High/Low) to help identify the two attributes of each ideal SC strategy profile as shown in Table 1.

Functional products usually have predictable demand, long product life cycles and lower profit margins (Fisher, 1997). Thus, firms handling such products require lower levels of capability response to rapid design changes and volume swings. As these products yield lower margins, such firms require a higher priority on cost efficiency. Further, due to automation and efficient sourcing processes, the supply base is well established (Lee, 2002). An efficient SC strategy is thus low on demand uncertainty and supply uncertainty.

Next, firms that employ a risk-hedging SC strategy typically hedge against supplier uncertainty. These firms face challenges related to the process reliability, supply base, and long lead-time from source to production, even though they produce functional products (Lee, 2002). Hence, a firm employing a risk-hedging SC strategy is high on supply uncertainty, but low on demand uncertainty.

The very nature of innovative products makes demand unpredictable, shortens their life cycles, albeit provides higher profit margins (Fisher, 1997). Firms that deploy a responsive SC strategy aim at being flexible to the changing and diverse needs of the market, reflecting a moderate degree of price and service consciousness (Mason-Jones et al., 2000). Such firms are oriented toward improving quality, delivery, modular design, and reliability performance. These improvements are beneficial to a SC strategy with innovative products while being reliable and have a stable supply base (Lee, 2002). A responsive SC strategy thus views the demand attribute as having high uncertainty but low uncertainty for the supply attribute.

There are also cases where high levels of flexibility and responsiveness to the marketplace are needed (Fisher, 1997; Mason-Jones et al., 2000). As an agile supply chain has an evolving process where the customer demands are still unstable and suppliers are unreliable and limited, such firms emphasize their resources and capabilities on quality, delivery dependability, and after-sales service (Lee, 2002; Mason-Jones et al., 2000). Hence, firms with an agile SC strategy view both SC attributes as having high uncertainty.

2.3. CE strategy ideal profiles

A CE strategy is defined in terms of the extent in which an organization is involved in a wide range of organizational and managerial actions on environmental issues (Argon-Correa et al., 2004; Sharma, 2000), and is categorized into different types and levels based on the endogenous and exogenous forces exerted on it (Argon-Correa et al., 2008; Banerjee, 2001b; Vastag et al., 1996) For ease of fit, for the CE strategies in this paper, we adopt Henriques and Sadorsky's (1999) strategy classification: reactive, defensive, accommodative, and proactive.

Drawing from the literature, we use resources and capabilities, social responsibility, and stakeholder management as the attributes of the four CE strategy configurations. Resources and capabilities imply that a firm's resources and capabilities facilitate economic and sustainable benefits (Hart, 1995). Social responsibility denotes the level of management commitment to society and the environment (Argon-Correa et al., 2004; Sharma, 2000). Stakeholder management emphasizes that the role of managing a firm's stakeholders is highly associated with effective environmental management (Delmas and Toffel, 2004; Henriques and Sadorsky, 1999). We follow Sabherwal and Chan's (2001) suggestion in using a parsimonious three-point scale (low, medium, and high) to identify the three attributes of each ideal CE strategy profile as shown in Table 2.

Under a reactive CE strategy, firms commit minimal resources to environmental management and employee training (Henriques and Sadorsky, 1999; Klassen and Whybark, 1999), on what they view as unimportant environmental issues (Argon-Correa et al., 2004; Sharma, 2000). Monitoring compliance is carried out at the middle management level (Vastag et al., 1996). Some institutional forces however affect a reactive CE strategy. For instance, a media stakeholder can persuade a firm to rethink that strategy (Henriques and Sadorsky, 1999) and focus more on environmental legislations (Buysse and Verbeke, 2003). We therefore view firms that employ a reactive CE strategy as being low, low, and medium on resources and capabilities, social responsibility, and stakeholder management, respectively.

Firms using a defensive CE strategy tend to commit more resources to environmental issues than firms on a reactive CE strategy (Henriques and Sadorsky, 1999). They may apply regulatory approaches but lend little development to modern environmental practices (Argon-Correa, 1998). These firms view environmental issues as threats rather than opportunities (Sharma, 2000) and admit only minor social responsibility (Argon-Correa et al., 2004). As for the institutional forces, a firm's actions is conditioned by the regulatory, secondary, and internal primary stakeholders (Buysse and Verbeke, 2003). This study thus proposes a defensive CE strategy as being medium on resources and capabilities and social responsibility, but high on stakeholder management, respectively.

The degree to which firms with an accommodative CE strategy interpret environmental issues as opportunities is greater than those with a reactive CE strategy (Sharma, 2000). Also, such firms perceive relatively higher pressure from all their stakeholders (Buysse and Verbeke, 2003). As such, these firms will develop green capabilities and adopt pollution prevention technologies for better firm performance (Argon-Correa et al., 2004; Buysse and Verbeke, 2003; Henriques and Sadorsky, 1999) but they have yet to adopt a proactive attitude to the environment (Molina-Azorín et al., 2009). Therefore, for a firm on an accommodative CE

Table 1
Ideal profiles of SC strategy.
Source: Derived from Lee (2002, p. 114).

Attribute	Efficient	Risk-hedging	Responsive	Agile
Demand uncertainty	Low	Low	High	High
Supply uncertainty	Low	High	Low	High

Table 2
Ideal profiles of CE strategy.

Attribute	Reactive	Defensive	Accommodative	Proactive
Resources and capabilities	Low	Medium	High	High
Social responsibility	Low	Medium	Medium	High
Stakeholder management	Medium	High	High	High

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strategy, resources and capabilities, and stakeholder management are at a high level, while social responsibility is at a medium level.

Firms move towards environmental proactivity when perceiving a higher impact on both the internal and external constituencies (Argon-Correa et al., 2004; Banerjee, 2001a, 2001b). Firms on proactive CE strategies thus develop unique capabilities to sustain competitiveness (Argon-Correa et al., 2008; Bowen et al., 2001) which are viewed as being critical to a broader range of stakeholders (Buysse and Verbeke, 2003; Henriques and Sadorsky, 1999). They view a CE strategy as being relevant to all divisions of the firm (Molina-Azorín et al., 2009) and that strategy is well defined and highly articulated in company publications (Vastag et al., 1996). This study thus views a proactive CE strategy as being high on all three CE strategy attributes.

2.4. Research model and hypotheses

Fig. 1 summarizes the overall model for this study. An alignment under a profile deviation approach is used to examine the multiple relations between the SC and CE strategies. The hypothesis development is discussed below.

Vastag et al. (1996) suggest that firms use advanced green practices only when environmental performance is an essential part of the business activity. Other studies also suggest that the performance derived from an environmental strategy depends on the economic fundamentals of the business. Schaltegger and Synnestvedt (2002) indicate that the scope of environmental concerns in the context of the overall firm's activities is critical in discussing the environment-performance link. Argon-Correa and Sharma (2003) identify ten propositions that present the contingency effects of a general business environment on such connections. Aragon-Correa and Rubio-López (2007) propose that a CE strategy may be contingent on the business environment. Simpson and Samson (2008) suggest the need to investigate the traditional supply chain management focus when devising a GSCM strategy. When alignment is lacking, Monczka and Petersen (2012) mention that supply management cannot support the business in response to socioeconomic pressures. Thus, firms must align their SC and CE strategies in order to boost the overall firm performance. We thus posit the first hypothesis:

Hypothesis 1. *The degree of alignment between the SC strategy and CE strategy impacts firm performance.*

Under an efficient SC strategy, the basis of competition is cost efficiency and price (Lee, 2002; Mason-Jones et al., 2000). By focusing on cost efficiency, a feasible approach is to integrate environmental issues into the operating decisions, providing maximum environmental benefits at minimum cost and under limited uncertainty (Walley and Whitehead, 1994). Environmental certifications such as ISO14001 are likely to be adopted for the efficient supply chain (Corbett and Kirsch, 2001; King and Lenox, 2001). However, the relationship between ISO14001 and environmental performance is not obvious (Aragon-Correa and Rubio-López, 2007; Corbett and Kirsch, 2001) and such certifications could be a reactive response to suppliers or customers in the chain. Further, due to the low SC uncertainty, a firm's environmental risks including materials, technologies, and customers are relatively less. Put simply, firms adopting environmental activities at the functional level will commit minimal resources to just meet local/national regulations (Simpson and Samson, 2008). At this point, a firm following an efficient SC strategy will most likely adopt a reactive environmental strategy (Vastag et al., 1996). Hence, the level of alignment will be high and from Bergeron et al. (2001), this will impact firm performance. Thus, our second hypothesis:

Hypothesis 2. *The degree of alignment between efficient SC strategy and reactive CE strategy impacts firm performance.*

To reduce the upstream disruption risk, a risk-hedging SC strategy will pool resources and information among the partners of the supply chain (Lee, 2002) to counter the effects of high supply side uncertainty. This is consistent with the research (Mollenkopf et al., 2010; Vachon and Klassen, 2006) which points out that a higher level of logistics integration is beneficial to some defensive environmental practices and monitoring. For instance, Green et al. (1996) indicate that environmental purchasing is easily diffused through close supplier partnerships, and Vachon and Klassen (2008) suggest that upstream collaboration is closely associated with superior process-based performance. From a green perspective, environmental purchasing involves new supplier assessment procedures and a deeper level of supplier integration and development. This requires a firm on a defensive CE stance to commit more effort and resources (Green et al., 1996; Handfield et al., 2005). Thus, a firm adopting a risk-hedging SC strategy is likely to adopt a defensive CE strategy, yielding a high level of alignment and again from Bergeron et al. (2001), this will have a impact firm performance. We thus propose the third hypothesis:

Hypothesis 3. *The degree of alignment between risk-hedging SC strategy and defensive CE strategy impacts firm performance.*

Following Gunasekaran et al. (2008), firms that employ a responsive SC strategy see it as a competitive weapon in a networked economy. Such firms will produce customized products

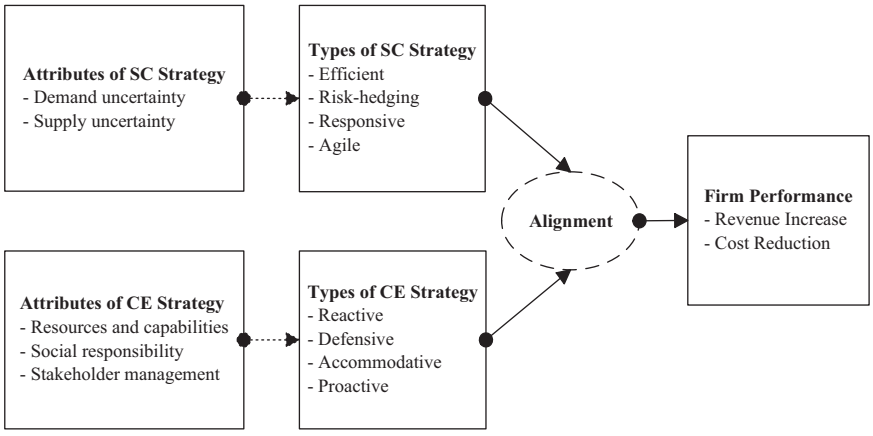

Fig. 1. Research model.

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through virtual organizations and exchange the goods through e-Commerce. In so doing, production is relatively leaner which in turn brings about environmental benefits such as source reduction and lower emissions (King and Lenox, 2001). However, this may require greater financial and managerial commitment to production changes, product redesign, and stakeholder management (Hart, 1997; Pane Haden et al., 2009; Simpson and Samson, 2008). In short, firms on an accommodative CE strategy are likely to embrace accommodative practices such as product stewardship, green marketing and/or cleaner technologies, resulting in spillover effects including resource productivity, new competitive posture, and manufacturing improvement (Hart, 1997; Simpson and Samson, 2008). Hence, the degree of alignment between a responsive SC strategy and an accommodative CE strategy will be high. Thus, the improvement in competitiveness through the supply chain and environmental management will lead to superior firm performance. Accordingly, we present the fourth hypothesis:

Hypothesis 4. *The degree of alignment between responsive SC strategy and accommodative CE strategy impacts firm performance.*

Firms with an agile SC strategy are very sensitive to demand and supply risks, and will use market knowledge for profit and competitiveness (Christopher and Towill, 2000; Lee, 2002; Mason-Jones et al., 2000). These firms will strategically and proactively deal with environmental issues, suggesting an opportunity-seeking behavior rather than threat aversion (Argon-Correa, 1998). Such firms will develop innovative capabilities to eliminate industry and environmental risks to realize better resource productivity, higher profits, and sustained competitive advantage (Argon-Correa et al., 2008; Christmann, 2000; López-Gamero et al., 2009). At the supply chain level, a proactive CE strategy may facilitate profitability, operation excellence, and sustainability for the partners in the chain (Kleindorfer et al., 2005; Rao and Holt, 2005; Zhu and Sarkis, 2004). Hence, the degree of alignment between an agile SC strategy and a proactive CE strategy will be high, leading to better firm performance. Thus, our next hypothesis is:

Hypothesis 5. *The degree of alignment between agile SC strategy and proactive CE strategy impacts firm performance.*

3. Research method

3.1. Sample and data collection

The research comes from export-oriented manufacturing firms in Taiwan that have experienced sustainable corporate environmental development prompted by their supply chain partners and other green initiatives. This factor makes the sample selection appropriate for testing our hypotheses. The sample is drawn from the 2011 *CommonWealth* directory of the top 1000 Taiwan manufacturers. The cover letter described the research goals and instructions indicating that the survey respondents (senior managers) should have a priori knowledge of the SC and CE strategies of their firms. From October to December in 2011, the questionnaires were distributed anonymously to the firms and followed by reminders which indicated the survey due date. Of the 230 questionnaires distributed, 178 were returned. Six were eliminated due to missing data and 172 qualified questionnaires were accounted for.

To check for non-response bias, we followed Armstrong and Overton's (1977) procedure and compared the answers of the early survey respondents against those of the late respondents. The test between the first wave ($n=129$, 75%) and the second wave ($n=43$, 25%) reveals no difference at a 5% significance level for geographic dispersion ($\chi^2=2.290$, $df=2$, $p=0.318$), employee number ($t=0.743$, $p=0.459$), and annual revenue ($t=1.505$, $p=0.134$). Table 3 shows the descriptive statistics of the respondent firms. The responding firms were fairly evenly divided in terms of geographical dispersion (measured as local, regional or global) and the size of the firm. On average, the annual revenue was USD 200 million.

3.2. Measurement

All items are operationalized based on related studies in the environmental management and supply chain management literature. In all, 10 items were used for the demand and supply uncertainty attributes, 14 items for the three CE strategy attributes, and 7 performance items for revenue increase and cost reduction. The CE strategy measures require that the firms respond based on their current situation, whereas the questionnaires on both SC strategy and firm performance require an evaluation of their condition against their competitors. All items are measured on a five-point Likert scale (1=strongly disagree, 5=strongly agree). The measures and their related literature are summarized in Tables 4–6.

This study uses two control variables: (1) geographic dispersion, and (2) number of employees as firm size. Prior studies suggest that the regulatory situation in different countries and their societal pressures and firm size affect the selection of environmental strategies and supply chain management (Ambec and Lanoie, 2008; Argon-Correa et al., 2008; Fabbe-Costes et al., 2011; Molina-Azorín et al., 2009). In particular, larger firms are more likely to adopt proactive CE strategies (Russo and Fouts, 1997; Sharma, 2000). Hence, we take geographic dispersion as a proxy for the regulatory and societal pressures, and the number of employees as a proxy for firm size, respectively.

3.3. Reliability and validity testing

We used SPSS ver 20.0 to assess how well behaved the observed variable were in terms of composite reliability, convergent validity, and discriminant validity. As shown through Tables 4–6, the composite reliabilities of all the factors exceeded 0.860, well above the threshold value of 0.7 (Gefen et al., 2000), indicating the existence of internal consistency. The test for convergent validity shows that all indicators load satisfactorily on the theorized constructs and the *t*-tests of all the loadings are at the $p<0.001$ level, providing evidence of convergent validity (Bagozzi and Yi, 1988). Only two items were middling between 0.6 and 0.7, which is acceptable for an exploratory study of this nature. Next, we tested for satisfactory discriminant validity of

Table 3
Profile of respondent firms.

Company demographics	Frequency	Percentage
Geographic dispersion		
Local (Taiwan)	49	28.5
Regional (Asia)	62	36.0
Global	61	35.5
Employees		
≤ 300	43	25.0
301–1000	63	36.6
1001–5000	39	22.7
≧5001	27	15.7
Annual revenues (in US million dollars)		
≤ 4	7	4.0
4.1–170	81	47.1
171–670	51	29.7
≧671	33	19.2
Total	**172**	**100**

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Table 4
Related literature, reliability, and validity results for SC strategy attribute measures.

Variable	Measurement items	Source	Factor loading	Composite reliability	α
Demand uncertainty	1. Product innovation in the market where our main products are sold is highly required	Christopher and Towill (2000), Fisher (1997), Lee (2002), Mason-Jones et al. (2000)	0.811	0.86	0.794
	2. Product life cycle in the market where our main products are sold is very short		0.735		
	3. Profit margins in the market where our main products are sold is very high		0.752		
	4. Volume demand in the market where our main products are sold is very volatile		0.618		
	5. Product variety in the market where our main products are sold is very high		0.785		
Supply uncertainty	1. Our firm has considerable variation in product quality	Christopher and Towill (2000), Fisher (1997), Lee (2002), Mason-Jones et al. (2000)	0.617	0.869	0.812
	2. Our firm has considerable variation in reliable suppliers		0.76		
	3. Our firm has considerable variation in capacity		0.864		
	4. Our firm has considerable variation in lead time		0.835		
	5. Our firm does not has considerable variation in delivery speed		0.725		

Table 5
Related literature, reliability, and validity results for CE strategy attribute measures.

Variable	Measurement items	Sources	Factor loading	Composite reliability	α
Resources and capabilities	1. Our firm provides environmental educations and training for managers and employees	Argon-Correa et al. (2008), Buysse and Verbeke (2003), González-Benito and González-Benito (2005), López-Gamero et al. (2009)	0.802	0.890	0.835
	2. Our firm provides financial, managerial, and production resources to improve environmental competence		0.880		
	3. Our firm has technical systems and manufacturing capabilities to improve environmental performance		0.780		
	4. Our firm has environmental management systems and policies		0.810		
Social responsibility	1. Managers give support to environmental issues due to environmental preservation and corporate social responsibility	Argon-Correa et al. (2004) and Sharma (2000)	0.832	0.899	0.831
	2. Managers have the knowledge and competence to control environmental issues		0.905		
	3. Managers view new environmental legislations as opportunities		0.857		
Stakeholder management	1. Our firm provides environmental reports or information to stakeholders	Buysse and Verbeke (2003), Henriques and Sadorsky (1999), López-Gamero et al. (2009)	0.814	0.914	0.883
	2. Our firm has a formal system to monitor regulatory changes		0.798		
	3. Our firm participates in government-subsidized environmental programs for compliance with changing regulations		0.800		
	4. Our firm seeks to be a leader in environmental protection in our industry and/or society		0.855		
	5. Our firm sponsors activities to preserve the environment		0.857		

the constructs using the square root of the Average Variance Extracted (AVE) which should be greater than the correlation shared between a construct and the other constructs (Hair et al., 2009). As such, we dropped two items (RC5 and SM1) from the CE category. Table 7 presents the mean, standard deviation, the correlations between the constructs, and the square root of the AVE on the diagonals.

This study adopts Sabherwal and Chan (2001)'s process to compute the level of alignment. This method, as discussed earlier, is a holistic view of the parsimonious and relatively homogeneous groups and assesses the alignment between two multivariate constructs. All the items of the SC and CE strategies are used to compute the level of alignment through profile deviation analysis. Thus, this study does not use CFA analysis to test for model-fit.

4. Empirical analyses and results

After using Sabherwal and Chan (2001)'s three step alignment analytic procedure to compute the level of alignment, we perform

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Table 6
Related literature, reliability, and validity results for performance measures.

Variable	Measurement items	Sources	Factor loading	Composite reliability	a
Revenue increase	Compared to competition, our existing corporate environmental strategy helps our firm to	Ambec and Lanoie (2008), Klassen and McLaughlin (1996), Rao and Holt (2005), Wagner and Schaltegger (2004)			
	1. have access to certain new markets and gain market share		0.909	0.919	0.867
	2. provide differentiated products to customers		0.912		
	3. achieve higher profit margin		0.843		
Cost reduction	Compared to competition, our existing corporate environmental strategy help our firm to decrease the	Ambec and Lanoie (2008), Klassen and McLaughlin (1996), Rao and Holt (2005), Wagner and Schaltegger (2004)			
	1. cost of risk management and relations with all stakeholders		0.874	0.912	0.871
	2. cost of materials and energy consumption		0.892		
	3. cost of environmental disasters that may affect employee health and security		0.813		
	4. cost of environmental liabilities		0.818		

Table 7
Correlation between research variables.

Construct	Mean	SD	1	2	3	4	5	6	7
1. DU	3.419	0.664	0.743						
2. SU	3.005	0.672	0.443	0.756					
3. RC	3.903	0.665	0.410	0.214	0.819				
4. ESR	3.713	0.720	0.414	0.214	0.741	0.865			
5. SM	3.591	0.756	0.389	0.202	0.800	0.793	0.825		
6. RI	3.585	0.763	0.487	0.268	0.509	0.634	0.268	0.889	
7. CR	3.717	0.729	0.527	0.277	0.529	0.546	0.570	0.665	0.850

Notes: DU: demand uncertainty; SU: supply uncertainty; RC: resources and capabilities; ESR: executive's social responsibility; SM: stakeholder management; RI: revenue increase; CR: cost reductions. The shaded numbers in the diagonal row are square roots of the AVE (average variance extracted).

a hierarchical regression on SPSS ver 20.0 to evaluate the level of alignment between the SC and CE strategies on firm performance.

4.1. Alignment analytic process

First, we compute the values of both the demand and supply uncertainty variables of the 172 observations and then compare each observation to the sample mean values of the demand and supply uncertainty measures. If the demand uncertainty value of an observation is greater than the mean value of the sample, then we regard this observation with a high demand uncertainty. The same classification method is employed on the supply uncertainty attribute. Based on the supply chain uncertainty attributes of Table 1, each respondent firm is classified into one of four SC strategies, namely: efficient, risk-hedging, responsive, and agile. Using this alignment analytic process, 69, 34, 30, and 39 of the respondent firms are categorized as having efficient, risk-hedging, responsive and agile SC strategies, respectively.

The second step is the normalization of all variables of the three CE strategy attributes. By using the z-score, we determine the relative location of the observation in a data set and the standardized scores are used for the remaining data analysis. This data standardization (mean centred with value of 0 and standard deviation of 1) removes the effects of different measurement units and potential multi-collinearity (Jaccard and Turrisi, 2003).

Third, the profile deviation, a measure of the misalignment between each firm's CE strategy and its ideal CE strategy profile, is computed. This step comprises three tasks. The first task is to determine the ideal CE strategy profile in terms of the three CE attributes (see Table 2). The ideal CE attribute values of the normalized scores were set to 1, 0, and −1 for high, medium, and low, respectively. The second task is to compute the Euclidean distance between each firm's CE strategy and its ideal CE strategy profile for a specific SC strategy adopted by a respondent firm. In short, if a firm is classified as having an efficient SC, the distance (misalignment) is computed for a reactive CE strategy as follows: $Misalignment\ (reactive)=\sqrt{\Sigma(X_j-I_{j,\ \mathrm{reactive}})^2}$ where X_j is the normalized score for the jth CE strategy attribute, $I_{j,\ \mathrm{reactive}}$ is the ideal normalized score of that jth CE strategy attribute, with $j=1, 2\ 3$ for the three CE attributes. A reactive CE strategy is expected to be best aligned with an efficient SC strategy. The same is done for the ideal CE strategy profiles of the other CE strategies. A respondent firm with a smaller Euclidean distance indicates that its CE strategy is closer to the ideal profile and that the degree of alignment is higher. The third task is to subtract the chosen CE strategy distance from 1, which helps convert it into a measure of alignment.

4.2. Results

We then perform a hierarchical regression to test the statistical significance of the profile deviation values and the hypotheses. The dependent variable is firm performance as measured by revenue increase and cost reduction. Table 8 shows the regression results of the alignment effects of the SC and CE strategies on firm performance. The VIF values in all the regression models (1.000 to 1.466) were all below 5, eliminating the likelihood of multi-collinearity.

Alignment is found to be significantly associated with firm performance in terms of revenue increase and cost reduction for the overall regression model ($R^2=0.127$, $F=9.269$, $p\leq 0.001$; $R^2=0.105$, $F=7.683$, $p\leq 0.001$, respectively). Hence, Hypothesis H1 is strongly supported i.e. the degree of alignment between the SC strategy and the CE strategy impacts firm performance. Thus, firms should strive for better alignment between these two sets of strategies so as to maximize their performance. Likewise, Hypothesis H3 is supported i.e. the degree of alignment between a risk-hedging SC strategy and a defensive CE strategy impacts firm performance through revenue increase and cost reduction ($R^2=0.339$, $F=6.632$, $p\leq 0.001$; $R^2=0.236$, $F=4.392$, $p\leq 0.05$, respectively). For Hypothesis H4, a similar results holds i.e. the level of alignment between a responsive SC strategy and an accommodative CE strategy impacts firm performance partially through revenue increase and significantly

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through cost reduction ($R^2=0.240$, $F=4.056$, $p\leq 0.05$; $R^2=0.458$, $F=9.154$, $p\leq 0.001$, respectively). As for Hypothesis H5, the level of alignment between an agile SC strategy and a proactive CE strategy also impacts firm performance with the following results $R^2=0.395$, $F=9.255$, $p\leq 0.001$; $R^2=0.343$, $F=7.600$, $p\leq 0.001$, respectively. The control variable, geographic dispersion does not appear to lend any statistical weight to the regression models, negating the results of earlier studies (e.g. Fabbe-Costes et al., 2011).

5. Discussion and conclusion

This study employs an alignment analytic process using profile deviation analysis to examine the relationship between SC strategy and CE strategy, and specifically the alignment effects on firm performance in terms of revenue increase and cost reduction. As shown in Table 8, except for the lack of statistical support on the need for a good alignment between an efficient SC strategy and a reactive CE strategy, selecting a right CE strategy within the context of a firm's SC strategy results in better firm performance through either revenue increase or cost reduction or both. Based on the findings, some implications and contributions are discussed.

5.1. Discussion of results

Our results provide two main issues for discussion. First, the alignment concept offers opportunities for firms to simultaneously consider the organizational and strategy domains holistically (Drazin and Van de Ven, 1985; Umanath, 2003). The result of Hypothesis 1 lends support to the notion that an alignment between the SC and CE strategies improves overall firm profitability. Our results thus suggest that an alignment viewpoint benefits in examining the complex relationships among the strategies, in which firms could view an aligning state of SC and CE strategies as a holistic construct to better understand the possible synthetic effects on firm performance. This study complements the extant research (e.g. Carter and Easton, 2011; Fabbe-Costes et al., 2011; Mollenkopf et al., 2010) which highlights that firms need to adopt a systems approach when assessing the complex relationships between environment, operations, supply chain, and performance.

Second, our findings identify that proper alignment between a risk-hedging SC strategy and a defensive CE strategy, a responsive SC strategy and an accommodative CE strategy, and an agile SC strategy and a proactive CE strategy leads to profit enhancement for the firm. Managerially, recognizing the alignment effects of SC and CE strategies is valuable as it establishes a useful decision making mechanism by which firms can effectively place a strategic focus on the environmental sustainability effort in a supply chain. In a dynamic marketplace, a firm's capability to identify a targeted set of supply strategies and managing competing strategic priorities between supply chain management and green initiatives is essential and worthwhile (Bielak et al., 2007; Monczka and Petersen, 2012). Specifically, an alignment under a profile deviation perspective enables firms to consider numerous configurations of the various SC and CE strategies systematically. In doing so, well placed decision making on environmental resource allocations for risk-hedging, responsive, and agile supply chains may ensure the leverage of both operational and environmental efficiency.

5.2. Implications for research

This study also offers some theoretical and managerial contributions. First, in terms of the implications for research, this study advances the existing research on operations management, supply chains, sustainability, and performance. Our results provide empirical evidence that the alignment of the SC and CE strategies may be useful as a holistic antecedent for firm performance. Accordingly, a possible research focus of sustainable supply chain management may shift from investigating the specific features of the supply chain (e.g. purchasing or logistics) to examining an integrated business model (Mollenkopf et al., 2010; Monczka and Petersen, 2012). Further, from an alignment viewpoint, we have modelled the multiple relationships of the SC uncertainty environment with the different configurations of the CE strategy. This is valuable to theory building as we set the tone and direction for a new stream of research.

Second, profile deviation analysis offers a theoretical extension of using the strategic alignment concept as proposed by Venkatraman (1989) to examine the multiple links between the supply chain and the environment. As prior studies mostly explore such complex relations using a reductionist approach through moderation or mediation models, this may not provide a deep enough understanding of the holistic patterns of

Table 8
Alignment effects of SC and CE strategies on firm performance.

Firm Performance	Overall model		Efficient SC		Risk-hedging SC		Responsive SC		Agile SC	
	Step 1	Step 2	Step 1	Step 2	Step 1	Step 2	Step 1	Step 2	Step 1	Step 2
Panel A: Alignment effects on revenue increase										
Geographic dispersion	0.046	0.007	−0.201	−0.193	0.182	0.096	0.081	−0.073	0.079	0.031
Firm size	0.178*	0.174*	0.179	0.171	0.291	0.369*	0.112	−0.157	−0.027	−0.043
Alignment		0.320***		−0.054		0.478**		0.647**		0.663***
F for step	3.636*	19.730***	1.489	0.193	3.316*	11.103**	0.353	11.193**	0.907	27.426***
F for regression	3.636*	9.269***	1.489	1.045	3.316*	6.632***	0.353	4.056*	0.907	9.255***
Adjusted R^2	0.030	0.127	0.014	0.002	0.123	0.339	−0.047	0.240	−0.050	0.395
Panel B: Alignment effects on cost reduction										
Geographic dispersion	0.078	0.046	−0.135	−0.097	0.158	0.089	0.153	0.027	0.176	0.133
Firm size	0.182*	0.178*	0.042	0.006	0.289	0.352	0.492**	0.272	−0.127	−0.142
Alignment		0.265***		−0.238		0.387*		0.528**		0.605***
F for step	4.622*	13.141***	0.517	3.855	2.934	6.304*	6.299**	10.454**	0.568	21.032***
F for regression	4.622*	7.683***	0.517	1.645	2.934	4.392*	6.299**	9.154***	0.568	7.600***
Adjusted R^2	0.041	0.105	−0.014	0.028	0.105	0.236	0.268	0.458	−0.023	0.343

Notes: Independent variable: alignment. Dependent variables: revenue increase and cost reduction. Control variables: geographic dispersion and firm size. Main table contains standardized coefficient betas.

* p≦0.05.
** p≦0.01.
*** p≦0.001.

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interdependency among the research constructs (Umanath, 2003). On the methodology side, using profile deviation analysis to measure the degree of misalignment provides a useful starting point to explore the multiple relationships between the business and the broader environment.

5.3. Implications for practice

Our results have managerial implications as well. For practitioners, repositioning the benefits resulting from green initiatives into a set of business goals should be a priority. This study offers some guidelines for firms to align goals for both operational efficiency and pollution-reduction from a strategic alignment perspective (i.e. under different supply chain uncertainties). This is more useful than the traditionalist view of negotiating trade-offs. As the alignment concept can generate knowledge about the synergies and conflicts between the SC and CE strategies, this can allow firms to be more proactive when deciding on strategic priorities. For instance, firms should know that when operating under a responsive SC strategy, they need to exercise an accommodative CE strategy so as to ensure that in their geographical theatre of operations, they will benefit materially and act as good corporate citizens, leading to a win–win situation for all concerned.

Finally, even though our results suggest the greater emphasis needs to be placed on aligning certain CE strategies with SC strategies, it may not be necessary nor appropriate for a firm to (1) confine to a specific aligning link(s) for an extended period, or (2) lead their competitors on certain environmental issues. It is common knowledge that even after a firm has achieved alignment between two sets of strategies, its supply chain will continue to evolve through changes in process or external uncertainties, thus leading to a possibility of alignment failure. Through our study, firms now have a basis to switch between two different classes of strategy simultaneously and maintain competitive posture. In short, the alignment viewpoint helps firms to recognize and respond strategically to the needs of business and society. This process of alignment can guide firms through corporate transformation adequately when operating a volatile marker such as Asia today.

5.4. Research limitations and future research directions

Some limitations exist. First, using the existing environmental management and supply chain management literature, we configure some attributes as the ideal profiles of the SC and CE strategies. Yet, our ideal profiles may lack comprehensive power in that not all factors relevant to the firm are evaluated. For example, Delmas and Toffel (2004) urge that competitive forces and industry characteristics may influence a firm's environmental policy. Thus, more variables could be included in future research when identifying the ideal profiles of the SC and CE strategies. The second limitation is that the sampling frame is manufacturing firms in Taiwan. Though using samples collected in a single country allows for greater control over contextual and operational factors, this limits external generalizability. Future research would benefit from expanding this investigation across several countries, which can assist in overcoming the potential problems with generalizability.

Today, sustainability is becoming a leading focus of doing business in Asia, at both the firm and supply chain levels. As such, incorporating sustainability must offer a better understanding of whether a firm's engagement in a sustainable supply chain can yield overall benefits to both the firm and society. Competition through and alignment of a SC strategy must go hand in hand with the environment.

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