A hierarchical framework for assessing corporate sustainability performance using a hybrid fuzzy synthetic method-DEMATEL

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ABSTRACT

This study constructs a valid and reliable hierarchical framework for assessing corporate sustainability performance. The traditional fuzzy synthetic method considers neither the causal interrelationships among criteria nor how to construct the hierarchical framework. In addition, previous studies have lacked a resource-based view, and few studies have discussed how to construct a hierarchical structure. Therefore, this study integrates the decision-making trial and evaluation laboratory method, exploratory factor analysis and the fuzzy synthetic method to assess corporate sustainability performance. The overall corporate sustainability assessment results for the Taiwanese textile industry are low because this industry needs to improve in social responsibility. However, the economic perspective performs well. This industry needs to focus on 1. the firm's economic activities; 2. stakeholder management; and 3. operational control aspects. The major causal effect criteria are listed in the discussion section. The contributions of this study are 1. a theoretical model to assess corporate sustainability performance and 2. the hybrid method proposed for this assessment.

1. Introduction

Corporate sustainability (CS) has been studied and defined in previous studies. Traditionally, these studies recommend improving CS performance through efficient use of resources, reduced waste, improved economic performance and promotion of social reputation (triple bottom line, TBL) (Tseng et al., 2008; Shi et al., 2017). Few studies have discussed how to organize a hierarchal structure and even fewer have focused on the resource-based view (RBV) for integrating CS activities. In reality, a firm can further improve customer preferences and generate innovative capabilities to reinforce their CS performance. A firm's activities and CS performance are usually assessed using qualitative preferences and quantitative information. Although many studies have stated that complex interrelationships exist among CS attributes (Dočekalová et al., 2017), these studies have failed to address these interrelationships. Therefore, the CS attributes need to be integrated into a hierarchical framework, and the complex interrelationships among the qualitative preferences and quantitative information need to be addressed in the context of a firm (Epstein and Buhovac, 2010; Klewitz and Hansen, 2014).

The literature states that firms need to achieve mutually interdependent sets of TBL issues in their business activities (Elkington, 1998). Tseng (2017) studied CS to benchmark the weights of the aspects and attributes as described by qualitative data and to analyze the decision-making process. That study demonstrated that by acquiring benefits from sustainable design, code of conduct and eco-products, firms can increase their exchange across supply chain networks. Wijethilake and Munir (2016) found that enabling management controls had a positive impact on CS, whereas limiting management controls negatively affected stakeholder relationships. Witjes et al. (2017) noted that although firms have shown an increasing awareness of CS, integrating the TBL into their business activities is still problematic. The CS framework is a strategic integration for increasing a firm's effectiveness through accomplishing sustainability goals that enhance a firm's activities, achieve better customer service and increase profitability. Unlike in previous studies, an RBV needs to be addressed to improve the competitive advantage of a firm.

In the RBV theoretical approach, the critical success factors can assist a firm in achieving its target or desired performance (Bryson et al., 2007; Fuisz-Kehrbach, 2014; Waligo et al., 2013). Rothaermel (2001) argued that appropriate resources provide more value and that firms perform better if they are connected with partners that have

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dissimilar resources. Grewatsch and Kleindienst (2017) showed that the development of firm capabilities is rarely independent of the surrounding context. A firm's capabilities co-evolve as top management implements diverse environmental and organizational attributes that decision-makers focus and act on, depending on the particular context of the firm's RBV (Barrutia and Echebarria, 2015). In addition, previous studies have failed to address how to form the hierarchical framework. Adopting an inward method by assuming complete management control of resources is necessary for achieving a competitive advantage. Therefore, this study proposes a valid and reliable hierarchical framework for analyzing the CS attributes in order to prioritize them. However, the attributes are usually assessed qualitatively.

Most previous studies used qualitative assessments (Azapagic, 2003; Lozano, 2012; Witjes et al., 2017), and most of the attributes were assessed using linguistic preferences. The CS attributes of a firm contain multi-level, qualitative information. Fuzzy set theory is used to interpret the human perceptions of the attributes given in linguistic preferences and has been used in many CS studies and applications (Cui et al., 2017; Shi et al., 2017; Vesely et al., 2016). The most important feature of human perceptions is ability to extract data from a large collection of information, which is still not well understood. In previous studies, the fuzzy synthetic method (FSM) was utilized to rank the weights of the attributes and determine the attribute priority from qualitative information. Therefore, this study proposes a hybrid method consisting of 1. exploratory factor analysis to create the hierarchical framework; 2. the decision-making trial and evaluation laboratory (DEMATEL) to reinforce the resources and to understand the causal effects of the attributes and 3. the FSM to establish the hierarchical framework using qualitative information.

This study assesses the priority of TBL perspectives in the proposed hierarchical framework. The firm is assumed to recognize the financial and strategic benefits of pursuing CS in their strategic decision-making process. Therefore, the study objectives are the following: (Amini & Bienstock, 2014) to include a set of valid attributes in the hierarchical framework; (Azapagic, 2003) to propose a hybrid method for addressing the hierarchical framework and complex interrelationships among linguistic preferences; (Barrutia & Echebarria, 2015) to present the critical success attributes in terms of both a theoretical discussion and practical implementation; and (Baumgartner & Ebner, 2010) to address the causal effects among attributes.

This study offers three main contributions. First, this study establishes and validates the attributes in a hierarchical framework to confirm the TBL perspectives. Second, the assessment combines and improves the FSM and DEMATEL (named FSM-DEMATEL) to improve the CS performance. Finally, the analytical results present the key success attributes. This study uses the RBV of the TBL for a firm's activities by decreasing the environmental impact and ensuring compliance with business goals. Along with pursing these objectives, firms tend to simultaneously improve their economic sustainability. The rest of this study is arranged as follows. Section 2 develops a theoretical approach and presents a literature review of the theoretical background. Section 3 presents the methods and the proposed analytical steps. The results are discussed in detail in Section 4. Section 5 provides the theoretical and managerial implications. The final section presents the conclusions, contributions, and limitations of this study along with possible future studies.

2. Literature review

This section presents a systematic review of the literature, defines the attributes and proposes analytical measures and methods.

2.1. Theoretical background

RBV can increase the competitive advantage of a firm, depending on the integration of the firm's capabilities. Transforming a short-run

competitive advantage into a sustainable competitive advantage requires utilizing these resources efficiently and effectively. This transformation of valuable resources is not completely imitation or substitution and requires considerable effort. Furthermore, coherent and sophisticated firm activities with reciprocal reinforcement can further distinguish a firm's capabilities. A firm that utilizes the eco-control package fosters TBL capabilities, such as eco-learning, innovation, stakeholder integration, and shared environmental vision, and in turn improves its economic performance (Barrutia and Echebarria, 2015, Journeault, 2016a, b).

Few studies discuss how to integrate CS and RBV, considering their interrelationships, into a properly implemented hierarchical structure under linguistic preferences. Therefore, this study proposes an approach that hybridizes the FSM and DEMATEL method to address this problem. Brockhaus et al. (2017) evaluated the impediments to the design and adoption of CS, and they identified four key motivations for these initiatives. However, the CS hierarchical framework is based on qualitative information and lacks a proper validation method; these issues must be addressed to help theorists and practitioners move towards a more enlightened practice and to unleash the market potential of mainstream sustainability (Rothaermel, 2001). The RBV approach could help explain CS performance.

2.2. Corporate sustainability

CS aims to ensure that environmental sustainability remains a priority rather than firms adopting a single, short-term emphasis on economic sustainability (Amini & Carol 201). Lozano (2012) defined CS as "*corporate activity seeking to achieve sustainability equilibrium, which consists of the economic, environmental, and social responsibility dimensions, for today as well as throughout the time dimension while addressing the firm's systems and its stakeholders*". Vildåsen et al. (2017) stated that CS emphasizes the interactions among the TBL values. The need for considering multiple values has contributed to a conflict in the conceptual framework in terms of the dichotomy of positivism and constructivism. This framework can be applied to increase transparency on epistemological challenges, thus strengthening the construct validity and leading to a trend of clustering theoretical positions and value constructs. Witjes et al. (2017) showed that most firm's CS activities have been developed in isolation and have not yet been completely integrated into the business activities. They aimed to understand how firms have integrated CS into their business activities. In previous studies, the TBL boundary is always presented, and there is a need to readdress the practical aspects based on the TBL perspectives.

Additionally, Lozano (2012) explained how firms can address their operations and processes, management and strategy, organizational systems, procurement and marketing, and assessment and communication to enhance the CS TBL. Journeault (2016a, b) suggested that the eco-control program supports the growth of environmental capabilities, such as eco-learning, environmental innovation, stakeholder integration, exchanged environmental vision and improved corporate performance. Wijethilake (2017) indicated that CS only partially mediates the relationship between proactive sustainability strategy and CS performance. Nonetheless, building CS management capability remains a key problem (Tseng et al., 2008; Fuisz-Kehrbach, 2014; Waligo et al., 2013). In addition, previous studies have failed to discuss the trade-off between capability and resources. Therefore, the RBV theory is properly addressed in this study.

Finally, from the firms' viewpoint, Van Bommel (2011) argued that reaching competitive advantage through strategic integration with CS relies on the existing initiatives that respect the selected strategic orientation. Hahn (2013) indicated that one reason for lacking a precise strategy is that CS has highly diverse aspects, leading to uncertainty. In other words, the strategic decision processes for considering diverse aspects might increase the complexity and uncertainty. Engert et al. (2016) noted that the attributes most necessary to address are

developing a framework, acquiring the organizational influences and the external and internal drivers, and supporting or obstructing the integration between CS with strategic management. However, to determine the attributes for a firm's strategic decision-making process, several questions about the proper attributes, how to measure the qualitative information or compare this information to the current operational data and what the decision-making priorities are need to be answered. An appropriate assessment method is lacking in previous studies.

2.3. Proposed method

Prior studies adopted quantitative information, survey-based approaches, and classical statistical methods in the CS context (Waligo et al., 2013; Witjes et al., 2017). However, few of these studies proposed a valid and reliable method for establishing the multi-level framework and translating the qualitative information. For instance, Lozano (2008) showed the cause-and-effect TBL interrelationships but failed to clarify the complex dynamic interrelations among attributes. However, the TBL is still unfamiliar to or misunderstood in different industrial applications. For an actual application, it is essential to facilitate a set of measures and understanding within and throughout the TBL concept.

For instance, the studies of Lozano (2008) (2012) noted that complicated interrelationships exist among attributes and showed a hidden hierarchical framework in a real-world assessment. Joshi and Li (2016) emphasized that the use of sustainability control systems, such as a sustainability balanced scorecard, eco-control or sustainability management control systems, in translating the chosen CS strategy into actual performance must be examined. Tseng (2017) indicated that the TBL hierarchical structure should be considered in the decision-making process for the cost-benefit assessment. Dočekalová et al. (2017) showed that interrelationships exist among the proposed attributes; previous studies applied unsophisticated applications of classical statistical methods using accurate numbers and information. However, CS performance is often highly nonlinear, vague, partially inconsistent and multidimensional (Tseng et al., 2015; Su et al., 2015). Wijethilake (2017) investigated the mediating effect of sustainability control systems on the relationship between a proactive sustainability strategy and CS performance; the survey data were collected and then analyzed using partial least squares modeling. These studies presented the interrelationships among attributes, the uncertain information and a hierarchical framework. However, these studies were unclear on the framework or focused only on the TBL concept. Only a few studies have explained and built a valid and reliable framework for assessing CS performance. The analytical gaps from prior studies support the arguments presented in this study.

Various methods can be used to determine the interrelationship among attributes in complex problems with limited historical data, which is often the situation for a firm's management functions. In the proposed model, the exploratory factor analysis groups the direct or indirect interrelationships among attributes and examines the validity and reliability of the attributes (Su et al., 2015; Tseng et al., 2015). In addition, the linguistic preference is uncertain in CS performance. Dočekalová et al. (2017) applied fuzzy similarity graphs to partially eliminate the problems related to a severe shortage of information. They used trends as non-numerical quantifiers, which resulted in the multi-level hierarchical framework. Very few studies traced back to find the causal effects of the attributes. Therefore, this study proposes a hybrid method to address complicated actual situations.

2.4. Proposed attributes

The existing literature has proposed several CS attributes developed from the TBL, and Table 1 presents these twenty-one attributes.

From the economic perspective, interrelationships exist among the

Table 1
Proposed CS attributes from 3 perspectives.

Attributes		References
C1	Synergistic organization	
C2	Code of conduct	
C3	Cost reduction	Hart and Dowell, 2010
C4	Stakeholder's relations	
C5	Multi-stakeholder engagement	Waddock and Samuel, 1997; Lozano, 2012
C6	Environmental performance	
C7	Environmental policy	
C8	Environmental reporting	Siebenhüner & Arnold, 2007
C9	Strategic nature	
C10	Eco-product and service design	
C11	Eco-operational process	Cheng & Shiu, 2012
C12	Manager attitude and behavior	Lozano, 2015
C13	Green manufacturing	Handfield et al., 1997
C14	Human capital development	Bonn and Fisher, 2011
C15	Talent attraction and retention	
C16	Labor practice indicators	Stead & Stead, 2013
C17	Corporate communication	Klettner et al., 2014
C18	Corporate reputation	
C19	Legal compliance	Stead & Stead, 2013
C20	Organization culture	Bonn, I., Fisher, 2011
C21	Transparency and communication	Van Bommel, 2011

proposed attributes. For example, multi-stakeholder engagement (C5) is related to several different attributes related to various stakeholder groups, contributes to the creation of shared value, and is connected with the strategic process (Waddock and Samuel, 1997; Lozano, 2012). In particular, synergistic organizations (C4) are more complicated in terms of CS. These organizations progressively build the perception of synergy between innovation and sustainability and then launch integrated innovation and sustainability efforts as part of sustainable design and production management (Hart and Dowell, 2010). Existing studies illustrate that stakeholder satisfaction affects a firm's financial performance and impacts resource generation, reinforcing competitive advantage. For instance, Waddock and Samuel (1997) demonstrated that diverse types of stakeholder engagement contribute to common value. Therefore, stakeholder engagement aligns with a firm's tactics and also affects other values; investor relationships are considered long-term interplay relations between firms and their individual and institutional investors in capital markets (C1). A code of conduct (C2) is an instrument for encouraging economic activities that support fair trade and build trust among producers, buyers and sellers within a market. In addition, cost reduction (C3) always accompanies CS integration: sustainable initiatives are able to reduce costs, develop environmental management systems, implement waste and energy management programs and improve the productivity and efficiency of material utilization (Lozano, 2015; Tseng 2017).

From the environmental perspective, most firms are aware of the environmental impacts associated with their operational activities. Environmental performance describes the interaction between firms and the environment and is used to identify the environmental impacts of production and consumption (C6). For instance, a manager's attitude and behavior are usually guided by economic performance, which is related to environmental policy (C7), e.g., emissions charges, licenses and standards may encourage firms to increase their innovation. Thereafter, environmental reporting (C8) helps firms to improve their social responsibility and increase their social image. The strategic nature of an organization's sustainability is inseparability intertwined with corporate communication efforts, both internally and externally. Improving the sustainability of consumption and production aims to change manager attitudes and behaviors in terms of CS integration, thus reducing the organization's shortages and reinforcing the strategic

nature of sustainability efforts (Baumgartner and Ebner, 2010). Maon et al. (2008) expressed that manager attitudes and perceptions with respect to CS significantly impact the strategic design. Lozano (2015) showed that manager attitudes and behavior related to sustainability integration create the least reduction in internal organizational deficiencies and that leadership is a driver for CS integration. Thus, green manufacturing (C13) is an economically driven, system-wide, combined approach for reducing and eliminating all waste streams as part of the eco-product and service design (C10) and eco-operational process (C11).

From the social responsibility perspective, the organizational culture (C20) is related to the sustainable beliefs, values and learning of a firm, which are embodied in arranging the materials and presenting the behavior of its stakeholders. Sustainability initiatives and the strategic nature of a firm's sustainability efforts need to consider the organizational culture. These attributes, such as human capital development (C14), talent attraction and retention (C15) and labor practice indicators (C16), link sustainability initiatives with organizational culture in a proactive way. Human capital development (C14) can be generated from productive consumption through investing in education and health to increase productivity and positively contribute to economic growth. In addition, talent attraction and retention (C15) are essential for supporting global enterprises; thus, a proper policy is needed to retain talented workers and overcome the predicament of labor mobilization. Moreover, labor practice indicators (C16) evaluate the level of labor protection, which allows the public to judge a firm's social accountability related to the environment. Beyond the organizational culture, transparency and communication (C21) reduces complexity, makes fulfilling the firm's strategic objectives manageable, and disseminates the CS culture. Corporate communication (C17) is the sophisticated communication of highly detailed information on CS activities and performance. Corporate reputation (C18) is the existing stakeholder perception of the firm in terms of CS. Finally, legal compliance (C19) is the difficulty of acquiring an overview of myriad industry-specific social and environmental regulations prior to launching activities; ensuring legal compliance is a huge challenge for firms (Tseng et al., 2008; Tseng et al., 2015).

Previous studies have resolved the issues related to external communication, primarily using sustainability reports. In contrast, internal communication is discussed only rarely. However, internal communication is also key to the integration process (Klettner et al., 2014; Siebenhüner & Arnold, 2007). In addition, a number studies have argued that integrating CS into strategic management improves a firm's competitive advantage (Lin and Tseng, 2016; Stead & Stead, 2013). Porter and Kramer (2002) stated that the main focus of a firm's sustainability initiatives should be adding value and then creating competitive advantage. However, a framework is required to provide an appropriate strategic link for addressing the social, environmental, and economic aspects of sustainability and to create value for the firm as well as society. This CS framework aims to help a firm achieve their objectives while integrating internal and external activities.

3. Method

This section discusses the case study background, the proposed FSM-DEMATEL and the proposed analytical analysis.

3.1. Case study background

The Taiwanese textile industry began in the 1970s and has become a worldwide industry. The required equipment is usually built in automated or semi-automated manufacturing plants owned by textile firms. The textile industry is considered to have great potential for bringing substantial benefits to the countries in which it operates. However, along with the growth of the industry, textile firms follow the TBL to operate their businesses. CS is increasingly required worldwide as part

of the complex network linking multiple stakeholders. Therefore, firms are facing the challenge of implementing TBL initiatives. Textile firms typically suffer from resource constraints when allocating resources for operational capabilities to improve their competitive advantage. This assessment has been verified by 35 academics and professionals. The respondents have at least 5 years of experience in the industry and a thorough knowledge of CS development.

The proposed criteria for addressing CS are pertinent and timely issues that are particularly relevant to the textile industry, which continues to play an important role in this sector. The RBV aims to help firms understand the periodization of their CS attributes. To assist Taiwanese textile firms in improving their CS with limited resources, the complex hierarchical framework and interrelationships in the firm's management functions must first be understood. This study determined the decisive attributes, thus providing important managerial insights for improving performance. This study also applied the proposed method to evaluate the hierarchical framework. Thus, this study not only examined the CS operational processes and controls but also evaluated the attributes and CS performance of this industry. The significance of sustainable operations for the environment, overall business functions, and business profitability deliberations are considered in this study.

3.2. FSM-DEMATEL

A multi-criteria evaluation model is proposed to assess the CS TBL. The series of criteria is $a = \{a_1, a_2, a_3 \ldots, a_n\}$, and the evaluation matrix is $(m_{ij})_{m*n}$, where m_{ij} is the degree of performance for a specific criterion. The TBL perspectives (P1, P2, P3) and the 21 criteria were collected through a questionnaire with a 5-point linguistic scale for the performance perceptions. The scale contains five linguistic degrees: very low (VL), low (L), medium (M), high (H) and very high (VH). m_{ij} denotes the degree to which the perspectives (P) satisfy criterion i in the evaluation matrix, which can be written in matrix form as follows:

$$(M_i^{P_k})_{1*5} = (m_{i1}^{P_k}, m_{i2}^{P_k}, m_{i3}^{P_k}, m_{i4}^{P_k}, m_{i5}^{P_k}) \tag{1}$$

The perspective can be calculated using the following equation:

$$P_k = \sum_{j=1}^{5} (r_j m_{ij}^{P_k}) \tag{2}$$

where r_j is the rating given to criterion i, namely, $r_j = 1, 2, 3, 4, 5$. The measurement criticality (MC) is typically adopted to measure how the criteria are related to the perspectives. Using the mathematical average to calculate the input value to the matrix and to keep the scale of MC consistent with the 3 perspectives and all the criteria, the following formula is proposed:

$$MC_i = \sqrt[n]{P1*P2*P3} \tag{3}$$

The P_k values are used to generate the direct relation matrix (P_k). RP_k is an $n \times n$ matrix that is generated from the paired comparisons of CS among the criteria after applying the FSM. Thus, $R_{ij}P_k$ represents the degree to which criterion i affects criterion j.

$$RP_k = [R_{ij}P_k]_{n*n} \tag{4}$$

Adopting the following equation normalizes the direct relation matrix RP_k.

$$D = RP_k / \max_{1 \leq i \leq n} \sum_{j=1}^{n} R_{ij} \tag{5}$$

Once the normalized direct relation matrix D is obtained, the following equation can be used to generate the total relation matrix TR, where I represents the identity matrix.

$$TR = D (I-D)^{-1} \tag{6}$$

Accumulating the rows (R) and columns (C) separately among the

total relation matrix TR and then applying $(C + R, C-R)$ produces the cause and effect graphic and divides the dataset into four quadrants based on the horizontal axis $(C + R)$ and vertical axis $(C-R)$. The horizontal axis vector $(C + R)$ represents the relative importance of the criteria. The positive portion of the vertical axis $(C-R)$ groups the criteria into causal groups, whereas the negative portion groups the criteria into effect groups.

$$TR = [d_{ij}]_{n \times n}, \quad i, j = 1, 2, ..., n \tag{7}$$

$$C = \left[\sum_{i=1}^{n} d_{ij} \right]_{n \times 1} = [d_j]_{n \times 1} \tag{8}$$

$$R = \left[\sum_{j=1}^{n} d_{ij} \right]_{1 \times n} = [d_j]_{1 \times n} \tag{9}$$

Next, the weight $W = (w_1, w_2...., w_k)$ of each criterion is determined from the specific TBL perspective, where k is number of criteria. The weights arranged to a specific perspective i can be obtained from the following equation:

$$w_i^{P(i)} = P / \sum_{i=1}^{k} P_i \tag{10}$$

The results of the assessment are presented in terms of the fuzzy composition of the weight vector WV and the assessment matrix EM, namely, $R = WV^*EM$. The $P1$, $P2$ and $P3$ membership function groups (g) can be calculated using the following equations:

$$r_{gj}^{P1} = \sum_{i=1}^{k} wv_i^{P1} x \, em_{ij}^{P1}$$
$$(R_g^{P1})_{1*5} = (WV_i^{P1})_{1*k} {}^*(EM_i^{P1})_{k*5} = (r_{t1}^{P1}, r_{t2}^{P1}, r_{t3}^{P1}, r_{t4}^{P1}, r_{t5}^{P1}) \tag{11}$$

$$r_{gj}^{P2} = \sum_{i=1}^{k} wv_i^{P2} x \, em_{ij}^{P2}$$
$$(R_g^{P2})_{1*5} = (WV_i^{P2})_{1*k} {}^*(EM_i^{P2})_{k*5} = (r_{t1}^{P2}, r_{t2}^{P2}, r_{t3}^{P2}, r_{t4}^{P2}, r_{t5}^{P2})$$
$$r_{gj}^{P3} = \sum_{i=1}^{k} wv_i^{P3} x \, em_{ij}^{P3}$$
$$(R_g^{P3})_{1*5} = (WV_i^{P3})_{1*k} {}^*(EM_i^{P3})_{k*5} = (r_{t1}^{P3}, r_{t2}^{P3}, r_{t3}^{P3}, r_{t4}^{P3}, r_{t5}^{P3}) \tag{12}$$

Based on the perspective (P), the membership functions of the criteria group (t) can generated as follows:

$$P_{Gt} = \sum_{1}^{5} (r_j r_{tj}^{Pk}), \quad k = 1, 2, 3 \tag{13}$$

$$MC_i = \sqrt{P1^*P2^*P3} \tag{14}$$

Next, the overall aspect weight for the perspective is calculated as $W_{As} = \{w_{As1}, w_{As2}......, w_{Asm}\}$, where x is the number of aspects. The weight assigned to perspective j uses the following equation:

$$w_{gj}^{Pk} = \left(\sum_{i=1}^{k} P_i \right)_j / \sum_{j=1}^{x} \left(\sum_{i=1}^{k} P_k \right)_j \tag{15}$$

where $(\Sigma_{i=1}^{k} P_i)_j$ denotes the sum of P for k criteria in group m. The perspective membership functions of the overall weight can be obtained using the following equations:

$$mr_{Allj}^{P1} = \sum_{i=1}^{x} wv_{Asm}^{P1} x \, MR_{jj}^{P1}$$
$$(MR_{All}^{P1})_{1*5} = (WV_{Asm}^{P1})_{1*x} {}^*(mr_{Asm}^{P1})_{x*5}$$
$$= (mr_{All1}^{P1}, mr_{All2}^{P1}, mr_{All3}^{P1}, mr_{All4}^{P1}, mr_{All5}^{P1})$$
$$mr_{Allj}^{P2} = \sum_{i=1}^{x} wv_{Asm}^{P2} x \, MR_{jj}^{P2}$$
$$(MR_{All}^{P2})_{1*5} = (WV_{Asm}^{P2})_{1*x} {}^*(mr_{Asm}^{P2})_{x*5}$$
$$= (mr_{All1}^{P2}, mr_{All2}^{P2}, mr_{All3}^{P2}, mr_{All4}^{P2}, mr_{All5}^{P2})$$
$$mr_{Allj}^{P3} = \sum_{i=1}^{x} wv_{Asm}^{P3} x \, MR_{jj}^{P3}$$
$$(MR_{All}^{P3})_{1*5} = (WV_{Asm}^{P3})_{1*x} {}^*(mr_{Asm}^{P3})_{x*5}$$
$$= (mr_{All1}^{P3}, mr_{All2}^{P3}, mr_{All3}^{P3}, mr_{All4}^{P3}, mr_{All5}^{P3}) \tag{16}$$

where $(mr_{Asm}{}^{Pi})_{x*}5$ represents a x^*5 matrix. The overall P_i membership functions and MC can be calculated as follows:

$$P_{i\,All} = \sum_{j=1}^{5} (r_j mr_{Allj}^{Pk}) \tag{17}$$

$$MC_{All} = \sqrt[n]{(P1_{All}{}^*P2_{All}{}^*P3_{All})} \quad \text{where} \quad r_j = 1, 2, 3, 4, 5 \quad \text{(Hart \& Dowell, 2010)}.$$

3.3. Proposed analytical steps

This study proposes the following steps of the hybrid method for collecting the TBL attributes and conduct the analysis.

1. The CS-related TBL information is gathered from the literature review, and a group of 35 experts are consulted to confirm the criteria. The questionnaire respondents are required to have the professional and academic knowledge needed to achieve the study goal.
2. The linguistic information is translated into FSM scales. Then, the fuzzy numbers are converted into comparable values, and the fuzzy assessments are defuzzified using Eqs. (1)–(3). Exploratory factor analysis is used to group the criteria into a hierarchical framework, and the hierarchical structure has natural interdependent relations within the structure. The decision matrix is composed using Eq. (4).
3. The crisp values are applied to the total DEMATEL relation matrix using Eqs. (5)–(9). The mapping graphic of the causal effect is then presented.
4. The first-level crisp values (perspectives versus criteria) are composed, and the group weights are calculated using Eqs. (10)–(14).
5. The second-level crisp values (perspectives versus aspects) are computed using the CS perspectives and the overall weights. Then, the weights of the aspects are calculated using Eq. (16). The overall perspective weights are computed using Eqs. (17)-(Hart & Dowell, 2010).

4. Results

This section applies the proposed hybrid method and analytical steps. The exploratory factor analysis groups the criteria and names the clusters.

4.1. Exploratory factor analysis

Table 2 presents the factor analysis with the factor loadings, which are greater than 0.7, indicating the validity of the criteria. There are 6 groups in the hierarchical framework. The reliability tests (Amini & Bienstock, 2014) the economic activities of the firm (Cronbach $\alpha = 0.898$); (Azapagic, 2003) stakeholder management ($\alpha = 0.856$); (Barrutia & Echebarria, 2015) policy and performance ($\alpha = 0.849$); (Baumgartner & Ebner, 2010) operational control ($\alpha = 0.901$); (Bonn & Fisher, 2011) corporate culture ($\alpha = 0.878$); and (Brockhaus et al., 2017) social image ($\alpha = 0.815$). The Cronbach α indicates the high reliability of these aspects.

The results of criteria 1 under P1 indicates that 20% of the

Table 2
Factor loading- grouping.

	Aspects	Criteria		Factor loading	Reliability
As1	Firms' economic activities	C1	Synergistic organization	0.856	0.898
		C2	Code of conduct	0.825	
		C3	Cost reduction	0.810	
As2	Stakeholder management	C4	Stakeholder's relations	0.789	0.856
		C5	Multi-stakeholder engagement	0.776	
As3	Policy and Performance	C6	Environmental performance	0.825	0.849
		C7	Environmental policy	0.817	
		C8	Environmental reporting	0.809	
		C9	Strategic nature	0.789	
As4	Operational control	C10	Eco-product and service design	0.778	0.901
		C11	Eco-operational process	0.774	
		C12	Manager attitude and behavior	0.764	
		C13	Green manufacturing	0.758	
As5	Corporate culture	C14	Human capital development	0.875	0.878
		C15	Talent attraction and retention	0.868	
		C16	Labor practice indicators	0.851	
		C17	Corporate communication	0.825	
As6	Social image	C18	Corporate reputation	0.798	0.815
		C19	Legal compliance	0.778	
		C20	Organization culture	0.774	
		C21	Transparency and communication	0.768	

respondents rated P1 as very low, 26% as low, 32% as medium, 19% as high and 0% as very high. Thus, the membership function of P11 is calculated as follows:

$$(M_i^{P1})_{(1*5)} = (m_{i1}^{P1}, m_{i2}^{P1}, m_{i3}^{P1}, m_{i4}^{P1}, m_{i5}^{P1}) = (0.20, 0.26, 0.32, 0.19, 0.00)$$

$P1 = 0.20/very\ low + 0.26/low + 0.32/medium + 0.19/high + 0/very\ high$

Table 3 presents the perspectives and criteria. The TBL perspectives are the economic perspective (P1), the environmental perspective (P2) and the social responsibility perspective (P3). For instance, the following equations show the computation for the perspectives relative to C1. The C1 MC value is 2.061, and the top 3 criteria are manager attitude and behavior (C12), eco-operational process (C11) and legal compliance (C19).

$P1 = 1*0.130 + 2*0.240 + 3*0.420 + 4*0.110 + 5*0.100 = 2.81.$

$P2 = 1*0.00 + 2*0.35 + 3*0.420 + 4*0.230 + 5*0.170 = 2.88.$

$P3 = 1*0.100 + 2*0.250 + 3*0.270 + 4*0.230 + 5*0.150 = 3.080.$

$$MC = \sqrt[3]{P1*P2*P3} = 2.061$$

4.2. FSM-DEMATEL

The FSM crisp value is used to compose the total relation matrix of the criteria. This analysis repeats the computational process using Eqs. (1)–(3). Table 4 presents the matrix determined using Eq. (4). Table 5 shows the significant and relation axis for the causal and effect groups. The criteria with positive values are causal criteria (C3, C4, C6, C7, C8, C9, C10, C11, C13, C14, C15, C18), whereas those with negative values are effect criteria (C1, C2, C5, C12, C16, C17, C19, C20, C21). For instance, the crisp value in C2 (P1-P3) versus C2 is calculated as $\frac{2.980 + 3.380 + 3.380}{3} = 3.247$.

Fig. 1 shows that the major causal criteria are cost reduction (C3), stakeholder relations (C4), environmental performance (C6), green manufacturing (C13), and talent attraction and retention (C15).

Taking As1 as an example, the P1 membership function was

Table 3
Perspectives and criteria's using FSE.

	P1						P2						P3						MC	Rank
	Value	Membership function					Value	Membership function					Value	Membership function						
C1	2.810	0.130	0.240	0.420	0.110	0.100	2.880	0.000	0.350	0.420	0.230	0.000	3.080	0.100	0.250	0.270	0.230	0.150	2.061	21
C2	2.980	0.100	0.170	0.450	0.210	0.070	3.380	0.000	0.170	0.450	0.210	0.170	3.380	0.150	0.170	0.400	0.210	0.170	2.134	13
C3	2.870	0.170	0.210	0.310	0.200	0.110	3.550	0.000	0.210	0.310	0.200	0.280	3.550	0.000	0.210	0.310	0.200	0.280	2.151	11
C4	2.930	0.150	0.180	0.370	0.190	0.110	3.530	0.000	0.180	0.370	0.190	0.260	3.530	0.000	0.180	0.370	0.190	0.260	2.152	10
C5	3.360	0.000	0.240	0.350	0.220	0.190	3.360	0.000	0.240	0.350	0.220	0.190	3.320	0.020	0.240	0.330	0.220	0.190	2.156	9
C6	3.350	0.000	0.240	0.370	0.190	0.200	3.350	0.000	0.240	0.370	0.190	0.200	2.900	0.050	0.280	0.405	0.250	0.015	2.124	14
C7	3.300	0.000	0.210	0.420	0.230	0.140	3.300	0.000	0.210	0.420	0.230	0.140	3.160	0.070	0.210	0.350	0.230	0.140	2.135	12
C8	3.570	0.000	0.170	0.350	0.220	0.260	3.570	0.000	0.170	0.350	0.220	0.260	2.970	0.150	0.170	0.350	0.220	0.110	2.161	7
C9	3.430	0.000	0.200	0.360	0.250	0.190	3.430	0.000	0.200	0.360	0.250	0.190	3.430	0.000	0.200	0.360	0.250	0.190	2.173	5
C10	3.710	0.000	0.190	0.270	0.180	0.360	3.710	0.000	0.190	0.270	0.180	0.360	2.920	0.150	0.200	0.350	0.180	0.120	2.177	4
C11	3.560	0.000	0.210	0.350	0.110	0.330	3.560	0.000	0.210	0.350	0.110	0.330	3.390	0.000	0.210	0.350	0.280	0.160	2.189	2
C12	3.740	0.000	0.150	0.230	0.350	0.270	3.740	0.000	0.150	0.230	0.350	0.270	3.520	0.050	0.150	0.300	0.230	0.270	2.222	1
C13	3.080	0.110	0.170	0.370	0.230	0.120	3.080	0.110	0.170	0.370	0.230	0.120	3.080	0.110	0.170	0.370	0.230	0.120	2.097	13
C14	3.040	0.130	0.160	0.350	0.260	0.100	3.040	0.130	0.160	0.350	0.260	0.100	2.744	0.150	0.232	0.350	0.260	0.008	2.065	20
C15	3.358	0.008	0.190	0.390	0.260	0.152	3.358	0.008	0.190	0.390	0.260	0.152	3.358	0.008	0.190	0.390	0.260	0.152	2.158	8
C16	3.230	0.120	0.110	0.400	0.160	0.210	3.020	0.120	0.180	0.400	0.160	0.140	3.030	0.110	0.190	0.400	0.160	0.140	2.100	16
C17	3.510	0.110	0.100	0.320	0.110	0.360	2.960	0.110	0.250	0.320	0.210	0.110	3.000	0.100	0.250	0.320	0.210	0.120	2.114	15
C18	3.410	0.130	0.090	0.280	0.240	0.260	3.390	0.000	0.270	0.280	0.240	0.210	3.390	0.000	0.270	0.280	0.240	0.210	2.166	6
C19	3.764	0.009	0.120	0.320	0.200	0.351	3.370	0.090	0.120	0.320	0.270	0.200	3.370	0.090	0.120	0.320	0.270	0.200	2.188	3
C20	2.900	0.150	0.210	0.330	0.210	0.100	3.040	0.090	0.230	0.350	0.210	0.120	3.040	0.090	0.230	0.350	0.210	0.120	2.077	18
C21	2.940	0.110	0.190	0.390	0.270	0.040	2.960	0.160	0.190	0.280	0.270	0.100	2.960	0.160	0.190	0.280	0.270	0.100	2.068	19

Table 4
The total DEMATEL relation matrix of criteria.

	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13	C14	C15	C16	C17	C18	C19	C20	C21	Row
C1	0.000	3.141	2.825	2.973	2.949	3.031	2.713	3.005	2.705	2.920	2.773	2.737	2.458	3.265	3.120	2.926	2.882	2.721	2.835	3.303	2.838	60.930
C2	3.247	0.000	3.124	3.108	3.200	3.189	2.868	3.152	2.868	3.209	2.887	3.084	2.888	3.091	3.249	3.265	3.155	3.040	3.023	2.893	2.959	61.233
C3	2.870	3.681	0.000	3.814	3.259	3.193	3.005	3.235	3.084	3.157	3.039	3.050	2.730	3.299	3.394	3.626	3.377	3.204	3.179	3.080	3.080	64.355
C4	2.930	3.669	3.356	0.000	3.439	3.516	3.258	3.515	3.106	3.439	3.162	3.199	3.205	3.502	3.392	3.776	3.473	3.343	3.167	3.236	3.486	67.290
C5	3.360	3.591	3.196	2.851	0.000	2.833	2.883	2.888	2.846	3.171	2.861	2.854	2.921	3.092	3.391	3.327	3.433	2.948	3.237	3.479	3.471	62.564
C6	3.350	3.869	3.354	3.158	4.122	0.000	3.172	3.483	3.208	3.630	3.216	3.127	3.033	3.039	3.390	3.536	3.612	3.409	3.135	3.461	3.327	67.734
C7	3.300	3.346	3.228	3.445	3.541	3.287	0.000	3.056	3.004	3.241	3.038	2.923	3.250	3.043	3.134	3.187	3.259	3.175	3.222	3.180	3.450	64.222
C8	3.570	3.529	3.538	3.250	3.640	3.017	2.891	0.000	2.875	3.280	3.075	2.889	3.054	2.910	3.119	3.323	3.082	2.959	2.918	3.102	3.648	63.973
C9	3.430	3.635	3.284	3.131	3.700	2.689	2.625	2.502	0.000	2.985	2.657	2.796	3.138	2.505	3.056	3.183	3.108	2.818	3.071	2.881	2.824	59.865
C10	3.710	3.687	3.288	3.398	3.773	3.413	2.957	3.302	2.954	0.000	2.950	3.309	3.130	3.076	2.849	3.588	3.306	3.187	3.124	3.507	3.326	65.483
C11	3.560	3.922	3.400	3.280	3.367	3.023	2.954	2.985	3.007	3.313	0.000	2.862	3.130	2.814	2.678	3.502	3.424	3.174	2.569	3.391	3.091	64.001
C12	3.740	3.158	3.257	3.015	2.685	2.711	2.427	2.622	2.343	2.985	2.449	0.000	2.889	2.428	2.345	3.039	3.170	2.556	3.589	2.620	3.147	56.155
C13	3.080	3.600	3.596	3.741	3.339	3.231	3.119	3.036	3.078	3.472	3.295	3.224	0.000	3.060	3.404	3.655	3.587	3.311	3.140	3.233	3.494	67.143
C14	3.040	3.178	3.440	2.956	3.264	2.710	2.644	2.689	2.832	2.938	2.919	2.690	2.828	0.000	2.974	3.209	3.124	2.693	3.111	3.076	2.986	59.330
C15	3.358	3.448	3.224	3.345	3.413	3.164	2.944	2.970	2.898	3.425	2.963	2.956	3.093	2.868	0.000	3.542	3.325	3.098	2.871	3.163	3.174	63.481
C16	3.230	3.431	3.151	3.258	3.090	2.732	2.685	2.939	2.585	2.936	2.613	2.880	2.733	2.410	2.674	0.000	2.893	2.667	3.147	2.993	2.770	57.542
C17	3.510	3.536	3.294	3.200	3.014	3.397	2.774	3.143	2.813	3.241	2.790	3.095	2.940	2.662	2.985	3.250	0.000	3.008	3.332	3.309	2.825	61.932
C18	3.410	3.375	3.157	3.707	3.109	3.187	2.866	2.880	2.983	3.356	2.869	2.855	2.962	3.460	3.172	3.217	3.515	0.000	3.147	3.143	3.247	63.800
C19	3.764	3.273	2.895	2.977	2.715	3.081	2.574	3.179	2.528	3.190	2.581	2.631	2.590	2.683	2.853	2.722	3.301	2.606	0.000	3.332	2.776	57.563
C20	2.900	3.093	2.963	3.154	3.035	2.996	2.710	2.728	2.714	3.094	2.756	2.445	2.959	2.729	2.774	2.857	3.140	2.734	2.890	0.000	2.996	57.667
C21	2.940	3.081	2.791	2.965	2.882	2.965	2.522	2.469	2.552	3.060	2.661	2.459	2.601	2.570	2.587	2.767	2.832	2.690	2.808	2.703	0.000	54.904
Max																						67.734

Table 5
The prominence and relation axis for cause and effect group.

	C	R	C + R	C-R
C1	9.060	10.120	19.179	(1.060)
C2	9.594	10.715	20.309	(1.122)
C3	10.083	9.981	20.064	0.102
C4	10.526	10.040	20.566	0.486
C5	9.694	10.158	19.852	(0.465)
C6	10.556	9.558	20.114	0.998
C7	9.892	8.840	18.732	1.052
C8	9.877	9.328	19.205	0.549
C9	9.286	8.891	18.178	0.395
C10	10.084	9.062	19.146	1.022
C11	9.909	8.977	18.886	0.931
C12	8.624	9.062	17.686	(0.438)
C13	10.444	9.068	19.512	1.377
C14	9.234	9.048	18.282	0.186
C15	9.858	9.435	19.293	0.423
C16	8.957	10.163	19.119	(1.206)
C17	9.618	10.082	19.700	(0.463)
C18	9.901	9.247	19.148	0.654
C19	8.894	9.588	18.482	(0.694)
C20	9.041	9.707	18.748	(0.666)
C21	8.591	9.770	18.361	(1.179)
Max	10.556	10.715	20.566	1.377
Min	8.591	8.840	17.686	(1.206)
Average			19.170	0.042

obtained using Eqs. (11)–(12):

$$r_{gj}^{P1} = \sum_{i=1}^{k} wv_i^{P1} x\; em_{ij}^{P1} \tag{11}$$

$(R_g^{P1})_{1*5} = (WV_i^{P1})_{1*3}{}^{*}(EM_i^{P1})_{3*5}=$

$$[0.324,\quad 0.344, 0.331]^{*}\begin{bmatrix} 0.130 & 0.240 & 0.420 & 0.110 & 0.100 \\ 0.100 & 0.170 & 0.450 & 0.210 & 0.070 \\ 0.170 & 0.210 & 0.310 & 0.20 & 0.110 \end{bmatrix}=$$

$[0.130, 0.240, 0.420, 0.110, 0.100]$

Then, the P1 of "firm's economic activities" can be calculated using Eq. (13). The P2 and P3 membership function were calculated following a similar method. Then, the MC was obtained using Eq. (14).

The weights of the CS perspectives for the risk groups are shown in Table 6. The perspectives contain 6 aspects weights, which are determined from the exploratory factor analysis. The weights assigned to the "firm's economic activities" perspective were obtained using Eq. (15).

$w_{gj}^{P1} = (\Sigma_{i=1}^{3}P_1)_j/\Sigma_{j=1}^{6}(\Sigma_{i=1}^{k}P_1)_j = 8.66/68.842 = 0.126$
$w_{gj}^{P2} = (\Sigma_{i=1}^{3}P_2)_j/\Sigma_{j=1}^{6}(\Sigma_{i=1}^{k}P_2)_j = 9.81/69.578 = 0.141$
$w_{gj}^{P3} = (\Sigma_{i=1}^{3}P_3)_j/\Sigma_{j=1}^{6}(\Sigma_{i=1}^{k}P_3)_j = 10.010/67.122 = 0.149$

Table 7 presents the overall CS perspective weights, which are used to assess the entire CS weight in level 3. The entire P1 membership function is obtained by computing the fuzzy composition of the weight vector and the assessment matrix using Eq. (16). The top 3 aspects are the firm's economic activities (As1), stakeholder management (As2) and operational control (As4)

$$mr_{Allj}^{P1} = \sum_{i=1}^{x} wv_{Asm}^{P1} x\; MR_{jj}^{P1} = \begin{bmatrix} 2.810 \\ 1.365 \\ 0.822 \\ 0.937 \\ 0.777 \\ 0.894 \end{bmatrix} x \begin{bmatrix} 0.130 & 0.240 & 0.420 & 0.110 & 0.100 \\ 0.070 & 0.084 & 0.172 & 0.089 & 0.051 \\ 0.000 & 0.059 & 0.091 & 0.047 & 0.049 \\ 0.000 & 0.055 & 0.092 & 0.029 & 0.087 \\ 0.002 & 0.044 & 0.090 & 0.060 & 0.035 \\ 0.034 & 0.024 & 0.073 & 0.063 & 0.068 \end{bmatrix}$$

$= [0.0365, 0.0674, 1.180, 0.309, 0.281]$
$mr_{Allj}^{P2} = [1.678, 0.000, 0.204, 0.245, 0.134]$
$mr_{Allj}^{P3} = [0.005, 0.011, 0.012, 0.011, 0.007]$

Then, the overall perspective values were calculated using Eq. (17)
$P_{1\;All} = 7.896; P_{2\;All} = 3.939; P_{3\;All} = 0.141$
Finally, the overall MC was obtained using Eq. (18)

$$MC_{All} = \sqrt[n]{(P1_{All}*P2_{All}*P3_{All})} = \sqrt[3]{7.896*3.939*0.141} = 1.637$$
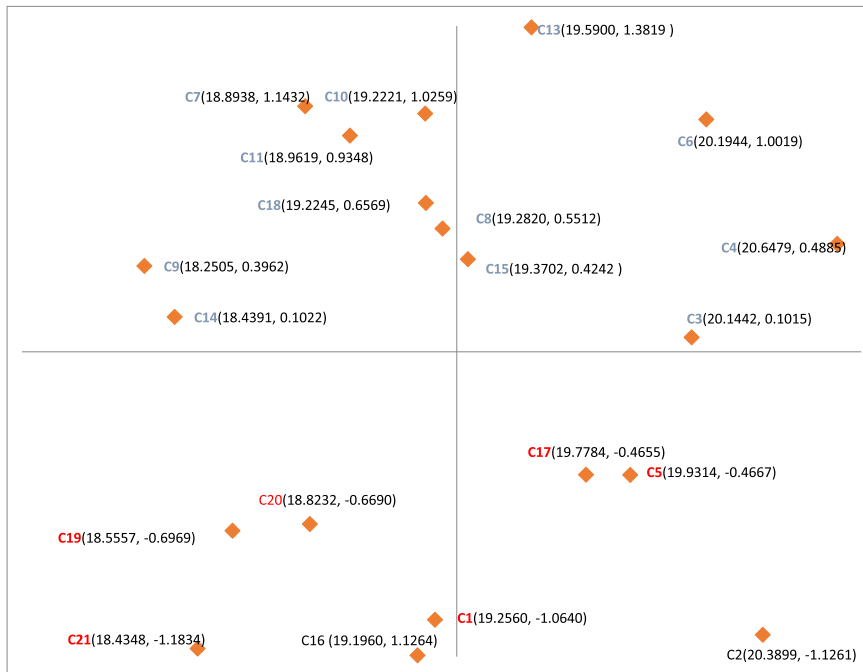
Fig. 1. Causal effect on CS.

The economic perspective (P1) is 7.896, the environmental perspective (P2) is 3.939 and the social responsibility perspective is 0.141. The overall MC of the CS performance in the Taiwanese textile was considered low (1.637). Therefore, there is still room for improvement.

5. Implications

This section discusses the theoretical implications of the RBV and the professional and managerial implications of the results for the textile industry.

5.1. Theoretical implications

The RBV seeks the resources needed to achieve superior firm

performance. If a resource exhibits the necessary attributes, then can enable the firm to sustain competitive advantage. However, to determines these key capabilities remains an issue for firms (Barrutia and Echebarria, 2015; Cui et al., 2017; Rothaermel, 2001). In lieu of this theory, this study composed a set of attributes for assessing the CS TBL perspectives. In the CS principle, TBL examines the business functions while addressing the profitability and stakeholder concerns, establishing a closer voluntary deliberation between corporate value creation and environmental concerns (Tseng et al., 2008; Fuisz-Kehrbach, 2014; Waligo et al., 2013). This study agrees with the finding of Tseng (2017) that firms are focused on both economic and environmental activities but that few firms address social responsibility.

This result perhaps occurs because manufacturing firms focus on building the manufacturing capabilities and following the customer

Table 6
CS perspectives and aspects weights.

		P1				P2				P3			
		Value	Sum	Factor weight	Group weight	Value	Sum	Factor weight	Group weight	Value	Sum	Factor weight	Group weight
As1	C1	2.810	8.660	**0.324**	0.126	2.880	9.810	0.294	0.141	3.080	10.010	0.308	0.149
	C2	2.980		**0.344**		3.380		0.345		3.380		0.338	
	C3	2.870		**0.331**		3.550		0.362		3.550		0.355	
As2	C4	2.930	6.290	0.466	0.091	3.530	6.890	0.512	0.099	3.530	6.850	0.515	0.102
	C5	3.360		0.534		3.360		0.488		3.320		0.485	
As3	C6	3.350	13.650	0.245	0.198	3.350	13.650	0.245	0.196	2.900	12.460	0.233	0.186
	C7	3.300		0.242		3.300		0.242		3.160		0.254	
	C8	3.570		0.262		3.570		0.262		2.970		0.238	
	C9	3.430		0.251		3.430		0.251		3.430		0.275	
As4	C10	3.710	14.090	0.263	0.205	3.710	14.090	0.263	0.203	2.920	12.910	0.226	0.192
	C11	3.560		0.253		3.560		0.253		3.390		0.263	
	C12	3.740		0.265		3.740		0.265		3.520		0.273	
	C13	3.080		0.219		3.080		0.219		3.080		0.239	
As5	C14	3.040	13.138	0.231	0.191	3.040	12.378	0.246	0.178	2.744	12.132	0.226	0.181
	C15	3.358		0.256		3.358		0.271		3.358		0.277	
	C16	3.230		0.246		3.020		0.244		3.030		0.250	
	C17	3.510		0.267		2.960		0.239		3.000		0.247	
As6	C18	3.410	13.014	0.262	0.189	3.390	12.760	0.266	0.183	3.390	12.760	0.266	0.190
	C19	3.764		0.289		3.370		0.264		3.370		0.264	
	C20	2.900		0.223		3.040		0.238		3.040		0.238	
	C21	2.940		0.226		2.960		0.232		2.960		0.232	

Factor weight (P1) times membership function (P1).

Table 7
CS perspectives and aspects overall weights.

	P1 Weight	P1 Value	P1 Membership function					P2 Weight	P2 Value	P2 Membership function					P3 Weight	P3 Value	P3 Membership function					MC	Rank
As1	2.810		**0.130**	**0.240**	**0.420**	**0.100**		1.985		0.846	0.000	0.103	0.123	0.068	0.149		0.031	0.077	0.083	0.071	0.046	0.940	1
As2	1.365		0.070	0.084	0.172	0.089	0.051	1.809		0.000	0.092	0.190	0.097	0.133	0.102		0.000	0.093	0.191	0.098	0.134	0.632	2
As3	0.822		0.000	0.059	0.091	0.047	0.049	0.822		0.000	0.059	0.091	0.047	0.049	0.186		0.012	0.065	0.094	0.058	0.003	0.501	5
As4	0.937		0.000	0.055	0.092	0.029	0.087	0.977		0.000	0.050	0.071	0.047	0.095	0.192		0.034	0.045	0.079	0.041	0.027	0.561	3
As5	0.777		0.002	0.044	0.090	0.060	0.035	0.747		0.032	0.039	0.086	0.064	0.025	0.181		0.034	0.052	0.079	0.059	0.002	0.472	6
As6	0.894		0.034	0.024	0.073	0.063	0.068	0.901		0.000	0.072	0.074	0.064	0.056	0.190		0.000	0.072	0.074	0.064	0.056	0.535	4

Weight value (As) times membership functions (P1).

requirements to produce green products as the retail channels demand more green products. This suggestion is in agreement with the sustainable supply chain management model, which states that the TBL must consider and develop the entire supply chain for sustainable development (Lin and Tseng, 2016; Tseng et al., 2015; Shi et al., 2017). Moreover, textile firms may seek to address environmental health and safety in order to take responsibility for environmental protection, to provide safe working conditions for job-related health and safety, to regulate and identify workplace hazards, and to reduce accidents and exposure to harmful conditions and materials. In addition, the target of RBV can achieve competitive advantage through management capabilities (Shi et al., 2017; Lin et al., 2011). This study determined the causal effect attributes and ranked them based on managerial and professional viewpoints. Furthermore, the results show that the overall CS performance is low. Therefore, the attributes could help the industry to improve their CS performance.

5.2. Managerial implications

The CS performance ranking is as follows: 1. economic perspective; 2. environmental perspective; and 3. social responsibility perspective. Moreover, the overall CS industrial assessment is low for this industry. This study also determined the ranking of the aspects and criteria. The top 3 aspects are as follows: 1. firm's economic activities; 2. stakeholder management; and 3. operational control. The top 5 criteria are as follows: 1. manager attitude and behavior; 2. eco-operational process; 3. legal compliance; 4. strategic nature; and 5. eco-product and service design. Additionally, the causal effect criteria are the following: 1. cost reduction; 2. stakeholder relations; 3. environmental performance; 4. green manufacturing; and 5. talent attraction and retention.

The attitude and behavior of a well-informed manager can easily and efficiently attract and inspire teams by searching the primary resources for talent attraction and retention in a specific field. A strategic management must prepare to adopt CS. However, this preparation does not mean that the management foresees a future trend; instead, the management is aiming to avoid risks via planning, organizing, managing and controlling. Effective management acquires the necessary strategic abilities that help managers to formulate objectives, set an action plan and direct the team towards business fulfillment. The attitude and behavior of managers also shapes the entrepreneurial attitude for discovering new ideas and processes in the business domain.

In summary, the industry is focused on building closer relationships in the supply chain and enhancing their competitive advantage. Specifically, a stakeholder is related to the supply chain network. Therefore, effective stakeholder management generates positive relationships with stakeholders through proper management of their expectations. To integrate these attributes together, a strategic firm needs to be well structured to identify the resources that can help sort out process control, cost reduction, eco-product design and eco-operational processes for current problems and to prevent future problems.

6. Conclusions

CS has received extensive attention in recent years, but the existing literature lacks a full analysis of the hierarchical framework. In addition to addressing the TBL issues, the causal effects need to be better understood, as previous studies lacked systematic analysis. This study determined the causal criteria that led to a low overall CS weight for the Taiwanese textile industry. In this case, the causal criteria are cost reduction, stakeholder relations, environmental performance, green manufacturing and talent attraction and retention. Thus, this study assists in understanding a firm's CS attributes by constructing an evaluation hierarchical framework and proposing an analysis method based on expert opinions.

The contribution of this study is providing a valid and reliable hierarchical framework that can be applied to complex

interrelationships. This study improved the traditional FSM and applied the DEMATEL to find the causal attributes that explain the low CS rating in the Taiwanese textile industry. In addition, previous studies were unclear on how to construct the hierarchical framework; therefore, this study uses the RBV theory as the basic foundation for understanding a firm's resources and capability trade off (Lin and Tseng, 2016). This study uses the RBV theory to address the CS, provide valid and reliable measures and propose a hybrid method for complicated situations. In traditional practice, a firm's economic activities, stakeholder management and operational control are prioritized. The results of this study suggest that future research should focus more on the social responsibility issues to better understand how firms can balance all of the proposed aspects.

The results show that the overall CS weight for the Taiwanese textile industry is low. Using the TBL, the economic perspective weight is very high, and the environmental perspective weight is medium. Environmental sustainability, which includes eco-friendly materials and energy-saving and recyclable apparel, is a mutual goal in the industry that is common deliberated. When considering the social responsibility of international retail channels, the channels are all moving towards more sustainable textile products. In this industry, internationally esteemed, successful professionals are developing the latest eco-friendly technologies and certification regulations with local manufactures (Tseng et al. 2015; Lin and Tseng, 2016). The likely reason for the low social responsibility perspective is the long working hours in this labor intensive industry.

To conclude, a valid and reliable hierarchical framework and limitations are essential for assessing CS. The proposed RBV theory should incorporate resources and consider capability conditions, relevant operation processes, and the desired performance improvement (Tseng et al., 2008). In certain cases, the proposed hierarchical framework should include additional measures. Additionally, this proposed framework should also be tested in empirical studies. Future studies could perform a data-driven analysis to test this hierarchical framework or conduct a longitudinal study on whether CS improves over time. Additionally, future studies could further analyze case studies, which are useful to practitioners.

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