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The sweet spot in sustainability: a framework for corporate assessment in sugar manufacturing

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The assessment of corporate sustainability has become an increasingly important topic, both within academia and in industry. For manufacturing companies to conform to their commitments to sustainable development, a standard and reliable measurement framework is required. There is, however, a lack of sector-specific and empirical research in many areas, including the sugar industry. This paper presents an empirically developed framework for the assessment of corporate sustainability within the Thai sugar industry. Multiple case studies were conducted, and a survey using questionnaires was also employed to enhance the power of generalisation. The developed framework is an accurate and reliable measurement instrument of corporate sustainability, and guidelines to assess qualitative criteria are put forward. The proposed framework can be used for a company's self-assessment and for guiding practitioners in performance improvement and policy decision-making.

Keywords: corporate sustainability; sustainability assessment; sustainability indicators; sugar industry; performance measurement

1. Introduction

Sustainable development was introduced by the Brundtland Report in 1987 as 'the development that meets the needs of the present generation, without compromising the ability of future generations to meet their own needs' (WCED 1987). The industrial sector, often blamed as a major source of environmental degradation and social deprivation issues, is required to demonstrate their responsibility by assessing and reporting performance with respect to sustainable development within their organisations (Azapagic 2003; Azapagic and Perdan 2000). Recent literature shows that the number of companies which regularly report their progress towards sustainable development has been increasing every year (Hubbard 2009; KPMG 2011; Lozano and Huisingsh 2011; Schneider and Meins 2012). However, sustainability assessment is complex because it is related to a large number of criteria, both quantitative and qualitative aspects, as well as uncertainties in scoring and assessing. These points pose challenges to researchers in providing an assessment instrument which could generate reliable results.

Since business systems vary among different countries, research findings based on a particular country tend to lack generalisability to other countries without further validations (Goyal, Rahman, and Kazmi 2013; Whitley 1992). This implies the demand of country- and

sector-specific study based on a general concept or theory. Salzmann, Ionescu-Somers, and Steger (2005) believe that sector-specific research in the sustainability context provides more accurate measurement and enhances the validity of the analysis. This paper is a response to an absence of empirical-based research in developing countries, particularly in Asia which contains two-third of the world's population (Goyal, Rahman, and Kazmi 2013; Heng et al. 2012). Thailand is regarded as a newly industrialised country and one of Asia's manufacturing hubs, where the number of factories has rapidly increased over a few decades (Das, Paul, and Swierczek 2008). Based on Phusavat and Kanchana (2007), Thai manufacturers generally address their competitive priorities towards internal processes and customer-focus whilst paying less attention to environmental issues and knowledge management. This implies that the concept of 'corporate sustainability' has not yet been greatly recognised among Thai manufacturers. Therefore, studies in sustainability assessment based upon a case in the Thai manufacturing sector should raise awareness, not only in the private sector but also in government, about decision-making to improve the sector's competitiveness and ability to sustain. The sugar industry was selected as it has been cited as one of the industries responsible for substantial impact on the environment and society

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(Cheesman 2004; Ingaramo et al. 2009; Lemus-Ruiz 1999).

The aim of this paper is to develop a framework for the assessment of corporate sustainability, specifically for the Thai sugar industry which is still unavailable for practitioners. One challenge here is to investigate how qualitative aspects of sustainability can be assessed in a standardised manner. Each dimensions of corporate sustainability is clarified, and 'quality' is here separately viewed as another contributor to the overall sustainability in order to make the performance analysis clear and transparent. Through the case studies, the framework provides insight into how sugar manufacturers can maintain their business and operations, sustainably. It presents appropriate and practical indicators for the assessment of progress towards sustainable development. The framework is finally tested for its reliability and generalisability through a survey across the whole Thai sugar industry.

2. The assessment of corporate sustainability

The concept of sustainability has been transposed to many areas as well as to the business and manufacturing sectors (Garetti and Taisch 2012), which focuses on the notion of 'corporate sustainability'. Dyllick and Hockerts (2002, 131), interpret this term as 'meeting the needs of a firm's direct and indirect stakeholders (such as shareholders, employees, clients, pressure groups, communities, etc.), without compromising its ability to meet the needs of future stakeholders'. On the other hand, it is directly defined by Perrini and Tencati (2006, 296) as 'the capacity of a firm to continue operating over a long period of time'.

Although the two definitions look at 'corporate sustainability' from different angles, they are communicating the same message. The extent to which a firm can indefinitely maintain itself depends on how the firm satisfies stakeholders in the present and future focus. Responding to sustainable development initiatives, Elkington proposed a framework called the triple bottom line (TBL) which encompassed three critical dimensions: economic, environment and social (Elkington 1997). The concept of TBL encourages practitioners to move beyond the consideration of monetary benefits and values to take the concerns of people and planet into account.

Over the past two decades, many concepts and frameworks relating to corporate sustainability assessment have been introduced. Ecological footprint (Wackernagel and Rees 1996) and the life cycle assessment (Rebitzer et al. 2004) are among the well-known concepts. Nevertheless, it has been argued that, when these concepts are used to measure or compare sustainability, they merely focus on historical measures which may not lead to truly sustainable practices. Moreover, a misleading conclusion is possibly made since only

environmental aspects of sustainable development are often considered (Barrett and Scott 2001; Fiala 2008; Kicherer et al. 2007; Moffatt 2000). Eco-efficiency is another concept which can be applied to sustainable development at the corporate level by focusing on maximising a company's economic values while minimising the ecological impacts and intensity of use of natural resources (WBCSD 2013). It combines economic measures with measures of environmental impacts in a ratio format (Burritt, Hahn, and Schaltegger 2002). This might be a useful way for comparing processes; however, it is insufficient to guarantee sustainability since it does not cover every aspect needed to become truly sustainable, especially in terms of social impacts (Dyllick and Hockerts 2002; Isaksson and Steimle 2009).

The Global Reporting Initiative (GRI) guideline is one of the best known frameworks for measuring and reporting organisational sustainability (KPMG 2011). The guideline provides a large number of indicators covering the three major aspects of sustainability: economic, environment and society. Although it is widely used, it is argued to be too complex for decision-making and benchmarking as it contains a large number of indicators without giving a guideline on how to combine the measures. Also, the practical guidelines for data collection are not clearly described (Labuschagne, Brent, and Van Erck 2005; Lozano and Huisinigh 2011; Panayiotou, Aravossis, and Moschou 2009; Veleva and Ellenbecker 2001), and it lacks consideration of customer focus and process orientation. It is therefore claimed to be insufficient to address the sustainability performance of a manufacturing organisation (Isaksson 2004; Isaksson and Steimle 2009).

Azapagic and Perdan (2000), Veleva and Ellenbecker (2001), IChemE (2004), and Labuschagne, Brent, and Van Erck (2005) propose an assessment framework comprising a set of criteria and indicators related to the sustainability of a manufacturing company. They propose standardised frameworks to apply across a wide range of industries. Guidelines to identify appropriate indicators for assessing corporate sustainability are mentioned in many articles. The key suggestions from these are summarised below:

- Indicators should reflect business characteristics, strategies and organisational culture (Azapagic 2003; Hubbard 2009; Keeble, Topiol, and Berkeley 2003)
- Indicators should be dynamic and flexible to deal with changes in situations and stakeholders' expectations (Azapagic 2003; Keeble, Topiol, and Berkeley 2003).
- A set of indicators should be balanced among concerns of all relevant stakeholders (Hubbard 2009; Keeble, Topiol, and Berkeley 2003).

- Indicators must be understandable and measurable. Not only must all the data required be readily available, but the measurement system must also be reliable. For qualitative aspects, a logical way to evaluate or quantify them needs to be clearly defined and standardised (Azapagic 2003; Székely and Knirsch 2005).
- The data collection process should be functional and cost-effective (Staniškis and Arbačiauskas 2009; Székely and Knirsch 2005).

Last but not the least, as stressed by Robèrt (2000), a framework should cover both indicators of favourable performances and indicators which reflect the principles for reaching those performances. As claimed by Schneider and Meins (2012), previous studies focus on existing performances without considering contributions from governance-related features. In their research, therefore, sustainability governance is incorporated into an assessment framework as the potential to pursue corporate sustainability.

A number of studies propose a sustainability assessment framework by integrating firms' social and environmental performance with the measures of the balanced scorecard (Figge et al. 2002; Hubbard 2009; Panayiotou, Aravossis, and Moschou 2009; Yongvanich and Guthrie 2006). As stated by Mooraj, Oyon, and Hostettler (1999) and Epstein and Wisner (2001), the typical concept of the balanced scorecard is still not comprehensive as far as corporate sustainability is concerned; it focuses on external and internal economic values without a complete incorporation of employee welfare, and supplier and local community perspectives. Although a more inclusive framework can be proposed after integration of such issues, most frameworks still present it only at the conceptual level without evidence of empirical exploration to confirm the relevance and practicality of the framework.

During the past decade, some studies propose additional aspects of organisational performance, such as leadership, innovation or communication, to extend the TBL (Hubbard 2009; Keeble, Topiol, and Berkeley 2003; Labuschagne, Brent, and Van Erck 2005; Schneider and Meins 2012; Staniškis and Arbačiauskas 2009; Székely and Knirsch 2005). This indicates that corporate sustainability is still a tentative topic in which its structure has not yet become mature or robust. There is still room for subsequent researchers to consider the significance of other dimensions in building up the holistic view of corporate sustainability. Among potential candidates, quality dimensions receive considerably greater attention from academic researchers as another aspect contributing to corporate sustainability (Curkovic et al. 2000; Hitchcock and Willard 2002; Isaksson 2004; Jonker 2000; Kuei and Lu 2013; Narasimhan and

Schoenherr 2012; Rusinko 2005; Srdić and Šelih 2011; Wiengarten and Pagell 2012; Yang, Huang, and Ke 2012). Quality improvement contributes to business sustainability in many ways. Firstly, focusing on quality supports sustainability in terms of financial performance and competitive advantage (Adam 1994; Forker, Vickery, and Droge 1996; Kaynak 2003; Lakhali 2009). Quality improvement also enhances a company's environmental performance. For example, the minimisation of product defects and scrapping of products leads to reduction in waste disposed of and in intensity of material use which are parts of the desired outcomes of environmental management (Lou et al. 2004). Yang, Huang, and Ke (2012) shows that focusing on quality assurance enables successfulness of green manufacturing system. Positive effects of the synergy between the quality and environmental management approaches to a firm's operational and financial performances have been also confirmed by the empirical studies of Wiengarten and Pagell (2012) and Grolleau, Mzoughi, and Pekovic (2013). In terms of the social aspect, as stated by van Marrewijk (2002), to be successful in quality improvement, not only does a company need to focus on product and process, but their employees and suppliers also need to be cared for, respected, and allowed to share mutual views and activities. Based on Lewis (2007), focusing on product and service quality is associated with enhanced employee loyalty, job satisfaction and commitment to the company. The overall perception is that, by proper integration, quality perspectives could broaden sustainability in terms of process and customer focus, while the concept of sustainability adds environmental and social concerns to quality management practices (Isaksson 2004).

Despite the positive terms, a trade-off between quality and the performance of the TBL is also implied in some articles as improving one dimension possibly loses the performance of another dimension (Hanssen 1999; Isaksson and Steimle 2009; Narasimhan and Schoenherr 2012; Székely and Knirsch 2005). From these, it may be better to say that the relationship between quality improvement and the development of the TBL is still inconclusive among different business practices. This supports the incorporation of quality performance into a framework of corporate sustainability assessment in order to ensure that all relevant and possibly conflicting aspects are captured and simultaneously considered. Based on the literature, quality performance indicators appear in some sustainability assessment frameworks, under different dimensions. For example, indicators concerning customer satisfaction and complaints are in the economic dimension in Veleva and Ellenbecker (2001), Tseng, Divinagracia, and Divinagracia (2009), and Li et al. (2012), while they are parts of the social dimension in Azapagic (2003) and GRI (2006). Azapagic and

Perdan (2000) also propose the use of the indicators ‘product durability’ and ‘service intensity’ as parts of the environmental dimension. With no consensus over the positions of quality indicators within the frameworks, it might be advantageous to sort the quality indicators into another dimension. Therefore, quality is separately viewed as another contributor to corporate sustainability in this proposed framework.

From a review of the literature, sets of indicators proposed by current references are generally broad. They usually include only a set of quantitative non-financial and financial indicators, or, propose qualitative indicators without clear communication of how the data can be collected and reported (Garetti and Taisch 2012). According to this, this paper suggests how qualitative aspects of corporate sustainability can be assessed in a standardised manner. Empirical research (case studies and a survey), which is limited in this field, is conducted in order to determine the list of criteria and indicators which is tailored to the specific concerns of sugar manufacturers.

3. Research methodology

The process of the framework development is illustrated in Figure 1. Firstly, 43 sustainability criteria were preliminary identified by examining works focusing on the manufacturing sector in general, rather than on a specific industry, in order to cover the general concerns within the field. To make the framework truly practical, the literature relating to various aspects of the sugar industry was reviewed, and indicators associated with each criterion were identified accordingly. From the review the sugar industry generally shares indicators common to many other industries in terms of economic and social performance, while the environmental and quality indicators are mostly specific to the industry. This is consistent with Hubbard (2009) who states that measures regarding economic value, market share, customer satisfaction and employee well-being identified by one organisation or industry are generally transferable to others, whereas measures of environmental performance are likely to be unique to each industry.

For qualitative criteria, such as ‘society and local community concerns’ or ‘conformance to standard of business conduct’, methods used to measure or assess them are still rather ambiguous and not clearly defined. Therefore, in order to standardise the assessment and enable comparison of performance among different companies, each qualitative aspect was broken down into a number of practice items. The rating scales or the evaluation grades for each item were then developed in order to allow the assessor to select the option which best reflects the actual practices of the company being assessed. Additional details and examples of this are given in Section 4.

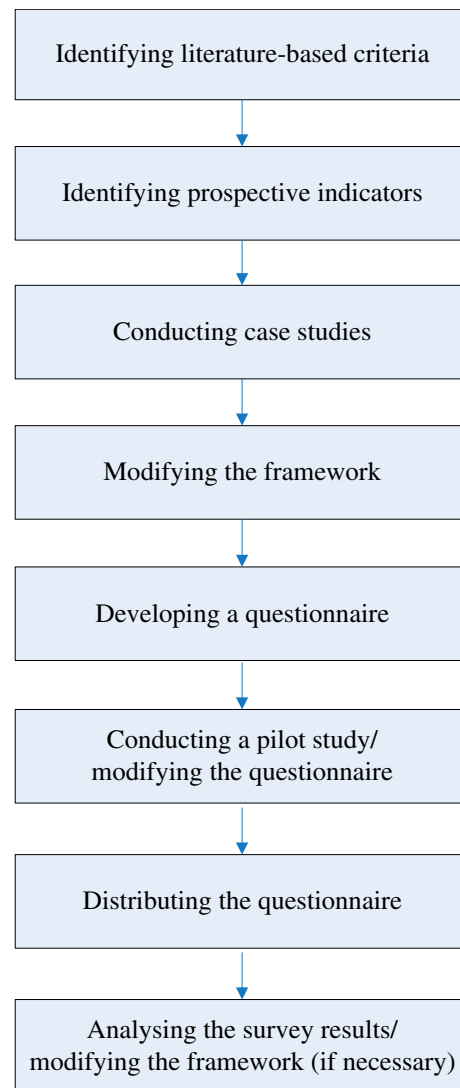


Figure 1. The process of framework development.

The case study approach was then employed to explore specific concerns of sugar manufacturers regarding their business sustainability (Yin 2009). It is also used as a screening method to ensure that the selected criteria and indicators are truly appropriate and practical (Keeble, Topiol, and Berkeley 2003). Multiple case studies were conducted in order to confirm the reliability of the results through replication (cf. Ryan, Scapens, and Theobald 2002; Sayer 1992). For this study, four companies agreed to take part in case studies. In Thailand, three of these organisations are viewed as large companies within the industry based upon their market share, age and reputation. From information on their organisational websites, sustainable development and/or corporate social responsibility were formally identified. The fourth company, a smaller organisation, was contacted in order to broaden the perspective of the study. Each year, this

company is ranked around 30th–40th in terms of market share among all 47 sugar manufacturers in Thailand.

The main research method employed in the case studies was interview. Primarily, access to top-level management in each company was required, since the sustainability context relates to every aspect of a business. Section or department managers whose jobs are directly related to one of the four dimensions, including production managers, quality managers, environmental management managers and human resource management managers, were also asked to participate. In total, 14 managers from the four companies agreed to take part and the interviews were conducted in May 2012. The interviews were semi-structured and conducted in the Thai language. Each interview lasted around 1–2 h. Related documents, such as annual reports, process control plans, check sheets, were also requested from the interviewees in order to supplement the interview data. Factory visits to two of the companies were also requested. Case study research is appropriate for areas where a theory or conceptual framework is not completely developed, such as the assessment of corporate sustainability for the sugar industry. Findings from case study research may require subsequent testing through larger sample sizes in order to confirm the power of generalisation (Ryan, Scapens, and Theobald 2002).

Following the case studies for the four companies, the criteria and indicators were refined by considering the main conditions that they need to be relevant to the core activities of sugar manufacturing and be associated with practitioners' concerns. Then, all criteria and indicators were organised in a hierarchical structure in order to break them down into a form which better corresponds to the human cognitive mode, so that they can be assessed easily and logically (Dyer and Forman 1992; Saaty 1980). The processes of grouping the criteria and identifying the words used to represent each group of criteria were based upon the explicit and/or underlying features of the criteria. The expectation here was to standardise the high levels of the hierarchy so they should be applicable to other companies in the manufacturing sector in general, while the indicators at the lowest level should be specific to the sugar industry. The guideline items belonging to each qualitative indicator and their evaluation grades were also modified.

Next, a survey was carried out to enhance the power of generalisation of the framework across a wide range of companies within the sugar industry. The questionnaire was divided into two parts. Part I validated the appropriateness and practicality of each quantitative indicator, while part II focused on qualitative indicators through investigation into internal consistency among guideline items forming the same indicator and the appropriateness of the assignment of each item to the indicator. A rating scale (1–5) was employed to develop

the questionnaire since it is considered to be simple and understandable for respondents (De Vaus 2002). The meaning of scales, as shown below, was clearly presented to the respondents at the beginning of each part of the questionnaire. For part I, the two sets of scales were applied to each quantitative indicator, and the respondents were asked to give a score which most reflects their opinion or attitude. The scale for part II was applied to each practice item belonging to each qualitative indicator, and the respondents were asked to rate the extent of the practices in their companies. The list of all indicators is presented in the next section.

Scale 1–5 for part I: the degree to which indicators are *representative* of criteria

- 1 = The indicator does not represent the criterion at all. Or, it has a different implication from the criterion.
- 2 = The indicator does not represent the criterion although its implication might relate to that criterion to some extent.
- 3 = The indicator tells something about the criterion.
- 4 = The indicator can represent the criterion.
- 5 = The indicator completely represents the criterion.

Scale 1–5 for part I: *practicality* of the indicators

- 1 = It is difficult to imagine how to measure this indicator.
- 2 = It is difficult to measure this indicator due to a number of limitations.
- 3 = The indicator is measurable, but it has never been measured in the company.
- 4 = The indicator is measurable. We have the data, but the data has not been analysed.
- 5 = The indicator is implementable, and the company is currently collecting, analysing and tracking such data.

Scale 1–5 for part II: the *extent* of the practices in the company.

- 1 = Very low/Not applicable
- 2 = Low
- 3 = Medium
- 4 = High
- 5 = Very high

Prior to sending out the questionnaire, a pilot study was undertaken in order to refine the questionnaire and eliminate potential problems (Flynn et al. 1990; Saunders, Lewis, and Thornhill 2003). Five people, including three managers who were involved in the first round of case studies, one secretary to an executive vice president of a sugar company, and one academic researcher, agreed to participate in the pilot study. The draft version of the questionnaire was sent to them by email. After receiving their responses, appointments were

made for follow-up calls in order to ask for their comments. Signs of misunderstanding of the questions such as omitted, incomplete or unexpected responses were discussed with each. After the pilot study, supplementary words or examples were added to some words and sentences pointed out by the respondents to be ambiguous and/or difficult to interpret. For example, the phrase 'external water', which was used as an indicator for the sub-criterion 'water consumption', was mentioned by three respondents as they were not sure about its meaning. Therefore, a short definition 'The external water means water from external sources including water from rivers, wells, ground water, and domestic water supply' has been added into the questionnaire. The respondents reported no problems with the design of the questionnaire. However, they all stressed that the questionnaire was too long (up to 25 min to finish it). Following this, the solution was to divide the questionnaire into two versions, A and B. Version A includes the questions only from part I (for quantitative indicators), while the questions from part II (for qualitative items) become the questionnaire version B. Each version was distributed to different groups of people which were randomly chosen from the whole population.

The list of names of prospective respondents from all 47 sugar manufacturing companies in Thailand was gathered from the website of the Office of the Cane and Sugar Board, which is under the jurisdiction of the Ministry of Industry of Thailand. These people were qualified based on their job positions. The website identified that many of the companies are in the same groups with common lists of management. Therefore, only 152 people qualified, and they are set as the population. They were then randomly separated into two groups (76 people per group) for the two versions of the questionnaire through the simple random sampling technique. Many of them had been telephoned and asked for their commitment to respond before the questionnaires were sent out in order to maximise the response rate. The questionnaires were distributed by post after May 2012. Due to the small size of the population, the expectation was to receive at least 30 usable responses for every part of the questionnaire in order to enable a reasonable statistical analysis of the data (Hines and Montgomery 1990). The analysis of the survey results is described in Section 5.

4. The proposed framework of corporate sustainability assessment

Figure 2 presents the hierarchical structure of sustainability performance for sugar manufacturers which has been developed based upon the literature and the case studies. It should be noted that it is impossible to cover all criteria for corporate sustainability. Nevertheless, the set of criteria identified here appears to capture all of the

important aspects of the corporate sustainability context promoted by academic researchers and leading sugar manufacturers. The criteria identified here include both beneficial criteria (the more the better) and cost criteria (the fewer the better) in order to reveal the whole picture of corporate sustainability and to encourage a company to satisfy relevant stakeholders by (i) enhancing favourable outcomes and (ii) avoiding negative impacts on them.

From Figure 2, sustainability performance is placed at the first level of the hierarchy and is viewed as a general attribute. The second level is comprised of the four core dimensions: environment, economic, social and quality. Then, under each dimension, the third and the fourth levels embrace 12 criteria and 30 sub-criteria, respectively. The criteria provide key information about the four dimensions and also enable the analysis of the causal relationship among different dimensions. Operational indicators can be finally placed at the fifth level. They are, however, not shown in the hierarchy in order to communicate that the list of indicators can be adjusted according to stakeholders' concerns, availability of data and the circumstances of the area where the framework is implemented. After the case studies, 40 indicators were identified which were a combination of both quantitative and qualitative indicators, as summarised in Table 1.

In terms of the quantitative indicators, most of these are normalised to a quantity of raw material inputs (a tonne of sugarcane processed) or a quantity of product outputs (a tonne of sugar produced) within a certain period of time (a year). For the qualitative indicators, on the other hand, lists of guideline items have been identified to facilitate the evaluation. Evaluation grades are specifically determined for each item so that an assessor can select the option which best reflects the actual situation of a company being considered. For each item, the number of grades can be different depending on how many distinct levels of feasible practices exist that are related to that item. In order to standardise evaluations from different assessors and minimise inconsistency in subjective grading, the definition of each grade should be clearly described by referring to evidence or feasible situations. Two sets of evaluation grades (A–E) shown below form example sets of grades for item 6.4 and 12.4, respectively (see Appendix 1).

Item 6.4 (under the indicator 'Employee involvement and empowerment')

'The company regularly hosts or supports activities to encourage or boost employee morale, team building and work commitment'.

- (A) There is no evidence to show that the company hosts or supports activities to encourage or boost employee morale, team building and work

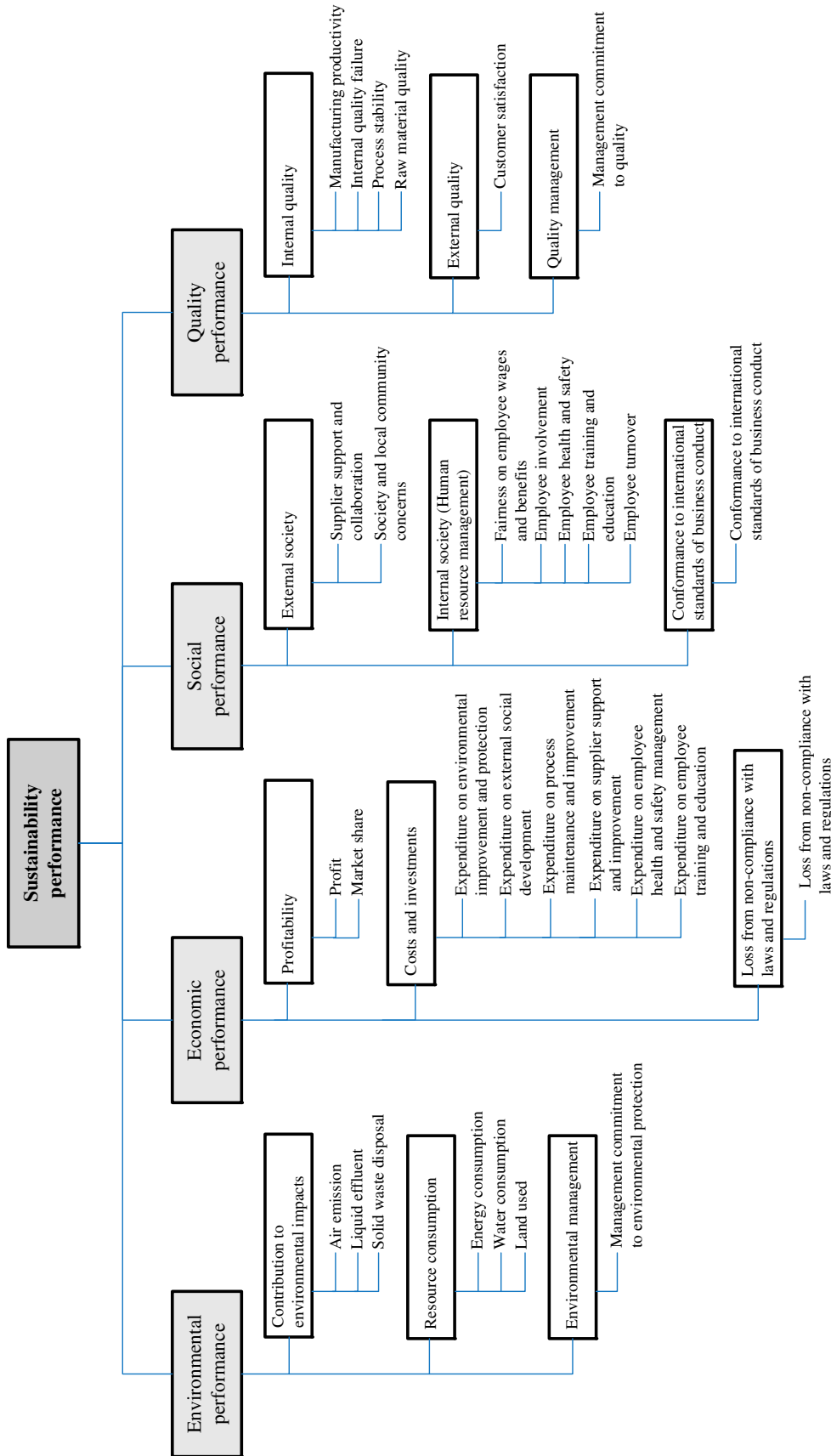


Figure 2. A hierarchical framework of corporate sustainability assessment for sugar manufacturing.

Table 1. List of indicators belonging to each sub-criterion.

Sub-criteria	Indicators	Measurement units
Air emission	Rate of fossil fuels used by steam boilers relative to total amount of electricity produced per year (1)	kg/kWh or l/kWh
Liquid effluent	Concentration of total suspended particulate (TSP) (2)	mg/m ³
	Rate of water discharged into the environment relative to a tonne of cane processed per year (3)	m ³ /t
Solid waste disposal	Rate of hazardous waste disposed of relative to a tonne of cane processed per year (4)	t/t
	Rate of non-hazardous waste disposed of relative to a tonne of cane processed per year (5)	t/t
Energy consumption	Rate of steam consumption relative to a tonne of cane processed per year (6)	t/t
	Rate of electricity consumption relative to a tonne of cane processed per year (7)	kWh/t
Water consumption	Rate of external water consumption relative to a tonne of cane processed per year (8)	m ³ /t
Land used	Rate of areas of sugar manufacturing sites relative to a tonne of cane processed per year (9)	m ² /t
Management commitment to environmental protection	Management commitment to environmental protection	Qualitative evaluation (5 items)*
Profit	Gross profit margin per year (10)	%
Market share	Percentage of market share based on the quantity of sugar produced per year (11)	%
Expenditure on environmental improvement and protection	Rate of expenditure on environmental improvement and protection per tonne of sugar produced per year (12)	Monetary unit/t
Expenditure on external social development	Rate of expenditure on external social development per tonne of sugar produced per year (13)	Monetary unit/t
Expenditure on process maintenance and improvement	Rate of expenditure on process maintenance and improvement per tonne of sugar produced per year (14)	Monetary unit/t
Expenditure on supplier support and improvement	Rate of expenditure on cane farming support and improvement per tonne of sugar produced per year (15)	Monetary unit/t
Expenditure on employee health and safety management	Rate of expenditure on employee health and safety management per tonne of sugar produced per year (16)	Monetary unit/t
Expenditure on employee training and education	Rate of expenditure on employee training and education per tonne of sugar produced per year (17)	Monetary unit/t
Loss from non-compliance with laws and regulations	Total amount of fines paid per year (18)	Monetary unit
	Total number of non-monetary sanctions and warnings per year (19)	Number
Supplier support and collaboration	Cane farmers support and collaboration	Qualitative evaluation (4 items)*
Society and local community concerns	The number of complaints from the local community per year (20)	Number
	Social responsibility	Qualitative evaluation (1 items)*
	Social development and participation	Qualitative evaluation (3 items)*
Fairness on employee wages and benefits	Internal fairness on employee wages and benefits	Qualitative evaluation (3 items)*
	External fairness on employee wages and benefits	Qualitative evaluation (3 items)*
Employee involvement	Employee involvement and empowerment	Qualitative evaluation (4 items)*
	Employee communication	Qualitative evaluation (2 items)*
Employee health and safety	Rate of work-related accidents relative to the total working hours in the working schedule per year (21)	Number/hrs
	Percentage of working hours lost relative to the total working hours in the working schedule per year (22)	%
	Employee health and safety provision	Qualitative evaluation (10 items)*
Employee training and education	Employee training and education provision	Qualitative evaluation (7 items)*

(Continued)

Table 1. (Continued).

Sub-criteria	Indicators	Measurement units
Employee turnover	Annual employee turnover rate (23)	%
Conformance to international standards of business conduct	Conformance to international standards of business conduct	Qualitative evaluation (11 items)*
Manufacturing productivity	The sugar yield at 96 POL – 10 CCS equivalent (adjusted kilograms of sugar produced per tonne of cane processed) (24)	kg/t
Internal quality failure	Percentage of reprocessing, derived from the weight of remelted sugar relative to total weight of the sugar produced per year (25)	%
Process stability	Percentage of production shutdowns, derived from the total hours of unplanned shutdowns relative to the total operating hours per year (26)	%
Raw material quality	Commercial Cane Sugar (CCS) (27)	CCS
Customer satisfaction	The number of customer complaints and product returns per year (28)	Number
Management commitment to quality	Management commitment to quality	Qualitative evaluation (5 items)*

*See Appendix 1.

commitment, and there is no evidence of plans to do this in the near future.

- (B) The company is planning to do something to encourage or boost employee morale, team building and work commitment in the near future.
- (C) Evidence shows that some departments, divisions or groups of employees have carried out some activities which encourage or boost employee morale, team building and work commitment, although the company has not officially allocated a budget for these objectives.
- (D) Evidence shows that the company officially hosts or supports activities to encourage or boost employee morale, team building and work commitment. However, there is no clear evidence to show that the results and feedback have been followed up and reported.
- (E) Evidence shows that the company officially and regularly hosts or supports activities to encourage or boost employee morale, team building and work commitment. Also, the operating results and feedback have been reported in management reviews.

Item 12.4 (under the indicator ‘Cane farmers support and improvement’)

‘Information on the subjects of price, CCS, transactional policies and conditions, knowledge concerning cane growing and marketing, and other related subjects has been transparently shared with the farmers’.

- (A) There is no evidence of any formal communication on the subjects of price, CCS, transactional policies and conditions, knowledge concerning cane growing and marketing, and other related subjects to the cane farmers.

- (B) Evidence shows that the company provides channels for the farmers to ask about price, CCS, transactional policies and conditions, knowledge concerning cane growing and marketing, and other related subjects.
- (C) Evidence shows that the company provides channels for the farmers to ask about price, CCS, transactional policies and conditions, knowledge concerning cane growing and marketing, and other related subjects. Moreover, this kind of information has been shared with the farmers through leaflets, brochures, notice boards, etc.

By providing a clear definition attached to each grade of a particular item, not only can the company’s current performance be understood but areas of improvement also can be identified. Each evaluation grade is linked to feasible practices. Therefore, in order to move from one grade to another, improvement plans and performance targets can be created according to the evidence required in the upper grades. This standardises the assessment and enables a fair performance comparison among different assessment units.

In the following section, the results from the survey analysis are presented, including the tests for the representativeness and practicality of the quantitative indicators and the tests for reliability and validity of the qualitative items. The results are then discussed based upon empirical information.

5. The analysis of survey

At the end of the three-month period from May to July 2012, 85 questionnaires were returned. From these, 39 responses were version A and the 46 were version B. Therefore, the response rates for the questionnaire parts I

and II were 51.31 and 60.52%, respectively, this is considered acceptable when compared to other studies in social sciences (Nulty 2008); it is also adequate for statistical analysis. The respondents of the questionnaire version A represent 28 sugar companies in Thailand which cover 59.6% of the whole industry (47 companies in overall), while version B receives responses from 26 companies which are considered to be 55.31%.

The analysis of the representativeness and practicality of the quantitative indicators is presented in Section 5.1. Then, Section 5.2 provides the analysis of the internal consistency of the items within the same qualitative indicator and also the validation of the assignment of each item to the indicator it belongs to.

5.1. The representativeness and practicality of the quantitative indicators

From the survey, Figure 3 presents average scores of each quantitative indicator through a two-dimensional scatter plot. Each node in the diagram represents an average score of each indicator regarding representativeness on the y-axis and practicality on the x-axis. The number attached to each node refers to the number in parentheses behind each quantitative indicator listed in Table 1. With two reference lines added to the diagram using the score 3, the plot area is divided into four areas: (1) unrepresentative and impractical, (2) unrepresentative but practical, (3) representative but impractical and (4) representative and practical.

Based on the scatter plot, it is satisfactory that all data fall into the fourth area. That means, as far as the average scores are concerned, all quantitative indicators used in this thesis are accepted by the industry as appropriate representatives of the criteria they belong to, and

they are also practical for implementation. However, analysing data based on only average scores may lead to the loss of important information and even misleading conclusions. In order to ensure generalisation, therefore, the distribution of individual scores for each indicator is also taken into account, and a number of respondents giving the ratings 1 or 2 were contacted by phone or email for further investigation. Overall, the post-survey discussions seem to indicate that a few people just misunderstood the instruction of the questionnaire; they overlooked the importance of that indicator; they believed that only a single indicator does not cover the entire picture of the criterion; or they still did not prioritise efforts to measure and track their own performance. Although some of the comments are interesting for further investigation, these are not considered as a strong reason to drop the indicators that receive high rating scores from the majority.

5.2. The internal consistency and validity of the qualitative items

Since the items are defined as qualitative statements which might be interpreted differently, the reliability of the items within the same indicator should be tested. For this study, a reliability coefficient, Cronbach’s alpha, is employed. Based on a rule of thumb, a Cronbach’s alpha value greater than 0.6 is acceptable for inferring that a group of items is homogeneous or internally consistent. If a value lower than 0.6 is found, the elimination of some items may be needed in order to improve the overall reliability of that indicator in the actual assessment (Hair et al. 2010; Saraph, Benson, and Schroeder 1989). The Cronbach’s alpha value of each indicator, computed by using Minitab software, is presented in Table 2.

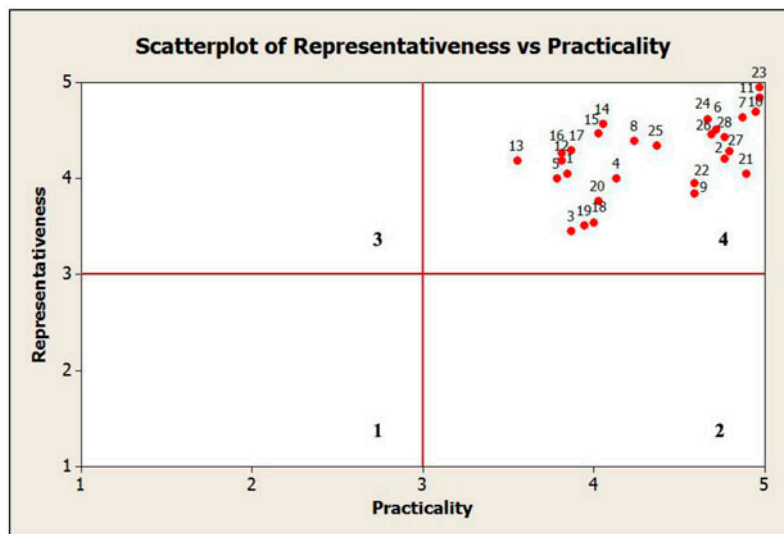


Figure 3. A scatter plot of the mean distribution of the representativeness and practicality of the quantitative indicators.

Table 2. Cronbach's alpha values for the qualitative indicators.

Qualitative indicators	Cronbach's alpha
(1) Management commitment to environmental protection	0.89
(2) Social responsibility	n/a
(3) Social development and participation	0.85
(4) Internal fairness on employee wages and benefits	0.83
(5) External fairness on employee wages and benefits	0.84
(6) Employee involvement and empowerment	0.87
(7) Employee communication	0.74
(8) Employee health and safety provision	0.94
(9) Employee training and education provision	0.89
(10) Management commitment to quality	0.88
(11) Conformance to international standards of business conduct	0.93
(12) Cane farmers support and improvement	0.92

The results show that the Cronbach's alpha values for all of the indicators range from 0.74 to 0.94. Since they are all over 0.6, this indicates that the measurement instruments developed here are sufficiently reliable, and that the items forming the same indicator are measuring the same aspect. The assumption behind the acceptable degree of internal consistency is that the items are not really measuring the same thing; they are simply measures of different things which are part of the same aspect (Nunnally 1967; Singh and Smith 2006). The internal consistency of the indicator 'social responsibility' are not tested because only a single item is assigned to this indicator (Litwin 1995).

The next step for this section was to check if the assignment of items to each indicator is correct. Nunnally (1967) introduces a method of evaluating the assignment of items to scales, termed 'indicators' in this paper, by analysing the correlations between the score of each item and that of each indicator, which is the average score of all items belonging to it. The expectation is that all items have high correlations with the indicator that they have originally been assigned to. Otherwise, low-correlation items should be deleted or moved to other indicators that display a higher correlation (Saraph, Benson, and Schroeder 1989).

From the analysis, most items correlate most highly with the assigned indicators. This means that they have been assigned to the correct groups already. Three items which have higher correlation scores with unassigned indicators than the assigned ones are item 9.3 under the indicator 'employee training and education provision' and items 11.8 and 11.9 of the indicator 'conformance to international standards of business conduct' (see the list of items in Appendix 1). The first concerns the provision of individual development programme, for which the highest degree of correlation (0.84) is with the indicator 'employee health and safety provision'. Although the

correlation between this item and the assigned indicator (0.79) is slightly lower, it is believed that this item has been assigned to the appropriate group already since its underlying meaning does not relate to the management of employee health and safety at all but is explicitly linked to the development of employee's knowledge and skill. Note that although statistical analysis is useful to facilitate the analysis, the conclusion still needs to be drawn based on the rationality of the information.

Regarding items 11.8 and 11.9 of the indicator 'conformance to international standards of business conduct', the first item relates to the enhancement of employee awareness of these standards through internal publications, training and dissemination, while the other suggests that a company should encourage their partners, suppliers and sub-contractors to align with their code of conduct. It can be seen that these two items have different implications compared with other items in the same set. While the others mention prohibitions based on either the law or ethical regulations, these two items encourage companies to promote the standards of business conduct internally and externally. This explains why the two items correlate more highly with other indicators such as 'employee communication', 'employee training and education provision', or 'cane farmers support and improvement'. This is evidence of a tentative measurement instrument, and it is suggested here that, in subsequent studies, consideration may be given to splitting the items belonging to the indicator 'conformance to international standards of business conduct' into two separate aspects.

6. Conclusion

The major objective of this study was to develop a framework for the assessment of corporate sustainability by using the case of sugar manufacturing in Thailand as a basis. Through empirical research methods, the framework was developed to closely fit the characteristics and specific concerns of sugar manufacturers. While the case study focused on understanding the concerns of the industry and the practicality of various criteria and indicators, a survey was undertaken in order to seek similar patterns or common characteristics in order to enable generalisation of the result.

Validity of the framework can be confirmed through the engagement of multiple sources of information (Ryan, Scapens, and Theobald 2002; Yin 2009), including the interviews of people from different departments, plant tours or direct observation, and support from related document and literature. Obtaining information from several sources enables more effective identification of relevant indicators not included in the initial list. The pilot study also allowed the researcher to discuss with the practitioners regarding the completeness of the framework. This is another way to confirm the content

validity which means an agreement among subjects and researchers that the measurement items cover all aspects they should and do not include anything which are not relevant (Litwin 1995; Saraph, Benson, and Schroeder 1989). At the same time, the validity of the assignment of practice items to each qualitative indicator is also confirmed through the survey analysis. Reliability of the items which are defined as qualitative statements is proved by the analysis of the Cronbach's alpha value. The pilot study and the post-survey discussion also ensure that the indicators and the items are clear enough for practitioners to interpret them in the same way.

The originality of the framework is due to the lack of a comprehensive measure of corporate sustainability designed specifically for the cane sugar industry. The focus here is placed on the four major dimensions: environment, economic, social and quality, by taking both present and future concerns of relevant stakeholders into account. As a consequence of attempting to compile and classify criteria and indicators, this is also the first study to propose the explicit appearance of quality performance, separate from the TBL, in the framework of corporate sustainability assessment. The benefit of doing this is to make the performance analysis for each particular dimension clear and transparent. Furthermore, the lack of a standard method to assess a company's performance relying on qualitative aspects is solved through the introduction of practice items. The defined evaluation grades clearly state what evidence is required in order to achieve each level for each item. This helps to minimise inconsistency in the assessor's subjective judgement (Yang, Dale, and Siow 2001). It also gives a clear guideline for how a company can improve its sustainability performance in terms of each aspect. Unfortunately, due to the word limit for publication, evaluation grades of all items cannot be displayed.

The list of criteria identified in the framework may not cover all criteria of corporate sustainability seen in the literature, since the term 'sustainability' can be broadly defined. However, the intention here is to capture all of the critical aspects promoted by academic researchers and emphasised by leading sugar manufacturers. Although the intention is to make the list of criteria and sub-criteria robust and generalised, the indicators and the guideline items are still flexible, allowing for future modification according to specific areas of interest and changed circumstances. Since the framework is empirically tested only within the Thai sugar industry, generalisation to other industries and countries cannot be guaranteed. However, it is believed that some insightful information from this paper can be useful to the development of frameworks in other areas, particularly the sugar industry in other countries.

For the analysis of sustainability performance, there are a number of challenges remaining for subsequent studies. For example, although a set of evaluation grades can be used to transform subjective opinions into numerical values and the problem can finally be analysed objectively, assessors might not be confident in stating that an indicator being considered matches a particular grade, and one or more additional grades might better suit the actual practice being assessed. Moreover, incomplete evidence may result in their hesitation in scoring or grading. Finally, another challenge arises as to how the information can be logically aggregated. Since there are some interrelationships among various sustainability criteria (De Montis et al. 2005; Munda 2005), simple aggregation techniques based on the additive value function approach, which are seen in many studies, tend to generate unreliable results. For this case, methods which do not assume preferential independence among criteria should be applied.

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References

- Adam, Everett E. 1994. "Alternative Quality Improvement Practices and Organization Performance." *Journal of Operations Management* 12 (1): 27–44.
- Azapagic, Adisa. 2003. "Systems Approach to Corporate Sustainability: A General Management Framework." *Process Safety and Environmental Protection* 81 (5): 303–316.
- Azapagic, Adisa, and Slobodan Perdan. 2000. "Indicators of Sustainable Development for Industry: A General Framework." *Process Safety and Environmental Protection* 78 (4): 243–261.
- Barrett, John, and Anthony Scott. 2001. "The Ecological Footprint: A Metric for Corporate Sustainability." *Corporate Environmental Strategy* 8 (4): 316–325.
- Burritt, Roger L., Tobias Hahn, and Stefan Schaltegger. 2002. "Towards a Comprehensive Framework for Environmental Management Accounting – Links between Business Actors and Environmental Management Accounting Tools." *Australian Accounting Review* 12 (27): 39–50.
- Cheesman, Oliver D. 2004. *Environmental Impacts of Sugar Production: The Cultivation and Processing of Sugarcane and Sugar Beet*. Oxfordshire: CABI.
- Curkovic, Sime, Steven A. Melnyk, Robert B. Handfield, and Roger Calantone. 2000. "Investigating the Linkage between Total Quality Management and Environmentally Responsible Manufacturing." *IEEE Transactions on Engineering Management* 47 (4): 444–464.
- Das, Anupam, Himangshu Paul, and Fredric W. Swierczek. 2008. "Developing and Validating Total Quality Management (TQM) Constructs in the Context of Thailand's Manufacturing Industry." *Benchmarking: An International Journal* 15 (1): 55–72.
- De Montis, Andrea, Pasquale De Toro, Bert Droste-Franke, Ines Omann, and Sigrid Stagl. 2005. "Assessing the Quality of Different MCDA Methods." In *Alternatives for Environmental Valuation*, edited by Michael Getzner, Clive Spash, and Sigrid Stagl, 99–133. Oxford: Routledge.
- De Vaus, David. 2002. *Surveys in Social Research*. 5th ed. London: Routledge.
- Dyer, Robert F., and Ernest H. Forman. 1992. "Group Decision Support with the Analytic Hierarchy Process." *Decision Support Systems* 8 (2): 99–124.
- Dyllick, Thomas, and Kai Hockerts. 2002. "Beyond the Business Case for Corporate Sustainability." *Business Strategy and the Environment* 11 (2): 130–141.
- Elkington, John. 1997. *Cannibals with Forks: The Triple Bottom Line of 21st Century Business*. Oxford: Capstone.
- Epstein, Marc J., and Priscilla S. Wisner. 2001. "Good Neighbors: Implementing Social and Environmental Strategies with the BSC." *Balanced Scorecard Report* (May–June): 1–6.
- Fiala, Nathan. 2008. "Measuring Sustainability: Why the Ecological Footprint is Bad Economics and Bad Environmental Science." *Ecological Economics* 67 (4): 519–525.
- Figge, Frank, Tobias Hahn, Stefan Schaltegger, and Marcus Wagner. 2002. "The Sustainability Balanced Scorecard – Linking Sustainability Management to Business Strategy." *Business Strategy and the Environment* 11 (5): 269–284.
- Flynn, Barbara B., Sadao Sakakibara, Roger G. Schroeder, Kimberly A. Bates, and James Flynn. 1990. "Empirical Research Methods in Operations Management." *Journal of Operations Management* 9 (2): 250–284.
- Forker, Laura B., Shawnee K. Vickery, and Cornelia L. M. Droge. 1996. "The Contribution of Quality to Business Performance." *International Journal of Operations & Production Management* 16 (8): 44–62.
- Garetti, Marco, and Marco Taisch. 2012. "Sustainable Manufacturing: Trends and Research Challenges." *Production Planning & Control* 23 (2–3): 83–104.
- Goyal, Praveen, Zillur Rahman, and A. A. Kazmi. 2013. "Corporate Sustainability Performance and Firm Performance Research: Literature Review and Future Research Agenda." *Management Decision* 51 (2): 361–379.
- GRI (Global Reporting Initiative). 2006. "Sustainability Reporting Guidelines, version 3.0." Accessed March 25, 2010. <http://www.globalreporting.org>
- Grolleau, Gilles, Naoufel Mzoughi, and Sanja Pekovic. 2013. "Is Business Performance Related to the Adoption of Quality and Environmental-related Standards?" *Environmental and Resource Economics* 54 (4): 525–548.
- Hair, Joseph F., William C. Black, Barry J. Babin, and Rolph E. Anderson. 2010. *Multivariate Data Analysis: A Global Perspective*. 7th ed. Cranbury, NJ: Pearson Education.
- Hanssen, O. J. 1999. "Sustainable Product Systems – Experiences Based on Case Projects in Sustainable Product Development." *Journal of Cleaner Production* 7: 27–41.
- Heng, Teh Boon, Chong Lee Lee, Yeap Peik Foong, and Ong Tze San. 2012. "A Framework of a Sustainable Performance Measurements (SPMs) Model for the Malaysian Electronic and Electrical Industry." *World Applied Sciences Journal* 20 (1): 107–119.
- Hines, William W., and Douglas C. Montgomery. 1990. *Probability and Statistics in Engineering and Management Science*. 3rd ed. New York: Wiley.
- Hitchcock, Darcy, and Marsha Willard. 2002. "Sustainability: Enlarging Quality's Mission." *Quality Progress* 35 (2): 43–47.

- Hubbard, Graham. 2009. "Measuring Organizational Performance: Beyond the Triple Bottom Line." *Business Strategy and the Environment* 18 (3): 177–191.
- IChemE (Britain's Institution of Chemical Engineers). 2004. "The Sustainability Metrics: Sustainable Development Progress Metrics Recommended for Use in the Process Industries." Britain's Institution of Chemical Engineer. Accessed May 20, 2010. <http://www.icheme.org/sustainability/metrics.pdf>
- Ingaramo, Alejandra, Humberto Heluane, Mauricio Colombo, and Mario Cesca. 2009. "Water and Wastewater Eco-efficiency Indicators for the Sugar Cane Industry." *Journal of Cleaner Production* 17 (4): 487–495.
- Isaksson, Raine. 2004. "Total Quality Management for Sustainable Development – Focus on Processes." PhD diss., Luleå University of Technology.
- Isaksson, Raine, and Ulrich Steimle. 2009. "What Does GRI-reporting Tell Us about Corporate Sustainability?" *The TQM Journal* 21 (2): 168–181.
- Jonker, Jan. 2000. "Organizations as Responsible Contributors to Society: Linking Quality, Sustainability and Accountability." *Total Quality Management* 11: 741–746.
- Kaynak, Hale. 2003. "The Relationship between Total Quality Management Practices and Their Effects on Firm Performance." *Journal of Operations Management* 21 (4): 405–435.
- Keeble, Justin J., Sophie Topiol, and Simon Berkeley. 2003. "Using Indicators to Measure Sustainability Performance at a Corporate and Project Level." *Journal of Business Ethics* 44 (2): 149–158.
- Kicherer, Andreas, Stefan Schaltegger, Heinrich Tschochohei, and Beatriz Ferreira Pozo. 2007. "Eco-efficiency: Combining Life Cycle Assessment and Life Cycle Costs via Normalization." *International Journal of Life Cycle Assessment* 12 (7): 537–543.
- KPMG. 2011. "KPMG International Survey of Corporate Responsibility Reporting 2011." Accessed March 26, 2013. <http://www.kpmg.de/Themen/27618.htm>
- Kuei, Chu-hua, and Min H. Lu. 2013. "Integrating Quality Management Principles into Sustainability Management." *Total Quality Management & Business Excellence* 24 (1–2): 62–78.
- Labuschagne, Carin, Alan C. Brent, and Ron P. G. van Erck. 2005. "Assessing the Sustainability Performances of Industries." *Journal of Cleaner Production* 13 (4): 373–385.
- Lakhal, L. 2009. "Impact of Quality on Competitive Advantage and Organizational Performance." *Journal of the Operational Research Society* 60 (5): 637–645.
- Lemus-Ruiz, Blanca E. 1999. "The Local Impact of Globalization: Worker Health and Safety in Mexico's Sugar Industry." *International Journal of Occupational and Environmental Health* 5 (1): 56–60.
- Lewis, B. R. 2007. "Managing Service Quality." In *Managing Quality*, edited by Barrie G. Dale, Ton van der Wiele, and Jos van Iwaarden, 234–257. Oxford: Blackwell Publishing.
- Li, Tao, Hongchao Zhang, Chris Yuan, Zhichao Liu, and Chengcheng Fan. 2012. "A PCA-based Method for Construction of Composite Sustainability Indicators." *The International Journal of Life Cycle Assessment* 17 (5): 593–603.
- Litwin, Mark S. 1995. *How to Measure Survey Reliability and Validity*. Thousand Oaks, CA: Sage.
- Lou, Helen H., Makarand A. Kulkarni, Aditi Singh, and Jack R. Hopper. 2004. "Sustainability Assessment of Industrial Systems." *Industrial and Engineering Chemistry Research* 43: 4233–4242.
- Lozano, Rodrigo, and Don Huisingh. 2011. "Inter-linking Issues and Dimensions in Sustainability Reporting." *Journal of Cleaner Production* 19 (2–3): 99–107.
- van Marrewijk, Marcel. 2002. "Concepts and Definitions of CSR and Corporate Sustainability: Between Agency and Communion." *Journal of Business Ethics* 44 (2–3): 95–105.
- Moffatt, Ian. 2000. "Ecological Footprints and Sustainable Development." *Ecological Economics* 32 (3): 359–362.
- Mooraj, Stella, Daniel Oyon, and Didier Hostettler. 1999. "The Balanced Scorecard: A Necessary Good or an Unnecessary Evil?" *European Management Journal* 17 (5): 481–491.
- Munda, Giuseppe. 2005. "Measuring Sustainability: A Multi-criterion Framework." *Environment, Development and Sustainability* 7 (1): 117–134.
- Narasimhan, Ram, and Tobias Schoenherr. 2012. "The Effects of Integrated Supply Management Practices and Environmental Management Practices on Relative Competitive Quality Advantage." *International Journal of Production Research* 50 (4): 1185–1201.
- Nulty, Duncan D. 2008. "The Adequacy of Response Rates to Online and Paper Surveys: What Can Be Done?" *Assessment & Evaluation in Higher Education* 33 (3): 301–314.
- Nunnally, Jum C. 1967. *Psychometric Theory*. New York: McGraw-Hill.
- Panayiotou, Nikolaos A., Konstantin G. Aravossis, and Peggy Moschou. 2009. "A New Methodology Approach for Measuring Corporate Social Responsibility Performance." *Water, Air, & Soil Pollution: Focus* 9 (1–2): 129–138.
- Perrini, Francesco, and Antonio Tencati. 2006. "Sustainability and Stakeholder Management: The Need for New Corporate Performance Evaluation and Reporting Systems." *Business Strategy and the Environment* 15 (5): 296–308.
- Phusavat, Kongkiti, and Rapee Kanchana. 2007. "Competitive Priorities of Manufacturing Firms in Thailand." *Industrial Management & Data Systems* 107 (7): 979–996.
- Rebitzer, G., T. Ekvall, R. Frischknecht, D. Hunkeler, G. Norris, T. Rydberg, W. P. Schmidt, S. Suh, B. P. Weidema, and D. W. Pennington. 2004. "Life Cycle Assessment Part 1: Framework, Goal and Scope Definition, Inventory Analysis, and Applications." *Environment International* 30 (5): 701–720.
- Robèrt, Karl-Henrik. 2000. "Tools and Concepts for Sustainable Development, How Do They Relate to a General Framework for Sustainable Development, and to Each Other?" *Journal of Cleaner Production* 8 (3): 243–254.
- Rusinko, Cathy A. 2005. "Using Quality Management as a Bridge to Environmental Sustainability in Organizations." *SAM Advanced Management Journal* 70 (4): 54–60.
- Ryan, Bob, Robert W Scapens, and Michael Theobald. 2002. *Research Methods and Methodology in Accounting and Finance*. 2nd ed. London: Thomson Learning.
- Saaty, Thomas L. 1980. *The Analytical Hierarchy Process*. New York: McGraw Hill.

- Salzmann, Oliver, Aileen Ionescu-somers, and Ulrich Steger. 2005. "The Business Case for Corporate Sustainability: Literature Review and Research Options." *European Management Journal* 23 (1): 27–36.
- Saraph, Jayant V., P. George Benson, and Roger G. Schroeder. 1989. "An Instrument for Measuring the Critical Factors of Quality Management." *Decision Sciences* 20: 810–829.
- Saunders, Mark, Philip Lewis, and Adrian Thornhill. 2003. *Research Methods for Business Students*. 3rd ed. Essex: Pearson Education.
- Sayer, Andrew. 1992. *Method in Social Science: A Realist Approach*. 2nd ed. London: Routledge.
- Schneider, Anselm, and Erika Meins. 2012. "Two Dimensions of Corporate Sustainability Assessment: Towards a Comprehensive Framework." *Business Strategy and the Environment* 21 (4): 211–222.
- Singh, Prakash J., and Alan Smith. 2006. "An Empirically Validated Quality Management Measurement Instrument." *Benchmarking: An International Journal* 13 (4):493–522.
- Srdić, Aleksander, and Jana Šelih. 2011. "Integrated Quality and Sustainability Assessment in Construction: A Conceptual Model." *Technological and Economic Development of Economy* 17 (4): 611–626.
- Staniškis, Jurgis K., and Valdas Arbačiauskas. 2009. "Sustainability Performance Indicators for Industrial Enterprise Management." *Environmental Research, Engineering and Management* 2 (48): 42–50.
- Székely, Francisco, and Marianna Knirsch. 2005. "Responsible Leadership and Corporate Social Responsibility: Metrics for Sustainable Performance." *European Management Journal* 23 (6): 628–647.
- Tseng, Ming-Lang, Louie Divinagracia, and Rochelle Divinagracia. 2009. "Evaluating Firm's Sustainable Production Indicators in Uncertainty." *Computers & Industrial Engineering* 57 (4): 1393–1403.
- Veleva, Vesela, and Michael Ellenbecker. 2001. "Indicators of Sustainable Production: Framework and Methodology." *Journal of Cleaner Production* 9 (6): 519–549.
- Wackernagel, Mathis, and William Rees. 1996. *Our Ecological Footprint: Reducing Human Impact on the Earth*. Gabriola Island: New Society Publishers.
- WBCSD (World Business Council for Sustainable Development). 2013. "Eco-efficiency Learning Module." Five Winds International, Accessed April 29, 2013. <http://www.wbcd.org/pages/EDocument/EDocumentDetails.aspx?ID=13593&NoSearchContextKey=true>
- WCED (The World Commission on Environment and Development). 1987. *Our Common Future*. New York: Oxford University Press.
- Whitley, Richard. 1992. *Business Systems in East Asia: Firms, Markets and Societies*. London: Sage.
- Wiengarten, Frank, and Mark Pagell. 2012. "The Importance of Quality Management for the Success of Environmental Management Initiatives." *International Journal of Production Economics* 140 (1): 407–415.
- Yang, Jian-Bo, B. G. Dale, and C. H. R. Siow. 2001. "Self-assessment of Excellence: An Application of the Evidential Reasoning Approach." *International Journal of Production Research* 39 (16): 3789–3812.
- Yang, Chang-Lin, Rong-Hwa Huang, and Wen-Chuan Ke. 2012. "Applying QFD to Build Green Manufacturing System." *Production Planning & Control* 23 (2–3): 145–159.
- Yin, Robert K. 2009. *Case Study Research: Design and Methods*. 4th ed. London: Sage.
- Yongvanich, Kittiya, and James Guthrie. 2006. "An Extended Performance Reporting Framework for Social and Environmental Accounting." *Business Strategy and the Environment* 15 (5): 309–321.

Appendix 1. List of qualitative items

- (1) *Management commitment to environmental protection*
 - (a) Environmental concerns are embedded in the company's policies and strategies.
 - (b) Mechanisms concerning environmental administration, such as ecological guidelines or environmental manuals for internal use, seminars concerning environmental management, training for employees, environmental management programmes, etc. are established and promoted to employees.
 - (c) Environmental performance is targeted beyond the minimum requirements of the current environmental regulations.
 - (d) Intensive attempts and investments have been made for state-of-the-art and green technology rather than focusing on end-of-pipe controls and cost reduction.
 - (e) Environmental aspects are incorporated into reward and remuneration programmes.
- (2) *Social responsibility*
 - (a) The company employs a programme to assess the risks for and the impacts on the local community, due to their operations. This not only includes the time period prior to the company entering the community but also the period during which they are operating within the community.
- (3) *Social development and participation*
 - (a) The company significantly contributes to a better quality of life for the local community through supporting education, health/medical, recreation, and public infrastructure and facilities.
 - (b) The company has been recognised as one of the major contributors to local employment.
 - (c) The company employs indicators or methods to assess the image of the company in terms of social contributions and external perceptions.
- (4) *Internal fairness on employee wages and benefits*
 - (a) Wages and benefits are allocated based on individuals' performances and contributions to the organisation. Overall, people who perform better receive higher wages than others who are in the same position or have the same responsibilities.

- (b) Employees understand clearly how their wage is determined.
 - (c) The wage range for each job grade is systematically controlled to prevent it becoming too wide.
- (5) *External fairness on employee wages and benefits*
- (a) Overall, the wages offered to employees in operational positions in the company are at the high end of the income distribution compared to other companies within the local area.
 - (b) Overall, the wages offered to employees in professional positions in the company is at the high end of the income distribution in the country.
 - (c) Overall, the additional benefits the company offers to employees are greater than those of other companies in the same labour market.
- (6) *Employee involvement and empowerment*
- (a) Team working which focuses on common desired results is encouraged in the working environment of the company.
 - (b) Employees are always empowered to make decision themselves with guidance and coaching from their managers/supervisors.
 - (c) Employees, either as individuals or working in teams, are encouraged to make suggestions and conduct improvement projects.
 - (d) The company regularly hosts or supports activities to encourage or boost employee morale, team building and work commitment.
- (7) *Employee communication*
- (a) Employees have a good understanding of the company's mission, vision, values, strategies, and short-term and long-term targets.
 - (b) The company's internal communication is effective in all directions: top-down, bottom-up and laterally.
- (8) *Employee health and safety provision*
- (a) Systematic inspection programmes for critical work conditions, such as lighting, air circulation, noise, vibration, temperature and cleanliness, are established in order to eliminate the risks of work-related accidents and illness and also to minimise mental stress while working.
 - (b) The testing, inspection and preventive maintenance of work stations, machinery and processing equipment are carried out in a systematic way in order to prevent accidents caused by unexpected machine operation.
 - (c) The use of hazards (chemical, physical, and biological substances and agents) is minimised and controlled. Replacement by less dangerous substances and agents is encouraged.
 - (d) Safety equipment, such as protective clothes, masks, gloves or earplugs, is provided to employees, and they are trained in the correct usage and maintenance.
 - (e) All relevant workers are clearly informed and trained before the introduction of new hazardous substances/agents and the implementation of changes in work procedures, materials, equipment or machinery.
- (f) The information about hazards is clearly available and displayed through colour-coded labels, symbols, information sheets or other methods.
 - (g) All employees are completely trained for emergency incidents, including first-aid and medical assistance, fire-fighting, evacuation, and preparedness for any emergency situations.
 - (h) Employees' health is periodically monitored through basic and/or specific medical checks in order to detect early signs or symptoms of illness, especially illness and disease specifically associated with the work environment.
 - (i) The company has ensured the establishment and effectiveness of a health and safety committee whose responsibilities are to investigate causes of and potential risk factors for accidents and illness and to provide corrective and preventive actions in order to avoid repetition of such incidents.
 - (j) Employee self-consciousness regarding health and safety procedures and the risks due to their working conditions are promoted and driven by their managers and supervisors.
- (9) *Employee training and education provision*
- (a) Self-education opportunities are provided to employees through internal communications and media, such as intranet, e-learning courses, self-paced courses, videos, internal library, etc.
 - (b) Employees are encouraged to participate in external seminars and training courses.
 - (c) Development programmes are arranged for individual employees. Managers or supervisors take part in planning the development programmes of their own sub-ordinates in coordination with the HR team.
 - (d) Job rotation or cross-training in job skills is incorporated into the training policy in order to allow employees to gain exposure to different positions and job functions.
 - (e) A mentoring programme is arranged as appropriate.
 - (f) Employees are encouraged to join or to be members of vocational and/or professional clubs in order to increase their knowledge and skills. In addition, this allows them to build connections with other people in the same careers or with the same interests.
 - (g) Employees are encouraged to study for a higher degree.
- (10) *Management commitment to quality*
- (a) Quality is continuously improved and regularly reviewed by top management.
 - (b) A statistical approach is embedded in quality control, quality assurance and/or quality improvement activities.
 - (c) Quality goals are clearly identified and converted into practical policies and plans.
 - (d) Sufficient personnel and resources are allocated to quality-related activities.
 - (e) Quality improvement is encouraged and driven through reward or remuneration.

- (11) *Conformance to the international standards of business conduct*
- (a) Abolition of child labour, forced labour, debt bondage, human trafficking and any kind of modern slavery.
 - (b) Avoidance of issues concerning unequal opportunities and discrimination, such as cases in which job opportunities for, and treatment of, employees are based on sex, skin colour, race, religion, social origin, political opinion or beliefs, without considering their capabilities and skills.
 - (c) Avoidance of issues concerning torture, violence and physical punishment.
 - (d) Avoidance of collaboration with corruption and illegal behaviour.
 - (e) Avoidance of employing people under unreasonable conditions, such as improper working hours, schedule, holidays and pay.
 - (f) Treating employees with respect, dignity and fairness.
 - (g) Avoidance of arbitrary interference in employees' privacy, family or home by referring to the job description and/or job-related conditions.
 - (h) Promoting employee awareness of the international standards of business conduct through internal publication, training and/or dissemination.
 - (i) Encouraging business partners, suppliers and sub-contractors to align with the company's standard of business conduct.
 - (j) Avoidance of direct or indirect offers, promises, acceptance or requests for bribes and unreasonable advantages at all levels of business operations.
- (12) *Cane farmers support and improvement*
- (a) The quantity of the canes supplied to the company is guaranteed by formal contract with the cane farmers.
 - (b) Overall, the extent of support for cane farming, such as in fertiliser, pesticide, herbicide, water supply, irrigation systems, agricultural and transportation equipment, fuel, etc. offered to cane suppliers is better than other companies within the same area.
 - (c) The company has provided sufficient staff responsible for supporting and collaborating with existing and prospective farmers in terms of training, research, improvement, problem solving, and starting or expanding cane growing areas.
 - (d) Information on the subjects of price, commercial cane sugar (CCS), transactional policies and conditions, knowledge concerning cane growing and marketing, and other related subjects has been transparently shared with the farmers.