From vicious to virtuous circles: problem structuring for quantified decision making in operationalization of Corporate Social Responsibility

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Abstract

There is no formalized approach for problem structuring and quantitative decision support to operationalise Corporate Social Responsibility (CSR) implementation. In this paper, techniques for considering criteria relationships are outlined and a holistic, systematic framework combining a qualitative and quantitative method for practical CSR integration is provided. Cognitive mapping (CM) is applied to structure the problem picture, and the cause effect relationships between decision elements. Soft CM methodology is employed to assess the cross-criteria interactions, at both an individual and a collective level. The interactions of criteria can have a significant impact upon CSR implementation. Such impacts can be direct or indirect through their close linkages to other criteria. The causal strategic map serves as an input to the Analytic Network Process (ANP) to carry out the multi-criteria decision analysis (MCDA). Then, CM and ANP are applied in a comparative analysis to verify whether the measures of criteria significance do correspond. The key criteria in networks are identified using centrality in CM and single limited priorities in ANP. This study demonstrates that using criteria without considering their interactions will result in shortcomings in the evaluation and assessment of CSR programmes. The holistic framework, combining CM and ANP proposed in this work, enhances the process of problem structuring and supports preference-based evaluation of decision alternatives. The results of our study yield that the mapping procedure has an influence on the criteria significance in networks. The correspondence between CM and ANP is stronger when cause-relationships are rigidly interpreted. More unambiguous interpretations of causal relations can be achieved if methods are used jointly and common peaks of importance in both CM and ANP could potentially serve as indications of key decision elements.

1. Introduction

Sustainable development is a key issue for any organization. One of the ways through which the sustainable development challenges can be addressed is Corporate Social Responsibility (CSR)(Merad, Dechy, Marcel, & Linkov, 2013). The World Business Council for Sustainable Development (WBCSD) (2000) defines CSR as ethical company behaviour towards society, whereby management act responsibly in the interests of stakeholders with legitimate claims. The Commission of the European Communities (2003) recognises CSR actions as accountable to all key stakeholders. CSR is a continuing business commitment to behave fairly and responsibly, contributing to economic development while improving the quality of life of the workforce and their families, the local community and society at large.

However, the practical integration of CSR is challenging given its different social, political, environmental and economic aspects. Further difficulty arises from the disagreements that can occur amongst the diverse stakeholders. How can the resources be effectively allocated, while the implications of diverse stakeholders' opinions are understood in a transparent, reliable, and consistent manner? There is dissatisfaction with current approaches to this challenge (Frynas, 2005). Given, the practical difficulties of implementing of CSR at the project level, regulatory bodies such as the United Nations Global Compact, OECD, World Business Council for Sustainable Development (WBCSD), and the Commission of the European Communities are searching for rigorous, transparent, and consistent approaches to ensure the operationalisation of CSR. The CSR frameworks that have been developed consist of a set of principles and policy guidance, in-depth management frameworks, guidance notes or address issue-specific guidelines (Castka, Bamber, Bamber, & Sharp, 2004; CBSR, 2009), whereas what is needed is a means of practical deployment of the many aspects of CSR. As a consequence, the operationalisation of CSR to ensure its practical, consistent, efficient, effective implementation is now one of regulatory bodies' decision making goals.

These challenges prompted the use of multi criteria decision analysis (MCDA) to support the integration of CSR into business models since it has the potential to consider a wide set of criteria that decision makers judge to be relevant and can support transparent and consistent decision making (Poplawska, Labib, & Reed, 2014; Tsai & Hsu, 2008). Participatory planning and management processes have successfully applied MCDA (Wolfslehner & Vacik, 2011). MCDA approaches are also proven tools for environmental and sustainability issues (Merad, Dechy, & Marcel, 2012; Merad, Dechy, Marcel, et al., 2013; Merad, Dechy, Serir, Grabisch, & Marcel, 2013; Poplawska et al., 2014; Vacik, Wolfslehner, Heckl, & Hackl, 2001). MCDA methods have also been applied in a wider range of settings, including strategy management (Bititci, Suwignjo, & Carrie, 2001), environmental protection (Wolfslehner & Vacik, 2008), finance (Niemira & Saaty, 2004), defence (Saaty, 2001), and

transport (Caliskan, 2006), however, their application in CSR has been limited (Poplawska, 2014).

The objective of this paper is to support CSR practitioners by investigating the integrated use of CM and ANP for CSR incorporation within business models. This work builds on our previous study which investigated an application of an integrated MCDA framework for CSR implementation applied to an extractive industry case study (Poplawska et al., 2014). This study aims to provide a holistic assessment of the practical implementation of CSR programmes by examining the different criteria interactions that occur during implementation, their connections, linkages, and relationships. The connections between criteria can directly or indirectly affect CSR programme implementation. Whilst criteria might not have an effect individually, the possible (probable) cross-criteria interactions may compromise the practical integration of CSR initiatives. Furthermore, a single criterion may not pose a risk, but several criteria may cause an overall risk to projects. This paper explores how the different modes of criteria interlinking in CM influence ANP-based CSR assessment and integration in business models.

The paper is structured as follows. In the next section the literature review is presented, followed by an overview of the methods employed in this work. The comparative study of CM and ANP- based CSR assessment illustrates the approach towards implementing CSR and addressing the criteria interactions that occur during implementation, their connections, linkages, and relationships. Finally, concluding remarks, areas for future research and practical implications are addressed.

2. Literature review

CM has been widely applied in different fields, including strategic change (Barr, Stimpert, & Huff, 1992), technology (Kaplan & Tripsas, 2008), environment (Fahey & Narayanan, 1989), entrepreneurship (Hines, 2000; Jenkins & Johnson, 1997), and software operations support (van Kouwen, Dieperink, Schot, & Wassen, 2009). The technique has the capacity to analyse the feedback loops within the system dynamics model (Eden, 1994).

Among the few CSR-related examples cognitive mapping and causal approaches have been highlighted by Aegerter (2006), Byrch, Kearins, Milne, and Morgan (2007), Petersen and Vredenburg (2009), Parisi and Hockerts (2008), Hockerts (2007), Fassin and Van Rossem (2009) and Sperry and Jetter (2012).

The ANP method has also seen acceptance in a range of decision-making problems in various areas (Aragonés-Beltrán, Aznar, Ferrís-Oñate, & García-Melón, 2008; Kirytopoulos, Voulgaridou, Platis, & Leopoulos, 2011).

With sustainability assessment problems, network approaches have been considered by Bottero and Mondini (2008), Bottero and Ferretti (2010), Tsai and Chou (2009) and García-Melón, Gómez-Navarro, and Acuña-Dutra (2012).

More recently, Wang et al (2012) found that structured OR techniques such as the analytical hierarchy process (AHP) with fuzzy logic can create decision variables (criteria) to be used in modelling and analysis and selection of different green initiatives and alternatives. Hussain, Awasthi, and Tiwari (2015) applied Interpretive Structural Modelling (ISM) and ANP to evaluate potential alternatives for sustainable supply chain management, and model the relationship between the various enablers with ISM. Hodgett (2015) found that few comparative studies exist that evaluate two or more methods with a singular problem and proposes a software framework which incorporates analytical hierarchy process (AHP), multi-attribute range evaluations (MARE) and ELimination Et Choix Traduisant la REalité trois (ELECTRE III) to examine equipment selection problem using the three decision analysis methods.

However, still the methodological approaches to understand interactions between concepts are limited in number (Mendoza & Prabhu, 2003). Wolfslehner, Vacik, and Lexer (2005) study compared two different multi-criteria analysis approaches: the analytic hierarchy process (AHP) with a hierarchical structure and the analytic network process (ANP) with a network structure to evaluate sustainable management strategies at forest management, and then expanded it to include the indicators required in the evaluation of sustainable management strategies (Wolfslehner & Vacik, 2008). Wolfslehner and Vacik (2011) analysed concepts' interactions when mapping sustainable indicators models in forest management. More recently, Golcuk & Baykasoglu (2016) discussed a joint application of DEMATEL and ANP to handle criteria interactions in a MADM setting.

In earlier research, most of articles studied modelling approaches to evaluate sustainable management strategies. Majority of researches deal with sustainability from environmental perspectives, but a limited number of them integrate both economic, environmental and social implications or concentrate on trading-off between profitability, competitiveness and environmental dimensions (Gunasekaran, Irani, Papadopoulos, 2013). Moreover, there is a limited focus on modelling and analysis of CSR at project level while balancing the interests of both social, economic and environmental interests. Despite the number of decision-making techniques available, few comparative studies exist that evaluate two or more methods with a singular problem in the field of CSR. Methodological approaches which investigate networks of criteria and their impact upon the final decision outcome have also received limited attention.

This study aims to provide a holistic assessment of the practical implementation of CSR programmes by examining the criteria interactions in comparative study of applying CM and

ANP in the CSR context. As cross-criteria interactions may compromise the practical integration of CSR initiatives and cause an overall risk to projects.

This research investigates how the different modes of criteria interlinking in CM can influence ANP-based CSR assessment and integration in business models. In this study, a holistic and systematic framework is offered to enable CSR practical implementation because CSR, as a business level approach to sustainability, requires 'system-level' thinking and research. A system-based framework enables assessment of the multitude of criteria interactions that may occur in the process of CSR projects' implementation. The holistic assessment of collective criteria impacts, in the form of a system-oriented framework, is an appropriate approach to consider for both the individual and the cross-criteria impacts.

In the framework suggested here MCDA analysis provides a structure for the analysis, then the dynamic cross-criteria relationships analysis is carried out with CM and ANP. Soft operational research methods can be employed to facilitate a formalised problem structuring process, where interactions among the concepts are constructed and analysed (Eden, 2004). In the proposed framework, the concepts generated in CM problem structuring pghase serve as an input to the ANP Network model. The cause-effect direction of the concepts' influences is established using the CM. Moreover, the centrality measure offered in CM captures the 'downstream' effect between the concepts through the indirect connections, in addition to the direct effects. Centrality of a criterion can be viewed as an indication of a criterion's strategic significance because it reflects the criterion's overall cumulative impact beyond its direct impacts. The centrality of a concept generated from CM is subsequently compared with single limited priorities in ANP. In this work, first the proposed techniques are presented and then the evaluation model and the significance of cross-criteria relationships in CM and ANP are discussed.

3. Methods

3.1 Cognitive mapping methodology

Cognitive mapping was chosen as the soft OR approach to investigate this problem. The method has the capability to capture and represent beliefs, values, and expertise of stakeholders (Eden and Ackermann, 2000; Eden, 1988). It allows to demonstrate the underlying structure of causes within 'messy problems' (Eden, 2004). Discussion with stakeholders facilitates identification of new ideas and thoughts through the process of cognitive map building (Ackermann et al, 1997). CM allows to represent cognitive modes of thinking with networks of concepts and links. The model is created by using short phrases to represent the thoughts of participants. Contextual richness is provided in the form of issues, goals, strategies, and aspirations related to the problem (Eden & Ackermann, 2002).

The main reasons behind applying cognitive mapping approach: (1) To assist in capturing the identification of strategic issues and problems (2) Applying both methods allowed for a greater comprehensive understanding of the embedded issues within the system; this enhanced the development of new knowledge by the key stakeholders which, in turn, facilitated greater buy-in and acceptance of results from the OR modelling.

Cognitive maps were developed using focus groups with senior professionals representing various stakeholders subgroups in CSR settings. Focus groups were scheduled for 2 hours and were conducted in a university settings. During these discussions, strategic issues emerged and potential solutions were solicited from the participants.

CM differs from traditional formal methodologies with respect to the results generated and the type of analysis provided. Soft methodologies, such as CM, yield descriptive rather than prescriptive results. Hence, insights generated from CM should be broadly stated in contrast to the insights from prescriptive or diagnostic methodologies, which provide more exact or even absolute results (Mendoza and Prabhu, 2003).

Different methods exist to analyse strategic causal maps, including domain analysis and centrality analysis for the effects of direct and indirect linkages, head and tail analysis, and givens-means-ends analysis for investigation of map complexity, cluster analysis for identification of positive and negative loops within the system and discovery of potent nodes. In this paper, the centrality analysis is investigated to verify its impact upon, and value added to, the construction of the complex web of CSR system interactions.

CM does not facilitate measurement of the strength of concepts' influences nor the evaluation of the different modes of actions. This can be accomplished by employing the ANP methodology. Hence, the integrated use of techniques is proposed in this work.

3.1.1 Centrality and Criticality of concepts in CM

The measure of centrality can serve as guidance for the identification of the strategically significant elements in a causal map (Mendoza & Prabhu, 2003). Centrality plays an important role in the holistic assessment. The concept of centrality relates to two values, the criterion's central score, and the number of criteria affected. The strategic value of a criterion is indicated with the central score. The central score reflects not only the number of criteria directly impacted but also the criterion's overall reach, reflected through its indirect connections with other criteria (Mendoza & Prabhu, 2003). The linkages between criteria can have different types of relationships. The influence of a criterion is dependent on the way its linkage is defined. Three different types of relationships between linkages can be distinguished. These can take the form of (i) hierarchical decomposition linkages, (ii) relationship linkages, and (iii) cause-effect linkages.

To obtain the overall centrality of a criterion it is crucial to take into account the direct linkages and the downstream effect of indirect linkages (Mendoza & Prabhu, 2003; Wolfslehner & Vacik, 2011), which is defined using the Eq. (1):

$$c_i = s_i + \frac{s_2}{2} + \frac{s_3}{3} + \frac{s_n}{n} \qquad \text{i= 1, 2, …, n} \qquad (1)$$

Where c_i is the centrality of an element, and the downstream linkages of an element are defined by $s_1 - s_3$.

Another meaningful concept in a holistic assessment is a criterion's criticality (Mendoza & Prabhu, 2003). Criticality reflects the extent of a criterion's connectivity to other criteria. 'Path', the concept used in assessing criticality, is a chain of criteria connected by a directed graph (or digraph). Forward path indicates the chain of effects emanating from a criterion, whereas the backward path is the chain of criteria that ends at the criterion. Causal factors can be identified with the forward path, while the sources of impacts can be explained with the help of the backward path. The number of paths and the number of critical criteria within the path reflect the criticality of a criterion. The combined measures of centrality and criticality can provide an insight into the structural process of network construction. The network was built in this work using the ANP methodology discussed in the next section.

3.2 Analytic Network Process methodology

The ANP method, an extension of Analytic Hierarchy Process (AHP), is one of several MCDA methodologies, and was developed by Saaty (1996). AHP models the decision making process using unidirectional hierarchical relationships between criteria, while ANP considers the complex interrelationships between criteria and takes into account dependence, feedback, and relationship between criteria. The technique enables effective decisions on complex issues by simplifying and expediting the natural decision-making processes and describing the problem by means of a network of concepts. ANP allows the evaluation of decision problems, which involve a high degree of uncertainty, multiple stakeholders, several criteria, and both qualitative and quantitative data. The network framework enables the connection of any element to the other elements that influence it. Following network construction, experts' judgments are required to compare and prioritise the influencing elements with respect to the element they influence. Mathematically, an ANP model is implemented following a three-step supermatrix calculation (Saaty, 2001). Firstly, the unweighted supermatrix is created directly from all the local priorities derived from pairwise comparisons among the elements influencing each other. Secondly, the weighted supermatrix is processed by multiplying the values of the unweighted supermatrix with their affiliated cluster weights. The supermatrix is made column stochastic by normalizing the weighted supermatrix. In the third and final step, the limit supermatrix is calculated. The

limit supermatrix is processed by raising the entire supermatrix to powers using the following calculation (Eq.2):

$$lim_k \left(\frac{1}{N}\right) \sum_{k=1}^{N} W^k \quad (2)$$

where W indicates the weighted supermatrix, N is the sequence, and k stands for the exponent determined by iteration. Limit priority values within this supermatrix indicate the influence flow of an individual element towards the overall goal.

The ANP network reflects all the different interactions between clusters, nodes and alternatives. Higher level strategic hierarchy, that controls all the benefit, opportunity, cost, and risk (BOCR) subnets, is applied in the process (Garuti & Sandoval, 2002). A multiplicative and an additive analysis enables the combination of the BOCR subnet priorities: (a) *Multiplicative analysis.* A single overall weight for each alternative can be obtained, when benefits, costs, opportunities, and risks are all equally important. To find this weight, the ratio of the four is used: BO/CR, i.e. (benefits x opportunities) divided by (costs x risks) and therefore, the alternative with the highest value can be found. (b) *Additive analysis*. The BOCR are rated one at a time with respect to high-level personal or corporate strategic criteria which are used to evaluate the merits of different decisions, when benefits, costs, opportunities, and risks are not of the same importance. The next section discusses the data collection process undertaken in this study.

4. Comparative study between CM and ANP in the context of corporate social responsibility practices in the extractive sector

4.1 Problem formulation

Extractive resource developments refer to the activities of companies extracting oil, gas, minerals and metals (Liebenthal, Michelitsch, & Tarazona, 2005). The investment of financial resources gained from natural resource extraction can bring economic, social and even environmental opportunities. Such developments may lead to investments in environmental and social programmes, to the development of social skills and capacities, and to other varied business opportunities and infrastructure developments (Davis & Franks, 2011). On the contrary, extractive activities can negatively affect communities, environments, and economies through deposits, reservoirs and processing facilities, etc. (Jenkins & Yakovleva, 2006). Different stakeholders experience the change to different degrees. The source of conflict may come from the fact that often the costs and benefits are unequally distributed or that the developments may not be compatible with stakeholders' interests and values or, at least, they can be perceived as being incompatible. However, the need for resources is immense and companies struggle with the other challenges and, therefore, achieving development through CSR activities in the extractive sector very often is flawed (Frynas,

2005). The development of CSR faces several constraints, such as country- and context-specific issues, difficulties in involvement of CSR beneficiaries, technical and managerial approaches, and the lack of CSR's integration into larger developmental plans (Frynas, 2005; Jenkins, 2004). However, holistic frameworks such as the one proposed in this study can aid development through CSR by allowing the incorporation of many elements, encompassing employment, environmental and local community issues. The following case study explores the effects of using a formalised approach, combining a causal mapping and an ANP-assessment, to investigate the significance of the elements and their collective impact in the context of this problem. The application of a formalised approach provides a means for CSR integration into company business models as well as CSR incorporation into larger developmental plans.

4.2 Data collection

This research project was sponsored by the University of Portsmouth, UK. The first step was an extensive literature review, followed by three workshops with professionals experienced with CSR to analyse the problem, develop the problem picture, test and later validate the framework constructed in the process (Poplawska et al., 2014). The workshops spanned a period of three months. The first author acted as a facilitator throughout the entire research process.

The first problem structuring workshop was conducted with six researchers from the University of Portsmouth, three of whom were practitioners in CSR, and one in total quality management. One participant was an engineer with extensive practical experience in the sector, and a practitioner who assessed the environmental aspect of the model. The participants were initially asked to identify the crucial concepts and variables that are affected through extractive projects and which, in turn, influence those projects and can jeopardise CSR investment projects. Initially, participants wrote their thoughts on post-it notes, which were aggregated into a map that later could be commented upon. The thoughts and ideas of the participants that surrounded the complex problem of CSR in the extractive sector were managed with cognitive mapping methodology and its accompanying software Decision Explorer.

Subsequent workshops were carried out with senior professionals working in different industries who were experienced with CSR. During the second workshop the model was populated with participants' judgements. In the final workshop, model results were presented to the participants to obtain their feedback and validate the outcome.

In addition, based on the data gathered from the workshops, a questionnaire was formulated to study CSR practices more widely and distributed among research participants.

Research participants included senior and middle management of extractive companies, trade associations, governmental entities and affiliates, mineral-related organisations, as well as industry consultancies among others. The participants were approached via postal and online surveys.

The questions focused on the CSR engagement of oil, gas and mining corporations. Respondents were asked to indicate issues of strategic importance in the sector as well as important stakeholders, and to rate the latter's importance on a Likert scale, ranging from 1- little importance to 5- highly important, and finally to indicate their preference(s) in terms of factors affecting CSR programmes practical implementation.

Subsequently the data was collected using postal and online survey, interviews and telephone interviews, focus groups, and networking. The postal survey was administered to 70 participants who are the main stakeholders in the UK mining sector listed in the UK Directory of Mines and Quarries (Cameron, D., Idoine, N., McDonnell, P., Hyslop, E., Brown, T., & Hill, 2008). Self- administered questionnaires were sent by mail in July 2012, including a reply-paid envelope and an accompanying letter. A total of 16 questionnaires were returned, of which 14 were usable. Along with the postal survey, an online survey was aimed at 20% of the still active companies (verified using Bloomberg database). Out of 15 returned questionnaires, 11 were of use in the study. A significant amount of secondary data for every identified company (e.g. annual reports, CSR reports, CSR statements, standards of business conduct, financial statements, and sustainability reports) about the extractive sector CSR practices was collected using this approach. The information was in line with data gathered during pilot study workshops and confirmed our findings in terms of the key strategic factors influencing CSR investments. The survey results matched those found in the literature. The total number of survey sheet returned to the authors is very less. In the case of using AHP/ANP, it is, however, sufficient. Authors aimed at collecting more responses, however, the industry response rate was very low.

Survey analysis (table 1) revealed that the majority of stakeholders approached in the course of this study are managers (23), followed by employees (9), and government officials (8) and community (6). The respondents' opinions tend to be more representative of management stakeholders as they are highly experienced with CSR decision making practices. The analysis indicates that 17 respondents were working within the extractive sector. The remaining 43 participants are employees of other sectors than extractive. Hence, the opinions obtained in the data collection process are representative for respondents working in a wide range of industries, including the extractive industry.

Table 1 Data analysis

Partici pa	*Stakeholder*	*Type of organisation*	*Company size*	*Organisation's time in operation*	*Annual turnover*	*Organisation's*	*% of company profit spent on*

nt			*(staff)*	*(years)*	*(GBP mln)*	*ownership*	*CSR*
1	community	tertiary education	250-500	>40	26- 100	public	2.5-3.0
2	supplier	mediation consultancy	<10	21-30	<5	private	05-1.0
3	community	private research centre (transport sector)	51-249	>40	<5	private	2.0-2.5
4	NGO	education	>500	>40	n/a	public	0
5	community	education	>500	>40	n/a	public	0
6	community	research	51-249	<5	n/a	public	0
7	community	n/a	n/a	>40	n/a	public	0
8	employees	research	>500	>40	26-100	public	>5.0
9	NGO	education	>500	>40	n/a	public	0
10	management	research	250-500	21-30	>100	public	0
11	n/a	education	>500	>40	>100	public	0
12	community	n/a	n/a	>40	n/a	public	0
13	n/a	CSR officer			n/a	public	0
14	management	telecommunication	>500	6-10	26-100	private	0.5-1.0
15	management	banking	250-500	<5	>100	private	0.5-1.0
16	management	contractors	>500	21-30	>100	private	0
17	employees	investment banking	>500	<5	>100	public	0
18	employees	contractors	11-50	11-20	<5	private	0-0.5
19	management	financial sales management	51-249	21-30	<5	private	0-0.5
20	management	healthcare	>500	>40	>100	public	1.5-2.0
21	management	not-for-profit organisation	250-500	21-30	<5	public	0
22	management	contractors	11-50	<5	5-25	private	0
23	employees	n/a	>500	>40	>100	private	2.5-3.0
24	management	IT	11-50	11-20	<5	private	0-0.5
25	management	mining	51-249	21-30	<5	private	>5.0
26	management	n/a	11-50	11-20	5-25	private	n/a
27	environmentalists	n/a	>500	31-40	5-25	public	0.5-1.0
28	management	supplier	11-50	31-40	5-25	private	0-0.5
29	management	mining	51-249	>40	>100	private	0-0.5
30	management	refining	51-249	>40	>100	private	0-0.5
31	management	oil	51-249	21-30	<5	public	0.5-1.0
32	management	ethanol	51-249	6-10	>100	public	n/a
33	government	oil	51-249	11-20	n/a	public	n/a
34	management	n/a	11-50	<5	5-25	private	up to 3.0
35	employees	oil	>500	>40	>100	public	>5.0
36	government	gas	51-249	>40	n/a	public	0.5-1.0
37	government	gas	51-249	>40	n/a	public	0.5-1.0
38	management	n/a	>500	>40	>100	public	0.5-1.0
39	shareholders	oil	>500	>40	>100	public	0.5-1.0
40	customers	n/a	n/a	<5	<5	private	0
41	management	n/a	>500	>40	>100	public	0.5-1.0
42	management	n/a	>500	>40	>100	public	0.5-1.0

43	management	n/a	>500	>40	>100	public	0-0.5
44	management	mining	>500	>40	>100	public	0-0.5
45	management	oil&gas	>500	11-20	>100	public	0-0.5
46	employees	oil&gas	>500	11-20	>100	public	0-0.5
47	employees	oil&gas	>500	11-20	>100	public	0-0.5
48	employees	oil&gas	>500	11-20	>100	public	0-0.5
49	employees	n/a	>500	11-20	26-100	public	0-0.5
50	employees	n/a	>500	21-30	26-100	public	0-0.5
51	government	n/a	>500	<5	26-100	public	>5.0
52	government	n/a	51-249	<5	5-25	private	>5.0
53	government	n/a	51-249	31-40	5-25	private	>5.0
54	government	n/a	51-249	31-40	<5	private	2.5-3.0
55	government	n/a	250-500	31-40	<5	private	1.5-2.0
56	shareholders	oil	250-500	31-40	<5	private	n/a
57	environmentalists	n/a	n/a	6-10	<5	private	n/a
58	customers	n/a	n/a	6-10	n/a	n/a	n/a
59	media	n/a	n/a	6-10	n/a	private	n/a
60	environmentalists	n/a	n/a	>40	n/a	private	n/a
61	n/a	n/a	n/a	>40	n/a	private	n/a

The analysis revealed that 34 participants are employed within public organisations, 26 in private and one informant is still in education. The data gathered in this study suggests that the age of an organisation together with its market capital have an impact upon allocation of profits to CSR investments. In this study respondents have been invited to assess the level of their companies' engagement in CSR activities. To examine the extent to which extractive sector companies are involved in CSR activities, the participants have been asked to give the percentage of annual profit turnover allocated to CSR investments. 14 respondents claim their organisations allocate around 0-0.5% of profit for CSR purposes, followed by 12 respondents who declare no allocation. 11 respondents declare the amount of investments to range between 0.5% and 1.0% of their annual profit turnover, followed by 6 informants who declare more than 5% of resources allocation to CSR. The allocation of profit ranging between 2.5% and 3% was declared by four informants, two informants indicated between 1.5% and 2.0% allocations; one respondent declared allocation of profit to CSR projects ranging between 2% and 2.5%.

4.3 Data Analysis

4.3.1 Cognitive mapping application for CSR problem structuring

The criteria for this work were selected during the first problem structuring workshop conducted with six researchers from the University of Portsmouth, three of whom were practitioners in CSR, and one in total quality management. One participant was an engineer with extensive practical experience in the sector, and a practitioner who assessed the environmental aspect of the model. During workshops at the University of Portsmouth complex maps of the CSR investment problem were developed (Figures 1 and 2). Figure 1 illustrates the partial picture of the complex net of stakeholders. The stakeholders' cluster portrays a wide range of relationships between its elements and illustrates the various stakeholders influences. Figure 2 provides a more general map of the CSR investment problem. The concepts revealed in both maps were scrutinised using the centrality analysis offered in CM. Table 1 provides the final list of the concepts surrounding the problem of CSR resources allocation, gathered from workshops.

[Take Figure 1 here]

[Take Figure 2 here]

The centrality of concepts provided an indication of criteria strategic significance and reflected their overall cumulative impact. To illustrate the centrality of the concepts discovered in the analysis process (figure 1), it can be seen from table 2 that *governments in all countries of operations*, *shareholders*, *local community*, *investments in CSR*, *Eco-activists actions*, *employees*, *decreasing profits*, *profits increase in the long- term, transparent governance* each have value of 16, 14, 13, 12, 12, 12, 12, 12,11 respectively; where the score reflects an overall importance of a criterion to the CSR investment problem.

Table 3 presents the centrality of the concepts gathered during the problem structuring phase of this study and two other analytical constructs for each criterion -number of criteria linked directly and indirectly, and the domain score. The number of directly and indirectly related criteria shows the degree of the criterion's significance and the extent of its cross-interactions with other concepts in the CSR investment problem. The centrality of the concepts generated in the CM mapping process was reviewed in more detail and compared with the ANP-generated single limited priorities in the next phase of the study.

Table 2 The final list of the concepts surrounding the problem of CSR resources allocation

STAKEHOLDERS: 1) Management, 2) Community, 3) Employees, 4) Environmentalists, 5) Government, 6) NGOs, 7) Shareholders, 8) Suppliers, 9) Media, 10) Customers
ECONOMIC: 11)Revenue management, 12) Linkages to the local economy, 13) Wider economic development
SOCIAL: 14)Migration, resettlement, land rights, 15) Human rights, 16) Development and labour, 17) Company image, 18) Product image, 19) Logistics, 20) Service
ENVIRONMENTAL: 21)Hazardous material management and transportation**, 22)** Site contamination, 23) Biodiversity protection, 24) Water and hydrology, 25) Air pollution
POLITICAL: 26) Conflict and political stability, 27) Corruption, 28) Local regulation, 29) National law and regulation, 30) International policies
CSR PROGRAMMES (ALTERNATIVES): 31) *Economic advancement of communities* Job creation, housing, small business development, contribution to local development; partnerships with public authorities, sponsorship and donations
32) *Education and training* Support for schools, colleges, universities; employees' training, programmes aiming at developing new talent; health and safety improvement projects; helping suppliers to incorporate social responsibility into their business strategies
33) *Implementing environment pollution controlling plan* Prevention of water, air, land pollution; waste management programmes; programmes aiming at development of clean technologies, investments in biodiesel production; programmes aiming at protection of natural habitat

Table 3 The Centrality analysis of the strategic cognitive map

Criteria No.	Criteria	Central scores	No. of criteria linked directly and indirectly	Domain analysis
1	loyalty and reputation	10	21	1
2	image and public relations	11	21	3
3	maintained license to operate	7	18	1
4	increase profits in the long term	12	24	3
5	fulfilling CSR	19	26	15
6	out of business	9	22	2
7	CSR programs highly uncertain	10	21	5
8	high probability of failure	3	7	1

9	decreasing profits	12	24	2
10	poor image, media relations	3	7	1
11	loss of license to operate	3	7	1
12	high expenditures on uncertain programs	10	21	1
13	bottom line is money	10	21	1
14	new markets	2	5	2
15	prioritisation of decisions related to resource allocation	11	23	3
16	new area of innovation	2	5	2
17	responsible organisation	11	23	3
18	competitive edge	8	18	3
19	review processes and approaches in relation to broader business awareness	10	21	2
20	economic market conditions	10	21	1
21	organisational profit maximisation	10	21	1
22	political pressure	10	21	1
23	lobbying environmental organisations	10	21	1
24	personal beliefs / ethics	10	21	1
25	media	10	23	2
26	cost at point of service	10	21	1
27	International communities	9	23	1
28	suppliers/partners	11	23	4
29	governments in all countries where the organisation operates	16	23	14
30	employees	12	23	6
31	shareholders	14	31	5
32	local community	13	23	8
33	pressure groups/environmental organisations	11	23	3
34	Eco-Activists actions	12	23	4
36	customers buying product	10	23	2
37	affordable prices	4	11	1

38	maximise profit	11	22	4
39	safe working conditions will be ensured	10	19	3
40	secure employment	10	19	3
41	improve sustainable environment life cycle	9	19	2
42	make profit	4	11	1
43	disseminate information	16	24	10
44	minimise negative environmental impact	8	19	1
45	create jobs	9	19	2
46	ensure positive contribution to economy	8	19	1
47	minimise negative social impacts	9	19	2
48	ensure reasonable costs	6	14	2
49	investments in CSR	12	19	8
50	can prevent negative impact upon natural resources	7	16	2
51	can ensure well-being of employees and society	8	14	3
52	societal balance	5	13	2
53	ecological balance	6	14	3
54	respect human rights	4	11	1
55	efficiency-not taking short cuts to save time and money	7	15	2
56	positive long-term impact	5	12	2
57	prevent one population to deprive another	5	13	1
58	Leaving resources to ensure well-being of future generations	4	7	2
59	require health and safety compliance (customers, suppliers, local residents)	5	13	1
60	have to be legally correct	5	13	1
61	CSR awareness throughout the supply chain	5	13	1
62	minimise ecological impacts short term	4	8	2
63	minimise ecological impacts long term	4	8	2
64	transparent governance	11	26	2
65	management	10	22	6

67	product sale	7	19	2
68	impact upon company profits	8	20	2

4.3.2 Analytic Network Process application for CSR implementation in the extractive sector

A cumulative vector of influence in ANP is calculated by a supermatrix calculation to obtain the alternatives ranking. The limit supermatrix is processed by raising the entire supermatrix to powers using Eq. 2.In order to calculate the final local priorities, the factors' priorities need to be normalised to one for each cluster. For instance, the *Management* factor in the *Stakeholders* cluster in the *economic benefits sub-network* is considered of the highest importance at 0.12159 or 12.15% as shown in table 4. The second is Environmentalists *at 11.67%, followed by Community* at 0.11598 or 11.59%, and *Shareholders* at 0.10718 or 10.71%.

Table 4 The Priorities for the elements in the benefits economic subnetwork

Cluster Name	*Factors*	*Normalised By Cluster*
Alternatives	Economic advancement	0.3264
	Education and training	0.3053
	Environment protection	0.3682
Stakeholders	Community	0.1159
	Customers	0.0952
	Employees	0.1002
	Environmentalists	0.1167
	Government	0.0773
	Management	0.1215
	Media	0.0995
	NGO's	0.0773
	Shareholders	0.1071

Cluster Name	*Factors*	*Normalised By Cluster*
	Suppliers	0.0887

Subsequently, the global priorities for the factors are calculated by weighting the local priorities by the priority of the economic (0.17501) and benefits (0.25000) merits (Table 5 appendix 1). For instance, for t*he economic advancement* the calculation is 0.32647 x 0.17501 x 0.25000 ≈ 0.0142. Similarly, the global priority for the *Management* is 0.12159 x 0.17501 x 0.25000 ≈ 0.0053 and for the *Community* is 0.11598 x 0.17501 x 0.25000 ≈ 0.005 The global priorities for all the factors in the decision-making model have been calculated in this way (table 5 appendix 1).

In the ANP assessment, the relative strength of influence between the elements was derived from priority vectors for single criteria. This priority vectors allow visualising the relevance of elements in the ANP network. In the next section the priority vectors obtained from the ANP assessment are compared with the CM centrality values.

4.4 Comparing CM centrality values and ANP priorities for decision elements

Finally, in this study, the centrality values of the concepts generated in the CM mapping process were compared with the ANP priorities for decision elements. The centrality values provided an indication of each concept's significance and the network analysis investigated and elicited the elements with the highest number of links and, therefore, the highest number of influences on other elements.

The central scores presented in table 3 were estimated using Eq. (1). The criteria with the highest central score can be perceived as the most strategic. Therefore, the most strategic is criterion *(5) fulfilling CSR* with a central score of 19. The central score is 'adjusted' as the level connection is further removed from the direct connections to the criterion concerned. Further downstream the overall strategic connection is weighted less. Table 3 reflects the extent of connectivity or linkages of a criterion. For instance, criterion *(5) fulfilling CSR* with the central score of 19 has 26 other criteria linked to it either directly or indirectly. The linkages reflect the criterion's strategic position and relevance.

In the ANP assessment, the relative strength of influence between the elements can be derived from priority vectors for single criteria and Wolfslehner et al. (2005) used this measure to identify the key network elements. To obtain the overall set of influences it is crucial to perform pairwise comparisons of each set of elements that are linked to a common node. By setting all pairwise comparisons as equally important at the criteria and cluster level, the strength of criteria influence can be obtained.

By comparing the centrality of a criterion in the causal map (table 3) with the priority vector for a single indicator in the ANP (table 6), the relevance of elements can be analysed. The centrality and single indicator priorities are used in this study to compare the CM and ANP methods and the two models.

Table 6 Limit super-matrix

Cluster Node labels		*CSR programmes*			*Stakeholders*				
		Economic advancement	*Education and training*	*Environment protection*	*Community*	*Customers*	*Employees*	*Environmentalists*	*Government*
CSR programmes	*Economic advancement*	0.1632	0.1632	0.1632	0.1632	0.1632	0.1632	0.1632	0.1632
	Education and training	0.1526	0.1526	0.1526	0.1526	0.1526	0.1526	0.1526	0.1526
	Environment protection	0.1841	0.1841	0.1841	0.1841	0.1841	0.1841	0.1841	0.1841
Stakeholders	*Community*	0.0579	0.0579	0.0579	0.0579	0.0579	0.0579	0.0579	0.0579
	Customers	0.0476	0.0476	0.0476	0.0476	0.0476	0.0476	0.0476	0.0476
	Employees	0.0501	0.0501	0.0501	0.0501	0.0501	0.0501	0.0501	0.0501
	Environmentalists	0.0583	0.0583	0.0583	0.0583	0.0583	0.0583	0.0583	0.0583
	Government	0.0386	0.0386	0.0386	0.0386	0.0386	0.0386	0.0386	0.0386

In this research, the CM centrality values and ANP priorities were examined to verify whether there were comparable measures of significance between the two models. The comparison was obtained by reviewing the two distributions graphically, see figures 3 and 4, which provide two different interpretations of the decision problem as represented by CM and ANP.

The distributions were fixed at lowest individual values on both primary (centrality) and secondary (priorities) y-axes and calculating a linear correlation of value pairs (R^2) (figure 4).

The parametric correlation coefficient was applied to measure the strength of the linear relationship between normally distributed variables. Linearity assumes a straight line relationship between each of the variables in the analysis and homoscedasticity assumes that data is normally distributed about the regression line.

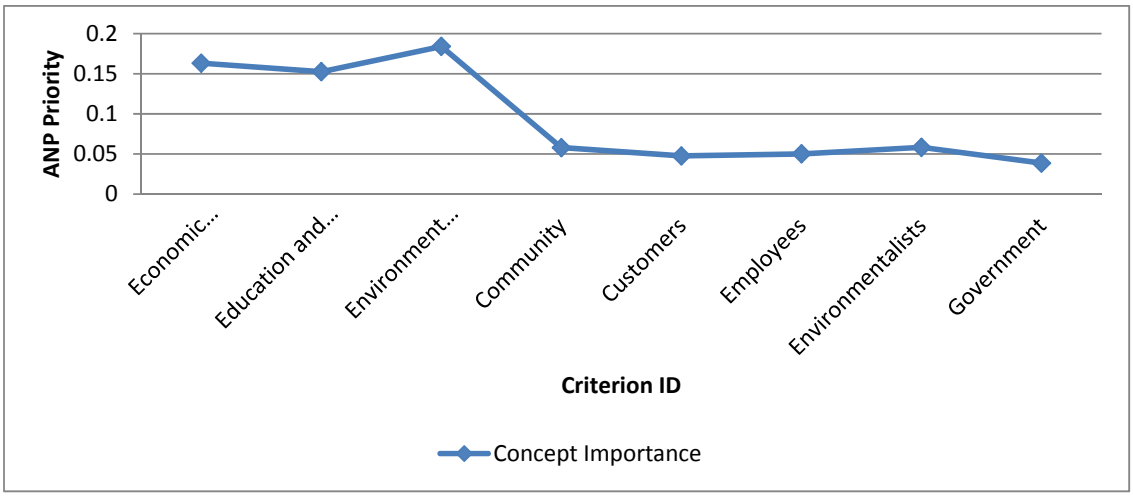


Figure 3 ANP criteria priorities

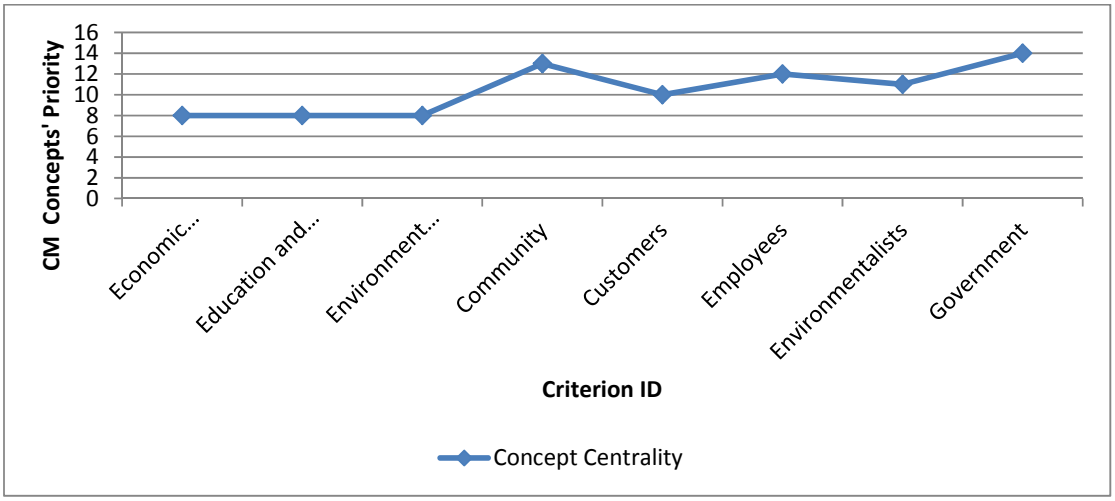


Figure 4 CM criteria priorities

From figures 3 and 4 it can be seen that CM and ANP represent interpretations of criteria priority. A correlation coefficient of – 0.871 indicates that the correlation between the variables is negative, i.e. as the value of concepts' importance in CM increases, the value of concepts' priority decreases in ANP. Figure 3 and 4 illustrate that the variables are negatively correlated in some (e.g.'*Community*' variable), but not all, cases. The holistic and systematic assessment, combining CM and ANP, proposed in this paper, however, takes

account of interdependencies among criteria. One way to analyse those interdependencies is through the use of graphs or influence diagrams. They can be used to denote relationships using arrow diagrams and the direction of the arrow represents the direction of the impact or the nature of causality relationship, if it exists. Causality relationships can take negative or positive form, if exist. The nature and direction of causalities among criteria can be denoted using feedback loops. CM methodology allows investigation of causality. In this study, the CM was used to investigate causality of concepts and aided the network development. The interdependencies between criteria were illustrated through the network structure of the problem. In this study, the analysis generated from CM was more descriptive rather than prescriptive in nature. The application of CM was well suited for the complex sustainability problem where many aspects and dimensions are difficult to comprehend. The use of CM enabled exploration of the functional relationships among criteria, qualitative inferences and analysis of these linkages using CM was suitable. Our assessment provided the system-wide impact of criteria.

5. Discussion

This study attempts to apply an integrated approach, using CM and ANP, to stakeholder prioritisation in the non-renewable extractive sectors. The centrality values in CM provided an indication of concepts' significance and it can be observed that the elements with the cause-effect linkages have the highest centrality, whereas low centrality in CM model is coherent with the low number of cross-criteria linkages. This leads to the assumption that the cause-effect relationships or high centrality concepts might lead to stronger loop effects via the response feedback as the nature and direction of causalities among criteria can be denoted using feedback loops.

The network analysis investigated and elicited the criteria with the highest number of links. The criteria significance patterns in ANP differ from those derived by centrality in the CM model. Here the priorities are relative values which are distributed out of the total sum of 1, whereas centrality is given in absolute terms. Some of the criteria in the CM map gain more influence as they are not only sources but also sinks in the cause effect chains, which are the major drivers in the ANP model; therefore, in the ANP model, other criteria are truncated due to missing sinks. A smaller number of relationships in the ANP map can lead to a stronger influence loss between criteria in ANP than in CM. By applying both approaches in a joint manner some mutual benefits of using the methods integratively are highlighted.

As a result, a formalized approach for CSR operationalisation is proposed in this study. CM provides the problem structuring deck for a highly technical method such as ANP. ANP, on the other hand, can provide the quantitative analysis of a network problem and the evaluation of decision alternatives while considering stakeholders' objectives. The analysis has revealed that the mapping procedure has an influence on the criteria significance in networks. The correspondence between CM and ANP is stronger when cause-relationships are rigidly interpreted. The joint use of the methods allows for the reduction of 'unwanted

noise' and leads to more unambiguous interpretations of causal relations. Common peaks of importance in both CM and ANP could potentially serve as indications of key decision elements.

The combined application of CM and a MCDA methodology in the initial phase of model development can provide a valuable support to CSR integration. Application of a formalised, holistic and systematic framework combining CM and ANP fosters a more realistic understanding of the decision problem and the inclusion of social, political, economic and environmental aspects of the problem. The holistic framework for CSR assessment can also be a source of valuable insight and inform policy-level processes. Such a systemic approach will create benefits in the sense of not only gaining an improved insight into the interactions within the system but also by providing an explanation pattern of the causes and effects among the system's elements.

6. Conclusions

This paper presented a joint use of two methodologies and provided a holistic and systematic framework for CSR assessment and implementation. Soft CM methodology provided an analysis of criteria interactions, while a MCDA methodology provided a quantitative analysis of multiple problem elements under a facilitated, participatory group decision-making environment. The problem's elements were generated and evaluated by estimating their relative importance values.

A soft qualitative methodology enabled the analysis of interactions, connectivity, and linkages between criteria, allowing a holistic assessment of direct and indirect criteria linkages as well as their individual and collective impact. A single criterion may not have an influence upon successful CSR integration, however, collectively the impacts of several criteria can have an overall cumulative dynamic effect.

In performing network analysis, it is strongly recommended that the elements of problem structuring are incorporated at an early stage. The combined application of methods provides valuable support in sustainability assessments and implementation. The prospective analysis of options and scenarios in CSR management presents itself as particularly interesting in policy-making, and may aid the integration of CSR aspects/activities not currently covered by current regulations and standards.

Furthermore, there is a need to improve CSR integration at all levels starting from the international and moving down to the project level. Supporting CSR integration, using formalised methods such as CM and MCDA, fosters a realistic understanding of CSR. Moreover, sound interpretation of CSR performance requires information on economic, social, political, and environmental processes and feedback from them, which is facilitated by an integrated approach to CSR and would support and strongly influence CSR management in policy-driven processes.

Practical implications

The holistic framework was applied to an illustrative example using the CSR context in the extractive industry. Lessons learnt from this study indicate that the methodologies were of sufficient rigour and structure, enabling a systematic analysis of criteria without the restrictions common within the most formal methods, e.g. require difficult mathematics, inadequate tools exist, formal methods can be incompatible with other software packages, may add lengthy stages to the process, require extensive personnel training adding. Formal techniques can aid in reasoning about systems. However, systems are often very large, made up of many components which correct interoperation is difficult to predict. Often there is a need to demonstrate the absence of undesired behaviour, rather than to simply verify the existence of particular features. Therefore, extensive system testing may also be required. Formal techniques have been designed to assist in all of these tasks. Despite extensive development and significant demonstrated benefits, they remain poorly accepted by industrial practitioners.

The benefits of the assessment proposed in this work are an improved insight into the interactions within the CSR integration system as well as the creation of explanatory patterns of cause and effect among these interactions.

CSR can become a substantive strategic activity for any corporation rather than just a bolster to boost corporate image, and the methodologies presented in this paper can serve towards its operationalization. Large, geographically dispersed organisations in particular, are in need of more effective ways to utilise their resources, among which are, for instance, time, personnel, and money, to compete in a complex and globalised world. The decision-making processes surrounding CSR resources allocation are complex, often involve multiple criteria, and a number of stakeholders competing for the resources who may have diverging demands. Hence, there is a need for empirically grounded and theoretically solid knowledge, aiding managers in obtaining organisational benefits and the competitive edge. The methodologies presented in this paper enable practitioners to apply CSR in practice and help not only shape organisations' CSR strategy but also become crucial elements to the leadership of successful and sustainable companies.

Future research

The different interpretations of criteria linkages have received limited attention in this study. Future work will demonstrate assumptions on systems' interactions and verify whether making the linkages explicit in qualitative or quantitative decision analysis, can cause strong deviations in model structure and evaluation. Mapping decision criteria without considering their relations and their effects on other criteria can cause shortcomings in the CSR assessment and evaluation. It is essential to visualise criteria

interactions consistently to allow not only the identification of the crucial criteria in a network but also the critical linkages.

References

Ackermann, F., & Eden, C. (2001). SODA- journey making and mapping in practice *Rational Analysis in a Problematic World Revisited* (pp. 43-61). United Kingdom: Wiley.

Ackermann, F., Eden, C., & Williams, T. (1997). Modeling for litigation: Mixing qualitative and quantitative approaches. *Interfaces*, *27*(2), 48-65.

Aegerter, D. (2006). THE SME OWNERS'PERCEPTION ON CORPORATE SOCIAL RESPONSIBILITY: AN APPROACH BASED ON COGNITIVE MAPPING. *Revista tinerilor economişti*(7), 112-121.

Aragonés-Beltrán, P., Aznar, J., Ferrís-Oñate, J., & García-Melón, M. (2008). Valuation of urban industrial land: An analytic network process approach. *European Journal of Operational Research, 185*(1), 322-339. doi: http://dx.doi.org/10.1016/j.ejor.2006.09.076

Barr, P. S., Stimpert, J. L., & Huff, A. S. (1992). Cognitive change, strategic action, and organizational renewal. *Strategic management journal, 13*(S1), 15-36.

Belton, V., & Stewart, T. J. (2002). *Multiple criteria decision analysis: An integrated approach.* Boston: Kluwer Academic Publishers.

Bititci, U. S., Suwignjo, P., & Carrie, A. (2001). Strategy management through quantitative modelling of performance measurement systems. *International Journal of Production Economics, 69*(1), 15-22.

Bottero, M., & Ferretti, V. (2010). Integrating the analytic network process (ANP) and the driving force-pressure-state-impact-responses (DPSIR) model for the sustainability assessment of territorial transformations. *Management of Environmental Quality: An International Journal, 21*(5), 618-644.

Bottero, M., & Mondini, G. (2008). An appraisal of analytic network process and its role in sustainability assessment in Northern Italy. *Management of Environmental Quality: An International Journal, 19*(6), 642-660.

Byrch, C., Kearins, K., Milne, M., & Morgan, R. (2007). Sustainable "what"? A cognitive approach to understanding sustainable development. *Qualitative Research in Accounting & Management, 4*(1), 26-52. doi: doi:10.1108/11766090710732497

Caliskan, N. (2006). A decision support approach for the evaluation of transport investment alternatives. *European Journal of Operational Research, 175*(3), 1696-1704.

Castka, P., Bamber, C. J., Bamber, D. J., & Sharp, J. M. (2004). Integrating corporate social responsibility (CSR) into ISO management systems–in search of a feasible CSR management system framework. *The TQM Magazine, 16*(3), 216-224.

CBSR. (2009). CSR Frameworks for the Extractive Industry. Retrieved from

Eden, C. (2004). Analyzing cognitive maps to help structure issues or problems. *European Journal of Operational Research, 159*(3), 673-686.

Eden, C., & Ackermann, F. (1998). Making Strategy: The Journey of Strategic Management

Eden, C., & Ackermann, F. (2001). Strategic options development and analysis: The principles.

Eden, C., & Ackermann, F. (2002). A mapping framework for strategy making. *Mapping strategic knowledge*, *302*.

Eden, C., & Ackermann, F. (2004). Cognitive mapping expert views for policy analysis in the public sector. *European Journal of Operational Research*, *152*(3), 615-630.

Eden, C., Jones, S., & Sims, D. (1983). *Messing about in problems*. Oxford: Pergamon.

EU. (2003). Corporate Social Responsibility, from http://ec.europa.eu/enterprise/policies/sustainable-business/corporate-social-responsibility/index_en.htm

Fahey, L., & Narayanan, V. K. (1989). Linking changes in revealed causal maps and environmental change: An empirical study. *Journal of Management Studies, 26*(4), 361-378.

Fassin, Y., & Van Rossem, A. (2009). Corporate governance in the debate on CSR and ethics: Sensemaking of social issues in management by authorities and CEOs. *Corporate Governance: An International Review, 17*(5), 573-593.

Frynas, J. G. (2005). The false developmental promise of corporate social responsibility: Evidence from multinational oil companies. *International affairs, 81*(3), 581-598.

García-Melón, M., Gómez-Navarro, T., & Acuña-Dutra, S. (2012). A combined ANP-delphi approach to evaluate sustainable tourism. *Environmental Impact Assessment Review, 34*, 41-50.

Garuti, C., & Sandoval, M. (2002). Comparing AHP and ANP shiftwork models: hierarchy simplicity v/s network connectivity

Gölcük, İ., & Baykasoğlu, A. (2016). An analysis of DEMATEL approaches for criteria interaction handling within ANP. *Expert Systems with Applications*, *46*, 346-366.

Gunasekaran, A., Irani, Z., & Papadopoulos, T. (2013). Modelling and analysis of sustainable operations management: certain investigations for research and applications. *Journal of the Operational Research Society*,*65*(6), 806-823.

Hines, T. (2000). An evaluation of two qualitative methods (focus group interviews and cognitive maps) for conducting research into entrepreneurial decision making. *Qualitative Market Research: An International Journal, 3*(1), 7-16.

Hockerts, K. (2007). *Managerial perceptions of the business case for corporate social responsibility*: CBS Center for Corporate Social Responsibility.

Hodgett, R. E. (2015). Comparison of multi-criteria decision-making methods for equipment selection. *The International Journal of Advanced Manufacturing Technology*, 1-13.

Hussain, M., Awasthi, A., & Tiwari, M. K. (2015). Interpretive structural modeling-analytic network process integrated framework for evaluating sustainable supply chain management alternatives. *Applied Mathematical Modelling*.

Jenkins, H. (2004). Corporate social responsibility and the mining industry: conflicts and constructs. *Corporate Social Responsibility and Environmental Management, 11*(1), 23-34.

Jenkins Johnson, M. (1997). Entrepreneurial intentions and outcomes: A comparative causal mapping study. *Journal of Management Studies, 34*(6), 895-920.

Kaplan, S., & Tripsas, M. (2008). Thinking about technology: Applying a cognitive lens to technical change. *Research Policy, 37*(5), 790-805.

Kirytopoulos, K., Voulgaridou, D., Platis, A., & Leopoulos, V. (2011). An effective Markov based approach for calculating the Limit Matrix in the analytic network process. *European Journal of Operational Research, 214*(1), 85-90. doi: http://dx.doi.org/10.1016/j.ejor.2011.03.043

Liebenthal, A., Michelitsch, R., & Tarazona, E. I. (2005). *Extractive Industries and Sustainable Development: An Evaluation of World Bank Group Experience*. World Bank Publications.

Mendoza, G. A., & Martins, H. (2006). Multi-criteria decision analysis in natural resource management: a critical review of methods and new modelling paradigms. *Forest ecology and management, 230*(1), 1-22.

Mendoza, G. A., & Prabhu, R. (2003). Qualitative multi-criteria approaches to assessing indicators of sustainable forest resource management. *Forest ecology and management, 174*(1), 329-343.

Merad, M., Dechy, N., & Marcel, F. (2012). Adapting participative governance framework for the implementation of a sustainable development plan within an Organization *Restoring Lands-Coordinating Science, Politics and Action* (pp. 217-237): Springer.

Merad, M., Dechy, N., Marcel, F., & Linkov, I. (2013). Multiple-criteria decision-aiding framework to analyze and assess the governance of sustainability. *Environment Systems and Decisions, 33*(2), 305-321.

Merad, M., Dechy, N., Serir, L., Grabisch, M., & Marcel, F. (2013). Using a multi-criteria decision aid methodology to implement sustainable development principles within an organization. *European Journal of Operational Research, 224*(3), 603-613.

Niemira, M. P., & Saaty, T. L. (2004). An analytic network process model for financial-crisis forecasting. *International Journal of Forecasting, 20*(4), 573-587.

Parisi, C., & Hockerts, K. N. (2008). Managerial mindsets and performance measurement systems of CSR-related intangibles. *Measuring Business Excellence, 12*(2), 51-67.

Petersen, H., & Vredenburg, H. (2009). Morals or Economics? Institutional Investor Preferences for Corporate Social Responsibility. [Article]. *Journal of Business Ethics, 90*(1), 1-14. doi: 10.1007/s10551-009-0030-3

Poplawska, J. (2014). *Decision support framework for resources allocation to corporate social responsibility (CSR) programmes.* (Doctor of Philosophy PhD Thesis), Portsmouth Business School, University of Portsmouth, Portsmouth, UK.

Poplawska, J., Labib, A., & Reed, D. (2014). A hybrid multiple criteria decision analysis framework for corporate social responsibility implementation applied to an extractive industry case study. *Journal of Operational Research Society*.

Saaty, T. (1996). *Decision making for leaders. The Analytic Hierarchy Process for decisions in a complex world*. Pittsburg: RWS Publications.

Saaty, T. L. (2001). Decision Making with the Analytic Network Process (ANP) and Its "Super Decisions" Software: The National Missile Defense (NMD) Example,". *ISAHP 2001 proceedings, Bern, Switzerland*, 2-4.

Sperry, R., & Jetter, A. J. (2012). *Fuzzy cognitive maps to implement corporate social responsibility in product planning: A novel approach.* Paper presented at the Technology Management for Emerging Technologies (PICMET), 2012 Proceedings of PICMET'12:.

Tsai, W.-H., & Chou, W.-C. (2009). Selecting management systems for sustainable development in SMEs: A novel hybrid model based on DEMATEL, ANP, and ZOGP. *Expert Systems with Applications, 36*(2), 1444-1458.

Tsai, W.-H., & Hsu, J.-L. (2008). Corporate social responsibility programs choice and costs assessment in the airline industry—A hybrid model. *Journal of Air Transport Management, 14*(4), 188-196.

Vacik, H., Wolfslehner, B., Heckl, F., & Hackl, J. (2001). *Importance of impacts on forest ecosystems for a sustainable use and maintenance of biodiversity.* Paper presented at the Proceedings of the Sixth International Symposium on the Analytic Hierarchy Process, ISAHP.

van Kouwen, F., Dieperink, C., Schot, P., & Wassen, M. (2009). Computer-supported cognitive mapping for participatory problem structuring. *Environment and planning. A, 41*(1), 63.

Wang, X., Chan, H. K., Yee, R. W., & Diaz-Rainey, I. (2012). A two-stage fuzzy-AHP model for risk assessment of implementing green initiatives in the fashion supply chain. *International Journal of Production Economics*,*135*(2), 595-606.

WBCSD. (2000). Corporate Social Responsibility (CSR) Retrieved 22/12/2014, from http://www.wbcsd.org/work-program/business-role/previous-work/corporate-social-responsibility.aspx

Wolfslehner, B., & Vacik, H. (2008). Evaluating sustainable forest management strategies with the analytic network process in a pressure-state-response framework. *Journal of Environmental Management, 88*(1), 1-10.

Wolfslehner, B., & Vacik, H. (2011). Mapping indicator models: From intuitive problem structuring to quantified decision-making in sustainable forest management. *Ecological indicators, 11*(2), 274-283.

Wolfslehner, B., Vacik, H., & Lexer, M. J. (2005). Application of the analytic network process in multi-criteria analysis of sustainable forest management. *Forest ecology and management, 207*(1), 157-170.

Table 4 The BOCR networks, the controlling factors, clusters and elements in the ANP model and their priorities.

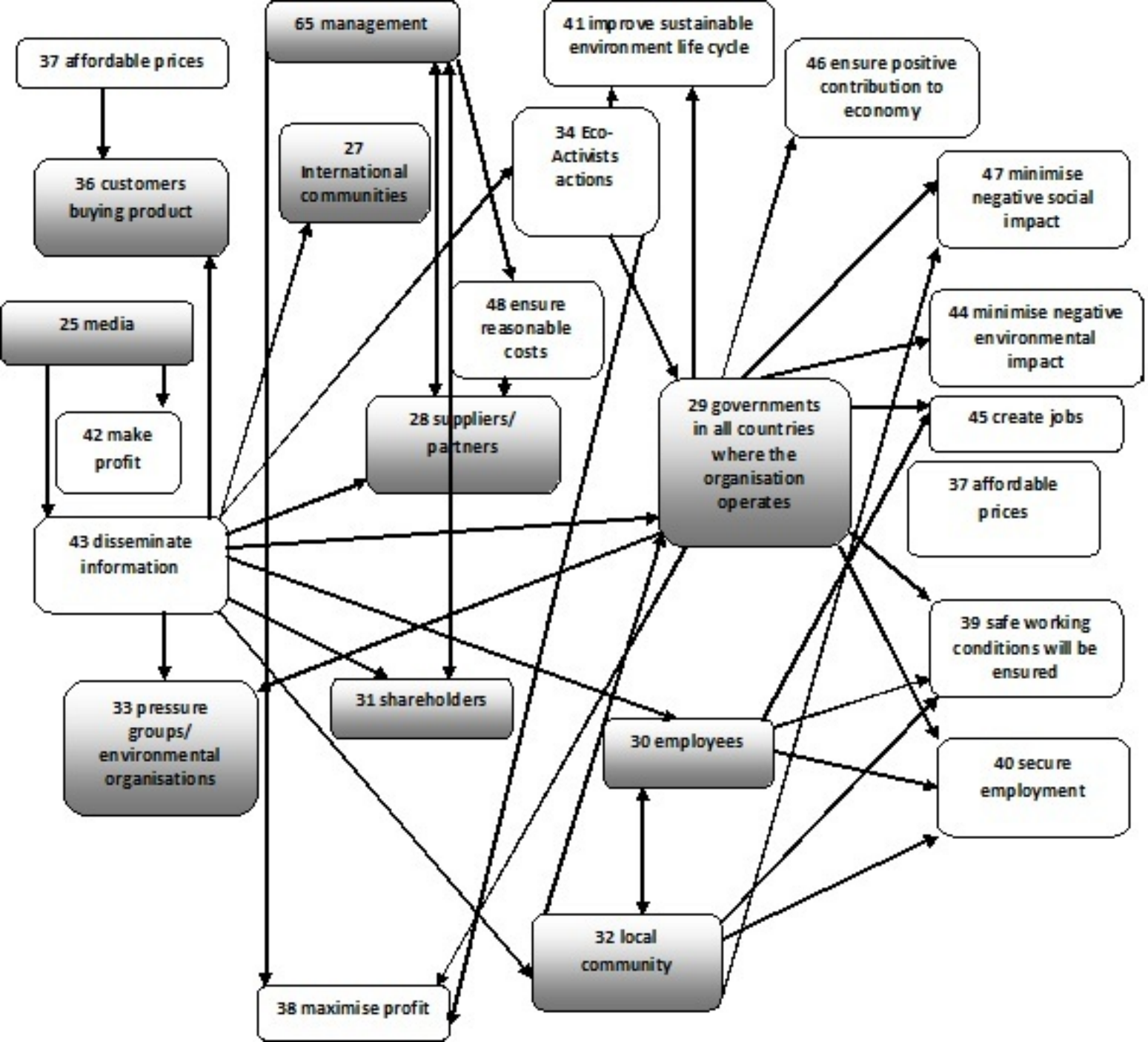
BOCR	*Control Criteria*	*Clusters*	*Elements*	*Local Priorities*	*Global Priorities*
Benefits (0.25000)	***Economic (0.17501)***	**Stakeholders**	**Management,**	**0.1215**	**0.0053**
			Community,	**0.1159**	**0.0050**
			Employees,	**0.1002**	**0.0043**
			Environmentalists,	**0.1167**	**0.0051**
			Governments,	**0.0773**	**0.0033**
			NGO's,	**0.0773**	**0.0033**
			Shareholders,	**0.1071**	**0.0046**
			Suppliers,	**0.0887**	**0.0038**
			Media,	**0.0995**	**0.0043**
			Customers,	**0.0952**	**0.0041**
	Social (0.28936)	**Image**	**Company,**	**0.6721**	**0.0486**
			Product,	**0.3278**	**0.0237**
		Social responsibility	**Development and labour,**	**0.3333**	**0.0241**
			Respect for human rights,	**0.3333**	**0.0241**
			Migration, resettlement and land rights	**0.3333**	**0.0241**

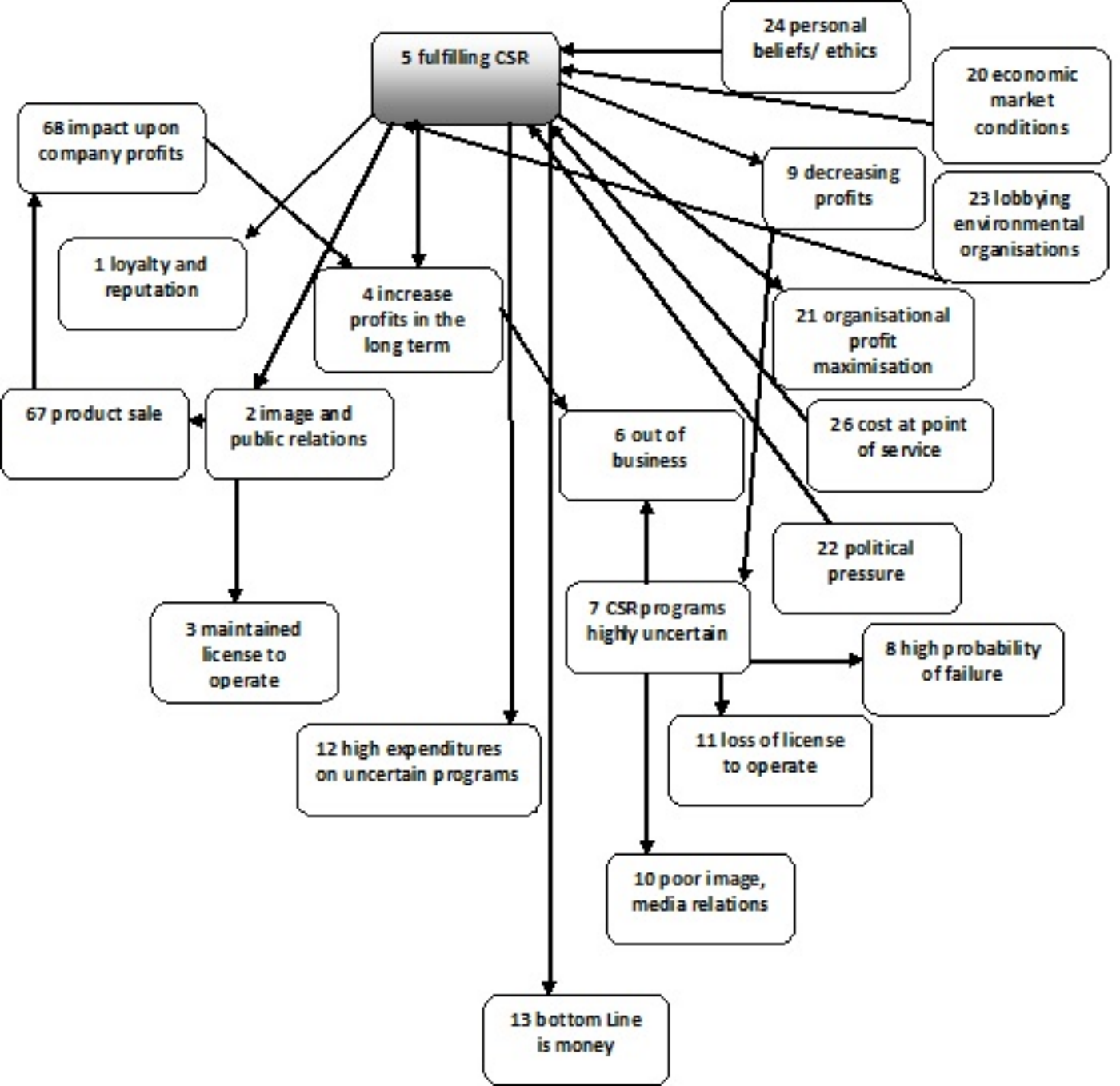
BOCR	*Control Criteria*	*Clusters*	*Elements*	*Local Priorities*	*Global Priorities*
		Infrastructure	**Logistics,**	**0.5000**	**0.0361**
			Service	**0.5000**	**0.0361**
	Political (0.24627)	**Political stability**	**Conflict,**	**0.5000**	**0.0307**
			Corruption	**0.5000**	**0.0307**
		Law and regulation	**Local,**	**0.2171**	**0.0133**
			National,	**0.4680**	**0.0288**
			International policies	**0.3148**	**0.0193**

	Environmental (0.28936)	**Natural Environment**	**Air,**	**0.3333**	**0.0241**
			Land,	**0.3333**	**0.0241**
			Water	**0.3333**	**0.0241**
		Business Environment	**Vendors,**	**0.3321**	**0.0240**
			Customers,	**0.3491**	**0.0252**
			Partners	**0.3186**	**0.0230**
Opportunities (0.25000)	***Economic (0.33333)***	**Economic**	**Reduced corporate tax,**	**0.5000**	**0.0416**
		opportunities	**Ahead of competition**	**0.5000**	**0.0416**
	Social (0.33333)	**Social opportunities**	**Maintaining reputation,**	**0.5000**	**0.0416**
			Provision of sustained development	**0.5000**	**0.0416**
	Political (0.33333)	**Political opportunities**	**Passing the corporate audit**	**0.5000**	**0.0416**
			Meeting IRS requirements	**0.5000**	**0.0416**
Costs (0.25000)	***Economic (0.39521)***	**Stakeholders**	**Management,**	**0.1107**	**0.0109**
			Community,	**0.0927**	**0.0091**
			Employees,	**0.1003**	**0.0099**
			Environmentalists,	**0.0974**	**0.0096**
			Governments,	**0.0978**	**0.0096**
			NGO's,	**0.0936**	**0.0092**

			Shareholders,	**0.1125**	**0.0111**
			Suppliers,	**0.1001**	**0.0098**
			Media,	**0.0954**	**0.0094**
			Customers	**0.0991**	**0.0097**
	Social (0.19760)	**Image**	**Company,**	**0.6625**	**0.0327**
			Product	**0.3374**	**0.0166**
		Infrastructure	**Logistics,**	**0.5000**	**0.0247**
			Service	**0.5000**	**0.0247**
		Social responsibilities	**Development and labour**	**0.3333**	**0.0164**
			Respect for human rights	**0.3333**	**0.0164**
			Migration, resettlement, land rights	**0.3333**	**0.0164**
	Political (0.16817)	**Political stability**	**Conflict,**	**0.5000**	**0.0210**
			Corruption	**0.5000**	**0.0210**
		Law and regulation	**Local,**	**0.1958**	**0.0082**
			National,	**0.4933**	**0.0207**
			International policies	**0.3108**	**0.0130**
	Environmental (0.23902)	**Natural Environment**	**Air,**	**0.3333**	**0.0199**
			Land,	**0.3333**	**0.0199**

			Water	**0.3333**	**0.0199**
		Business Environment	**Vendors,**	**0.3333**	**0.0199**
			Customers,	**0.3333**	**0.0199**
			Partners	**0.3333**	**0.0199**
Risks (0.25000)	***Economic (0.25000)***	**Stakeholders**	**Management,**	**0.0886**	**0.0055**
			Community,	**0.1280**	**0.0080**
			Employees,	**0.0952**	**0.0059**
			Environmentalists,	**0.1098**	**0.0068**
			Governments,	**0.1078**	**0.0067**
			NGO's,	**0.0882**	**0.0055**
			Shareholders,	**0.0946**	**0.0059**
			Suppliers,	**0.0920**	**0.0057**
			Media,	**0.0886**	**0.0055**
			Customers	**0.1066**	**0.0066**


65 management
41 improve sustainable environment life cycle
37 affordable prices
46 ensure positive contribution to economy
27 International communities
34 Eco-Activists actions
36 customers buying product
47 minimise negative social impact
48 ensure reasonable costs
25 media
44 minimise negative environmental impact
28 suppliers/ partners
29 governments in all countries where the organisation operates
45 create jobs
42 make profit
37 affordable prices
43 disseminate information
39 safe working conditions will be ensured
33 pressure groups/ environmental organisations
31 shareholders
30 employees
40 secure employment
32 local community
38 maximise profit


5 fulfilling CSR
24 personal beliefs/ ethics
20 economic market conditions
68 impact upon company profits
9 decreasing profits
23 lobbying environmental organisations
1 loyalty and reputation
4 increase profits in the long term
21 organisational profit maximisation
67 product sale
2 image and public relations
6 out of business
26 cost at point of service
22 political pressure
3 maintained license to operate
7 CSR programs highly uncertain
8 high probability of failure
12 high expenditures on uncertain programs
11 loss of license to operate
10 poor image, media relations
13 bottom Line is money