Corporate Sustainability Measurement: A Literature Review

Fist Output

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Abstract:

The environmental and socio-economic problems faced by our modern society have led to a considerable amount of research in the recent past on the issue of sustainable development. Researchers acknowledging that the main causes of environmental damage are unsustainable production and consumption practices have tried to formulate and design systems that would help monitor sustainable practices in corporate units. However, there are many challenges associated with the measurement of corporate sustainability that have yet to be addressed. The purpose of this article is to review the past research which tries to measure corporate sustainability and to identify future directions for research in the design, implementation, use, and evolution of measurement of sustainability at the corporate level. A concise review of key literature published in the last two decades is presented.

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1. Introduction

In the last few decades, environmental and socio-economic problems faced by our modern society have given rise to considerable research. Sustainable development is a contested concept, with various definitions and theories shaped by researchers and organizations worldwide, which in turn influence how the issues are formulated and policy actions are proposed. It is widely presented as an intersection between the environment, society and economy which are conceived of as separate although connected entities.

There is ample literature which addresses the issue of sustainable development at a macro level, comprising the three fundamental, inter-related and complimentary issues - economic, environmental and social development. Recently, there is a growing realization that the issue of sustainability must be addressed also at a micro level, by looking at corporate contributions towards sustainability. However, it is to be noted that the term “sustainability” at a micro level still remains a slightly vague concept, especially in a firm-level perspective, since it could be used to describe everything from organic yoghurt to petroleum production. Moreover, the heterogeneity of firms in various aspects, including its

product mix, causes problems in constructing an unique sustainability performance indicator which would enable comparison of firms. Nevertheless, there have been various attempts by many studies in the past decade or so in this direction. The paper provides a review on the publications that has attempted to measure corporate sustainability.

Section 2 reviews the concept of sustainability at a macro level while section 3 gives an overview of the concept of sustainability at a micro level. Section 4 provides a review on the various initiatives by institutions and by several literatures on sustainability performance measurement. Section 5 gives the conclusions.

2. Concept of sustainable development at macro level

There have been various definitions given by several authors and institutions on Sustainable development at a macro level. Most of them agree that in general, sustainable development comprises three fundamental components which are equivalent, interrelated and complimentary, namely, the economic, environmental and social development.

The definitions provided by various institutions like World Commission on Environment and Development (WCED), The International Institute for Environment and Development (IIED) and the World Business Council for Sustainable Development (WBCSD) can be considered as representative of the versions of definitions provided by institutional establishments.

The concept of sustainable development was first introduced in the Brundtland Commission Report, *Our Common Future*, published by the World Commission on Environment and Development (WCED). The concept is defined as "development that meets the needs of the present without compromising the ability of the future generations to meet their own needs" (WCED 1987).

The International Institute for Environment and Development (IIED) provided a related definition identifying three basic systems necessary to any process of development: biological or ecological system, economic system and social system. The objective of sustainable development would be to maximize goal achievement across these three systems at the same time.

As a direct extension of WCED definition, the other establishment version is the one given by WBCSD. WBCSD states in its charter that "Business leaders are committed to sustainable development, to meeting the needs of the present without compromising the welfare of future generations. This concept recognizes that economic growth and environmental protection are inextricably linked, and that the quality of present and future life rests on meeting basic human needs without destroying the environment upon which all life depends" (Schmidheiny 1992).

There is also abundant literature on the concept and definition of sustainable development at a macro level ((Goodland, (1997), Hanley (2000) and Moldan et al. (2012)). However, there has been a consensus in the literature regarding the definition, most of them agreeing to the definition including the three major domains: environmental, social, economic.

3. Concept of sustainable development at micro level

The concept of sustainable development which originated from the macro level, (among others, Hanley, 2000), was later applied also to micro level economic entities such as firms (eg Gladwin et al., 1995a and Callens and Tyteca, 1999). The concept of sustainable production at micro level emerged at the United Nations Conference on Environment and Development in 1992 (Rio Earth Summit in 1992) and was recognized as a key component of sustainable development, which comprises three principal objectives: the social, economic and environmental objective. The major conclusion reached during the conference was that the continued global environmental damage is mainly due to unsustainable pattern of consumption and production, especially in industrialized countries (United Nations, 1992). Sustainable production targets the companies and organizations involved in producing products or offering services, while sustainable consumption targets consumers (Veleva and Ellenbecker, 2001).

However, the literature has identified that measuring sustainability at a micro level is not trivial. Atkinson (2000) suggests that this problem could be avoided by addressing these issues in terms of corporate contributions to sustainability. Consequently, the sustainability of a company can be evaluated depending on its economic, environmental and social performance.

There are ongoing debates regarding the meaning of sustainability in a corporate context and many definitions of corporate sustainability have been offered. For example, Dyllick and Hockerts (2002) have defined corporate sustainability as: ‘‘meeting the needs of the firm’s direct and indirect stakeholders (such as shareholders, employees, clients, pressure groups, communities, etc.), without compromising its ability to meet future stakeholder needs as well.’’ In another typical definition, van Marrewijk (2003) explained that corporate sustainability refers to ‘‘demonstrating the inclusion of social and environmental concerns in business operations and in interactions with stakeholders’’ (van Marrewijk 2003). Like many others, these definitions build on stakeholder theory (Freeman 1984), which is one of the most commonly applied theoretical frameworks for research on corporate sustainability. Stakeholder theory implies that corporations have obligations to individuals and groups both inside and outside of the corporation, including shareholders, employees, customers, and the broader community. However, there is a growing consensus that it is necessary to move from trying to

define it toward developing concrete tools for promoting and measuring achievements.

4. Measurement of corporate sustainability: A review

There have been many initiatives by institutions and researchers to measure the sustainability performance of corporate units and to make an integrated approach for the same which would allow comparisons across business units. The following two sub-sections provides as overview of the sustainability evaluation initiatives by various institutions and a review of the literature which tries to develop on these existing initiatives or following a different methodology to measure sustainable performance of firms.

4.1. Overview of few sustainability evaluation initiatives

The Global Reporting Initiative (GRI) develops globally applicable sustainability reporting with core economic, social and environmental indicators which can be used for preparing reports on environmental, social and economic impact of corporate activities. It serves as an important tool for decision making develops and disseminates the globally applicable at a level of the senior management, at an operational level and at a level of internal and external stakeholders. One of the main advantages of the GRI initiative is possibility to use benchmarking, because a standard format is used for reporting sustainability performance. The indicators are divided into the following groups: economic, environmental, human rights, employee and workplace related, product related and social indicators. In total, 70 key indicators are recommended, and these indicators are presented in detail in the indicator protocols (GRI, Global Reporting Initiative, 2006).

World Business Council for Sustainable Development (WBCSD) in 2000 developed another methodology for eco-efficiency performance evaluation. The WBCSD develops indicators that are general for all activities and also activity-specific indicators. The important feature of this methodology is the integration of two sustainability dimensions: environmental and economic. One of the limitations of this methodology was that social aspects are not covered, but this could be solved by adding socio-economic indicators as suggested by Schaltegger et al (Schaltegger S., et al, 2002).

Researchers at the Lowell Center for Sustainable Production (LCSP) at the University of Massachusetts developed the indicator hierarchy as a tool to manage performance indicators and to enable companies to evaluate effectiveness of their indicator systems (Veleva V., Hart M., Greiner T., Crumbley C., 2003). Application of such hierarchy is very useful as it helps to keep a clear structure of indicators and corresponds to the level of the enterprise‘s ambition in performance evaluation.

There are also sector-specific sustainability performance evaluation initiatives, for example, the Britain's Institution of Chemical Engineers (IChemE) (Fiksel J., 2002), Global Mining Initiative (Institution of Chemical Engineers, 2003).

4.2. Review of literature measuring corporate sustainability

In addition to the above mentioned initiatives in the previous section, there are attempts by various authors in the direction of measuring sustainable performance of business units. This section of literature review is done with the objective of understanding how various studies evaluate sustainability. The first objective is to identify the proposed method in which the paper evaluates sustainability. For example, the potential methods could be using indicators, benchmarks, indexes, standards or some other ways. Secondly, the review tries to understand at what levels : farm, company, industry (or other level) in which sustainability is evaluated. Thirdly, the review takes into account the definition of sustainability and whether the models proposed encompasses the three pillars of sustainability: economic, ecological and environment. Fourthly, the review also tries to understand the empirical application of the models in real business.

One of the first attempts to measure corporate sustainability is performed by Knapen et al (1997), where the study present a technique different from the existing indicators developed by Dijk et al. (1992) and Mitchell (1996). The approach can be viewed as a "top-down" definition of sustainability indicators, i.e, the measurement is performed with respect to some global, predetermined level of sustainability, therefore corresponding to sufficient conditions for sustainability. The added advantage of the present methodology is that it considers all forms of environmental pressure on production system. The study uses a case study approach (a paper mill in Netherlands) to measure sustainability of a production system. It measures the sustainability of the paper production process, by gaining knowledge of the quantities in which the paper mill contributes to environmental problems.

To measure sustainability, the study uses an eight step methodology, mainly employing EUS (Environmental Utility Space). In the theoretical considerations and sustainability definition, the authors acknowledge the three pillars of sustainability[1], but mainly focus on the ecological dimension. The author highlights the argument that ecological sustainability is a prerequisite for social and economic sustainability: "the carrying capacity of the biosphere is limited and should not be exceeded by socioeconomic activities". Environmental utility space (EUS) refers to this notion. The case study

[1] The three pillars are into social, economic and ecological sustainability. Economic sustainability refers to growth and efficiency in the socioeconomic system. Social sustainability means social equity, justice and reducing social frictions.

indicates that the EUS can be used to measure the sustainability of spatial units of a production system. In this framework, sustainability is seen as a level of impact of socioeconomic activities on the environment. Therefore, in the case of a paper mill, the socio economic activity of consumption reflected in the usage of energy, resources, the output of white papers and the emissions to air and water among others are compared with (EUS) to create a a graphical representation of the paper mill's different impacts on the environment. The paper argues that the results could serve as a benchmark for corrective actions by producers, consumers and regulatory institutions.

Tyteca (1999) proposes firm level indicators for sustainable evaluation. The study is an empirical application of principles of productive efficiency framework to evaluate the indicators at firm level. Using the data by Fare and colleagues (1996) collected for U.S. electric utilities that use fossil fuels (coal, oil, and gas) and discharge sulphur dioxide, nitrogen oxides and carbon dioxide into the atmosphere, the study propose indicators for sustainable evaluation. Since the firm is a part of industrial subsystem, located in the economic system, which is located in the social system, which is located in the ecological system, they employ different forms of indicators namely; economic, social, ecological, economic-ecological and social-ecological indicators to understand the interrelations of the system. As firms uses resources to produce various desirable and undesirable products, avoiding inefficiencies in all the above mentioned system is required to promote sustainable production. The methodology primarily calculates several PEIs (Productive Efficiency Indicators) for power plant ranking, which cannot be equated with degrees of sustainability. Instead they suggest that a plant that is found to be less efficient than a second one will probably turn out to be less sustainable.

The methods proposed can be utilized for ranking of firms, which could indicate which firms perform better than others and which firms are the laggards. However, in this approach it is not possible to state whether a company is sustainable or not due to the lack of global sufficient conditions for measuring sustainability. For this purpose of ranking, model by Jaggi and Freedman (1992) is used where each variable is compared one by one to its best possible value among the observed set. Thus, the main interest of the indicators is to serve as a tool to detect where improvements can be made, which would help in improving an existing situation toward a more sustainable one.

Tyteca and Callens (1999) contribute to the literature by calculating indicators for the assessment of sustainability of business activities. The study acknowledges economic, social and environmental efficiency as a necessary (but not sufficient) step towards sustainability. In this back ground, the efficiency of each decision making units (DMU) are computed from a set of observed data, using mathematical programming techniques, resulting in DMUs that are 'efficient' and DMUs that are

'inefficient'. In order to cope with the multidimensionality of sustainability, indicators are built on both the concepts of cost-benefit analysis and the principles of productive efficiency. The inability of measuring some coefficients with no market value in the cost-benefit analysis has led to the development of productive efficiency analysis, namely the DEA approach. The study discusses three of DEA approach which incorporates social and environmental factors under three different perspectives.

The study suggests to base decisions not only on one unique, aggregate sustainability indicator, but also to develop two or three partial indicators that stress different aspects of the problem. It is argued that the proposed indicators could be used as an aid to detect so-called factors of unsustainability, and hence to provide for recommendations as to the regulations and incentives, or managerial practices, that will contribute to overall sustainability. Additionally, this could gain accuracy in the description of the situation, while providing the decision maker with the possibility of meaningful tradeoffs. The study additionally acknowledges that sustainability frontier is not static and should change with the additional knowledge incorporating new goals for future generations.

Bond et al (2001) conducts integrated impact assessment through three case studies which differ in their impact on socio-economic and environmental dimensions[2]. The case studies discuss regional development issues, including creation and implementation of policies, increasing investments in private sector and other goals. The aim of the study was on one hand to understand the various integrated impact assessment program and the main determining influences on these and on other hand to find methods to strengthen the approach. Given the different characteristics and objectives of these projects, the study acknowledges that no single integrated assessment program could be employed and all the three cases showed considerable variation right from the methods used in consultation and stakeholder participation. Thus, impact assessment techniques differed in each case and integration was a highly difficult issue.

Veleva and Ellenbecker (2001) present 22 indicators for sustainable production with a detailed guidance for their application. Based on the Lowell Center Indicator Framework, the authors suggest a new methodology of core and supplemental indicators for raising companies' awareness and measuring their progress toward sustainable production systems. The paper builds on the indicators developed by other groups and organizations, such as the GRI, WBCSD, CWRT, and ISO 14031, providing a detailed guidance on indicator calculation and use. The twenty-two core indicators are chosen to measure

[2] The projects include large-scale scheme to finance the installation of a hydropower facility at the existing dam in Mali and power distribution to three countries: Mali, Senegal and Mauritania. The second case is an Area-Based Growth with Equity (ABGEP) Programme in Sri Lanka with a goal to integrate the activities of government agencies, nongovernmental organizations (NGOs) and private sector over a five- year period. The third case study dealt with Acid Waters Problem Study in Wales, UK.

common issues for all production facilities, such as chemical releases, energy use, water use, hazardous and non-hazardous waste, work-related accidents and injuries, charitable contributions. Core indicators and supplemental indicators are given the same importance. An eight-step continuous-loop model for defining and measuring sustainability performance of companies is presented and provides a context for indicator implementation. The paper also explains the strengths and weaknesses of the methodology as well as recommendations for testing the indicators.

Steen and Borg (2002) estimated the cost of metal concentrates produced sustainably. The scope of study can be defined as estimating the sustainability of one of the business processes (metal extraction) not taking into account further processes, such as how the metal is used in the manufacturing of goods or how much of the metal is recycled and reused when the life cycle of the metal product ends. In their study, they explain what would the sustainable metal extraction procedure look like and estimate the price of metal, produced in such a sustainable way. Thus the study focuses on a specific industry – mining – and studies the possibilities of sustainable metal extraction comparing the sustainable metal extraction prices with the prices of metals in the market during the time of the research.

Clift (2003) reviews the development of indicators to reflect the three pillars of sustainability: economic, ecological and social, when applied to various levels including industrial sectors, companies and broad groups of products or services. The paper argues that indicators of environmental and economic performance are relatively well established, while indicators of social performance is more complex, particularly indicators to describe the social value of products and services. The indicators of economic and environmental performance can be combined to identify activities which are significantly less sustainable than the average of human economic activities. They can also be used to reveal unsustainability in supply chain. The reason for the absence of proper social indicators is the lack of public acceptance which is achieved through well-structured participatory decision processes. In short, the paper states that for indicators to be used effectively, it must be recognized that they will identify some economic activities which are so unsustainable that they must be discontinued.

Keeble et al. (2003) presented two case studies on the development of corporate sustainability indicators. The first case study employed a five-step approach to establish nine indicators to help measure corporate-wide sustainability performance focusing on the social and environmental performance of the organization. The second case study focused on the development of 69 sustainability indicators applicable to the project-level to assess the economic, social and environmental impacts. The indicators are build on 4 major pillars, the economic, social, environmental quality and use of natural resources. A Project Assessment Matrix was developed which would record

the scores for the project activities based on the direct and indirect economic, social and environmental impacts. A key benefit of the tool is that it can be used several times throughout the project lifecycle to assess impacts, inform decision-making and track progress. The case studies demonstrated the importance of encouraging debate within the organization on the indicators to employ, involving external stakeholders in the development of the indicators, and using existing standards as reference points (Keeble et al. 2003).

Kranjc and Glavic (2003) present indicators for assessing and promoting business sustainability. The study reviews the main concepts of production and a set of necessary conditions that firms must fulfill in order to be sustainable. It also identifies major functions of indicators and it proceeds to presenting the role of indicators which could be used as strategic metrics for assessing the sustainability level of a company. Indicators compress a large amount of information into a format that is easier to manipulate, compare and understand. Indicators in manufacturing are broadly classified into input and output indicators and they are based on commonly measured environmental aspects of sustainable production (energy use, materials use, water consumption, products, wastes, and air emissions). They argue that the methodology of creating indicators must overcome the subjectivity related to the choice of decision-makers in what to measure. Moreover, each indicator has to be considered on an individual basis to reflect specific characteristics of different companies. In this regard, a new approach to the systematization of indicators and their symbols and units is attempted.

Azapagic (2004) acknowledges the fact that sustainability assessment is more complex in mining sector. Following the findings of, Minerals and Sustainable Development (MMSD) project, this paper aims to contribute to these activities at the sectoral level, through a development of a framework for sustainability indicators as a tool for performance assessment and improvements. The indicators have been developed specifically for metallic, construction and industrial minerals. The framework comprises economic, environmental, social and integrated indicators, which can be used both internally, for identification of ‘hot spots’ and externally, for sustainability reporting and stakeholder engagement. In an attempt to help standardize corporate reports and enable cross-comparisons, the framework is compatible with the general indicators proposed by the Global Reporting Initiative (GRI); however, a number of sector-specific indicators have also been developed to reflect the characteristics of the industry.

Figge and Hahn (2004) proposed a new approach called sustainable value added to measure corporate contributions to sustainability. The study develops a more promising sustainable measure based on opportunity costs which shows how much more value is created when a company is more efficient than

a benchmark. In the earlier studies, approaches to measure corporate sustainable performance only took into account external costs caused by environmental and social damage or focused on the ratio between value creation and resource consumption. Besides the current method is argued to consider efficiency and effectiveness of all three dimensions of sustainability. Moreover compensation in this context is quite different idea as it refers to a purely allocative question and means paying other, less eco-efficient or social-efficient users of resources to reduce exactly the environmental and/or social impacts in question rather than paying the victims of some externality.

The method shows the amount of value created brings no additional impact on environmental and social sectors. However the author claims no empirical application. Theoretically, the concept of Sustainable Value Added could be empirically applied to observe, how much a company has contributed to more sustainability which is expressed in either economic, environmental or social terms. If expressed in economic terms, Sustainable Value Added expresses in absolute monetary terms the sustainable performance of the company relative to a benchmark.

Figge and Hahn (2005) tried to develop and apply a valuation methodology to calculate the cost of sustainability and the sustainable value creation of companies. The methodology understands the need of incorporating all sorts of capital rather than just economic capital and is heavily influenced by the concept of returns on capital in financial markets. The study considers capital costs as opportunity costs, and performs an extended application on all other forms of capital. The author further asserts that the methodology is suitable for the analysis of the sustainability performance of any form of economic activity or entity such as companies, regions, national economies, processes, or products. An empirical application is performed on British Petroleum (BP) for the time period of 2000-2001. The data to calculate BP's sustainable value, and thus contribution to sustainable development, consists of 2 economic, 6 ecological and 1 social indicator. Based on the performance data at the corporate and the benchmark level, sustainable value is calculated in the five steps[3]. The results of the calculations conclude that BP creates a sustainable value of − (minus) £72billion. The use of only two resources (economic capital and work accidents) contributes positively to sustainable value while the use of all other resources has a negative impact on sustainable value creation.

Hervani et al (2005) provides an overview of the various issues related to environmental (green) supply chain management performance measurement (GSCM/PMS). The study is based on experiences, case studies and other literature related to performance measurement in environmental supply chains. The authors seek to integrate works in supply chain management, environmental management, and

[3] For details See PP54 in Figg and Hahn (2005)

performance management into one framework. A systems framework forms the discussion outline with a focus on controls/pressures, inputs, tools, and outputs as major categories for evaluation and review. The major contribution of this paper, which is the introduction of various topics and concerns of GSCM/PMS ranging from the various internal/external pressures, types of metrics that need to be developed, potential designs of GSCM/PMS, as well as tools and results of a GSCM/PMS.

Kranjic and Glavic (2005) propose a new model namely, Composite Sustainable Development Index (I_{CSD}) to assess sustainable development at a company level by measuring the performance along all the three dimensions of sustainability – economic, environmental, and social. In the light of the complexity of using various indicators, the study develops the (I_{CSD}) by integrating three sustainability sub-indices which stress different aspects of sustainability. The sub-indices are finally merged into the overall sustainability index using specific weights of individual indicators. These indicators are normalized which acts as an overall indicator of a company performance helping in decision making in a significant manner. The model is empirically applied to a case study, where they study using the data of the company Henkel, from 1998-2003. The case study asserted the utility of I_{CSD} with its relevance for decision-making. The paper argues that the model offers a good starting point for research showing how different indicators could be compared when integrated into a composite index.

Labuschagne et al (2005) underlines the recognition of three pillars of sustainability into a company's operational practices. This study adopts a broader approach in defining the object of sustainability evaluation: it is named "business sustainability", which he refers as the "sustainability of operations in the manufacturing sector", "the assessment of the sustainability performances of technological developments during project management", "industry sustainability" (p. 374), "sustainability performances of a company and its operational activities", "projects that are undertaken in the process industry" (p. 384). The paper argues that this method is particularly applicable to assess projects that are undertaken in the process industry and even to assess the sustainability of products (in this case is a large petrochemical industry in South Africa) and is subjected to the same sustainability assessment process as in other cases. Although individual indicators may be similar, the overall set of indicators to assess company, project and technology sustainability would typically be dissimilar. A combination of monetary valuation and Multi-Criteria Decision Analysis (MCDA) techniques is further evaluated to integrate sustainability assessment results into decision making practices. However, the overall procedure (and subsequent indicators) would, most probably, be company specific in nature.

Different from above literature focusing on industrial sustainability, the study by Tae Ko (2005) tries to

develop a procedure for the assessment of tourism sustainability using different geographical backgrounds of 12 cases. The methodology is a combination of reductionist and holistic approaches which uses a wide set of methods and indicators right from the identification of systems to evaluation. Two important indicators are developed namely, 'Barometer of tourism sustainability' (BTS) and AMOEBA of tourism sustainability indicators' (ATSI) to assess the tourism sustainability. From the perspective of sustainability dimensions, the author distinguishes two systems: the human system and the ecosystem, and granulate them into further dimensions: human system dimensions further classified as political, economic, socio- cultural, production structure, and ecosystem dimensions into general environmental impacts, ecosystem quality, biodiversity, environmental policy and management. Thus, the BTS model represented a comprehensive level of tourism sustainability in a given destination, combining both human and natural indicators into an index without trading one off against the other. The ATSI model is introduced to complement the BTS analysis and to illustrate individual levels of sustainability of tourism indicators. When BTS and ATSI models are matched accordingly with Tourism Sustainability Assessment Maps (TSAM) it is argued to provide a comprehensive and individual level of sustainability in a tourist destination. Therefore, all the three broadly accepted dimensions (ecological, social and economic) are included and even further expanded in the proposed tourism sustainability assessment procedure.

De Jong (2006) argues that corporate sustainable development (CSD) can influence life sciences industry (LSI) to be more accountable on sustainability issues. The CSD method is argued to take care of the diverse understanding of stakeholders in sustainability issues in one hand, and the level of corporate commitment on sustainability and its performance on the other hand. In order to achieve this, the model uses a two -phased stakeholder-oriented evaluation method for evaluating CSD-strategies on specific sustainability issue. In other words, during the first phase, corporate commitment is challenged against the stakeholders' expectations, followed by evaluating the effective corporate performance against the corporate commitment by the stakeholder. The aim of the study is an opportunity to asses to what companies commit themselves, what they deliver and how this commitment and these deliverables are valued by the stakeholders. Four case studies from the Life Sciences industry in Basel, Switzerland, are used which focus on evaluation of pharmaceuticals in water, historical landfills, genetically modified (GMO's) and access to treatment. As discussed above this method of evaluation does not use indicators or indexes, or calculations, but studies and compares opinions of the corporations and their stakeholders. It uses interviews and other information sources, such as reports, websites, press releases, newspaper articles etc. Thus the study does not directly evaluate corporate

sustainability, but rather evaluates the perceptions of corporate sustainability among the stakeholders.

Lozano (2006) have adopted a new technique to focus on sustainability evaluation of Universities. From the perspective of business sustainability evaluation, the paper is of interest, as universities happen to be both public and private and hence, if a university operates as a private university, it could be considered a business entity, supplying educational services to the society for a payment.

In this study, the sustainable evaluation of university is performed incorporating the environmental dimensions of sustainability. Among the various methodologies, GRI guidelines was found and considered a better option due to the stakeholder approach and the higher number of indicators in the economic, environmental and social dimensions. However, for usage of GRI in education and research institutions, it requires modification and the current paper adds in this dimension. The tool named Graphical Assessment of Sustainability in Universities (GASU) uses graphs to facilitate comparisons of the university's efforts towards sustainability and helps in benchmarking to other universities. By grading each indicator of the GRI modification and scaling them, the study compares chart from one year to the next by which they could observe the evolution of their efforts towards sustainability over time.

Nordheim and Barrasso (2006) proposed a program on sustainable development for the European aluminum industry in 2001. As a first step, the paper tries to trace the development of a set of sustainable development (SD) indicators for the industry during 2001 and 2002 with both internal and external stakeholder groups. Using a survey data from all European plants producing alumina, primary aluminum, rolling ingots, extrusion ingots, foil and recycled aluminum, 34 indicators were developed. In the second stage, experience from stakeholder workshops were employed in the process of refining the indicator set in order to eliminate certain indicators and include others based on the discussion with stakeholders. The basis for the methodology for developing this set of indicators was the GRI guidelines. The paper used GRI guidelines which provide generally applicable indicators such as energy (joules) and materials (tonnes or kilograms) in order to derive at comparable and verifiable data. The guidelines also refer to qualitative characteristics for reports.

Sarmento et al (2006) evaluate the effectiveness of companies in implementing environmental strategies for a sustainable development, and consequently defines the sustainability concept used. The objective of the study is to identify and characterize groups of companies that share similar sustainable strategies implemented by their managers in the first step and secondly to understand the innovative practices followed by them. The research is based on a survey applied to a sample of 480 private potential polluting companies. The sustainable profiles were studied on the basis of ten clean

environmental strategies, implemented by a sample. Based on a survey, the database are processed and analyzed using multivariate statistic methods including the Likert scale where five levels are used to assess managers' valuation about the sustainable strategies that he implements. The data analysis reveals that most companies are innovating for reducing or eliminating pollution, some companies recycle the generated wastes during the production process, while some companies resort to the use of external equipment to minimize the environmental impacts. The study also suggest that large environmental efforts on innovation are positively related with company size.

Bebbington et al (2007) after acknowledging the limitations of cost-benefit analysis (CBA), propose a newer development in accounting discipline named the Sustainability Assessment Modelling (SAM), designed to support sustainable development decision-making and evaluation. This method is applied in UK and New Zealand in the fields of oil and energy generation, forestry, housing and other industries. SAM is applied at the project level and offers a way to understand impacts of all three dimensions of sustainability. According to the model, the impacts are categorized into four categories: the financial flows, usage of resources, environmental impacts and social impacts. The insights developed using the SAM approach is argued to help decision makers recognize in a better way the socially constructed nature of their understandings and expose the "hidden commitments" (values and assumptions) of traditional decision-making models. Thus by facilitating stakeholder dialogue, the study provides new measures of organizational performance which are more open and transparent.

Rusinko (2007) presents an exploratory study of the relationship between relationships between specific environmentally sustainable manufacturing practices, and competitive outcomes. The study utilizes the data from the entire U.S. commercial carpet industry where the respondents represent 84 percent of the market. They find that environmentally sustainable manufacturing practices like pollution prevention, product stewardship may be positively associated with competitive outcomes like reducing manufacturing cost and improving product quality. However, the study faces a limitation that it concentrates mostly on one dimension of sustainability, namely ecological dimension (with some aspects of economic benefits in the competitive advantages gained). The social dimension is lacking in the study.

Russell and Allwood (2007) evaluate the environmental impact of a product based on their study considering two products: namely high density polyethylene (HDPE) shopping bags and beds in Jamaica. The scope of the study is not on a company, but on a single product but through all its life cycle. To evaluate the impacts of a product on the environment, the study used Life Cycle Assessment (LCA) as a tool. Moreover, they developed different scenarios to be able to estimate whether local

production, recycling and local raw material extraction could change the products' impact on the environment. A scenario technique is employed, where three alternative production techniques are constructed for each product, which are then compared to existing supply chain. Since the authors do not consider other aspects (social and economic) of sustainability, the study cannot be called sustainability assessment study, but just an environmental assessment study.

Singh et al (2007) tried to develop indicators for sustainability assessment of steel industry in India. As integration of key sustainability indicators for decision making, they employ the method of composite indicators namely, Composite sustainability performance index (CSPI) to evaluate sustainable performance. Apart from the conventional three pillars of sustainability, organizational, governance and technical aspects have also been considered as fourth and fifth dimensions of sustainability. The paper also presents a conceptual decision model, using analytical hierarchy process (AHP) to assist in evaluating the impact of an organization's sustainability performance. AHP has been used to determine the weights at various levels. Sub-indices have been evaluated and aggregated to form CSPI. As argued in the study, this approach allows industry to identify opportunity for improvement and could also be used in bench marking exercise.

Hutchins and Sutherland (2008) measures sustainability at the company (corporation) level by exploring the sustainability practices and corporate social responsibility (CSR) policies which could influence the supply chains. The sustainability practices and CSR followed by individual corporation could significantly influence the supply chains as they are well interconnected. Therefore, the study considers both individual company and the companies of the supply chain in their analysis. The paper primarily reviews metrics, indicators, and frameworks of social impacts and initiatives relative to their ability to evaluate the social sustainability of supply chains. Utilizing the relationship between monetary activity and indicators of social sustainability on a national scale, it was observed that an individual corporate decision can affect national measures of sustainability. The study uses "supply chain sustainability index" which is developed from the indexes of companies in the supply chain as a measure. The study however faces the limitation that it partially encompasses environmental and economic dimensions.

Munoz et al. (2008) tries to distinguish whether companies that are more strategically committed to stakeholders show better social and financial performance. For this purpose, they devised different indexes to measure the commitment of stakeholders and its relationship between financial and social performance. The information is collected from the company publications and an index is created. This along with other indexes is finally compared with the financial and social information. By integrating

these three aspects, the paper tries to create a sole index using fuzzy logic to analyze the approach of organization towards sustainability. Using a sample of 52 Spanish firms, companies belonging to several sectors (eg. Petrol and power sector: 8 companies, consumer goods: 4 companies, financial services and real estate: 16 companies etc.), the study draws conclusions about the company and the sector performance at the same. Among them, technology and telecommunication sector stands out due to both its stakeholder orientation and its sustainability and strategic consistency. However the study has not employed any environmental information, and therefore lacks itself a complete sustainability approach.

Hubbard (2009) recognizes that measuring sustainable performance has to be conceptually based but simplified to be practically useful. It proposes a stakeholder-based, Sustainable Balanced Scorecard (SBSC) which is a conceptual framework coupled. The method widens the stakeholder base by adding factors specifically designed to capture a firm's social and environmental performance to create a Sustainable Balanced Scorecard (SBSC). Additionally, it develops an Organizational Sustainable Performance Index (OSPI), a single indicator that is invaluable for communicating organizational performance simply to non-expert, but nonetheless critical, stakeholders. The greatest advantage of SBSC is the simplicity and it can be easily understood by senior managers and analysts and will be more likely to be accepted as a performance measurement tool, much like the existing BSC. This approach could also be applied here. Additionally SBSC offers a high level, easy-to-communicate summary which is better than usual financial performance measures like balance sheets, profit and loss and cash flow statements. Similar to Hubbard (2009), Sardinha and Reijnders (2005) also used balanced scorecard format to evaluate the environmental and social performance evaluation of 13 companies operating in Portugal. The companies were categorized according to compliance with the law while emphasizing pollution control, pollution prevention or eco-efficiency. The paper using the thematic balanced scorecard format as a tool for analysis shows that different matters can be important at different intra-organizational levels in the company.

La Rovere et al (2009) proposed a methodology to analyze the sustainability of the expansion of electricity generation. They used data envelopment analysis (DEA), a linear programming tool that allows establishment of the relative efficiency of production units and their hierarchy. DEA is a multi-criteria analysis which can be used as an evaluation tool generally applied to situations which involves sector expansion. Indicators were developed encompassing four dimensions: environmental, social, economic and technological dimensions. For performing the DEA approach, the social and absolute indices were used as output and technological, economic and environmental index acts as inputs.

The study by Philips and Davis (2009) employs a multi-stage fuzzy reasoning model to assess a corporation's sustainability which divides Overall sustainability (OSUS) into two fundamental components: human and ecological. However the OSUS is a function of a large number of often ill-defined parameters, which are multifaceted and fraught with uncertainty and subjectivity, which makes it difficult to quantify these parameters on a common scale and to combine them in a meaningful mathematical way to compute sustainability. The fuzzy logic method solves this by normalizing value of the basic indicator and adding more weights to recent observations as they provide more information than past values. The component has up to four inputs: economic, political, knowledge, and welfare, while the ecological component consists of four inputs: air, water, land, and biodiversity. These 8 components[4] are analyzed by considering basic inputs suitable for evaluating a given corporation. A sensitivity analysis of the model reveals the important indicators affecting the corporate sustainability, and the areas where managers needs to tighten up. An empirical application is carried out on three large MNCs in the same industry.

Tseng et al. (2009) evaluates the performance of synthetic Sustainable Production Index (SPIs) by adopting fuzzy measure and Analytical Network Process (ANP) method in a multi-national equipment manufacturing firm. They focus their sustainability evaluation study on a company level, and at a factory level using the data from four production plants of these companies located in Taiwan and Philippines. The proposed model incorporates a hierarchical SPIs structure, fuzzy measure which is an effective method for weighting of candidate criteria from subjective judgment. The study later applies the ANP to the evaluation of 22 criteria under uncertainty. The expert group followed the application solution with the five-phase procedure. The indicators selected include all three sustainability dimensions, and are grouped into 5 groups: namely Energy and material for natural environment, Economic performance, Community development or social justice, Workers and Products, and criteria inside them.

Al-Sharrah et al (2010) proposed simple sustainable development indicators to be used in the planning of the petrochemical industry. In this study indicators cover the three aspects of sustainability-environmental, economic and safety, where they serve as a tool for assessing the performance of companies in decision-making and planning for the future. In this work, the petrochemical industry was structured for three sustainability objectives: minimum environmental effect, maximum economic gain and minimum operational risk. These sustainability indicators were used as objectives for a mixed-

[4] Air, Land, Water, Biodiversity, Policy, Wealth, Health and Knowhow

integer optimization model to plan the development of a typical petrochemical industry, and were found to be very useful in identifying a balanced petrochemical network. A sensitivity analysis using a simple Monte Carlo simulation showed that the model is able to accommodate variations in prices and demand.

Bojkovic et al. (2010) in their study focus on sustainability evaluation of one sector, namely, transport. The purpose of this study was to introduce a non compensatory analytical tool, which integrates multidimensional conditions present in the sustainability concept, which is called Elimination And Choice Corresponding to Reality (ELECTRE) method. Earlier, cross country evaluation has been performed mainly using sustainability metrics based on composite indices, which allow complete ranking of the countries. On the brighter side, the ELECTRE, possess the characteristic of non compensatory nature, which is of special importance for the sustainable and balanced development. The study use indicators, grouped according to three sustainability dimensions: economic, social and environmental and the method is applied in 10 countries. The results show that Slovakia, Turkey and Czech Republic provides the most sustainable transportation and the modified model of ELECTRE additionally adds Latvia to the existing group. The results are presented in a convenient graph form and then compared.

Chee Tahir and Darton (2010) presented a generalized model, namely, ‘‘The Process Analysis Method’’, for selecting indicators to measure business sustainability performance. The Process Analysis Method consists of 5 steps, starting with the in-depth review of the business operation. The second step is the definition of sustainability and deriving the business perspectives focusing on the major priorities implicit in the definition. Here, the major priorities set by the authors are on the following three domains: the environment, the economy and the domain of human/social capital. The impact on the above said three domains can be related to two business perspectives: (1) Resource efficiency, which measures the effectiveness of conversion of natural, financial, human and social capital; (2) Fairness in benefit which describes how fairly the benefits and disbenefits of changes in the three domains are distributed amongst stakeholders. The next step is defining the system boundary, which is governed by two factors: the spatial scale (scale of physical size of the system) and temporal scale (time scale of business operations). The fourth step is the sustainability framework consisting the methodology where the indicators and metrics are selected and designed. The final step is to verify and revise the indicators and metrics through fieldwork reviews and consultation with experts and stakeholders. The paper also presents a report on a case study on which this Process Analysis Method was applied to the oil palm fruit production business.

Fan et al (2010) presents an investigation of sustainable manufacturing indicators in both industry and academia. The study acknowledges the fact that a little consensus have been reached with respect to the measurement and definition of sustainable development especially on the economic and social dimension. The study tries to investigate current application status of sustainable indicators within U.S. manufacturing companies, and explore various views from academia in regards to weighting Economic / Social indicators through Analytic Hierarchy Process (AHP). The investigation of the indicators for measuring sustainable manufacturing in this research is conducted in forms of surveys. The industry survey and academia survey are analyzed separately in this research. For the industry survey, all nine managers collected and aggregated through averaging, while an academic survey response were analyzed using AHP software. The indicators are selected based on three criterions: Relevance, Analytical Soundness and measurability. The paper however warns that survey respondents may not be representative of average organizations, due to the limited resources and time largely affect the credibility of the investigation results. Most of the indicators included can be applied across industry, but they are not aimed at being uniformly applicable to all sectors. In short, the study calls for a comprehensive system to implement the indicators in manufacturing companies which could bring greater sustainability awareness, measurement and reporting.

Phillis (2010) in their review of sustainability assessment models, mention that some of the models discussed in their paper, can be used to assess corporate sustainability. Various quantitative approaches to study sustainability is employed, but due to the lack of conceptual and measurement understanding, they provide only rough estimates. One common characteristic of the models herein is their hierarchical nature that provides sustainability assessments for countries in a holistic way. They assert that the models fall in the System of Systems (SoS) category; and therefore cannot be just considered as simple indicators or measures. However, these models are not based on global models that can rank countries holistically, and such models exhibit a hierarchy, characteristic to system of systems. Among the various models like Eco-compass, Eco-indicator, COMPLEMENT and a couple of guidelines to assess corporate sustainability (CERES, GRI), the study proposes SAFE (Sustainability Assessment by Fuzzy Evaluation) model and a number of indicators to assess business sustainability. However, there is only few information on the model structure and evaluation of SAFE technique.

Summarizing the studies on measuring sustainability, we see that all the studies propose different indicators and methods for evaluating corporate sustainability. While most of the studies have tried to encompass the three pillars of sustainability, some studies have concentrated on the impact of environmental and social dimensions. All the studies have acknowledged the need for the calculation of

indicators and then evaluating the values of the indicators to reach possible conclusion about the sustainable aspect of each project.

5. Conclusions

Various studies employed different methods in approaching the problem of measuring corporate sustainability. While some literature specifically focused on a Balanced Scorecard approach to sustainability performance measurement (Dias-Sardinha and Reijnders 2005; Hubbard 2009), issues associated with the development of indicators relevant to supply chain management have been discussed by Clift (2003) and Hervani et al. (2005), among others.

The most important observation reviewing the existing literature is that there is no unique and comprehensive method for evaluating corporate sustainability and it differs from industry, sectors and is influenced by many factors. The differences in the model proposed by different studies varies from the selection of data, the creation of indicators, how they are grouped, normalized and calculated, how this indicators are used in methodologies to create several indices or other measurement techniques.

As the focus of the review was on the measures of sustainability evaluation at the company level, most of the reviewed papers were focused on this respect. Nevertheless, there are different approaches and attempts to evaluate sustainability of a broader level of a group of companies, companies in an industry or in a value chain, evaluating products or process sustainability, evaluation of industries and even universities.

In most of the reviewed studies, all three sustainability dimensions (ecologic, social and economic) have been analyzed, but the empirical studies sometimes have a narrower scope researching only one dimension. There were also studies, which had a different approach, defining two systems: the nature system, and the human system, and these were further divided. Nevertheless, these frameworks also encompass all the three dimensions, as the economic aspect is often included inside the social dimension.

As stated above, in order to assess the success or failure of a business unit's sustainability initiatives and whether or not it is making progress on its key economic, environmental, and social goals, there should be indicators developed which would incorporate the specificities of the business unit. Moreover, there is a need for an unique and comprehensive method for evaluating corporate sustainability of business units at least within the same sectors. There is a increasing demand among investors, communities and consumers of standardized sustainability indicators that allow comparisons between companies (Dow Jones Sustainability Group Index, 1999). There is growing need for further

research in this direction.

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