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Sustainability Assessment Framework: A Mini Review of Assessment Concept

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Sustainability assessment is viewed as a vital instrument to aid in the shift towards sustainability which is simply an appraisal method which integrates an iterative and pluralistic procedure. Sustainability assessment is viewed as a vital instrument to aid in the shift towards sustainability. Sustainability assessment is a rather complex appraisal technique conducted for supporting decision-making and policy in an extensive environmental, economic and social perspective. Sustainability assessment transcends a technical or scientific evaluation. Sustainability assessment tools are essentially a structured process encompassing different field-specific analytical methods and models. The growth of indicators in numerous fields has influenced sustainability assessment methodologies to a great extent. In general two broad approaches for sustainability can be distinguished, top-down and bottom-up. Despite the abundance and diversified procedures for evaluating sustainability, indicators based assessment is one of the most widely used platform. Many parties feel that the presence of conceptual inconsistencies and the absence of operational definitions have hampered attempts to appraise, let alone achieve, sustainability. Assessing the sustainability assessment schemes in a quantitative manner requires the identification and integration of diverse phenomena or indicators, in a framework consistent with the evolving concept of sustainability. In fact, integration of indicators for sustainability assessment, have been at the forefront of various political, academic and scientific researches. Existing sustainability assessments schemes typically provide interpretation in the form of comparative value analysis where impacts are scored based on pre-set values, utility analysis where impacts are ranked on a uniform scale and weighted, cost-benefit analysis where positive and negative impacts are apportioned to monetary values, multi-criteria analysis where quantitative as well as qualitative impacts are scaled on pre-set criteria or risk assessment where degrees in risk reduction is identified relative to pre-set risk thresholds. Consequently, the paper that follows provides an integrative analysis of existing sustainability assessment approaches. Such review not only offers a very valuable insight on the features of existing sustainability assessment schemes, but also highlighting gaps to a certain extent.

1. Introduction

This review examines existing assessment schemes that help in tracking and benchmarking environmental performance (Hubbard, 2009). This review is not intended to evaluate the best or point out the weaknesses of these schemes, but rather to compare the main features of each of the schemes. The scope of the review that follows is limited to the integration in manufacturing processes, even though the evaluation of the existing indicators sets are very relatable to other businesses as well. In addition, emphasis is put on the environmental pillar of sustainability. The sustainable production proposition has increasing gain attention and is now a key component of business strategies. Therefore, meaningful data on production system and current performance is needed to drive this notion. The demand for a metrics or index is grounded on the notion that "what you don't measure, you can't manage" (OECD, 2010).
The administration of a multi-faceted issue such as environmental sustainability calls for a systematic management and representation in a simple manner that enables objective driven decision making (Stockle et al., 1994). This condensed data is regarded as indicators. Indicators provide the flexibility to set target and subsequently track their progress (Daly, 2006). Indicators are capable to go beyond the role as simple information and represent trends and cause-effect interaction between various situations (Ahlroth et al., 2011).

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Indicators are also capable to raise alertness and appreciativeness by setting baseline and current performance of an entity. Many organizations integrate a number of parameters and indicators and apply these as a set for ease of execution. The categories outlined in Figure 1 were identified on the basis of multitude sets of indicators which encompasses all kinds of metrics application (Angelakoglou and Gaidajis, 2015). The following categorization centers on the techniques organization consolidate data and how these various sets of indicator are distinguished from one another based upon their features.

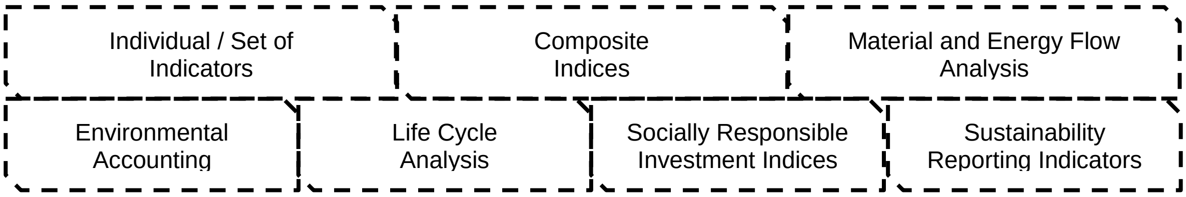

Figure 1: Sustainability Assessment Schemes Classification (Angelakoglou and Gaidajis, 2015)

2. Methodology

Primarily, an integrated approach using multi-criteria analysis with indicators/indices is selected. Each principle is aggregated into key performance indicators called as criteria which further describe key impact areas of each principle with respect to palm oil production that could foster or impede the attainment of each sustainability goal. This requires a comprehensive review on palm oil estate and management to understand the current practices in palm oil industry (Thomé and Scavarda., 2015). The generic process of crude palm oil production will be studied to understand the nature of the process. In addition, stages which are at risk of environmental issues are determined along with the types of discharge and emission from the manufacturing process. Subsequently, the filtered criteria are re-categorised and refined to enable quantitative measurement and easy application. One key step would be to normalize or standardize the criteria to allow all of the data into proportion with one another for ease of comparing and also reflect meaningful relative activity between each variable. Thus, the index can be computed establishing an environmental sustainability index profiling mechanism. An extended analysis would include setting of threshold value simply defined as the minimal level of acceptable performance. This is done by benchmarking mainly to regulations and industry best practices. Finally, the weak areas can be identified and appropriate actions can be taken to address the prevailing issues.

3. Sustainability assessment schemes in manufacturing industry

3.1 Individual indicators

Individual indicators are used in measuring single items. A set of individual indicators is basically a simple collation of single indicators which measure the diverse features of sustainability. This set of individual indicators is capable of measuring sustainability both quantitatively and qualitatively by using standard units and descriptions. Examples of individual measurements are water usage amount, waste generation and energy consumption (OECD, 2010). Each individual indicator is independent and therefor benchmarked separately. Sets of individual indicator are usually the preliminary stage in developing robust sustainability indicators. There is no restriction on the number of individual indicators that can be used in measuring sustainability. However, noting the fact that the process of collecting data for a wide range of components can be rather resource intensive, organization tend to limited the number of individual indicators referred to as the core or minimum set of indicators. One prominent drawback of individual indicators does not serve in comparability activity since they are entity centric. Each organization has the flexibility to customize the individual indicators to suit their needs (OECD, 2010). Individual indicators are best used for internal assessment purposes. From the decision making perspective, individual indicators does not give the performance overview as a whole which does not shows any form of linkage or trade-off between other factors. As a variety of data of presented independently, improvement in one factor may probably result in deterioration in another factor making improvement activities difficult. Examples of individual indicators schemes used in manufacturing industries are IChemE Sustainable Development Progress Metrics, Indicators of Sustainable Development for Industry, Indicators of Sustainable Production (ISP), Sustainability Reporting, Guidelines Sustainability Assessment Framework for Industries and Wuppertal Sustainability Indicators (WSI).

3.2 Composite indices

Composite indices operate by synthesizing clusters of individual indicators both qualitative and quantitative to describe an intricate state by means of a restricted number of indices. Composite indices are very useful to explain vast information in a simple comprehensible mode to stakeholders. This method also assists in understanding and comparison of relative condition given the restriction in number of statistics used and capability to present the summary indices. A crucial step in implementing this assessment technique is the need to standardize variables to permit comparison as more often than not the variables exist in various different units. Besides, there is a need to assign weightage to the sub-indices to generate a fair representation of the impact of the diverse sustainability elements. Nevertheless, weightage allocation requires an extensive insight on the industry which is commonly done by consulting experts or negotiation among similar organization to arrive to a consensus (OECD, 2010). This process may lead to conflict particularly in convincing entities throughout the supply chain to adopt the same principle. From decision making standpoint, composite indices are extremely useful because information from several aspects are aggregated and simplified enabling easy interpretation. The risk of using composite indices is misinterpretation of data as each sub-indices may have their own scope and limitation, is not reflective of the actual situation arising from gaps in the raw data as well as the way indicators are picked and weighted (OECD, 2010). Example of composite indices scheme (Angelakoglou and Gaidajis, 2015) used in the manufacturing environment are BASF Method, Composite Sustainability Performance Index (CSPI), Compass Index of Sustainability (COMPASS), Organizational Sustainability Performance Index (OSPI), Compliment Index (COMPLIMENT), Quantitative Assessment of Sustainability Indices (QASI), Index of Sustainable Performance (SP Index) and Sustainable Environmental Performance Index (SEPI).

3.3 Material and energy flow analysis

Material flow analysis method in simple term is the mechanism of accounting for resources input and output (Brown and Herendeen, 1996). The consumption of materials has been on the rose for the past decade globally which raised concerns of natural resources shortage, energy security and eventually environmental impact. Material flow analysis is a subset of material balance analysis with the objective to monitor the movement of materials and environmental impact at each step from cradle-to grave beginning from extraction all the way to disposal through manufacturing, use in product including recycle all the way to disposal (OECD, 2010). A prominent feature of the material flow analysis is the ability to focus on the entire sector, organization or individual material, product and even specific substances (Brunner and Rechberger, 2004). This analysis operates on the basis that material throughput is necessary in all economic activities and assesses the movement of materials is sustainable with respect to the environmental burden it generates. The material flow analysis takes into account all material as well as energy used during production and consumption which includes hidden flows of materials that gets extracted during production but do not end up in the final product. In essence, there’s two parts to the material flow analysis. First, the material flow accounting system where materials are quantitatively represented in physical units with the purpose of describing material flow as extraction, production, conversion, consumption, recycling and disposal (as waste, emission to air or discharge to water). This accounting system consists of inputs, outputs and build-up in material stocks. Second, material flow indicators resultant from these accounts (direct material input, total material requirement, total material consumption) delivers policy related information to non-expert audiences on the prominence of material flows in relation to economic and environmental matters. The physical balance of inputs and outputs is progressively used in environmental performance reports as it offers extensive information for environmental management. It also helps in tracking developments in resource productivity and environmental performance at large. A disadvantage of the material flow analysis is the identification of waste which is conventionally unaccounted for. Some examples of material flow analysis schemes in the manufacturing field (Angelakoglou and Gaidajis, 2015) are Ecological Footprint, Water Footprint, Substance Flow Analysis (SFA), Sustainable Process Index (SPI) and Material Inputs per Service and Ecological Rucksack (MIPS). Similarly, the energy flow analysis applies the exactly same concept as the material flow analysis by looking at the energy input and output instead. The energy flow analysis is implemented and interpreted in the same manner as the previous analysis. Examples of energy flow analysis (Angelakoglou and Gaidajis, 2015) are Cumulative Energy/Energy Demand, Energy Analysis, Exergy Analysis and Embodied Energy.

3.4 Environmental accounting

Environmental accounting can be summarized as assessing the profitability of environmental investment. Environmental accounting incorporates the mechanism of standard financial accounting system (Brown and Herendeen, 1996). It is a structured method to evaluate vital environmental factors. At its simplest, this method ensures environmental related costs are more transparent and visible in accounting systems and reporting (Jasch, 2003). At the same time, it measures the impact of the cost both investment and expense made with regards to environmental conservation. Environmental accounting is widely incorporated at decision making level to link environmental matters to financial cost accounting which leads to evaluating prospective balance between environmental protection and financial lucrativeness (OECD, 2010). A weakness of this environmental accounting technique is the vagueness and subjectivity of classifying production associated environmental costs. This results in some costs to fall into the grey zone or sometimes grouped as partly environment. Costs which are definite environmental costs include cost incurred in complying with environmental policy, costs for environmental remediation and pollution control device while cost that fall into the grey zone include costs of production equipment that could be regarded as environmental cost given that the equipment is part of clean/green technology (OECD, 2010). This detail on whether a cost is categorized environmental or not is crucial when it comes to comparing performance externally. Hence, in the event environmental accounting is to be used for external benchmarking, serious attention is to be given to the comparability in designing environmental accounting data. This scheme is very beneficial in decision making process as it focuses on the area of interest-cost computation- and delivers outcomes in simple monetary terms. Examples of environmental accounting schemes (Angelakoglou and Gaidajis, 2015) are Cost Benefit Analysis, Contingent Valuation Method, Total Cost Assessment, Material Flow Cost Accounting and Environmental Management Accounting.

3.5 Life cycle analysis

Life cycle analysis embraces the cradle-to-grave management model. In other words, this analysis is defined as a study of the environmental features and prospective influences of a product, process or service throughout the its life cycle, beginning from raw material acquisition all the way to disposal covering manufacturing, use and transport (Finkbeiner et al., 2010). A highlight of the Life Cycle Analysis is its capability in examining a single product, a material, cluster of materials and services along the life cycle both qualitatively and quantitatively. Life Cycle Analysis is primarily used to associate products with comparable functions or to define 'hot spots' in the life cycle which are prominent to the overall environmental impact (OECD, 2010). It is possible to locate the stages of the manufacturing processes with the prevalent impact and thus improve them. A value added aspect of Life Cycle Analysis is that it takes into consideration 'hidden' flows namely fossil fuels used in production and transport which is also part of the product's overall impact on the environment, rather than only prioritizing the materials flows mobilized in the course of manufacturing. This analysis helps organization to consider the manufacturing process from the sustainability point of view by means of incorporating eco-design objectives to encourage the development of products or services are designed in a way that will cause very minimal damage to the ecosystem over the life cycle. The outcome of the life cycle analysis can be certainly used for comparison of environmental impact over the entire life cycle along with accompanying emission and energy consumption (Deutsch et al., 2013). Comparison is made easy as the outcome of the Life Cycle Analysis is presented in comparable unit such as the most commonly used kg CO_2-equivalent (Carvalho et al., 2014). Nonetheless, there has been a challenge in setting consistent system boundaries to permit fair comparison specifically for complex supply chains. Industries tend to have different system boundaries assigned to fit their individual needs. Above all, life cycle analysis does not only help industry players in making informed decisions but at the same time delivers meaningful message across to end users. Many products now display eco-labels as an approach to reveal the environmental impact associated with the product or service which will benefit consumers in purchasing decisions. Examples of Life Cycle Analysis schemes (Angelakoglou and Gaidajis, 2015) are Carbon Footprint, Life Cycle Sustainability Dashboard, EDIP 2003, TRACI, IMPACT 2002+, Bridges to Sustainability Framework, LIME and ReCiPe.

3.6 Socially responsible investment indices

Socially responsible investment is used to benchmark performance in financial markets. It refers to an investment strategy that strives to get the most out of financial return, social and environmental good simultaneously. The socially responsible investment indices are generic, composite index entailing quantitative and qualitative indicators. The methodology clearly mirrors the criteria of investors in expanding the market in terms of economic, social and environmental sustainability. The socially responsible investment functions to scrutinize and appraise organizations for particular groups of financial investors based on pre-set criteria. Conventionally, the indices were grounded on negative selection criteria which simply means investment was avoided in detrimental fields, but recently a new approach of 'positive screening' came about which looks for best practices among competing entities to inspire them to improve their performance via benchmarking (OECD, 2010). The criteria of the socially responsible investment have a rather strong influence on the sustainability aspects as they are regularly surveyed by rating bodies which permits effective comparison between competing organizations that indirectly influence investors'' choices. However, this scheme is usually applied by large-scaled companies. By assimilating the sustainability factors in developing business strategies, organizations are bound to focus on long term worth which is am added advantage of this scheme. Examples of such scheme (Angelakoglou and Gaidajis, 2015) are Dow Jones Sustainability Index, FTSE4Good Index and OEKOM Corporate Rating.

3.7 Sustainability reporting indicators

Socially responsible investment indices are sets of indicators predominantly serves the purpose of informing stakeholders on the performance of the three pillars of sustainability. It summarizes the economic, environmental and social activities and their progress for a wide range of institutional or geographical entities regardless of level (OECD, 2010). Organization can opt to use the socially responsible investment indices to pinpoint and manage risks and opportunities which are non-financial and intangible (OECD, 2010). This scheme allows organization to present collected data in an organized manner in sustainability reports coupled with mission, governance and management system with regards to sustainability. Conversely, since the indices are defined by external parties, they are very unlikely to be applied internally for organization to monitor or advance their production processes or services at operational level. Nor it is projected for data aggregation and standardization. Although sustainable reporting indicators were initially designed for external disclosure, it also a starting point for data collection and monitoring progress internally. A comprehensive reporting enables organization to deliver their vision and mission in addressing economic, environmental and social challenges by showing the steps taken to reduce risks and seize opportunities. An important point to note is that consistent boundaries must be defined to not only ensure efficient data aggregation and standardization, but also avoid double counting. Sustainable reporting itself does not contribute to the effort of identifying innovative products as it only aims to provide data on high level corporate performance. Commonly used sustainable reporting indicators are Global Reporting Initiative and International Council on Mining and Metals (Fernandes et al., 2013).

4. Future work

Existing sustainability certification schemes that include various assessment methodologies have not adequately addressed the central idea of sustainability due to the use of ambiguous, vague or unmeasurable criteria. The criteria do not contribute in focusing and clarifying what exactly needs to be measured and also what to expect from the measurement. The indicators and criteria in place at the moment are very subjective, thus gives room for different interpretation. Realising the need that these indicators could play an important role in helping countries in making informed decisions concerning sustainable development, the criteria and indicators used currently particularly the widely accepted RSPO does not help to simplify and aggregate information for policy makers. It is beneficial for sustainable assessments to provide a calibrated progress towards sustainable development goals (Atkisson and Hatcher, 2001). Furthermore, readily available sustainable assessments do not provide early warning to mitigate setbacks. Noting this fact, a more holistic and comprehensive sustainability framework with focus on environmental aspect would bring about a different perspective to the palm oil industry, serving as a more pragmatic scheme of modelling, measuring and reporting a wide range of indicators linked to the whole manufacturing supply chain. A tool to facilitate quantitative comparison of sustainability performance with the objective of enhancing environmental conditions needs to be developed in a manner that it can be easily replicable for use by other stakeholders within the industry regardless of magnitude (Siche et al., 2008).

5. Conclusion

Manufacturing industries attempt to generate meaningful information on their sustainability performance due to the increasing acceptance among stakeholders on the fact that sustainability measurement can lead to better decision making (Ekins, 2011). The growing demand for interpretable information has been the ultimate driving force behind the development of sustainability measurement and management (Brundtland, 1987). One of the greatest challenges is to establish a consistent measurement technique. Information demand varies with time resulting in fragmented use of conceptual approaches and operational framework. There is never an ideal indicator set as each assessment scheme has its own strong suit and shortcomings (Hák et al., 2007). Many organizations use more than one sustainability assessment schemes at the same time as the structure and scope of application differ, even though they are often not comparable. In practical, sustainability indicators should assist in decision making and improving production activities or services (Sands and Podmore, 2000). A major barrier to the adoption of indicators is the lack of clarity on what data needs to be measured. To summarize, sustainability assessment schemes should be able to fulfill six main intents- external comparability for benchmarking, applicability to organization irrespective of scale, contributes to decision making, effective in driving improvement at operational level, enables information aggregation and standardization and finally a guide in discovery of innovative products or services.

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