



Sustainability Assessment for Small and Medium Enterprise (SMEs) by Using Fuzzy Logic Approach: A Direction and Further Research

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DOI: <https://doi.org/10.30880/ijie.2021.13.02.002>

Received 9 June 2020; Accepted 1 December 2020; Available online 28 February 2021

Abstract: Sustainability assessment have been studied by several researchers focusing to determine set of criteria on case studies selected. However, only few studies have been done on assessing the sustainability of SMEs in Malaysia. Although there are several studies on sustainability assessment for manufacturing company in Malaysia, they do not provide a comprehensive study that including all Triple Bottom Line (TBL) perspectives. To fill this gap, this study will propose a comprehensive framework for assessing sustainability among SMEs that including all TBL perspectives, which is covering environmental, economy and social aspects in sustainability assessment. Primary and secondary data will be used in this study. For primary data, Delphi study will be conducted to obtain the reliable data. Next, fuzzy inference system (FIS) will be applied in this study as methodology for integrating collected data. As for secondary data, literature review from previous current research work will be summarize for comparison purpose. This study is expected to guide SMEs towards sustainability as well as increase awareness hence to promote a serious path towards a more sustainable business model. In regards, Malaysia Government can monitor the sustainability level among SMEs which is have linked with the Malaysia regulations.

Keywords: Sustainability, TBL, Fuzzy Logic Approach

1. Introduction

The concept of sustainability is very wide covering triple bottom line (TBL) perspective namely environment, economy and society. Several researchers expanded the sustainability assessment study by proposing tools or framework for assessing the sustainability focused on general product or services [1–7]. Several frameworks were developed for monitoring the various sustainability indicators for assessing performance of governmental progress [8]

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and process industry [9-11]. There are studies focus on sustainability assessment for SMEs focusing IN Regional Australia [11,12], and Region on Central Europe [13, 14]. However, optimal decision can only be made when all TBL aspects are all considered in one model [15].

Previous study on sustainability assessment of SMEs in regions of Central Europe [14]. They presented an approach for assessing the sustainability of SMEs, together with resulting normalized quantitative indicators. The tool presented enables the evaluation of energy and environmental performance of SMEs. According to study on 2013, appropriate ICT tools for assessing energy efficiency in SMEs is needed for widely used. However, this research lack of another two important sustainability criteria which is, economy and social aspects [16]. In Australia, SMEs are playing an ever-increasing role in the national and regional economy. Australia Bureau of Statistic in 2011 stated that Australian small firms constitute 95% of all businesses in services and industry in Australia [17]. Hence it is obviously shows that the potential environmental and social impacts of the small firms should not be underestimate. A previous study on sustainability assessment for SMEs by developing a framework of analysis. The framework developed takes into consideration the internal and external factors for matching with sustainability principle in Australia [18]. Here, the sustainability principle is not referring to TBL aspects. However, this study focusing more on internal factors such performance, employees and managers and external factors such government, customers and stakeholders, which is reflects more to social-sustainability (one of the TBL aspects).

Although there are some studies on indicator development for SMEs such as development of environmental to assess the environmental performance of SMEs, but performance assessment perspectives considering all TBLs aspect is still missing [19,20]. In Malaysia, little study had been done on sustainability assessment for SMEs [21], most of the previous researchers focus on certain manufacturing company [22]. This study is an attempt to full fill these research gap by developing a comprehensive framework for assessing the sustainability considering all TBLs aspects by using Artificial Intelligence (AI) system.

2. Literature Review

The theory of sustainability assessment is largely discussed by scientists. Sustainability assessment is defined as a process of evaluating the implications of an initiative on sustainability [23]. In this case, initiative can be described as a proposed activity, plan, program, or system. Assessment of sustainability could potentially be applied in a range of different conditions or circumstances. Sustainability assessment reveals that sustainability is a social state with a particular characteristic or condition, which is defined by sustainability parameters. However, determining parameters depends on different conditions, such as types of case studies, to obtain satisfactory results. The most important criteria discussed entirely in this study are the three pillars of sustainability assessment known as TBL. The TBL approach for sustainability assessment is wide. The three pillars consist of environmental, social, and economic criteria. However, conflicts arise among the three pillars of sustainability assessment. The conflict concerns the integration of all the criteria mentioned. According to previous research work, sustainability assessment deals with life cycle sustainability assessment (LCSA), life cycle costing (LCC), and social life cycle assessment (SLCA), which have to be conducted separately [24]. The concept features consider life cycle approach from LCA to LCSA.

By contrast, authors [25] and [6] stated that sustainability assessment should be depicted as one solution rather than as separate assessments among the three-pillar criteria. Moreover, separate assessment makes the three pillar criteria a poorly interrelated sustainability problem, which demands response that seeks the relation of the features. Sustainability assessment emphasizes making trade-offs or balancing each criterion. However, assessment of sustainability depends on the factors to be assessed, such as product or system relation, services, organization, and others. The process depends on the objective of the sustainability assessment itself. The parameters involved for sustainability assessment should be explained clearly. Furthermore, the selected system boundary plays an important role in developing sustainability assessment.

Larger organization are adopting various sustainability strategies in their manufacturing operations due to pressures from consumers, regulators and community [26]. In addition, in order to achieve better supply chain performance in term of sustainability, larger enterprise extend these practices to their suppliers [21]. SMEs constitute around 80% of suppliers [12, 27]. In Malaysia, contribution of SMEs to gross domestic product (GDP) is 41% and provides employment to 57.4% of Nation workforce [28]. It is showing that the majority of the manufacturing SMEs are the supplier for multi-national companies in their global supply chain. Therefore, SMEs under the increasing pressure to improve their sustainability level. The lack of sustainability efforts in SMEs attributed due to characteristic of SMEs [21]. SMEs often lack the awareness, expertise, skills, finance and human resources to build the required changes for sustainability within the organization [21, 29, 30]. Hence, authors [31] identified the drivers for sustainability which is customers, government, local community employees, insurers, banks and larger companies. Thus, the idea for proposing a framework, so that SMEs and Malaysia Government can be monitoring their level of sustainability can be seen as 'bridge' to solve the problem.

Previously, several sustainability assessment frameworks developed for assessing the sustainability for different type of case study. Table 1 summarizes the various sustainability evaluation methods. Most of the framework focus on general product [1,2,5,32-38], specific product [39-41], governmental usage for general services [8-9], process and operations [10, 42-43], and SMEs [14, 21]. Various type of frameworks proposed previously depending on the purpose

of its development. However, the success of the assessment method also depends on the selection of appropriate set of parameters. Parameters with its set of criteria should be simple and robust, reproducible and consistent, cost-effective in data collection, complement regulatory requirement and coherent with organization's vision [21]. From this study, parameters with its criteria will be determined based on primary and secondary data that will be collected. Considering environmental, economy and social aspects, sustainability assessment frameworks and methods are still evolving.

Table 1 - An example of a table

References	Focus		Sustainability elements consideration		
	Product	Services	Environment	Economic	Social
Cantele et al., (2018)		√	√		
Kumar and Prakash (2018)		√	√		√
Salimzadeh (2016)		√			√
ProSET (Hassan et al., 2016)	√		√	√	√
Mahmood et al., (2016)	√		√	√	√
Ramli et al.,(2015)	√		√	√	√
Vinodh et al., (2014)	√		√		
Fargnoli et al., (2014)	√		√	√	√
Pusnik et al., (2016)		√	√	√	√
UNCSD Framework (UNCSD, 2001)		√	√	√	√
Hermdi et al., (2013)	√		√	√	√
Lindow et al.,(2013)	√		√	√	√
Tseng et al. (2012)	√		√		√
Russo (2011)	√		√		
Kengpol and Boonkanit (2011)	√		√		√
Life Cycle Index (LinX) (2006)	√		√	√	√
Ten Golden Rules (Khan et al., 2004)	√		√		
Global Report Initiatives (ICheme, 2002)		√	√	√	√
Lowell Centre for Sustainable Production (Greiner, 2001)		√	√		
Wuppertal Sustainable Framework (UNCSD, 2001)		√	√	√	√
EcoIndicator95 (1995)	√		√		
EcoIndicator99 (1999)	√		√		

3. Proposed Methodology

In order to propose a framework for assessing the sustainability among SMEs, researchers first need to understand the current issues regarding on the sustainability assessment. Currently, no frameworks proposed to assess the sustainability for SMEs in Malaysia. The next stage is review and summarize the current sustainability assessment approach for SMEs in other region. There are several studies conducted by previous researchers for another region on sustainability assessment for SME. However, there are no comprehensive frameworks proposed for assessing the sustainability among SMEs covering all TBLs aspects namely environmental, economy and social. Therefore, review stage is very important to summarize and compare the current study. Comparison of each study is important to differentiate the parameters considering the geography, climate change, peoples, regulations and others.

Data need to be collected by distributing a set of questionnaire to academicians, Malaysia Government representatives, practitioners from industries especially SMEs by conducting a Delphi Study. This Delphi Study will help on the data collection for determination of parameters for each TBL aspects and their set of criteria. In order to obtain the reliable data, respondents will be select carefully based on their background. Next step is proposed a framework for assessing the sustainability among SMEs by integrating Artificial Intelligence element by using fuzzy inference system (FIS). It is acknowledging that FIS in the fuzzy logic approach is a suitable as a convenient way to map an input space to an output space by using of codification of common sense. Input space from the previous statement refers to parameter determined for each TBLs aspects, while output space refers to result in term of score or

index for sustainability assessment. FIS is an operator to mapping input to an output. FIS is operated by using Matlab Software [44].

4. Research Direction

This study proposes a framework for assessing the sustainability among SMEs in Malaysia. The result of this study will identify the level of sustainability of SMEs in term of index or scoring system. Previously, no framework proposed to assess the sustainability of SMEs in Malaysia. Determination of the parameters is unique since it covers all TBLs aspects (environment, economy and social). Most of the previous research works focus on certain element especially on environmental element without consider another important element in sustainability perspective, which is economy and social. The proposed framework integrating with AI, which is FIS operated by using Matlab Software. It is expected that the framework proposed can help Malaysian Government to strengthen the regulation regarding on sustainability. In addition, by implementing the proposed framework, it can be emphasizing SMEs for healthy competition by achieving good sustainability rank. Appendix A shows the example of proposed methodology considering all triple bottom line in the framework constructed.

5. Conclusion

This paper is aimed to propose the research direction for assessing the sustainability of SMEs as a whole. While literature on sustainability assessment for industry is plenteous and growing, only few studies have explored to cover for SMEs. In addition, most of the previous research work focusing on certain aspects such environmental aspects only.

Acknowledgement

Tier 1 Vot H250 from Universiti Tun Hussein Onn Malaysia.

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Appendix A: An example of proposed methodology considering triple bottom line (TBL)

