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# ASSESSING SUSTAINABILITY FRAMEWORK OF AUTOMOTIVE-RELATED INDUSTRY IN THE MALAYSIACONTEXT BASED ON GPM P5 STANDARD

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**ABSTRACT**

Corporate sustainability starts with a company's value system and a principled approach to doing business. This means operating in ways that, at a minimum, meet fundamental responsibilities in the areas of human rights, labour, environment and anti-corruption. Over the years, national and international efforts to identify an appropriate sustainability indicator have been consistent. However, such efforts to assess sustainability with regards to the principles derived in UN Global Compact initiative are not known in the context of automotive-related industries in Malaysia. Due to that, the level of corporate sustainability awareness and development of tools to manage, monitor and improve the sustainability performance at all stages of the decision making process is yet to be explored. In this study, the Green Project Management (GPM) P5 Integration Matrix is used to understand the perception of Malaysian consumers towards companies which practice sustainability as part of their business culture. This study will provide guidelines to the R&D engineers and project managers to incorporate sustainability assessment as part of their product development phases.

**Keywords:** sustainability assessment, green project management, P5 Integration matrix, UN global compact.

## INTRODUCTION

### UN global compact

'Earth provides enough to satisfy every man's need, but not everyman's greed' (Mahatma Gandhi). Indeed the word sustainability is about balancing or harmonizing social, environmental and economical interests is it short term or long term, locally and globally, consuming income not capital, reflects transparency and accountability and practiced with good personal values and high ethics [1]. In 1992, the global leaders have met in the UN Conference on Environment and Development or better known as the Earth Summit to develop Agenda 21, a comprehensive plan of action toward sustainable development to be executed globally. However only in 2000, the UN Global Compact was launched as both a policy platform and a practical framework for companies that are committed to sustainability and responsible business practices [2]. The UN Global Compact is the largest corporate citizenship and sustainability initiative in the world. Its members support Millenium Development Goals of which ensuring environmental sustainability is one of the goals. The UN Global Compact asks companies to embrace, support and enact, within their sphere of influence, a set of core values in the areas of human rights, labour standards, the environment and anti-corruption. Recently in 2012, 20 years after the Earth Summit, governments , NGOs, and businesses came together in Rio, Brazil for Rio+20 in which the theme encompass building the green economy and how to improve international coordination for sustainable development [3].

### P5 integration matrix

The engineering problem associated with the sustainability assessment is the shortcoming of sustainability measurement tools and frameworks. So far sustainability measurement tools and frameworks are focus on environmental and governance aspects. However, based on GPM P5 standard, we need to consider profit, planet and people alongside with the other two integrated elements, i.e. product and process. In this study, such assessment approach is to be explored in the area of automotive-related industries in the context of Malaysian business.

This research proposal attempts to provide guidelines to the R and D engineers and project managers to incorporate sustainability assessment as part of their product development phases. It is hypothesized that the higher amount of practice according to GPM P5 standard will increase the business longevity and profitability. This is based on the assumption that Malaysian society more attracted to consume products from companies that contribute to the sustainability of mother earth on top of their profit interest.

Are Malaysians concerned about the environmental, governance and people oriented company? What is our automotive-related industries status in the context of sustainability (in the context of Malaysia industries)?

## LITRATURE REVIEWS

Several tools for sustainability evaluation have been developed, such as LCA, Eco-Indicator 95, Eco-Indicator 99, Life Cycle Index (LinX), Green Pro, and Ten Golden Rules. However, most of these tools do not integrate a nature-economic-society aspect because they mainly focus on the environmental aspects. Other frameworks include those developed by the United Nations Commission on Sustainable Development (CSD), the Global Report Initiative (GRI) of The Institution of Chemical Engineers (IChemE), and the Lowell Centre for Sustainable Production (LWSP) and Wuppertal

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Sustainable frameworks of the United Nation CSD. These frameworks are focused on the governmental progress of countries that belong to the United Nations. Existing sustainability assessment methods are as follows:

**LCA**

LCA methodology is a generalized tool that can be applied to evaluate any type of product and service. LCA focuses on the environmental aspect to estimate the environmental burden during a product life cycle. This tool does not consider economical aspects, such as cost. However, LCA is an advantageous tool when supporting the environmental aspect from beginning to end [4].

**Eco indicator 95**

The Eco Indicator 95 is a generalized tool that can be used to evaluate any product type. A designer can easily apply this tool because the environmental terms are easy to understand. The tool also considers both environmental and social aspects. However, it does not consider economical aspects, such as cost, resource depletion, and technology [5].

**Eco indicator 99**

This tool is a modification of Eco Indicator 95, which is based on the damage-oriented method for LCA. The Eco Indicator 99 was developed based on three main categories: human health, ecosystem, and mineral resources. Similar to the Eco Indicator 95, Eco Indicator 99 is a generalized tool that can be used to evaluate any product type. This tool is also well documented and accepted as an international standard. However, Eco Indicator 99 still does not include an analysis of cost and technology [6].

**LInX**

This tool is an indexing system for the evaluation of process design. The environmental, economical, and social aspects are considered. This tool is a generalized tool that can be used to screen and evaluate any product type and process design. However, the boundary analysis is limited from cradle to gate, which does not cover all the life cycle stages or does not reach the end of a product life [7].

**Green Pro**

Green Pro is a systematic methodology for process design that considers the assessment and minimization of environmental impact. This analysis includes environmental, technological, and economical factors at the design stage to determine a cost effective solution. The main element of this tool is the application of multi-criteria decision making, which is a guide for making decisions. The boundary analysis is limited from cradle to gate, which does not cover the usage and life end of products. In addition, this tool does not consider social aspects [8, 9].

**Ten golden rules**

Ten Golden Rules is a qualitative analysis method that provides the common foundation used as a basis and guide for the development of a specific product design. The rules can be customized based on the specific product requirements. However, this tool only considers environmental aspects. Furthermore, a user must already have background knowledge to properly use these rules. The analysis results may also differ depending on user knowledge and experience [10].

**United nation CSD**

This framework was developed to monitor the various sustainability indicators for assessing the performance of governmental progress. It has an additional element called institutional aspects. This framework focuses on the governmental progress of the United Nations Development. However, other case studies or applications can adopt this framework [11].

**GRI**

The IChemE introduced a set of sustainability indicators to measure the operation sustainability within a process industry. This framework is less complex, impact-oriented, and strongly favors environmental aspects. It focuses more on the development of social indicators than on balancing each sustainability element of the framework [12].

**LWSP**

This framework has seven sustainability fronts, namely, waste elimination, benign emission, renewable energy, loop closing, resource-efficient transportation, sensitivity hook-up, and commerce redesign. It consists of five levels toward sustainable system. LWSP framework focuses on increasing the comprehensive measurement of environmental impact [8, 9].

**Wuppertal sustainable framework**

This framework is an innovation of the United Nations CSD framework, and its indicators are applicable for national focus. The framework focuses on the governmental progress of the United Nations Development. However, other case studies or applications can adopt this framework [8, 9].

## OBJECTIVE OF THE RESEARCH

The general objective is to understand the perception of Malaysian consumers towards companies which practice sustainability as part of their business culture. The specific objectives of the proposed research are as follows:

(a) To determine the level of the awareness in terms of the sustainability business culture in the context of Malaysian industries in the area of automotive-related businesses.
(b) To develop the sustainability indicator to measure the involvement of sustainability as part of business culture.

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## METHODOLOGY

The general framework of the approach is as depicted in Figure-1.

### Stage 1

(a) Multi-objective optimisation to identify the sustainability parameters based on P5 standard.
(b) Quantification of selected parameters from various viewpoints using a numerical rating as shown in Table-1.

**Table-1.** Numerical rating [13].

| Numerical rating | Description |
| --- | --- |
| **0** | Absolutely useless |
| **1** | Very inadequate |
| **2** | Weak |
| **3** | Tolerable |
| **4** | Adequate |
| **5** | Satisfactory |
| **6** | Good with few drawbacks |
| **7** | Good |
| **8** | Very good |
| **9** | Exceeding the requirement |
| **10** | Ideal |

The scale between 0 - 10 was developed to ease the respondents' group for rating the evaluation criteria. The rating value obtained from the survey then will be used to quantify the attribute ratings $\otimes v$ at later stage.

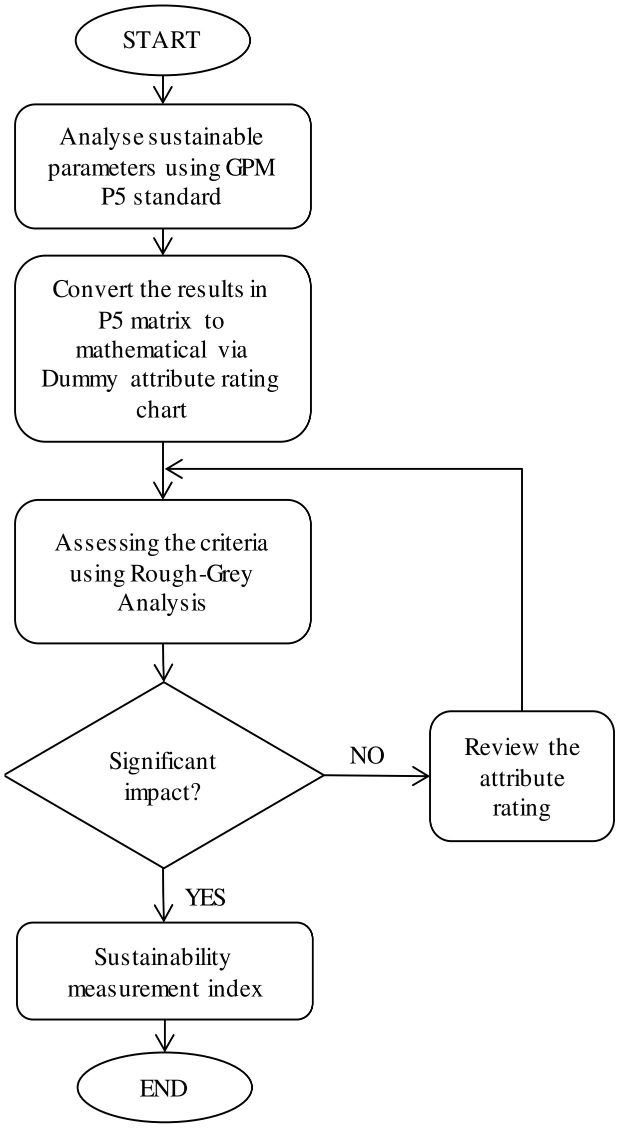


**Figure-1.** General framework of proposed approach.

### Stage 2

Method of quantifying the attribute ratings. The new method of quantifying the attribute ratings value, $\otimes$v as described in the following paragraph:

(a) Develop the dummy attribute ratings chart for all criteria as shown in Table-2, where *Vi* refers to the rating value of evaluation criteria from respondents' survey results, *K* is the number of group of respondentsR is abbreviation of respondent.
(b) Determine the  and  using the following formula:

$$\underline{v}_{ij} = \frac{1}{K}\left[v_{ij}{}^{1}{}_{Min} + v_{ij}{}^{2}{}_{Min} + \ldots + v_{ij}{}^{K}{}_{Min}\right] \quad (1)$$

$$\bar{v}_{ij} = \frac{1}{K}\left[v_{ij}{}^{1}{}_{Max} + v_{ij}{}^{2}{}_{Max} + \ldots + v_{ij}{}^{K}{}_{Max}\right] \quad (2)$$

**Stage 3**

The Rough-Grey Analysis approach is very suitable for assessing the criteria in an environment of uncertainty. The attribute ratings $\otimes v$ for benefit attributes are shown in Table-3.

**Table-2.** The scale of attribute ratings $\otimes v$ for benefit attributes.

| Scale | $\otimes v$ |
|---|---|
| Very poor (VP) | [0,1] |
| Poor (P) | [1,3] |
| Medium poor (MP) | [3,4] |
| Fair (F) | [4,5] |
| Medium good (MG) | [5,6] |
| Good (G) | [6,9] |
| Very good (VG) | [9,10] |

**Table-3.** Dummy attribute ratings chart [13].

| $a_j$ | $S_i$ | R*1* | | | … | … | R*K* | | |
|---|---|---|---|---|---|---|---|---|---|
| | | $v_{ijTyp.}$ | $v_{ijMin}$ | $v_{ijMax}$ | … | … | $v_{ijTyp.}$ | $v_{ijMin}$ | $v_{ijMax}$ |
| $a_1$ | $S_1$ | $V_{11}$ | $V_{11}$-0.5 | $V_{11}$+0.5 | … | .. | $V_{1K}$ | $V_{1K}$-0.5 | $V_{1K}$+0.5 |
| | $S_2$ | $V_{21}$ | $V_{21}$-0.5 | $V_{21}$+0.5 | … | … | $V_{2K}$ | $V_{2K}$-0.5 | $V_{2K}$+0.5 |
| | ... | … | … | ... | … | … | … | … | ... |
| | $S_n$ | $V_{n1}$ | $V_{n1}$-0.5 | $V_{n1}$+0.5 | … | … | $V_{nK}$ | $V_{nK}$-0.5 | $V_{nK}$+0.5 |
| … | | … | … | … | … | … | … | … | … |
| … | | ... | … | … | … | … | ... | … | … |
| $a_7$ | $S_1$ | $V_{11}$ | $V_{11}$-0.5 | $V_{11}$+0.5 | … | .. | $V_{1K}$ | $V_{1K}$-0.5 | $V_{1K}$+0.5 |
| | $S_2$ | $V_{21}$ | $V_{21}$-0.5 | $V_{21}$+0.5 | … | … | $V_{2K}$ | $V_{2K}$-0.5 | $V_{2K}$+0.5 |
| | ... | … | … | ... | … | … | … | … | ... |
| | $S_n$ | $V_{n1}$ | $V_{n1}$-0.5 | $V_{n1}$+0.5 | … | … | $V_{nK}$ | $V_{nK}$-0.5 | $V_{nK}$+0.5 |

The selection procedures are summarised as follows [14, 15]:

**a) Establishment of grey decision table**

Form a group of respondents, R and determine attribute values of alternatives. Assume that a group has K persons and then the grey number value of attribute can be calculated as:

$$\otimes v_{ij} = \frac{1}{K}\left[\otimes v_{ij}^1 + \otimes v_{ij}^2 + \cdots + \otimes v_{ij}^K\right] = \left[\underline{v}_{ij}, \bar{v}_{ij}\right] \quad (3)$$

where$i$ refers to alternatives, while $j$ refers to different attributes; $\otimes v_{ij}^K = \left[\underline{v}_{ij}^K, \bar{v}_{ij}^K\right]$, $(i=1,2,\cdots,m; j=1,2,\cdots,n)$ is the attribute rating value of the $K$th R that is expressed by a grey number.

**b) Normalisation of grey decision table**

Form a group of respondents, R and determine attribute values of:

$$\otimes v_{ij}^* = \left[\frac{\underline{v}_{ij}}{v_j^{\max}}, \frac{\bar{v}_{ij}}{v_j^{\max}}\right] \quad (4)$$

where $v_j^{\max} = \max_{1\le i\le m}\{\bar{v}_{ij}\}$.

For cost attributes, its normalised grey number value $\otimes v_{ij}^*$ is expressed as:

$$\otimes v_{ij}^* = \left[\frac{v_j^{\min}}{\bar{v}_{ij}}, \frac{v_j^{\min}}{\underline{v}_{ij}}\right] \quad (5)$$

where $v_j^{\min} = \min_{1\le i\le m}\{\underline{v}_{ij}\}$.

The normalisation method mentioned above is to preserve the attribute that the ranges of normalised grey numbers belong to [0, 1].

**c) Determination of the suitable alternatives**

In order to reduce unnecessary information and maintain the determining rules, we determine the suitable alternatives by a grey-based rough set with lower

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approximation. The lower approximation of suitable alternatives S* are determined by:

$$\underline{R}S^* = \{S_i \in U \mid [S_i]_R \subseteq S^*\} \tag{6}$$

where $S^* = \{S_i \mid d_i = yes\}$.

**d) Making the ideal alternative for reference**

According to $\underline{R}S^*$ obtained from equation (6), we determinate the ideal alternative $S^{max}$ for reference by:

$$S^{\max} = S_0 = \left\{ \begin{array}{l} \left[\max\limits_{\forall i} \underline{v}_{i1}^*, \max\limits_{\forall i} \bar{v}_{i1}^*\right], \\ \left[\max\limits_{\forall i} \underline{v}_{i2}^*, \max\limits_{\forall i} \bar{v}_{i2}^*\right], \\ \cdots, \left[\max\limits_{\forall i} \underline{v}_{im}^*, \max\limits_{\forall i} \bar{v}_{im}^*\right] \end{array} \right\} \tag{7}$$

**e) Selection the most suitable alternative**

The grey relational coefficient (GRC) of $\otimes x_i$ with respect to $\otimes x_0$ at the $k$th attribute, is calculated as [16]:

$$\gamma(\otimes x_0(k), \otimes x_i(k)) = \frac{\Delta\min + \rho\Delta\max}{\Delta_{0i}(k) + \rho\Delta\max} \tag{8}$$

where

$$\Delta\max = \max_{\forall i, \forall k} \max L(\otimes x_0(k), \otimes x_i(k)) \tag{9}$$

$$\Delta\min = \min_{\forall i, \forall k} \min L(\otimes x_0(k), \otimes x_i(k)) \tag{10}$$

$$\Delta_{0i}(k) = L(\otimes x_0(k), \otimes x_i(k)) \tag{11}$$

$L(\otimes x_0(k), \otimes x_i(k))$ is the Euclidean space distance of $\otimes x_0(k)$ and $\otimes x_i(k)$ which is calculated by equation below:

$$L(\otimes x_1, \otimes x_2) = \sqrt{(\underline{x}_1 - \underline{x}_2)^2 + (\bar{x}_1 - \bar{x}_2)^2} \tag{12}$$

ρ is the distinguishing coefficient, ρ=[0, 1]. The grey relational grade (GRG) between each comparative sequence $\otimes x_i$ and the reference sequence $\otimes x_0$ can be derived from the average of GRC, which is denoted as:

$$\Gamma_{0i} = \sum_{k-1}^{n} \frac{1}{n} \gamma(\otimes x_0(k), \otimes x_i(k)) \tag{13}$$

where $\Gamma_{0i}$ represents the degree of relation between each comparative sequence and the reference sequence. Through the calculation of GRG between comparative sequences $\underline{R}S^*$ with reference sequence $S^{max}$, the alternative corresponding to the maximum value of GRG can be considered as the most suitable alternative.

**CONCLUSIONS**

This ultimate goal of this research is to provide guidelines to the R and D engineers and project managers to incorporate sustainability assessment as part of their product development phases. However, the scope of current study is only to understand the perception of Malaysian consumers towards companies which practice sustainability as part of their business culture. The proposed method is expected to obtain the level of the awareness in terms of the sustainability business culture in the context of Malaysian industries in the area of automotive-related businesses. In addition, the involvement of sustainability as part of business culture will also be measured.

In overall, the proposed framework will provide R and D engineers and project managers with a hands-on analytical tool to formulate an order winning strategy while considering any undertaking for product improvement. Furthermore, the proposed framework provides a structured criteria assessment process, which may useful in new product development.

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