ORIGINAL ARTICLE

Sustainability Performance Level of Small Medium Enterprises in Pahang in the Context of Non-renewable Energy Consumption using Correlation Analysis

Siti Sarah Abdul Manan[1], Kartina Johan[1,*] and Faiz Mohd Turan[1]

[1]Faculty of Manufacturing and Mechatronic Engineering Technology, Universiti Malaysia Pahang, 26600 Pekan, Pahang, Malaysia.

ABSTRACT – The usage of non-renewable energy in Malaysia has become a normal thing especially in the importance of electricity generation. Majority of the industry and households in Malaysia use non-renewable energy as the source of electricity generations. For that, this research aims to analyse the consumption of energy and electricity bills that is used in small-medium enterprises (SMEs) and the awareness level of sustainability in managing their businesses in Malaysia. This research is conduct around Pahang, Malaysia to analyse the awareness level of the SME owners on the percentage of the electricity used. The electricity management and the Sustainable Development Goals are reviewed through the literature survey as a reference to construct a conversion table. The normalization technique is used to reduce the bias in the data. Pearson's and Spearman's Correlation Analysis are used in this research to determine the correlation analysis from the finalized results.

INTRODUCTION

The consumption of non-renewable energy as source of electricity is an important component that people tend to missed out. The sources for the usage of electricity are also important to take note as they can also give impacts towards the environmental sustainability. The implications are huge as the non-renewable source cannot be renewed after it finished. In Malaysia, the urge of using renewable energy as source of electricity is still lacking among entrepreneurs as they are not exposed to the importance of this aspect.

High rate of failure for sustainable performances in SMEs are recorded. The SMEs unable to sustain their business with an almost 50% rate within 5 years of establishment. Malaysians consume fossil fuels as the main source to generate electricity [1]. According to data shown from the National Energy Balance 2010, 53% of electricity generated is from natural gas meanwhile the other 40%, 5%, and 2% are from met by coal, hydro, and coal. The impact of this consumption on the environment is huge as they can contribute to the emission of the greenhouse gas. Non-renewable energy releases methane, carbon dioxide, and other gasses into the atmosphere and thus creates a warm atmosphere for plants and warming effects for the planet. We continue heating the planet as we burn more non-renewable fuels. This can affect the changes in weather patterns that turn in to affect the production of food, biodiversity, and also the ecosystem. The quality produce by the air keeps plunging if we do not take this matter seriously. Therefore, this paper will focus on the sustainability awareness and the usage of non-renewable energy as the source of electricity by SMEs owners in Pahang, Malaysia. The objectives of this reasearch are:

i. To study the effects of non-renewable energy as source of electricity to the environment, the consumption of electricity by SMEs and also the awareness of SME owners on sustainability.

ii. To develop a conversion table for consumption of non-renewable energy for source of electricity based on the responds to the survey.

iii. To analyze the relationship between the consumption of non-renewable energy and the sustainability awareness level of SME owners.

This research will be done by distributing questionnaires to the owners of SMEs. The questionnaires will be related to the scope of sustainability in the industry regarding the source of electricity and consumption of electricity for their business. This will be done to improve their awareness of the importance of environmental sustainability.

RELATED WORK

Small and medium-sized enterprises (SMEs) in Malaysia plays an important role in improving the economy as it makes up 98.5% of businesses in Malaysia. This sector contributes more than 5 million jobs with over RM500 million to gross domestic products (GDP). 89.2 % of the SMEs in Malaysia came from the service sector, meanwhile, the manufacturing sector conquers 5.3%, the construction sector contributes 4.3%, agriculture 1.1%, and mining and quarryconqueruers 0.1% of the SMEs. 20.6% of SMEs are women-owned which means that under 51% of the equity is held by women [2].

As the sector increases, it also brings threats to the environment. Although the SME's importance increases, this can generate higher threats to the environment. SMEs should plan towards achieving their goals without having a limit in the ability of future generations to meet theirs.

According to AmBank's Managing Director, it is stated that almost 80% of SME's cannot survive for the first three years. This failure rate can be higher over time as these numbers can be a reliable indicator of the challenges of sustainable growth in SMEs.

Sustainable entrepreneurship is one of the possible ways to handle the degradation of the environment. The cognitive process of the SMEs owners can be an important factor that affecting the engagement of sustainable entrepreneurship [3].

Non-renewable and Renewable Source of Electricity in Malaysia

In Malaysia, the common source of electricity used is non-renewable energy. Non-renewable energy is generated from source that will deplete over time. The common sources for non-renewable energy are coals and fossil fuels. As for renewable energy, it is produced from the source that can be renewed and continuously replenished. Some of the examples of the sources are wind, solar, hydro and geothermal [4].

The electricity generation in Malaysia is accessed by 97.6% of Malaysians from different sectors. Malaysia has shown a continuing increase of electricity consumption by 8.7% from 1980 to 2014 [5]. The main utility companies for electricity generation in Pahang are mostly come from Tenaga Nasional Berhad (TNB). The maximum amount of electricity demand in Peninsular Malaysia has increased by 2.05% from 16,562 MW in 2013 to 16,901MW in 2014 [5].

Method of Analysis

In this research, there are several methods that are used to analyze statistical data from the questionnaires and survey on the sustainability awareness to the usage of non-renewable energy as source of electricity in Pahang, Malaysia.

Questionnaire is a type of surveying method or research instrument that consist a set of questions to get data from respondents with a better efficiency and also low cost. This type of method is fast and also easy to cover large samples of geographical area and also it is easy to analyze. The questions that will be constructed needs to have a good words constructions so it can be easily understands by all the respondents and also, the questions need to be good questions that will help with the survey.

Microsoft Excel is a software that allows user to organize data and calculating data using the spreadsheet features. This tool is a popular choice to analyze data. This tool can be easily accessed as it enables data-handling, processing and also the analysis of the data collected. A tool that is normally used for decision making is called the Analytical Hierarchy Process. This tool is not cost-friendly as the users have to purchase the tool.

MATLAB is a software that was developed by MathWorks that uses a high-performance language for technical computing. MATLAB can also be used for statistical analysis of the data using the linear mixed effects models and random field theory. Typical uses of MATLAB are in math and computation, algorithm development, data analysis, exploration and visualization and also prototyping and modelling. MATLAB uses high-level matrix/array language with control flow statements, data structures, functions and etc.

Correlation is a term for the relationship between two qualitative variables to measure the association between the variables. Pearson's Correlation Coefficient produce a correlation between two variables based on three assumptions which are the linearity of the relationship, the independency on each variables and also the distribution of the variables [6]. Spearman's Correlation Analysis is a part of Correlation Analysis Method. Spearman's Correlation Coefficient Analysis is a bit different from Pearson's Correlation Analysis because in Spearman, ranks given is used for the observation instead of their actual values and is used when the assumptions in Pearson is not met [6].

Likert scale questionnaires are commonly used as a method of collecting data from survey as it is efficient and allows researchers to collect huge amount of data easily. Likert scale can sum up the rating scale score from respondents to a simpler sum of responses over time.

METHODOLOGY AND FRAMEWORK OF THE RESEARCH

The proposed framework for this research regarding on the study on the sustainability awareness level on the usage of non-renewable energy as source of electricity of small-medium enterprises (SME) owners, focusing on SMEs around Pahang, Malaysia is shown in Figure 1.

This research framework is divided into three phases. The first phase is to carry out the study and the literature surveys to find out about the consumption of energy used for electricity in SMEs and the effects on the environment. The data is tabulated to see the parameters analyzed. Next, focus of case study on the electricity used by the SME owners by distributing surveys and questionnaires that contains a set of questions related to the SDGs and GPM P5 Standard. The surveys are conducted to study the impacts of sustainability awareness levels of the SME owners. The questionnaires will be distributed by using Google Forms to the SME owners in Pahang.

Phase 2 is data collection and data analysis phase after the surveys are completed. For each question being asked, respondents are needed to rate based on evaluation criteria. Sustainability Assessment (SA) tool will be used to quantify the data as a tool to make the data collected through surveys significant using the weighting criteria. The conversion table is used to transform the data from the qualitative to quantitative state.

The final phase, phase 3 is the normalization and evaluation of the data to see the relationship between the level of sustainability awareness among the SME owners to the usage of the source of electricity by using the Pearson's and Spearman's Correlation Coefficient Analysis. This is to show relevant the sustainability awareness can give positive impact to electricity management by the SME owners in Pahang, Malaysia.

In this research, systematic sustainability assessment (SSA) is a tool used to convert the qualitative data into quantitative data. The questionnaires questions will be developed according to weighing criteria. The sustainability parameters and resolution for each parameter that based on SDGs and the GPM P55 standard are determined using a scoring method which is ranked with the value from -2 to 2.
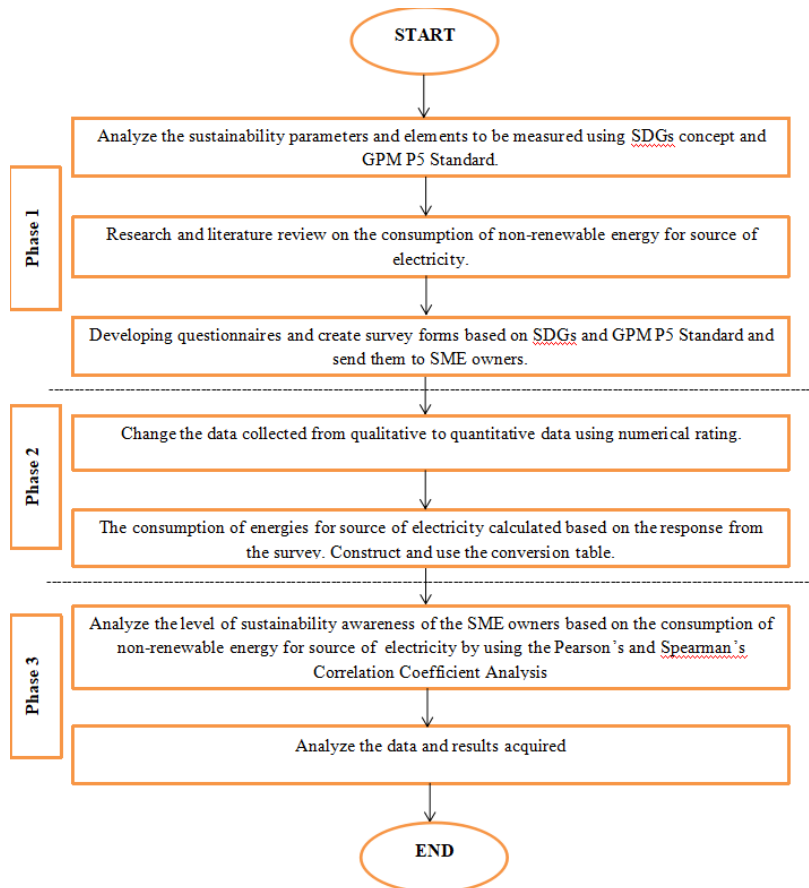

Figure 1. General research framework
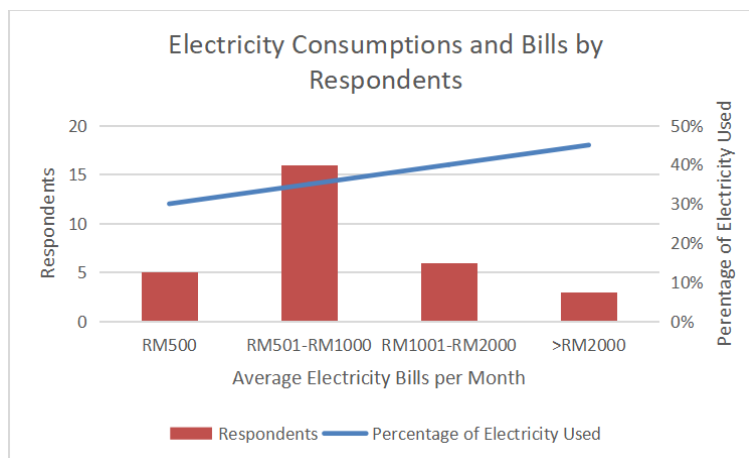
EXPERIMENTAL RESULTS

Figure 2. The electricity bill and the amount of electricity consumption daily

Figure 2 shows the electricity bill and the amount of electricity consumption daily based on operating hours by the respondents. It can be seen that the higher percentage of electricity used contributes to the increase of average electricity bills per month. Most of the respondents have the average of electricity bills of RM501 until RM1000 per month.

The calculation of the Pearson's correlation is shown in Equation 1. For this correlation analysis, the sustainability awareness and practices is used as the x value. 95% confidence interval is used with the value of alpha equals to 0.005 to calculate the correlation value for the data. After evaluating the data using Pearson's Correlation Coefficient Analysis in MATLAB Software as in Figure 3.

$$r = \frac{\sum (x_i - \bar{x})(y_i - \bar{y})}{\sqrt{\sum (x_i - \bar{x})^2 \sum (y_i - \bar{y})^2}} \tag{1}$$

Where:
r   = correlation coefficient
x_i = values of the x-variable in a sample
$\bar{x}$ = mean values of the x-variable
y_i = values of the y-variable in a sample
$\bar{y}$ = mean of the values of the y-variable

```
Correlation = xlsread ('C:\Users\user\Desktop\FYP 2\Correlation Analysis.xlsx')
%Pearson's Correlation Coefficient with 95% confidence level
%Note: R = Pearson's Correlation, P = p-value, RLO = Lower Limit, RUP = Upper Limit
[R,P,RLO,RUP] = corrcoef(Correlation,'alpha',0.05)
```

Figure 3. Function of MATLAB for Pearson's correlation

The Pearson's correlation value between the percentage of electricity consumption daily and the sustainability awareness is shown in Table 1 which is is -0.5536. The negative value indicates that there is a negative response for statement. There can be said that if the percentage of electricity consumption daily increases, the sustainability awareness by the SMEs decreases. The p-value of this Pearson's Correlation Analysis is 0.001 which shows that it is less than value of 0.05. The value of p that is less than 0.05 indicates that the data is statistically significant. The smaller the p-value, the greater the evidence against the null hypothesis. Null hypothesis is a hypothesis which concludes that the two parameters are independent with each other. So here, we can confidently states that percentage of the non-renewable source of electricity is dependent with the sustainability awareness of the SME owners.

Table 1. The mean for the variables, p-value and r-value

	Mean, $\bar{x}$
Consumption of non-renewable source of electricity daily	37.5
Sustainability awareness	0.44
P-value = 0.001 r-value = -0.5536	

The equation for Spearman's correlation is shown in Equation 2. For this correlation analysis, the sustainability awareness is used as the x value. 95% confidence interval is used with the value of alpha equals to 0.005 to calculate the correlation value for the data. After evaluating the data using Spearman's Correlation Coefficient Analysis in MATLAB Software as shown in Figure 4.

$$\rho = 1 - \frac{6 \sum d_i^2}{n(n^2 - 1)} \tag{2}$$

Where:
ρ = Spearman's rank correlation coefficient
d_i = differences between the two ranks of each observation
n = number of observations

```
Correlation = xlsread ('C:\Users\user\Desktop\FYP 2\Correlation Analysis.xlsx')
%Pearson's Correlation Coefficient with 95% confidence level
%Note: R = Pearson's Correlation, P = p-value, RLO = Lower Limit, RUP = Upper Limit
[R,P,RLO,RUP] = corrcoef(Correlation,'alpha',0.05)
%Spearman's Correlation Coefficient with automatically 95% confidence level
[RHO,PVAL] = corr(Correlation,'Type','Spearman')
```

Figure 4. Function MATLAB for Spearman's Correlation

From Table 2, it is shown that the Spearman's correlation value between the percentage of electricity consumption daily and the sustainability awareness is -0.4770. The negative value indicates that there is a negative response for statement. There can be said that if the percentage of electricity consumption daily increases, the sustainability awareness

by the SMEs decreases. The p-value of this Spearman's Correlation Analysis is 0.007 which shows that it is less than the value of 0.05. The value of p that is less than 0.05 indicates that the data is statistically significant. The smaller the p-value, the greater the evidence against the null hypothesis. Null hypothesis is a hypothesis which concludes that the two parameters are independent with each other. So here, we can confidently states that percentage of the non-renewable source of electricity is dependent with the sustainability awareness of the SME owner.

Table 2. The mean for the variables, p-value and ρ-value

	Mean, $\bar{x}$
Consumption of non-renewable source of electricity daily	37.5
Sustainability awareness	0.44
	P-value = 0.007 ρ-value = -0.4770

Both of the correlation analysis can be used to investigate the relationship between the two variables in this data which are the sustainability awareness and the consumption of non-renewable source of electricity. But, to be more precise and clarified, Pearson's Correlation Analysis is chosen as the best method as it gives a linear visual of the data, and to see the significant linear relationship of the variables. Pearson's Correlation Analysis is also a widely used correlation method because it measures the relationship of a normally distributed data.

CONCLUSION

This paper reports the statistical analysis method called Pearson's Correlation Coefficient and Spearman's Correlation Coefficient to study the relationship between the consumption of non-renewable source of electricity and also the sustainability awareness among the SME owners. Pearson's Correlation Analysis gives the value of -0.5536 with the p-value of 0.001 which indicates that the data statistics are significant and there are negative relationship between the sustainability awareness of the SME owners and the consumption of non-renewable energy as source of electricity. For Spearman's Correlation Analysis, the value of ρ is -0.4770 meanwhile the p-value is 0.007.

REFERENCES

[1]   T. Yusoff, S. A. Wahab, A. S. A. Latiff, S. I. W. Osman, N. F. M. Zawawi, and S. A. Fazal, "Sustainable Growth in SMEs: A Review from the Malaysian Perspective," *Journal of Management and Sustainability*, vol. 8, no. 3, p. 43, Aug. 2018, doi: https://doi.org/10.5539/jms.v8n3p43.

[2]   "MSME Statistics," *Smecorp.gov.my*, 2015. https://www.smecorp.gov.my/index.php/en/policies/2020-02-11-08-01-24/sme-statistics (accessed Jun. 01, 2023).

[3]   W.-L. Koe, R. Omar, and J. R. Sa'ari, "Factors Influencing Propensity to Sustainable Entrepreneurship of SMEs in Malaysia," *Procedia - Social and Behavioral Sciences*, vol. 172, pp. 570–577, Jan. 2015, doi: https://doi.org/10.1016/j.sbspro.2015.01.404.

[4]   K. S. Koh and A. S. Mohd Fauzi, "An Overview of Renewable and Non-Renewable Energy Demand as Well as Development Status in Malaysia," *Chemical Science and Biomolecular Engineering*, vol. 1, no. 1, Mar. 2019, doi: https://doi.org/10.31021/csbe.20171101.

[5]   H. A. Bekhet and N. S. Othman, "The role of renewable energy to validate dynamic interaction between CO2 emissions and GDP toward sustainable development in Malaysia," *Energy Economics*, vol. 72, pp. 47–61, May 2018, doi: https://doi.org/10.1016/j.eneco.2018.03.028.

[6]   N. Gogtay and U. Thatte, "Principles of Correlation Analysis," *Journal of The Association of Physicians of India*, vol. 65, pp. 78–81, 2017.