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Research paper

Sustainable Performance Measurement of Automotive and Machinary Industrial Cluster based of Industrial Symbiosis Scenario in the Industrial Estate

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Abstract

Sustainability issues become a remarkable study lately, including the industrial sustainability, it is in line with the long term of industrial development goal to build industry according to sustainable development concept. This research aims to design a sustainability performance measurement system of automotive and machinery industrial cluster with the approach of Sustainability Balanced Scorecard and Labuschagne (SBSC-L) model, and to measure and evaluate the sustainability performance of the industry using Objective Matrix (OMAX) and Traffic Light System methods. Results of measurement and evaluation of the overall sustainability performance on scenario 0 are obtained that industry P is 4.43 (yellow) which means good, industry Q is 3.38 (red) which means poor, and industry R is 4.74 (yellow) that means good or satisfactory, industry R has the highest value of sustainability performance, and average of sustainability performance is 4.25. The application of industrial symbiosis scenario provides improved sustainability performance on average in scenario I by 68%, scenario II by 81%, and scenario III by 96% compared to scenario 0. Thus, it needs the policy for encouraging the application of industrial symbiosis systems in order to improve the sustainability performance of the industry in the industrial estate.

Keywords: *Industrial Estate, Industrial Symbiosis, OMAX, SBSC-L, Sustainability Performance*

1. Introduction

Sustainability issues become a remarkable study lately, including the industrial sustainability, it is in line with the long term of industrial development goal. Therefore, sustainable industrial performance should be improved and enhanced continuously, it can be formed by using the application of Industrial Symbiosis (IS). IS is beneficial collaboration among different industries by utilization of by product and wastes as raw materials and energy for other industries (Harris, 2007). Bansal, et al. (Bansal & Mcknight, 2000) reported that IS is essential to the achievement of sustainability, not only because of the waste management aspect, but also about the social and economic aspects. Mubin, et al. (Mubin, Zagloel, Soemantojo, & Darmadi, 2012) also reported that the application of IS concept can improve the efficiency and performance of economic, social, and environmental industries.

Many researches regarding to Sustainability Performance (SP) have been done by the researchers, but the study which was concerning PS with IS in the industrial park is quite uncommon to be done. Mubin (Mubin, 2016) reported the results of his research on the development of Performance Measurement System (PMS) based on a scenario of IS of electronic and plastic industrial cluster. This study evaluates the different objects namely SP measurement in the automotive and machinery cluster industry that has different characteristics to electronic and plastic cluster.

This study aims to design PMS of industrial sustainability in automotive and machinery cluster by using Sustainability Balanced Scorecard-Labuschagne model approach (SBSC-L) (Kaplan & Norton, 2007); (Bieker & Waxenberger, 2001); (Figge, Hahn, Schaltegger, & Wagner, 2002); (Labuschagne, Brent, & Van Erck, 2005); (Mubin, 2015); (Mubin, 2016). This study also intends to determine the application of IS scenario as the strategy improvement of SP, and to measure and evaluate industrial SP in accordance with the application of IS scenario in industrial area.

2. Methodology

This study was conducted in three industries related to automotive and machinery industrial cluster in industrial estate X. Sustainability PMS of the industry is designed by using an approach named as SBSC-L. To measure and evaluate SP of the industry is in accordance with the application of IS scenario in industrial area which is using Analytical Hierarchy Process (AHP) (Saaty, 2008), Objective Matrix (OMAX) (Carl, 1998), and Traffic Light System (TLS) method. Furthermore, performance value is equivalent to the weight which is

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multiplied by the score, while SP value is the performance cumulative value of the economic, environmental and social performance value (Mubin, 2016).

Solving problems framework is divided into five phases, that are; (1) the preliminary research, (2) designing sustainability PMS by using SBSC-L model, (3) determining application of IS scenario, (4) measuring and evaluating the SP by using AHP, OMAX, and TLS method, (5) analysis, (6) making conclusion.

3. Results and Discussion

The result of this study reveals that from designing the sustainability PMS of the industry, it was successfully gain 10 strategic objectives, 5 KPIs of economy perspectives, 54 KPIs and sub KPIs of environmental perspectives, and 10 KPIs of social perspectives (Mubin, 2015).

The results of measurement and assessment of SP for scenario 0 or without IS on the three industries (industry P, Q, and R) from the survey list, it was obtained that the performance value on each perspective and overall SP value of the industry. Industry R has higher value for overall SP value than the other industries that is 4.74 (yellow or good). Overall average value of SP on the three industries is 4.25 (yellow or good).

In scenario I which is about the application of IS in raw materials, utilization of by-products, and waste aspect. Scenario II is related to the application of IS in raw materials, water use, the use of by-products, and waste aspect. While in scenario III, it is related to the application of IS in raw materials, water use, energy use, utilization of by-products and waste aspect. The results of the overall SP calculation of the industry are presented in Fig. 1, 2, and 3.

Fig. 1 illustrates that the overall value of SP in industry R is relatively higher that the other industries, moreover in first scenario the score is 7.29, and the average score of SP is 7.07, however it shows improvement by 62% compared to the prior application of IS (scenario 0). Fig. 2 describes that in scenario II, the SP value of industry R is higher than the other industries which obtained 7.96, and the average SP value is 7.62, it is increasing by 96% from scenario 0. While Fig. 3 shows that in scenario III, the average value of SP is 8.22, it shows improvement from scenario 0 that is 96% improvement. Meanwhile, for the consolidated value of SP of the industry (scenario I-III) can be perceived in Fig. 4.

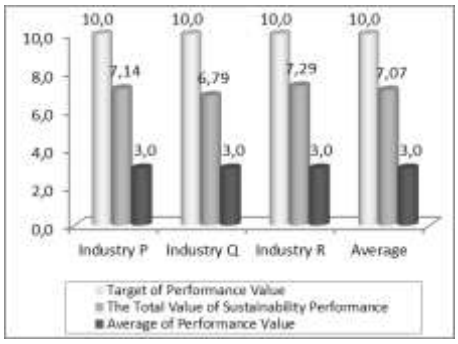


Fig.1: Value of overall sustainability performance of industries P**,** Q and R (Scenario I)

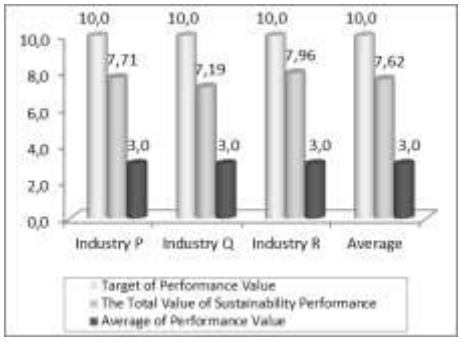


Fig.2: Value of overall sustainability performance of industries P, Q and R (Scenario II)

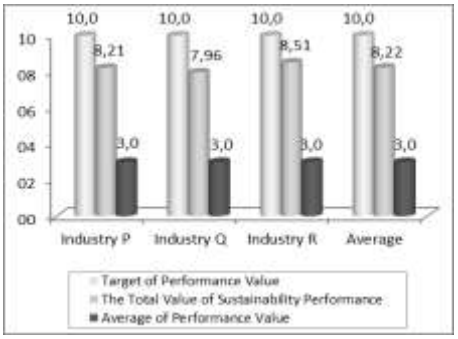


Fig.3: Value of overall sustainability performance of industries P, Q and R (Scenario III)

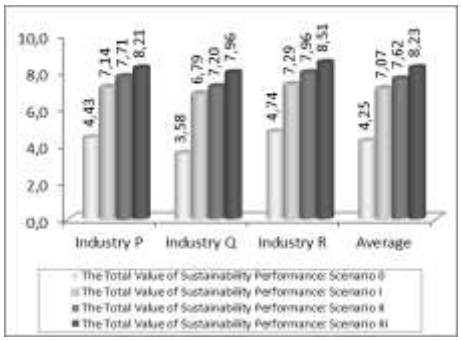


Fig.4: The combined value of overall sustainability performance of industries P, Q and R (Scenario I-III)

4. Conclusion

Designing sustainability Performance Measurement System (PMS) by approach of Sustainability Balanced Scorecard - Labuschagne (SBSC-L) model which consists of three aspects: economic, environmental, and social, consist of 10 strategic objectives, 5 KPIs of economic perspectives, 54 KPIs and sub KPIs of environmental perspectives, and 10 KPIs of social perspective.

Results of measurement and evaluation of the overall Sustainability Performance (SP) on scenario 0 were obtained that industry P is 4.43 (yellow) which means good, industry Q is 3.38 (red) which means poor, and industry R is 4.74 (yellow) that means good or satisfactory, industry R has the highest value of SP, and average of SP is 4.25. The application of Industrial Symbiosis (IS) scenario provides an improving SP on average in scenario I by 68%, scenario II by 81%, and scenario III by 96% that are compared to scenario 0. Thus, it needs encouragement for the application of IS in order to improve the SP of the industry in industrial estate.

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