

USING QUALITY FUNCTION DEPLOYMENT (QFD) IN DESIGNING THE “GREEN PRACTICE” OF GSCM FOR MALAYSIA’S SMEs INDUSTRIES

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ABSTRACT

The worldwide is now much debated about the environmental problem and the preservation. In the meantime, GSCM has been introduced and accepted by many environmental experts and to apply this concept to solve the environmental problems. Unfortunately, found that many studies just discussed about the constraints and drivers of GSCM in the industries and not to the problem solving for environment awareness. Therefore, this study will focus on the design of green practice for the environmental awareness with considering the constraints of the customer requirements in the industries. The factor analysis and correlations analysis were used to complete the design in satisfying the requirements of the customer constrained by the limited resources of the technical requirements. Among the methods to fulfill the area of this study is the quality function deployment (QFD) and it was used to identify the desirable the design in green practice of GSCM in Malaysia’s SMEs industries.

Keywords –Green practice, Green supply Chain Management (GSCM), Quality Function Deployment (QFD).

1.INTRODUCTION

In the context of environmental protection, the most common thoughts that come to mind when it comes to going business organization that can contribute to the green. [1]. Though “green” may generally refer to “eco-friendliness” or “sustainability” its has been predominantly reactive compliance with environmental regulations or public demand [2]. In view, the strategy for environment protection should be considered at all stages of the product lifecycle, design and development, manufacturing, distribution, sales, use and disposal as well as in the closed-loop operation system. Therefore, the necessary is that for the industries react and drive their organizations towards the enhancement of capabilities of Supply Chain Management [3]. The literatures review has study and discuss of Green Supply Chain (GSCM) is one of the recent innovation for the enhancement of capabilities of Supply Chain Management to preserve the environment [4]. This statement is supported by [5][6]. Thus, the green supply chain management (GSCM) was introduced to enhance the capability in the environment preservation and that has now been widely accepted in many countries and industries [7][8]. [9] they defined the objective of green supply chain is to eliminate or minimize negative environmental impacts (air, water, and land pollution) and waste of resources (energy, materials, products) from the extraction or acquisition or raw materials up to final use and disposal of products.

In essence, some of SMEs have implement the green supply chain and it has just started to be implemented by manufacturing firms in Malaysia [10]. The reality is SMEs in Malaysia are still left behind and not totally aware to preserve environmental as compare to large industries and developing countries.[11]. Many SMEs are unaware of the environmental legislation that effects their business [12] feel that it does apply to them [13] [14]. SMEs are also dubious about the business benefits of environmental improvement and they are just only look on the reduction in their business costs [13] [14].

Therefore, most of the SMEs are practicing the green but they were not motivated to implement GSCM’s approach with fully managed by the better strategies, consistencies and continuously [11]. SMEs also have not totally implements

the elements what are required in GSCM compliances [14][16]. These will contribute to the environmental risk and bottleneck in pursuing the goal of greener supply chain in Malaysia[1][11] and also agreed by [17] which it is that could be a major contribution to the serious environments pollution and waste disposal in Malaysia.

In specifically, this research will provide new insights to SMEs, those planning or currently implementing green practices. This inspire has come out from motivation of the current situation in SMEs in Malaysia. This study will develop a modeling framework for designing green practice for Malaysia's SMEs industries using Quality Function Deployment (QFD).

2.LITERATURES

2.1 Green Supply Chain Management (GSCM)

There are various definitions and concepts found from the literature. Unfortunately, there is no special definition describes GSCM and its applications [17] [18][19][20]. According to the study of philosophy, GSCM which is the elements of supply chain management (or SCM) and the environment are combined in one concept [21][22]. It depends on the perspective and purpose of GSCM implementation in an organization [23][24].

The concept of GSCM as an approach to improve the efficiency of resource use, including product design, the life of the product, the management of machinery and equipment, inventory management, waste management, recycling, reuse, and workplace safety and well-being [19] While, at the external level of the organization has focused on resource acquisition, compliance with environmental laws, customer management, supplier management, logistics management and environmentally friendly transport system [25]. The concept of GSCM implementation, [22] found that GSCM is a general concept in environmental management systems and have no special guidelines for its implementation.

2.2 Quality Function Deployment (QFD)

Quality Function Development (QFD) is a method for translating customer requirements into appropriate company requirements at each stage, from research and product development, to engineering and manufacturing, to marketing/sales and distribution. In other words, QFD can be considered as the process of taking the voice of customers (or users), all the way through product (service or systems) development to the factory floor and out into the market place . It is considered as a thorough method to match customer requirements to a product's engineering characteristics. QFD is not merely a quality tool but it is a tool of great importance to introduce new existing products, processes, as well as services. It pays attention in understanding customer's requirements to make sure each of it is identified in the product at the design stage. Approximately 60-80% of the total cost of a product is committed at that stage. It recognizes the importance of the person who buys (or who contributes to the buying decision the most) a product which decides how successful the commercial of the product is, making it the premise of the QFD method.

Therefore, highest priority should be given to the voice of customer to determine the attributes of the products. Among of QFD's strengths is, the product design/development team is given the chance to ascertain different options before it can proceed to pick any particular design. The skills within an organization are concentrated and monitored by QFD, firstly in designing, secondly in manufacturing and then marketing goods of customers' queries. These are carried out in the form of charts of documentation and extensive use of analysis.

[Fig. 1] depicts the basic structure of a house of quality, which includes six departments of: 1. Customer requirements of GSCM Benefits (Whats); 2.Technical requirements of GSCM critical success factor (Hows); 3. Relationship matrix of Customer requirement and Technical requirement (Whats vs. Hows); 4 .Relationship matrix of Customer requirement (WhatsvsWhats; 5: Relationship matrix of technical requirement (Hows vs. Hows); 6.Competitive analysis of Customer requirements 7.Competitive analysis of Customer requirements to the Technical requirements.

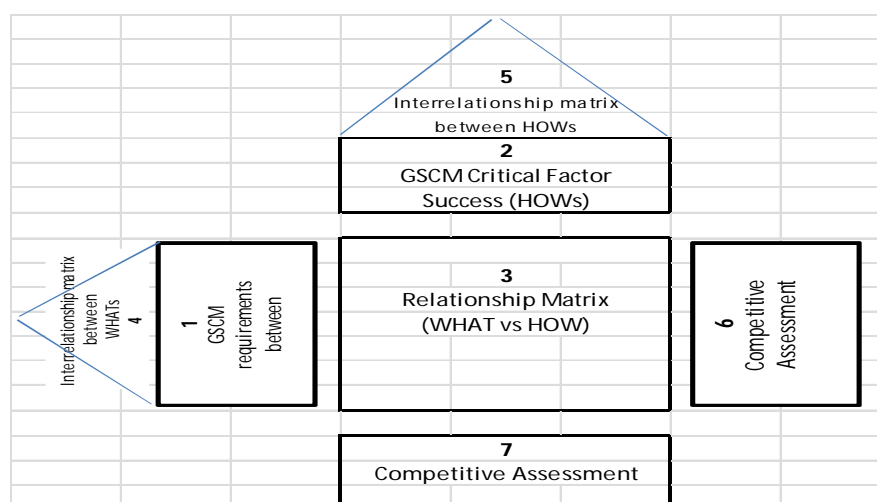


Figure 7: The House of Quality

3.METHODOLOGY

3.1 Quality Function Deployment

The modeling approach presented in Figure.2 provides a formal structure and solution approach to QFD for green practice in Malaysia's SME industries. The model starts with the voice of the customer, which is translated into the house of quality as customer requirements. The survey applied to the customers and stake holder (internal and external) is in (step 1 in Fig.2). However, it is not possible to include all of them in the matrix in the QFD. Therefore, factor analysis, in order to classify and decrease those customer requirements and Technical requirements (step 2 in Fig. 2).

This matrix of QFD shows the SMEs industries capabilities of satisfying the customer requirements with the capabilities of technical requirements they have in green practice improvements. The improvement is based on the ratio (relates the goal or target with the current performance measure in a specific requirement), and the weight of (a computed value relating the importance to customer, the improvement ratio, and the performance achievement in green practice). All of this information will help us in determining what kind of actions to take in order to improve our customer ratings in the different customer requirements. This is cover for in the step 3 and step 4 in figure 2. There are using Correlation analysis to define the weight based on the three scales of (weak, moderate and strong). Finally, in step 5 of Fig. 2, translate the customer requirements (what's) into technical requirements (how's). The technical requirements are placed at the top of the house of quality and the middle of the house of quality in measurement the correlation between what's and how's.

Finally, using the information that comes from matrices on step 1, 2, 3,4 and 5 in figure 2.in the house of quality can be created and a detailed of the result for whole process by the competitive analysis. The result will be concluded at this final stage for showed that which group of variables should be given priority for achieve the objective of the QFD development in this study.

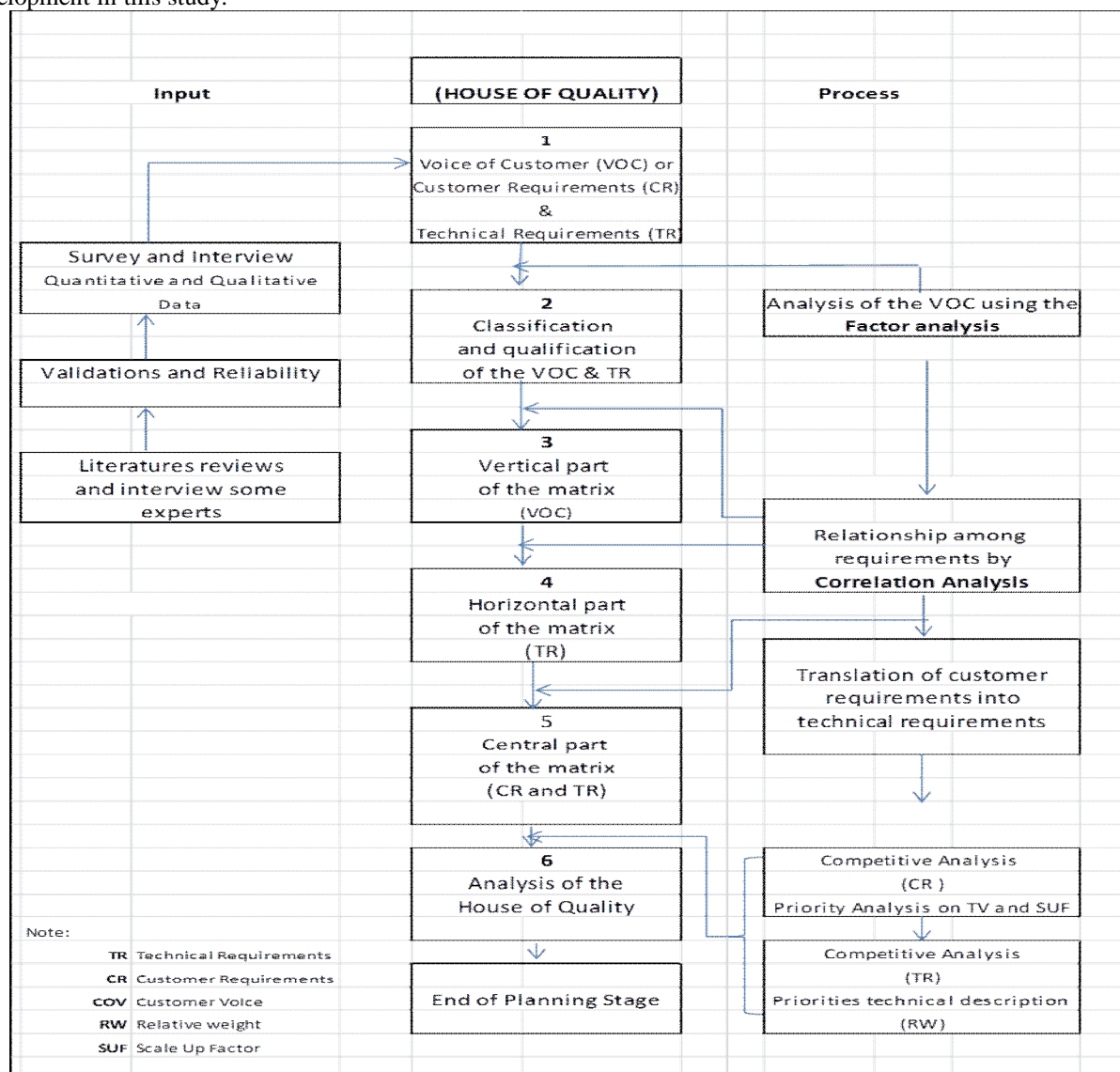


Figure 8: The house of quality process in Quality Function Deployment (QFD)

4.RESULT AND DISCUSSION

Table 1 and Table 2 depicts the customer requirements in (X) and the technical requirement in (Y) from the first screening and the number of variables related to them from the original data. Using factor analysis [26], a level of importance was assigned to each requirement, in order to classify and reduce those customer requirements and the technical were required in improvement in the green practice. In this section of the house of quality stage (step 2 in Fig. 2). From the reducing and the classification by the factor analysis, the variables are group into four categories. As a Table 1, they are internal customers, internal stakeholder, external customer and external stakeholder. Internal customer is the company's employees and the internal stakeholder is the owner for the company said. The external stakeholder is from the investor or the partnership of the company business included the public people, especially in surrounding at the company and the external customer consisted from the buyers. Meanwhile, Table 2, showed that the four categories has classified. There have economic, social, environment and others. It is found from survey from some expertise in the environment and the supply chain. These categories are working for satisfy the customer requirements in the green practice at the company.

The two of customer requirements and the technical requirements will through the correlation analysis to test the rating weight of the variables that are currently found in the industries. The rating and the weight are based on the three scale (Weak, Moderate, Strong). The scale will use in the correlation analysis result and it is required in the house of the quality as a figure 2, for step 3, step 4 and step 5 in QFD. The purpose is to match every single item of variables selected in the table 1 and table 2 for develop a design in green practice for future improvement by the QFD development as a figure 3.

Table 1: The List and Abbreviations for HOWs Group

HOW	ABBREVIATIONS	GROUP
Cost and expenses	Ya1	Y
Reach the high business profitability	Ya2	
Widely apply new technology and integrated systems	Ya3	
Efficient business process management/activity operation	Ya4	
Cost and expenses	Ya5	
Good environment operation, such as pollution and waste prevention	Yb1	
High efforts in utilizing natural resources	Yb2	
High efforts in conserving natural resources	Yb3	
Efforts in natural resource regeneration, such as reuse	Yb4	
Effective energy utilization, such as fossil energy, bio energy	Yb5	
High satisfaction of customers and business partners in SCs	Yc1	
High efforts in social equity, such as salary, work load	Yc2	
High efforts in public benefits, such as training, welfare	Yc3	
Apply the optimization techniques or methodologies in SCs	Yd1	
Collaborative operations among facilities in SCs	Yd2	
High efforts of planning and conducting environment policy	Yd3	
High compliance in environment legislation	Yd4	

Table 2: The List and Abbreviations for WHATs Group

WHAT	ABBREVIATIONS	GROUP
Efficient communication	Xa1	X
Safe in work environment	Xa2	
High employee benefits	Xa3	
Least work pressures	Xa4	
Consumer Safety	Xb1	
Compliance in product	Xb2	
Least cost on product	Xb3	
Consumer health	Xb4	
Least operation cost	Xc1	
Good for collaboration	Xc2	
Competitive advantage	Xc3	
Good for globalization	Xc4	
Effective work process	Xc5	
Best return on investing	Xd1	
Good for public health	Xd2	
Good for public benefits	Xd3	
Human right protection	Xd4	

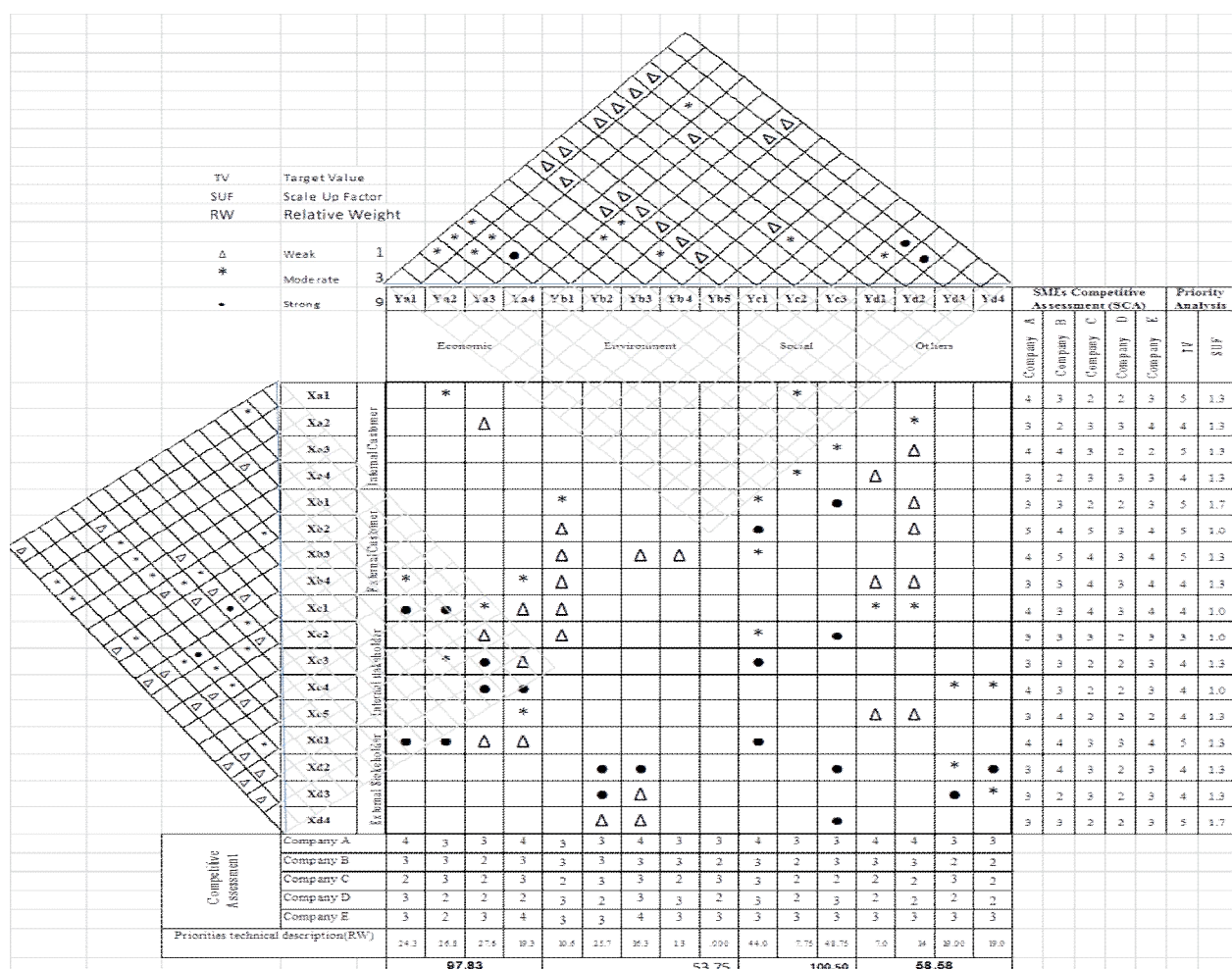


Figure 9: The Quality Function Deployment (QFD) Development for Green Practice

Describing the HOQ, the first column on the left side of the HOQ given above shows the customer's requirement in (X). The column next to the customer's requirement demonstrates rating (Average) given by the internal and external of the customer and stakeholder for the variables. The row on the top is the list of the technical requirements in (Y) by the expertise in environment and the expertise of the companies. The central part of the HOQ depicts the strength of relationship (Strong, Moderate, Weak) between customer's requirements and the technical requirements. The last column on the extreme right is weighted average calculated using the formula (Importance Average \times Sum of all the relationship strength) for the SMEs competitive analysis and the Priority analysis where the numeric scores for relationship strengths are assigned as: Strong = 9, Moderate = 3, Weak = 1. The roof of the house shows the internal relationship between the different courses.

Finally, based on the priority value from the process of "house of quality" done will use for the competitive analysis in SMEs between Technical requirement (Y) and Customers requirements (X) of the target value and the scale up factor value in the QFD. The conclusion from the process is on "related weight" for economic, environment, social, and others. It can be seen from the results of figure 5 that the relative weight of economic 97.83, 53.75 is environmental, 100.50 is social and 50.50 is in others. That means, based on the results of our surveys, social is more important followed by economic, environmental and others.

The attributes in Voice of Customer (VOC) to be put in the questionnaire. The data collected through the questionnaire shows that the expectation about Yc1, Yc2 and Yc3 of social factor was ranked as the most important skills that future green practice need to comply for meet the standard of GSCM. This factor must be considered seriously in the final green practice design. After the evaluation of the data collected from the three of it showed that are the most critical expectations and must be addressed in green practice of GSCM for the improvement.

5.CONCLUSION

With regard to the implication the statistical analysis in factor analysis and correlation analysis in QFD that was pointed out in the previous section of this essay, it is undeniable that different members behave differently and have their own strategies of cooperation. In this very specific matter of the green practice in a supply chain do come from a diverse range of levels of importance.

This study demonstrates the effectiveness of the application of this technique in manufacturing SMEs industries, and suggests to the industry an effective way green practice. This study describes the case of application of QFD to design an effective guideline in green practice based on GSCM for Malaysia's SMEs manufacturing industries. The results of the QFD suggested to emphasizing the four categories in the green practice. They are economic benefits, social benefits, environments concerns and others.

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