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Key performance indicator of sustainability in the Malaysian food supply chain

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Abstract. The food supply chain in Malaysia plays a significant function in the nation's economy. Since the industry is dominated by small and medium sized enterprises (SME), the local food supply chain must satisfy consumer demand. In order to help Malaysia to become more self-sufficient, improvements in the supply chain in terms of key performance indicators (KPIs) are important. However, it is common that strategic and operational KPIs are different and a disparity often exists between them. To be more successful for measuring the entire supply chain, the linkage of strategic objectives to operational objectives must be aligned to ensure the appropriate KPIs measure a proper connection between what they do and what the business achieves. The objective of this article is to propose a preliminary key indicator to measure sustainable performance within the perspective of Malaysian food supply chain. Key indicators have been summarized based on the previous researches focusing on the issue between 2007 until 2018. An overall of nine perspectives on sustainable performance measures in the food supply chain involved employee, supplier, health and safety, community, customer, cost effectiveness, quality, compliance and efficiency. These perspectives can be classified into three hierarchies; namely, strategic, tactical and operational. This paper proposes integration of key indicators as a starting point to evaluate the generic performance of Malaysia food supply chain.

1. Introduction

The food industry portrays a crucial part in supplying both essentials and necessities for sustaining various individual activities and behaviours [1,2]. Once harvested and manufactured, the food ought to be stored, distributed, then put on the market to reach the final customers by the due date [2]. According to the most current statistics announced by the Food and Agriculture Organization of the United Nations [3], each year, all around the world, 1.3 billion tonnes of food are “lost” or wasted. This number amounts to a third of total food produced for human ingestion. Two-thirds of the wasted food occurs in the supply chain, such as harvesting, shipping and storage [2,4]. Over the coming decades, the world population is expected to increase from 7.4 billion at the end of 2016 to 10.5 billion in 2050 [3]. To ensure a food supply for the increasing number of people, there is a need for expansion and intensification of agriculture and food production, which will put pressure on the environment and on societies [5,6].

According to previous researches [7,8], sustainability practices have turned out to be one of the highly critical factors affecting customer's judgments and decision-making activity. Besides, customer involvement refers to their feedback in terms of effort, acquaintance, time, or other types of sources associated to service production as well as distribution [9]. Research on customer engagement in sustainable supply chain management (SSCM) recently has stretched beyond the customers' role of purchasing sustainable product [10]. The level of customer involvement in food supply chain sustainability has expanded to social paired with functional role where customer involvement has been



driven by the customer's satisfaction or business interest in the past. Customers attitudes and behaviour involving satisfaction, loyalty and commitment to pay for premium or sustainable food are tending to be motivated by sustainable food supply chain. Recently, the concern with ethical, environmental and health issues amongst customers around the world are becoming increasing dramatically [11,12,13]. A heightened demand for green manufactured goods has also been stated with exclusive reference to food industries [14], and organic products in the Malaysia have also testified a growth in sales due to the same reasons [15].

Today, the food supply chain in Malaysia must remain strong enough to be competitive in the market with the changes of customer needs and trend. One of the alternatives is to implement and monitor a performance indicator of the supply chain, concentrating on sustainability and its dimensions of economy, environment and society. To ensure efficient and sustainable development, there is also a need for scientifically validated and accepted indicators that take into account all three aspects of sustainability – economics, environment and society – to reduce costs, protect the environment and help societies to improve their standard of living [16] besides the alignment of customer demand and behaviour to the performance indicators of the supply chain.

Recently the evaluation approaches are primarily dedicated on the strategic level and offer slight insight into tactical and operational levels, which are acknowledged as significant areas for accomplishing strategic alignment. Additionally, majority of the current approaches are experimented in large organisations and little research is undertaken to assess the effectiveness of these methods in small and medium enterprises (SMEs) [17]. The Malaysian food processing and production sector has not yet received due attention, even though it is a significant contributor to issues relating to global sustainability [18]. In addition, there is no method is available to enable the Malaysian food sector to evaluate its sustainability performance [19].

In order to evaluate the accomplishment of supply chains, a sufficient sustainable performance measurement system (SPMS) that consider customer needs and behaviour and align with strategic, tactical and operational levels to be developed [20]. Performance indicators occur to be as benchmarks where the performance in terms of services, products as well as correspondingly production practices are able to be assessed [20]. However, sparse literature is available focusing on alignment between strategic, tactical and operational levels for performance measures in organizations. This alignment is important for improving performance, enhancing efficiency and allowing organizations to be more competitive in their respective industries [17] as well as driven by the customer demand and behaviour [12, 13, 14]. The alignment of the three levels would contribute to a company's competitive strategies, but there is also no available research to assist in determining a set of performance measures to align these three levels in the Malaysian food supply chain together with the customer demand and behaviour. Therefore, this article aims to develop a key performance indicator, aligning strategic and operational levels and customer demand and behaviour in Malaysia in order to enable the whole supply chain to remain competitive in the market, from farmer/grower to end customer in terms of sustainability perspectives.

2. Existing food supply chain performance measure

A literature study was conducted to investigate the perspectives and indicators that are commonly used for evaluating performance around the context of food supply chain. Studies focusing in behaviour of customers regarding sustainability issues in purchasing food amongst customers are in dramatically increase trend whether in Malaysia [15] or developed countries [12, 13, 14]. The gap between the customer behaviour and performance indicators is there is no clear link to align them to make the performance indicators develop based on the customer needs. A summation of the general studies associated to food performance measures is shown in Table 1. It can be deduced that of the thirteen (13) articles, six (6) have categorised the employee and quality perspective as the most important aspect of a sustainable performance measure for the food supply chain.

Table 1. Summary of research perspectives on food sustainability performance measures.

Authors	Perspectives on food sustainability performance measures								
	Employee	Supplier	Health and Safety	Community	Customer	Cost Effectiveness	Quality	Compliance	Efficiency
N. Yakovleva (2007)	√								
Aramyan et al. (2007)							√		√
Carter and Rogers (2008)						√	√		
Baldwin (2009)	√	√	√				√		√
Hassini et al. (2012)		√							
Bloemhof et al. (2013)	√		√			√	√		√
Van der Vorst (2013)	√						√		
M. Bourlakis et al. (2014)					√	√	√		
Xu and Gursoy (2015)					√				
Ju and Chang (2016)					√				
Maestrini et al. (2017)	√					√			
Ahmad et al. (2017)	√	√		√	√	√	√		√
Rashid et al. (2017)			√	√				√	√

Therefore, the linkage with the customer behaviour with the sustainable food supply chain and its performance indicators is crucial especially on the Malaysian perspective.

2.1. Sustainability performance measures for the Malaysian food supply chain

Referring on the research review from former studies as shown in Table 1, this study has developed a conceptual framework of key performance indicators (KPI) for the Malaysian food supply chain. The conceptual framework of the KPIs consists of three main components; external factors, attitude and consumer behaviour and sustainability performance measurement with three main aspects which are social, economic and environmental. The external factors that may influence the attitude and consumer behaviour such as government policy [21], environmental degradation issues [21, 22], and social value [23]. While the attitude and consumer behaviour can categorize into five perspectives [15, 24] including performance, convenience and price sensitivity, reducing packaging waste, reusing/recycling, reducing carbon footprint and beneficial, safe and health to individual and community. Then, the nine perspectives of preliminary performance measurement of sustainable food supply chain is introduced as presented in Figure 1.

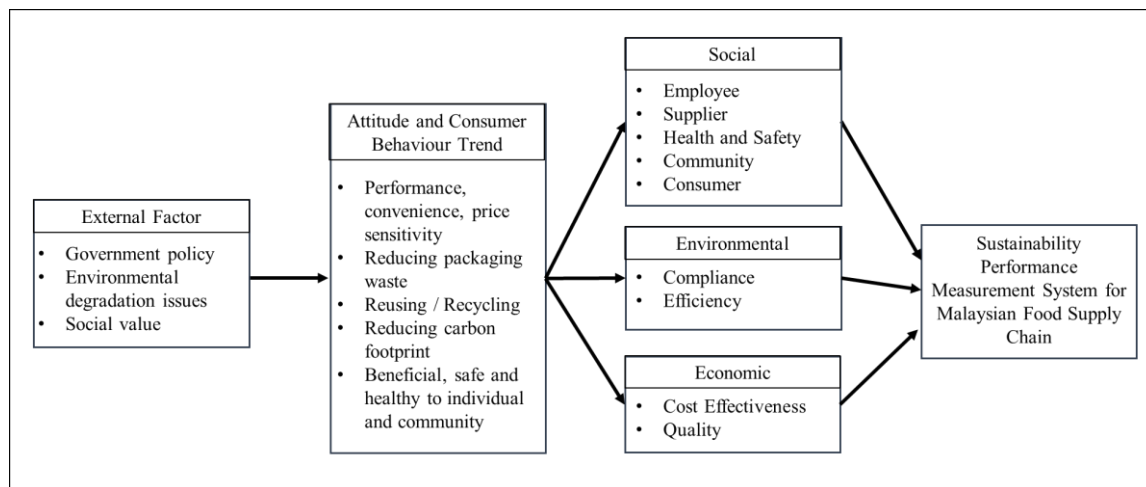


Figure 1. Preliminary key performance indicators for sustainable performance measures in the Malaysian food supply chain.

The KPI adopts a decision-making approach by dividing the indicators into three hierarchies; strategic, tactical and operational. It is believed that a balanced and integrated KPI benefits organizations by creating competitive advantage, essential for a sustainable organization. Moreover, a hierarchical manner will ensure that performance measures have direct linkage and a clear impact on business strategy and profit generation.

Finally, the preliminary KPI of the Sustainable Performance Measure for Malaysian Food Supply Chain is proposed with 113 indicators in total, which are categorized in the social, economic and environmental factors. These indicators were adopted and modified to fit the KPI based on relevant literature in Table 1 and attitude and customer behaviour that influenced by external factors.

Table 2 presents the social dimension of the preliminary key performance indicators of the sustainable performance measurements for the Malaysian Food Supply Chain. In this dimension, five perspectives namely; employee, supplier, health and safety, community and customer are introduced. These perspectives consist of 52 indicators and are categorized into strategic, tactical and operational aspects.

Table 2. Social dimension of preliminary key performance indicators for a sustainable performance measure for the Malaysian food supply chain.

SOCIAL FACTOR		
STRATEGIC	TACTICAL	OPERATIONAL
Employee Perspective		
Learning and Growth	Skill development	Improved employee education and skills Training per employee Sustainability training
Recruitment program	Human rights observance	Fair pay systems Male-female ratio
Employee satisfaction	Employee well-being	Turn-over rate Absence

SOCIAL FACTOR		
STRATEGIC	TACTICAL	OPERATIONAL
Supplier Perspective		
Supplier relation	Improved supplier commitment	Percentage of suppliers with up-to-date sustainable development policies
		Increase certified suppliers with ISO certification
	Percentage of contracts with provincial suppliers	Utilize local supplier
	Percentage of purchase orders placed with Aboriginal companies	Strengthen relationship with aboriginal people.
Health and Safety Perspective		
Increased public health and safety practices	Follow guidelines for Good Manufacturing Practice (GMP)	
Increased occupational health and safety	Improved work environment	
	Improved work safety	Number of accidents
Community Perspective		
Community well-being	Community Projects	Number of community projects
	Environmental fines	Number of fines received
Customer Perspective		
Customer well-being/Customer Satisfaction	Customer satisfaction rate	Customer complaints
	Health and safety assessment of products	Product recall
	Customer Loyalty	Positive Recommendation of product to others
		Repurchasing product
	Customer willingness to pay	Willing to pay premium/ pay more to buy sustainable product
Sustainable food preparation	Sustainable food ingredients	Use certified organic vegetables
		Use environment friendly fed meats and dairy products
		Use on-site food produce
Food service organization	Green Packaging	No disposable food service item
		Disposable food service items for reusable or recycled materials
		Disposable food service items for bio-based materials

Conversely, Table 3 presents the economic dimension of the preliminary key performance indicators of sustainable performance measures for the Malaysian Food Supply. This dimension shows another 2 perspectives; specifically, cost effectiveness and quality. These perspectives consist of 48 indicators, also classified into strategic, tactical and operational aspects.

Table 3. Economic Factor of Preliminary Key Performance Indicators of Sustainable Performance Measures for the Malaysian Food Supply Chain.

ECONOMIC FACTOR		
STRATEGIC	TACTICAL	OPERATIONAL
Cost Effectiveness Perspective		
Manufacturing budget	Operational and capital cost	
	Raw Material cost	Total purchase of raw material
	Labor cost	Average wage Overtime
Distribution budget	Transportation cost	Average travel cost per shipment Average fuel consumption cost per shipment
	Handling cost	Average handling cost in warehouse
	Storage cost	Average holding cost in warehouse
	Transaction cost	
	Delivery cost	Average delivery cost of shipment
Quality Perspective		
Food quality	Appearance	Color Size and form Firmness Lack of blemishes and damage Taste
	Shelf life	
	Product safety and health	Salubrity Product safety
	Product reliability	Ratio of actual product composition and product description
Process quality	Production system characteristic	Traceability Storage condition Transport condition Working condition
	Environmental aspect	Energy usage Water usage Pesticide usage Recycling/reuse
Packaging quality	Labeling	Clearer product information
	Safety	Material used
		Types of food to be pack

Finally, 13 indicators for the environmental aspect are presented in Table 4. The measures demonstrate two perspectives namely; compliance and efficiency. Indicators in the environmental aspect are also alienated into three hierarchies; strategic, tactical and operational.

Table 4. Environmental factors of preliminary key performance indicators of sustainable performance measures for the Malaysian food supply chain.

ENVIRONMENTAL FACTORS		
STRATEGIC	TACTICAL	OPERATIONAL
Compliance Perspective		
Compliance with regulations	Improved compliance with environmental standards	Qualified by professional body
Efficiency perspective		
Eco-efficiency	Resource consumption	Reduced water usage Reduced waste water emission Reduced energy consumption Reduced non-renewable resources usage Reduced hazardous inputs usage Reduced solid waste Land use Reduced emission of polluting gases

3. Discussion and conclusions

This study has explored available sustainability perspectives and indicators, focusing on the Malaysian food supply chain. These indicators are divided, in a balanced manner, into three factors of sustainability namely; social, economic and environmental, and simultaneously cascaded into three hierarchies; specifically, strategic, tactical and operational which generated from customer demand attitude and behaviour as well as external factors. This is a generic classification, which could be used together with an in-depth organization analysis as a basis for improving business strategies and profit generation.

On the other hand, this study proposes nine (9) perspectives of sustainable performance measures, which can contribute to improved performance of the Malaysian food supply chain. A questionnaire survey are planned to be carried out to collect data from the customer to derive their attitude and behaviour that will be aligned with the perspective of supply chain players in food industries for the conclusive arrangement of key performance measures specially tailored for the Malaysian food supply chain.

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