Measuring Supply Chain Using SCOR Model in Palm Oil Downstream Industry: A Review

Fitra Lestari, Kamariah Ismail, Abubakar Abdul Hamid,Eko Supriyanto,Hisbunnazar,Wahyudi Sutupo

Abstract—**Aim** of this research is review of methods for measuring supply chain performance in the palm oil downstream industry. To establish a method, it will require process mapping on overall business process in the palm oil supply chain. Case study is conducted on Malaysian palm oil industry. This paper shows mapping of business processes in the palm oil downstream industry involving industry of crushings, refineries and oleochemicals. Then, finding is SCOR model more suitable to measure supply chain performance in this case. Further research is required to test into case study in the palm oil downstream industry in order to validate indicators that will be made. It is necessary to note that this article provides the gap of knowledge to show a method for measuring supply chain performance in the palm oil downstream industry based on case study in the Malaysian palm oil industry.

Index Terms—**supply chain, process mapping, palm oil, downstream industry, SCOR model**

I. INTRODUCTION

PALM oil industry has the high complexity of the business chain. These business processes are initiated from plantation, and then processed by the processing industries, distributed to industry of product developers that produce diverse products until the end user as customer. Therefore, this business has networked in different processes and activities in order to bring products and services to the market with the purpose of customer satisfaction and shareholder value [1]. These industries consist of many businesses along the supply chain involving plantations, millings, refineries, and oleochemicals [2].

Data export palm oil in Malaysia shows there is an increasing number of export to several countries to 33% from 2011-2012. Nevertheless, in this year there are also

increasing four local industries that produce oil palm derivative products [3]. This shows that the inability of the local industry that is represented by a network of supply chain to increase the value added of the oil derived products. It is necessary to techniques for measuring supply chain performance in the local industry.

Supply chain performance measurement can be done by mapping the business activities between suppliers, manufacture and customers. Mapping of the business flow in palm oil industry is necessary; therefore, it requires of linkage among of stakeholders that operate within it [4]. Currently, most research on supply chains in palm oil sector is developing models for designing supply chain networks for local and international markets [5], [6]. Nevertheless, stakeholders are difficult to map the palm oil industry because the sequencing of relationship among entities in supply chain process becomes one of the critical barriers in achieving the supply chain integration [7]. Thus, it caused the difference in perception of the business process in palm oil industry.

Furthermore, there are several methods for measuring supply chain performance. Nevertheless, the research found that the supply chain strategy was used for different constructs for different country because the manager has different perceptions and cultures on how to arrange a strategy for its organization [8]. Previous studies have shown that different industry may also have a different effect on supply chain management practices [9], [10]. To solve these problems, the decision maker should find fitting on these approaches and models based on respective business processes. In addition, the relationship between the members of a supply chain becomes one of the important barriers in achieving the supply chain integration. It is important to see the integration aspects between the members of the supply chain [11]. This paper aims to review several methods in order to find the suitable approach to measuring supply chain in the palm oil downstream industry.

II. PROCESS MAPPING IN PALM OIL SUPPLY CHAIN

Process mapping will be developed focusing on case study approach on the Malaysian Palm Oil industry. Data of process mapping are collected based on Malaysian Palm Oil Board (MPOB) annual report for the year 2012.

A. Stage One: Understanding Business Process

Process mapping will be developed focusing on case study approach on the Malaysian Palm Oil industry. Understanding the first stage is used as guidelines in developing business process in palm oil industry from

upstream to downstream. In the upstream sector, Malaysia has a plantation area of palm oil covering 5.076.929 hectares comprising of 50.39 % hectares Peninsular Malaysia and Sarawak-Sabah of 49.61% hectares. In addition, the area has produced 85.74% and approximately 14.26% of the rest are waiting for the harvest. The actors in the Malaysian palm oil industry involve public, private sector and independent smallholders [12]. Fresh fruit bunch (FFB) is the main product in palm oil plantation which it will be brought to the milling process. This process produces some derivative products that can be developed to give added value to the customer. Furthermore, milling process can be elaborated to become several products such as Crude Palm Oil (CPO), Kernel, Empty Bunch, Shell and Fiber [13], [14].

In the downstream sector, the yield of oil palm from the milling process is later taken for processing industries. According to Belai et al. [15], Palm Kernel is processed by crushing industry to produce Crude Palm Kernel Oil (CPKO) and other byproducts such as Palm Kernel Cake can be directly sold as animal feed. Then, the yield of oil such as CPO and CPKO are processed in the refining industry to produce Refined Bleached and Deodorized Palm Oil (RBDPO). Refinery industry also produces RBDP Stearin and RBDP Olein. On the other hand, RBDPO is processed by Oleochemical industry to produce Palm Fatty Acid Distillate (PFAD). Not all CPO products were produced by refineries, but part of them through the fractionation processes that produce Crude Palm Olein and Crude Palm Stearin.

Export and import of palm oil derivatives products use shipping services [16]. Thus, there are a number of companies that used the port distribution center for the export of palm oil derivative products to the market internationally. In addition, Malaysia is not only targeting the international market, but also palm oil derivative products are traded in the local market to stimulate local industry. These products will be processed by the developed countries to retail businesses such as food products, chemical industry, personal care products, animal feed, cleaning products and several sources of energy [17].

B. Stage Two: Developing Supply Chain Structure

Supply chain structure is built based on the sequence process that occurs in the palm oil industry. The structures are arranged into the block diagram and assisted by arrows that show the direction of the relationship of activity in the system. In addition, the arrows indicate the flow of products that describe the movement from one operation to another operation. Furthermore, block diagrams that have been linked to the business processes will be compiled with the attributes of the data.

On the other hand, Malaysian palm oil industry more uses motor transportation than other facilities in domestic market. Infrastructure like the road is used to ship goods into several areas. However, motor shipment across multinational boundaries involves a number of different import regulations. Another facility of shipping on logistic infrastructure is ocean transportation that is used to activity of export and import. Malaysia has some bigger ports that will support on shipping activity to other countries. In this case, an arrow which notes in red line is transportation using ocean. While, motor transport will be shown using black line. Shipping uses other transportations such as air and rail on the palm oil industry in Malaysia just a few cases. Consequently, these transportations are ignored within the process mapping.

C. Stage Three: Data Collection of Supply Chain

These data depend on forecasting of palm oil demand in the local market and international. Entities on business process in palm oil industry involving plantations, millings, crushings, refineries, oleochemicals, and distribution to the market. It also describes that Malaysia has six categories of player in palm oil industry. Private estates have the highest land area in Malaysia around 62 %. Then, several numbers of industries in Malaysia are 429 millings, 46 crushings, 54 refineries, and 17 oleochemicals. Processing industry in the export sector is supported by the port as shipping service. In Malaysia, there are the big five ports such as Butterworth, Port Klang, Pasir Gudang, Lahat Datu and Sandakan. Most destinations exporting of oil palm products are delivered to developed country such as China, India and Netherlands.

D. Stage Four: Developing Whole Chain into a Map

The data of the entire operation drafted into a map after the mapping structure of the business processes is done. This map shows the overall business activity from upstream to downstream. Then, each entity is given data attributes involving data of industry capacity, area plantation, and type of product in the processing industry. The overall operation of the supply chain will be described in the form of a rich picture diagram. The results of process mapping produce a set of activities that are interlinked in a business chain. The finding of this process mapping in the Malaysian palm oil industry for the year 2012 can be shown in figure 1.

E. Stage Six: Identify Issue and Competitiveness

Final map can be used as tools to identify problems that are happening in the business chain. Several issues are obtained from this method. The results of the process mapping showed that Malaysia still focuses on upstream industries. The two main islands in Malaysia involving Peninsular Malaysia and Sarawak Sabah are used as area for palm oil plantation. Almost all states planted palm oil trees while the number of palm oil downstream industries in Malaysia is still limited. In addition, Malaysia exported more palm oil to several countries that could transform oil into finished goods to retail businesses. Then, it also shows that some industries in Malaysia are still imported from various countries. It means there is a shortage of palm oil feedstock.

In the future, downstream industry in Malaysia can compete in the global market because industries of palm oil derivative products have been clustered into specific product and produce into final products. For instance, many local industries produces cooking oil. As known, Malaysia has a lot of product cooking oil circulating in the market that comes from other sources than oil palm. It is also necessary to answer the question of how measure supply chain performance in Malaysian palm oil downstream industry.
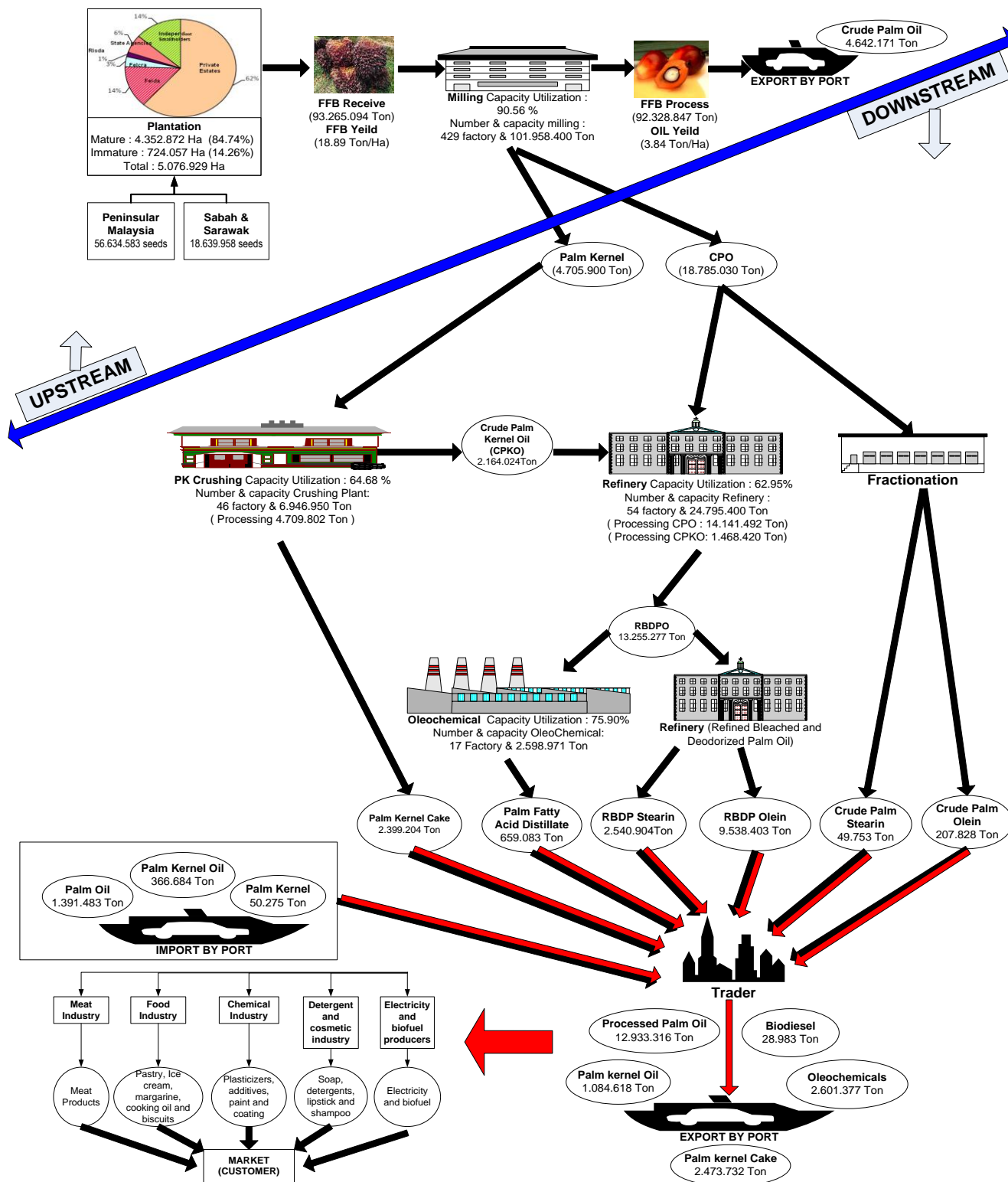
Fig. 1. Rich picture diagram of process mapping Malaysian palm oil industry

III. MEASURING SUPPLY CHAIN PERFORMANCE

Nowadays, there are several approaches that have been used by researchers in measuring supply chain performance. This paper will try to review supply chain performance measurements on several case studies that have investigated such as Balanced Scorecard (BSC), Total Quality Management (TQM), Economic Value Analysis (EVA), Activity-Based Costing (ABC) and Supply Chain Operations Reference (SCOR).

The balanced scorecard framework was made by Kaplan and Norton in 1992. This method aims to measure performance based on four perspectives: financial, customer, internal business and innovation and learning. Several case studies empirically in the different system show implementation of BSC relevant financial and non-financial indicators. Then, it can also achieve the vision and mission of the organization's strategy in order to run the business more measurable [18], [19]. Nevertheless, several case

studies concluded that the indicators were not suitable to be generalized in other case studies, although some extrapolations can be made [20]. In addition, the method of measuring performance using the BSC does not have a standard in business process reengineering. Therefore, this method is much more being applied to measure the performance of the overall system which includes not only strategic in the supply chain.

Total quality management was adopted by the Japan Company, which focuses on performance measurement based on quality of product and customer satisfaction. All entities within the organization will be pushed to implement continues improvement into a supply chain quality that began from design to manufacturing, then factory to retailers and to deliver to end customers [21]. Moreover, Measurement of the supply chain using TQM aims to measure, analyze and improve the goal of the business process in form products, services, and processes by creating value for customers [22]. TQM in supply chain considers its application in real life. Applying TQM and SCM seem to be clear, but the results are somehow unclear and difficult to figure out. Based on a case study in Indian cement manufacturing, it shows very weak correlation between SCM and TQM. This indicates that it has not leveraged these tools effectively and efficiently [23]. Therefore, TQM focuses on quality of product and customer satisfaction thus the difficulty in implementing this method.

There is other approaches focus on financial data, such as Economic Value Added (EVA) and Activity Based Costing (ABC). Based on a case study in packaging industry using EVA, accounting data were required in order to achieve more accurate results and contribute to measure performance within the value-based management approach. This method measure the overall financial value of supply chain performance in a company. Nevertheless, EVA should account the capital markets, which shareholders as well as investors because it is important to justify investments in supply chain management with the company value. Thus, senior executives' base their decisions not only on financial data [24]. In other hand, ABC considers the cost driver which the method is not suitable for non-financial measurement. This technique more time consuming in collecting cost data and disruption of management decision making [25]. The strength of ABC method can determine the costs of operations and pursue the objective of providing desired customer service at the least total cost [26].

Supply Chain Operations Reference (SCOR) was built by the Supply Chain Council (SCC) as a tool to diagnose the business activities in supply chain management. This method is used to investigate the relationship between suppliers, manufacture and customers. So, this method is not suitable for use in simple business process [27]. Based on research in oil producing company in Iran, SCOR models can reengineering and improve the effectiveness of supply chain that includes business process, metrics, best practices and technology [28]. However, improving the system in measuring performance needed some suitable metrics or indicators in representing the real system. In addition, the reengineering process is based on of the stages that have standardized on Plan, Make, Source, Deliver and Return [29]. Comparison of methods for measuring the supply chain performance is necessary to determine the appropriate method in solving the problem in the palm oil downstream industry.

IV. DISCUSSION

According to process mapping in palm oil supply chain, it shows that downstream industries involve crushings, refineries and oleochemicals. This industry has feedstock dependence of the milling process and use of port facilities to deliver the final products. Profit from the final products in downstream industries affected by the industry's ability to transform the oil into products that has high value of the goods. Currently, palm oil downstream industry export processed oil palm in developed countries. It is an open question whether the local industry in Malaysia capable of producing final products that is acceptable in the international market. It makes the business of palm oil downstream industry has become more complex. Thus, it required to propose a method to measure downstream industry based on supply chain performance. Performance measurement will be based on the relationship of business process in the downstream industry that is classified into the categories of suppliers, manufacturing and customers. Then, this relationship will be elaborate become indicators that will be measured.

All of the above methods have outlined some approaches in measuring supply chain performance based on strength and limitations in implementing into a case study. When this method is compiled in the case study in the palm oil downstream industry, there are some considerations that will be taken to measure the supply chain performance. The suitable approach to measure supply chain performance in the palm oil downstream industry is using the SCOR method. Therefore, this method can be measured when they are represented by several indicators based on activity between suppliers, manufacturer and the customer. Then, selection of indicators can be clustered into basic performance measurement. In addition, these entities have the similar process within crushing, refineries and oleochemical that include business process reengineering into the Plan, Source, Make, Deliver and Return.

The plan represents the planning activities that used in achieving corporate targets for balancing supply and demand of products. Palm oil downstream industries have the main raw material from milling process which will produce CPO and kernel as palm oil derived products. Source represents suppliers that will supply raw material to the industry. Then, process transformation of raw materials into finished products will be represented by Make. It is identical to enhance the value added product. Deliver is a process to distribute and deliver finished products to the customer. If there is customer complaints about product of reject, defect, and repair, the product will be returned to the industry. This process is represented by Return. Application of SCOR Model in the palm oil downstream industry can be seen in figure 2.
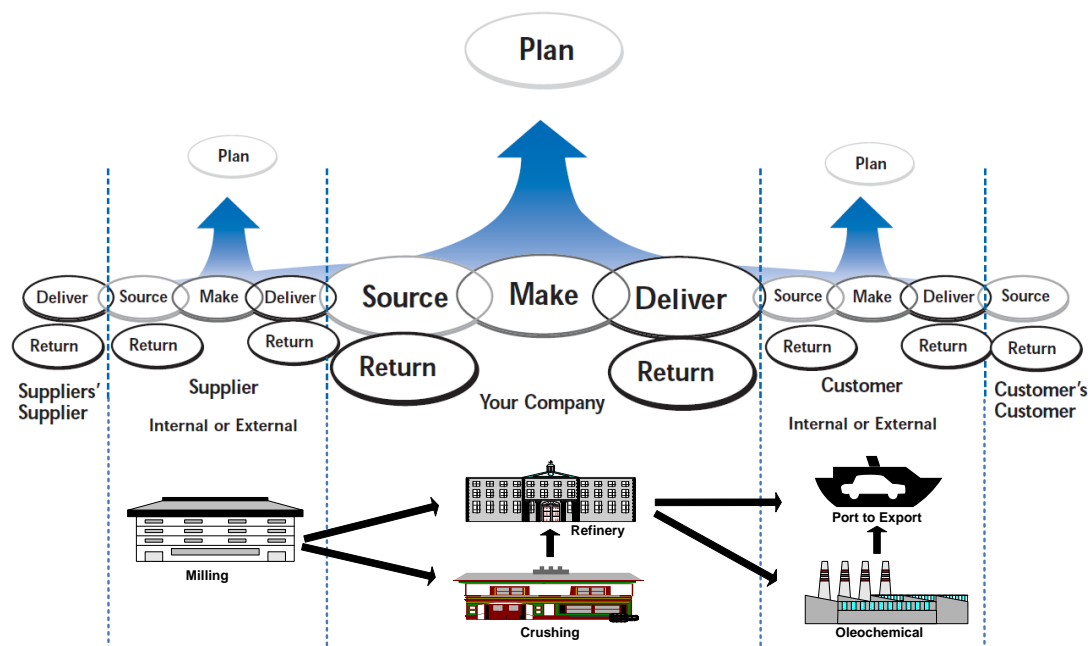
Fig. 2. Application of SCOR model in palm oil downstream industry

V. CONCLUSION

This paper described supply chain in the palm oil business through process mapping from upstream to downstream. In addition, it summarizes the result of literature review on measuring supply chain performance using five existing methods. The main contribution of this paper proposes a technique for measuring supply chain performance in the palm oil downstream industry involving industry of crushings, refineries and oleochemicals. This research justifies that SCOR model more suitable to implement in this case. Therefore, SCOR model can be reengineering of business processes based on relationships among entities such as suppliers, manufacturing and customers. In addition, supply chain performance will be measured using the step as Plan, Source, Make, Deliver and Return to develop key performance indicator.

Further research will test into a case study with collecting the data that related to business process reengineering in the palm oil downstream industry. Furthermore, it would be built several indicators to measure supply chain performance into a model. Finally, the models will be validated in order to determine whether indicators represent the real case.

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