

# Uncertain Supply Chain Management

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## Supply chain relationship in a downstream sector

Fitra Lestari<sup>a\*</sup>, Rahmad Kurniawan<sup>a</sup>, Kamariah Ismail<sup>b</sup> and Abu Bakar Abdul Hamid<sup>c</sup>

<sup>a</sup>Department of Industrial Engineering, Sultan Syarif Kasim State Islamic University, Indonesia

<sup>b</sup>Faculty Management, University Technology Malaysia, Malaysia

<sup>c</sup>Putra Business School, University Putra Malaysia, Malaysia

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### ABSTRACT

The purpose of this paper is to provide a method of process reference to supply chain relationships in a downstream sector. It serves as a tool to analyze collaboration between entities in the supply chain strategy. The study is categorized into the case study research in Malaysian oil palm refineries. The data collection is accomplished through semi-structured interview using snowball sampling and observation by visiting four oil palm refineries based on selecting non probability sampling technique through purposive personal judgment. Most of downstream industries select produced end products with the aim of getting greater margins. Nevertheless, a process reference analyzes that the downstream industry distributes semi-finished products to the international market than producing end products in the local market. There are the effects of supply chain relationships between upstream and downstream. Furthermore, entities that have the high dependencies tend to follow the strategy of the dominant entities consequently network of business process driven by the strong entities. The result gives implication to leverage SCOR model for analyzing the supply chain relationships between entities. It can be applied to any industry that decide the effective collaboration with their supplier, distributor and buyer.

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## 1. Introduction

Supply chain strategy has the larger issue that is conducted in the business process because there are a lot of collaboration between entities within the system. Lorentz et al. (2012) conducted the overall process in supply chain strategy where it was divided into upstream and downstream sector because these sectors mutually influenced each entity. In addition, collaboration between entities tend to cluster supply chain strategy based on push upstream activity and pull downstream activity (NG & Chung, 2008). The dependency between upstream and downstream sector include providing raw material by the supplier to deliver finished products to end customer. Especially for downstream sector, according to Chima and Hills (2007) and Mentzer et al. (2001), the collaboration not only exists between entities within this sector, but also it almost depends on upstream activity.

Guan and Rehme (2012) investigated the effect of driving forces and consequences of vertical integration between upstream and downstream sector. They found the vertical integration decision

\* Corresponding author

E-mail address: [fitra.lestari@uin-suska.ac.id](mailto:fitra.lestari@uin-suska.ac.id) (F. Lestari)

given strategic positions and value to supply chain actors. Kähkönen (2014) revealed that collaboration existed between the entities with power position in the network. Therefore, it gives consideration to the entity in order to keep or remove into their network. Moreover, the effective collaboration can enhance productivity to improve the business processes (Hwang & Seruga, 2011). Thus, to optimize the collaboration, there is a need to analyze the relationship between entities in supply chain strategy.

Supply chain downstream sector requires to maintain the supply chain strategy. Circita and Glaser-segura (2012) provided a standard framework to assess internal performance in the downstream supply chain. Nevertheless, the limitation of this study has shown that the firms are using performance matrix independently of the decision to coordinate the activity. In addition, Demeter et al. (2006) revealed that the effect of supply chain strategy within an industry influenced the overall entities and then determine the configuration of business process.

This study is an evident from the previous research that rarely consensus has been reached on how effect of supply chain strategy in an industry decide the collaboration within downstream sector. Thus, to fulfill of gap research, the purpose of this study is to provide a method of process reference to supply chain relationships in a downstream sector. It emphasizes the collaboration among the entities involving supplier, manufacturer and customer in business process.

The structure of this paper is as follows: in the next section, the main concept of supply chain relationships relevant to the topic is summarized. Then, a description of research design and case study are explained. The findings of the study for the data analysis are examined. Finally, discussion, implication and suggestions for future research are concluded the paper.

### *1.1 Supply Chain Relationship in Downstream Sector*

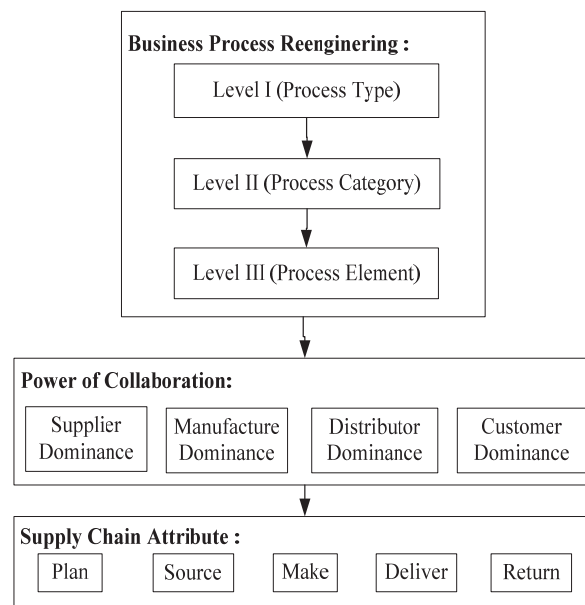
The relationship between entities needs adopting efficient strategies in order to determine the optimal supply chain in business process. Most of the studies indicate that stakeholders should optimized the relationships in the business process by analyzing supply chain strategy (Naslund & Williamson, 2010; Cetinkaya, 2011; Masoumik et al., 2014). In addition, Li et al. (2006) revealed the implementation of supply chain strategy and considered the relationship between entities to improve the system. These studies focused on downstream industries to analyze the supply chain strategy which is directed based on the relationship between entities. Therefore, entities in the downstream sector depend on entities on the upstream sector into a supply chain strategy. Moreover, the major issue in downstream industry is complexity of solving the optimal production problem from incoming raw material to end product dispatch (Tahar & Abduljabbar, 2010). They analyzed the relationships between entities in supply chain strategy (Lejeune & Yakova, 2005; Swaminathan et al., 1998).

### *1.2 Process reference*

Most of the studies conducted supply chain strategy used Supply Chain Operation Reference (SCOR) proposed by the Supply Chain Council. This technique commonly has been used by corporations because it adopted process modeling and performance measurement (Persson & Araldi, 2009). Nevertheless, few studies used SCOR to analyze the relationship between the entities. Thus, there is a need for analyzing the supply chain relationship through SCOR model. The early step of supply chain relationship required to identify the existing system in business process through the business process reengineering combined with a networking (Groznik & Maslaric, 2010). Furthermore, the SCOR model consists of several main processes involving planning, supply of raw material, the transformation product, delivery product and the level of customer satisfaction. Huang et al. (2005) found that the supply chain strategy of existing systems using the SCOR model was developed through a computer-assisted configuration tool. Their case demonstrated some tools with a manufacturing facility of a company. Thus, it does not cover the interactions among multiple manufacturing facilities and cannot analysis the overall supply chain strategy. Industries in downstream sector have different operational strategies in production, although they have similarity in their core businesses. Therefore, operational

strategies in production are influenced by the entities in a business process (Benton & Maloni, 2005; Roberto & Dalcol, 2009). Most of the studies on supply chain strategy only considered production based ordering process (Sharma et al., 2013; Guo & Tang, 2008). Furthermore, the particular operational strategy influences supply chain relationship with their supplier and customer. Lee and Whang (2000) conducted supply chain strategy in terms of the buyer-supplier relationships. They found the type of relationship profile between supplier, manufacturer and customer where the collaboration between entities indicated that there was dominance from an entity to other entities. Thus, this research also requires exploring some of operational strategies in the downstream sector.

The supply chain relationships in the downstream sector require analyzing through several performance indicators. According to Georgise et al. (2013), the SCOR model developed process modeling of business process into several levels. It aims to systematically measure the supply chain strategy based on performance indicators that have been set into attributes. They determine the supply chain attributes involving reliability, responsiveness, flexibility, cost and assets. Not all businesses within the supply chain strategy can be evaluated using these attributes. Thus, identifying the appropriate supply chain attributes in a system needs to be considered. Rabelo et al. (2007) conducted value chain analysis using the SCOR model to measure the integration of supply chain performance. The finding showed the proposed model was categorized into four attributes involving profitability, responsiveness, customer satisfaction and political stability. As a result, the SCOR model has some parameters depending on the system that will be improved. The complexity of supply chain strategy makes drawing performance indicators to be a heavy task. Nevertheless, the previous studies have been conducted this method, according to the SCOR model: plan, source, make, deliver or return that can be seen in Table 1. Thus, this study needs to identify appropriate supply chain attributes for defining supply chain relationship in the downstream sector. Empirical study of supply chain relationships in the downstream sector using the SCOR model requires to prove as it is shown on Fig. 1. To fill the gap of the research in this study, several objectives are made. The first objective is to find the relationships between entities in the downstream sector through business process reengineering. Then, the second objective is continued for deciding supply chain attributes. Finally, the results provide the power of collaboration that are caused by correlation between supply chain strategy and its attributes.



**Fig.1.** Supply chain relationship using SCOR model

**Table 1****Performance indicator of supply chain strategy in previous literature**

Category	Performance Indicator	Definition of Supply chain relationship	A	B	C	D	E	F	G
<b>Plan</b>	Perfect order fulfillment	Ability of order fulfillment to meet customer requirement			•	•		•	•
	Total supply chain management cost	The cost associated with operating the supply chain			•		•	•	•
	Total supply chain cycle time	Time to fill order whenever low the inventory level	•		•			•	•
	Accuracy of forecasting techniques	Ability to keep production schedule and make what the market will accept	•	•	•	•			
	Order lead time	Time between the receipt of the customer's order and the delivery of the goods	•	•					•
	Order entry method	Technique to convert the customer specification into useful information and affect the scheduling of all activities	•						•
	Customer order path	Ability to eliminate the time that is spent in different routes and also non-value adding activities	•	•	•				
<b>Source</b>	Purchase order cycle time	The average cycle time of a fragment of a procure-to-pay process	•		•				•
	Supplier Lead time	The interval of time until the supplier or manufacturer can actually ship product	•	•	•				•
	Purchase order procedure	A step toward making all budget holders accountable for their actions while purchasing goods	•		•				
	Supplier Fill Rate	Supplier's ability to fill orders completely during a definite period of time		•		•	•	•	
	Total Supply Cost	Costs related to supply planning, supplier management, and procurement execution over a defined period of time		•		•		•	•
	Shipping Accuracy	Ability to measure the accuracy of shipments in terms of the products and quantities shipped		•		•	•	•	•
	% Orders with Products on Back Order	The percentage of orders which the supplier did not have sufficient stock on hand and had to back order products during a defined period of time		•		•	•		•
<b>Make</b>	Storage resource	The total storage space actually being used out of the total storage space available		•				•	
	Manufacturing cost	Total cost of manufacturing, including labor, maintenance, and re-work costs				•	•	•	•
	Manufacturing lead time	The total amount of time required to produce a particular item or batch			•	•	•		•
	Inventory Velocity	The average amount of time a product remains in inventory		•	•		•		
	Capacity utilization	Ability to affect the speed of response to customer demand through its impact on flexibility, lead time and deliverability	•			•			
	Effectiveness of scheduling techniques	Activities that are undertaken to manage resources that will flow in an operating system effectively	•		•	•	•		
	Percentage of rejecting the product	The percentage waste of wrong products made after the product to be finished goods	•					•	
<b>Deliver</b>	Value of Product Damaged in the Warehouse	The value of products damaged during a defined period of time in the warehouse		•	•	•			•
	Distribution cost	Total cost of distribution, including transportation and handling costs		•	•		•	•	•
	Average Delivery Time	The average transit time from a shipment leaves a facility until it arrives at its destination	•	•				•	
	Product lateness	Delivery date minus due date				•	•		
	Number of on time delivery	Enabling the buyer's organization to meet its customer service commitments	•		•		•	•	•
	% Shipments Arriving in Good Condition	The percentage of shipments arrive in good condition without damage to the products during a defined period of time		•	•				
	Stock Keeping Units Fill Rate	Customer's order that is filled on the first shipment and has implications for transportation efficiency		•		•	•	•	•
<b>Return</b>	Return process cost/warranty	The cost of repairing or replacing previously sold products during their warranty periods		•		•		•	•
	Return Shipments Shipped on Time	Effective method to manage returns efficiently and satisfy to customers' requirement for fast and easy returns			•	•			
	Customer Response Time	The amount of time that are required from the time an order is placed until the time the order is received by the customer			•		•	•	•
	The post transaction activities	Part of customer service and provide valuable feedback for further improvements in the supply chain	•					•	
	Flexibility service system	The capability to provide products that meet the demands of customers				•	•	•	•
	Rate of complaints	The number of customer complaints registered			•		•		
	The customer query time	The time, which it takes for a firm to respond to a customer inquiry with the required information	•					•	•

Note: A= Gunasekaran et al., 2004; B= Aronovich et al, 2010; C= Lockamy and McCormack, 2004; D= Cohen and Roussel, 2005; E= Beamon, 1999; F=Sarode and Khodke, 2009; G= Cirtita and Glaser-Segura, 2012.

## 2. Material and Methods

The study attempts to understand some larger reality of supply chain relationships in the downstream sector by examining a reality within the contextual model. Empirical study of this research accomplished at Malaysian oil palm refineries because these industries directly obtain the input of

upstream sectors and have the collaboration with overall entities in the oil palm downstream sector. In addition, the refineries also have different supply chain strategies to run the business process. Thus, the result shows how a process reference define supply chain relationships in the downstream sector.

### *2.1. Research design*

Research design in this study is the guide in collecting and analyzing data. This study needs understanding of business process that is obtained by perspectives from the human being whose participants can share their individual experiences. Furthermore, to achieve meaning of participants, it requires social interaction with the human community to build the theoretical paradigms in order to generalize the finding on supply chain relationship in the downstream sector (Creswell, 2009; Mackenzie & Knipe, 2006). According to Font et al. (2008) to obtain better understanding on the ideas and get insights, the study learned a lot on how to explore the phenomenon through existing records and propose a concept before implementing in the system. Therefore, the direct implementation of the methodology has very costly endeavors (Rudder et al., 2001). There are a lot of oil palm refineries in Malaysia that collaborate with other entities from upstream to downstream sector. Thus, this study was categorized into case study research where a strategy of inquiry explored in depth a program, event, activity and process in order to obtain the data collection within the real life (Yin, 2003). In addition, case study research was an intensive study of the selected cases on the current phenomenon drawn from multiple sources of evidence on primary or secondary sources (Darke et al., 1998; Rowley, 2002). Procedure of data collection in this research focused on open-ended interview and observations because this method provided opportunities to listen directly the ideas and opinions of the stakeholders. The result was a model to define supply chain relationship that was obtained from understanding's people meaning through an investigation of qualitative research. Greenhalgh and Taylor (1997) revealed that qualitative research began with an idea accomplished through generating data and allows a conclusion to be drawn.

Sampling approach in this study influence a set of choices in conducting case study research because it is affected by the determination of the type and number cases. In addition, these include how many cases are to be used in case selection and sampling. Voss et al. (2002) revealed that the fewer the number of cases given, the greater the opportunity for depth of observation. The use of multiple than single case research was likely to develop more robust (Eisenhardt & Graebner, 2007). Nevertheless, single case had weakness on the generalizability of the conclusions drawn (Dyer & Wilkins, 1991). This research required multiple case studies to conduct the current phenomenon that was obtained from multiple sources of evidence. Therefore, this study needs to generalize exceeding the immediate case study and help guard against observer bias. Yin (2003) suggested that 6 – 10 cases were sufficient to generalize the case study if the results turn out as predicted. Eisenhardt (1989) suggested 4 – 10 cases usually work well because it is difficult to capture the complexity of the real world. Otherwise, it becomes difficult to cognitively process the information whenever it is more than ten. Barratt et al. (2011) reviewed a number of case selections in qualitative case studies. They suggested that there were no distinctive patterns relating the number of cases used and the research outcomes of case studies research (Voss et al., 2002). The oil palm refineries in Malaysia cannot directly distribute their finished products to local industry and international market through the port. Thus, the samplings of the case study selected certain refineries that deliver the finished product to both of them. The technique adopted sampling based on purposive personal judgment which was nonprobability sampling (Wilson, 2008). Data collection was done by visiting some industries using the technique of interviewing with several stakeholders related to the content in this study and observation to see core business activities (Driscoll, 2011). This study adopted semi-structured interview, which generally organized around a set of predetermined open-ended questions. Case study considered interviewing multiple respondents since it was important to recognize that informants are prone to subjectivity and biases. Creswell (1998) suggested to achieve saturation in qualitative interview we need to use 5 to 25 interviews. Morse (2008) suggested that 10 interviews conducted from expert will obtain richer data than 50 interviews from an inexperienced person. This study used snowball sampling technique to obtain the information from

some people in charge in the industries. Merriam (2007) suggested that snowball sampling was used whenever the researcher does not select an entire sample at the start of a study. Then, it found some participants who refer them to other individuals. This process was continued until the desired information was reached. Table 2 shows a list of informants during data collection. Moreover, the study implemented the non-participant observation method since it was used for additional information to support data collection, such as detailed observation of activity and talk including watching and recording what people do and say (May & Pope, 1995). Mulhall (2003) revealed that observation is also understanding and interpret of behavior.

**Table 2**  
Case studied and respondents interviewed

Refinery	Informants	Location (Port)
A	Logistic Manager	Port Klang
A	Logistic Executive	Port Klang
B	Logistic Executive	Pasir Gudang
B	operation Manager	Pasir Gudang
B	operation Executive	Pasir Gudang
C	Shipping and Logistic Manager	Pasir Gudang
C	Production Executive	Pasir Gudang
C	R & D Executive	Pasir Gudang
D	Purchasing Executive	Port Klang
D	Logistic Executive	Port Klang

The validity is done by allowing interim data analysis and corroboration to ensure matches between findings and participants reality. It conducted using multiple source of evidence (Yin, 2003) where it considered a variety of participants that were interviewed. The data were obtained from the multiple sources involving interviews, information in web pages, market information and reports about business process in the oil palm refinery. Then, the data were processed to in-depth analysis in order to the original evidence was documented. Furthermore, reliability was achieved with the concept consistency of data (Voss et al., 2002) which the steps of the research were verified through examination using qualitative analysis software. The data involved the original transcripts of interviews of the code and categorize data used in the analysis study. The code and categorize data were put in separate documents in order to make the analysis easier. Then, result of the software shown categories based on coded. Thus, the finding provides that the main theoretical insights can develop supply chain relationships with comparing each case study in the refineries based on similar category.

## 2.2 Case study

Business processes of oil palm are initiated from plantation, then they are processed by the processing industries, and distributed to industry of product developers who produce diverse products until the end users as customers. Business strategies of oil palm include linkages between the plantation, milling, crushing, refining, oleochemical and customer and illustrates the relationship between entities within business processes (Omain et al., 2010). The upstream industry produces raw materials from oil palm business. These industries involve the plantation that produces fruit fresh bunch (FFB), the milling and crushing that extracts the raw material in form of oils (van Duijn, 2013). These industries commonly are an upstream stage in its production process. Moreover, downstream industry involves processing the materials collected from the upstream industry into finished products which it consists of refinery and oleochemical (Sarmidi et al., 2009). The type of customer depends on market destination such as international market and local market. In addition, the downstream industry has direct contact with customers through the finished products.

The focus of this case study is on refineries where they were in two main islands in Malaysia involving the Peninsula and Sabah Sarawak. Nevertheless, there were not local industry in Sabah and Sarawak such as oleochemical industries that support downstream industry to produce end oil palm products. Thus, the case study was conducted to oil palm refineries in Peninsula Malaysia and it is based on Annual report MPOB in year 2013 illustrated in Fig. 2. The case study has been conducted on four oil palm refineries placed close to Johor Port, Pasir Gudang and Port Klang, Selangor. In addition, two oil palm refineries were considered as the sample size in each port. Commonly, finished products that were produced by the refinery such as Olein, Stearin and Palm Fatty Acid Distillate (PFAD). This industry had two main suppliers of crude oil such as Crude Palm Oil (CPO) and Crude Palm Kernel Oil (CPKO) where these were supplied by the milling and crushing. The transportation service provider of the refinery was supported by lorry tanker and the vessel collaborated with Third Party Logistic (3PL) or using own fleet. Moreover, the destination of finished products is not only associated with local market, but also international market requires these products. Thus, supply chain strategy conducted the relationship between refinery with other entities such as supplier, distributor and buyer. Therefore, the operational strategy of each refinery affects the collaboration between entities in oil palm downstream sectors involving providing crude oil, strategy to distribute finished product and finding potential buyers.

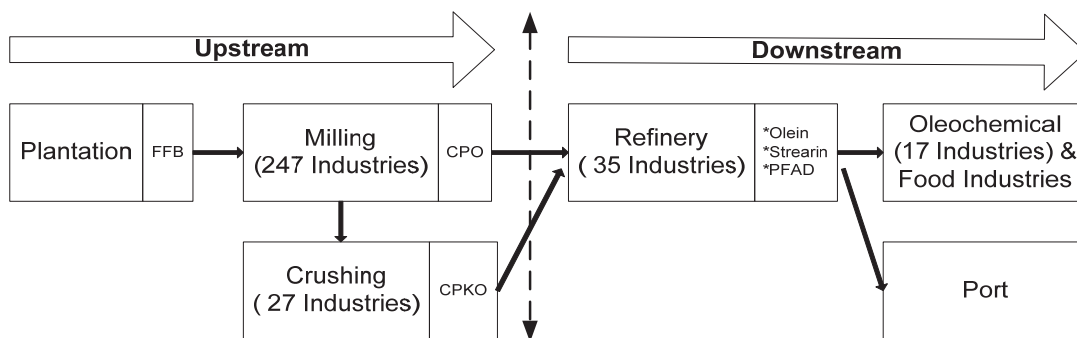


Fig. 2. Oil palm supply chain in Peninsular Malaysia

### 3. Results

Supply chain relationship within the oil palm downstream sector was explored based on qualitative research which this study analyzed the result through several techniques on four case studies in the oil palm refinery. Firstly, capturing the information was done from the web pages in each oil palm refinery. Then, conducting the interview to find flow of business processes involved ordering process, schedule production activities, supplier and raw material, financial, strategy of logistics, shipping and warehouse, holding group, outsourcing, and IT Sharing. Lastly, the observation directly was done on site to support the information about the research and obtained truly descriptions of business process.

The subsequent sections describe the result of case studies based on the research objectives. The first objective is to define the relationships between entities in the business process. The result shown there identified several patterns of business process in supply chain relationship between oil palm refinery and other entities. The second objective conducted the relationship models of business process in the oil palm refinery. The study categorized oil palm refinery into supply chain relationship between supplier, refinery, distributor and buyer. Then, to achieve the third objective, the case study used a software namely *Atlas Ti* to analysis qualitative research in data collection. Furthermore, the input of the software entered the information of participating from an interview that described the business process in the oil palm refinery. Then, it was categorized the performance indicators. In addition, this study provided several performance indicators of supply chain strategy based on the literature reviews which was implemented in the oil palm refinery. Most of them were categorized into supply chain attributes using SCOR model.

### 3.1. Business process reengineering

Workflow in oil palm refinery was analyzed using Business Process Reengineering (BPR). In this study, BPR approach was described in the SCOR model using process wizard software which the first level of process type was shown in the geographic diagram module. This level described one of the case studies in oil palm refinery, where Refinery C was placed in Johor Port, Malaysia. Data collected shown that the main suppliers of crude oil were delivered under control Head Quarter (HQ). Therefore, this refinery was a fully-owned subsidiary under its holding group where it was one of player in upstream to the downstream sector of oil palm business. Furthermore, the customer of the finished product was the other industry that produced the advance process of oil palm products such as food industry and oleochemical. The above information was transformed into the SCOR model in level 1. Moreover, this model was supported by the map as represent the real situation in business process. For more detail SCOR model level 1, it can be shown in Fig. 3.

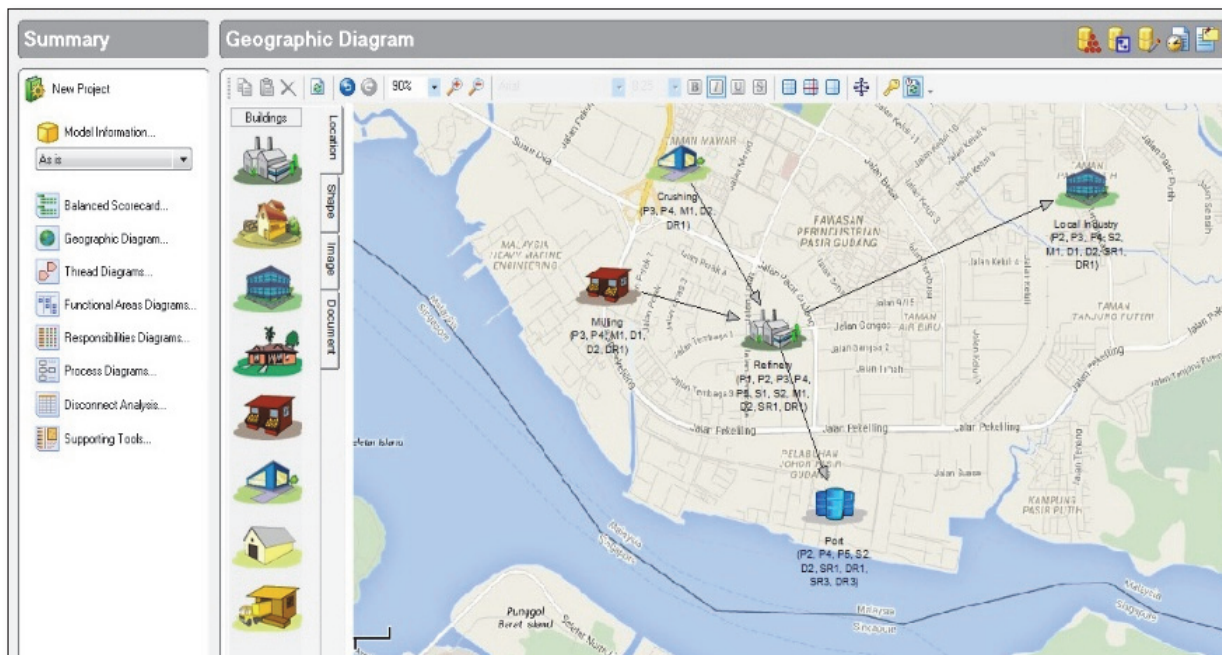
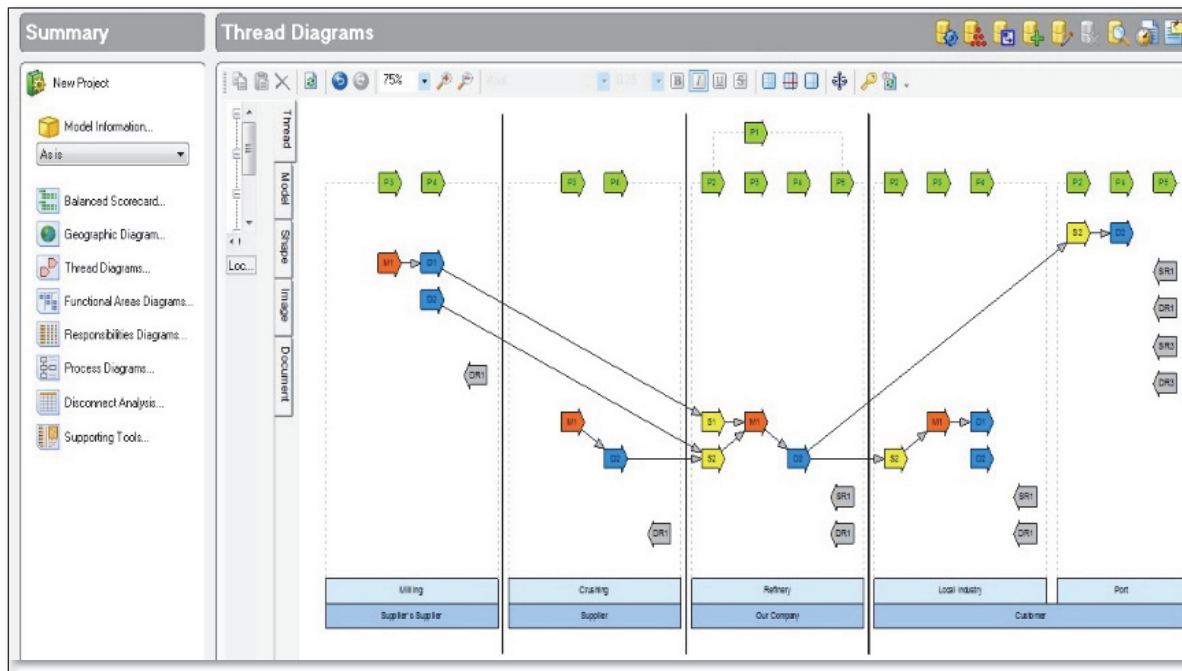


Fig. 3. Geographic diagram of SCOR level 1 in refinery C

The second level was process category shown through the thread diagram module. The subsequent section described the SCOR model in-depth because this shows a supply chain strategy for each entity in business process. For the instance, most of the suppliers of this refinery included the industries under their holding group so ordering process of crude oil can be scheduled. Based on SCOR model, the strategy of supplier was categorized into deliver stocked product. This strategy consequently influenced production system in the refinery. As the result, refinery put the stock of crude oil in the silo as the inventory. Then, they ran production through make-to-stock of the finished products. On the other hand, the finished product was delivered based on order. For those who need product through the port, the refinery booked bulking in the port and the schedule of the vessel. To customer at the local market, the refinery collaborated with 3PL. Fig. 4 shows detail process supply chain strategy based on SCOR model level 2 in thread diagram module.





**Fig. 4.** Thread diagram of SCOR level II in refinery C

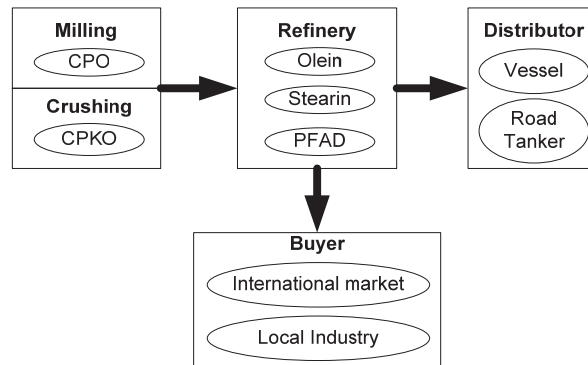
The third level was process elements of business process. SCOR model level 3 decomposed process category into process element more detail. The supply chain relationship was elaborated into activity in business process which described workflow among departments in an oil palm refinery. The first phase was Plan, which described the customer order of finished products through a signed contract in HQ involving capacity, delivery date, and transportation mode. Then, HQ informed the logistics department to arrange the delivery schedule for the customer. The second phase was Source which describes purchasing of crude oil. Refinery C supplies crude oil directly from suppliers under their holding group. Thus, the schedule delivery of crude oil is determined based on master production schedule (MPS) which is arranged based on forecasting annual demand in this refinery. The third phase was Make which described of the issue product and production process. Then, the finished products were categorized into solid and liquid which the oil store in silos and fats packed in the warehouse. Fourth phase was Deliver which described the distribution of finished products to the customer. This industry used 3PL (Third Party Logistic), thus the refinery informs the road tanker service and delivers product to local industry and port. Nevertheless, for customers order product through the port, the refinery scheduled of delivering product is based on schedule and route the vessel. Fifth phase is Return which describes the returning process of crude oil and finished products. Returning of the product is caused by quality of crude oil and finished products do not meet the specification or standard. The most important issue is that capacity customer demand must be suitable with product delivered. The detail workflow of SCOR model level 3 in Refinery C can be shown in Fig. 5. In addition, the summarizing workflow of SCOR model to four refineries can be seen in Table 3.



Oil palm refineries in the downstream sector show there were four entities including mutual interaction involving supplier, refinery, distributor and buyer. All of them collaborated within a network in order to influence each other. Thus, there was dominance of power position within the collaboration. This analyzed supply chain relationship into dominance of supplier, refinery, distributor and buyer using SCOR method. Supplier dominance described the ability of supplier to push products to the refinery using their forecasting. There were two main suppliers of refinery involving the milling produce CPO and the crushing produce CPKO. Milling industry obtains FBB every day from plantation and cannot postpone to produce CPO because the fruits that have been stored for long periods prior to processing have high free fatty acid (FFA) contents. FFA still remains within the standard level of 5%, which it is stored on average under five-day (Tagoe et al., 2012). Furthermore, based on the MPOB annual report in years 2013 there were abilities to export crude oil of millings and crushing around 24% and 14%. This report has shown that international market ordered the finished products from suppliers only a few percentages than total number production per year in Malaysia. Thus, most of its finished products were pushed to distribute to local refineries and depend on the demand of refineries. However, CPO and CPKO were the main crude oils in refineries. The power of supplier in supply chain relationships followed the information from the refinery. Thus, the supply chain relationship in this term shows the power of the supplier in the supply chain downstream sector is not dominance. There was the power of collaboration in supply chain strategy described the ability of manufacture or refinery influenced the entities in business process. The result of the case study show there were several types of the refineries tend to run the business process based on make to stock production. Case A, Case C and Case D categorized a refinery as an entity that had the power to influence other entities in business process. Therefore, these industries arranged production schedule based on demand in annual forecasting. Thus, they had the power to manage their resources and suppliers with the higher authorization involving determining the capacity of batch production, delivery size, and lead time of order crude oil. Furthermore, the pattern of these business process shows that the industries ran the business process under coordination of their holding group. It means that supplier and refinery directly were controlled by Head Quarter (HQ) to deliver crude oil and determine the fixed lead time of schedule delivery product. Consequently, the supplier was pushed by the refinery to stock crude oil in their storage. Indeed, refinery and supplier conduct joint forecasting and cooperate to achieve the optimal size of batch production. Thus, three of refineries in this case study are categorized into refinery dominance.

Delivery of finished products to the customer was supported by transportation service provider. Every refinery had difference strategy using the transportation mode such as third-party logistics (3PL) and using own fleet. In addition, most of refineries were built close to the port. Thus, there was a few of refineries install piping to deliver oil in bulking in the port especially for oil production. For solid product, it uses 3PL involving tank lorry. The main transportation service provider in distributing the finished products of the oil palm refinery in international market was the vessel. Most of them followed the schedule of the vessel whenever distribute using the port. Furthermore, oil world in the year 2013 reported that export of oils and fats in the world consists of 62% of palm oil and palm kernel. In addition, Malaysia supplied these products around 42% because most of products exported to international market through the port. Consequently, the distributors such as the vessels have a high degree of dependency on transportation service provider because they have the power in the supply chain strategy as an entity which is indispensable to move the finished product forwards to the customer. Thus, the distributor is one of actor dominants in this relationship model. This case study also has shown that Case B was the refinery that ran the business process based on customer order. This refinery had standalone operations because it was not influenced by holding groups. In addition, the refinery selected suppliers of crude oil directly without coordination with other entities. Thus, the schedule in the activity production was determined based or customer order. Consequently, this industry prepared the strategy of outsourcing of finished product whenever shortage occurs. To solve this condition, this refinery kept their relationships with other entities in order to provide the best service to the customer involving transportation service providers and suppliers. The above supply chain strategy shows that Case B represented the power of buyer dominance whenever describes in supply

chain relationship. The result of this case study has shown there were two types of business processes in the oil palm refinery involving push and pull strategy that can be seen in Fig. 6. The first type shows that refinery and supplier of crude oil joint forecasting ran the business process which was controlled directly by HQ (Refinery = Supplier). This collaboration has also shown that refinery was more dominance than buyer (Refinery > Buyer). Then, the distributor feels indispensable because there was high demand of international market and the refinery must follow the schedule of vessel to deliver to the customer (Refinery < Distributor). Thus, this business process implemented the strategy based on push strategy. Second type described that buyer dominance than refinery (Refinery < Buyer) where the scheduling production was created based on order customer. Then, the refinery contacted the supplier and transportation provider after obtaining the confirmation order by the customer. Thus, it pushed the supplier to fulfill the requirement of refinery (Refinery > Supplier). This type implemented the pull strategy where production only ran whenever there were orders from customers.



<b>Collaboration</b>	<b>Push Strategy</b>	<b>Pull Strategy</b>
<b>1</b>	Refinery = Supplier	Refinery > Supplier
<b>2</b>	Refinery < Distributor	Refinery < Distributor
<b>3</b>	Refinery > Buyer	Refinery < Buyer

**Fig. 6.** Supply chain relationship in Malaysian oil palm refinery

### 3.2 Supply Chain Attribute

Description of business process selected several attributes of supply chain relationships in the case oil palm refinery. There were 35 indicators of literature review providing based on SCOR model which was analyzed into supply chain attribute. This paper has shown the results of supply chain attributes which was obtained by identifying the theme into code and categorized using *Atlas Ti software*. Then, the study has found five attributes that are suitable in the oil palm refinery in order to the analyze supply chain relationship. They were presented based on output in qualitative analysis involving as reliability, responsiveness, quality, cost and utilization. Furthermore, reliability describes the ability to fulfill orders based on customer demand. Responsiveness describes the time fulfillment of the order. Quality describes the response of customer satisfaction. Cost describes the overall cost driver to earn the profit which directly influenced the cost of operation. Lastly, utilization describes resources are being used to produce goods with comparing actual time to available time. Furthermore, the results of four case studies have shown there were different performance indicators that influenced the business process. The attributes of four case studies can be seen in Table 4. The graphic described the relationship between the attributes of the supply chain relationship. The high percentage described the attributes optimized whenever it was implemented in the refinery. In addition, this figure has shown it had different patterns of graphics in each case study. Case A, C and D adopted push strategy and had the higher percentages in attributes of quality, responsiveness and reliability. The analysis data has also

shown these refineries tend to run the production to consider the ability to fulfil the demand and kept the quality of the finished products. On the other hand, the Case B that adopted pull strategy shown attribute of cost and utilization had the higher percentages. It means the refinery optimized using their resources and managed the cost of the supply chain.

**Table 4**  
Supply chain attributes for case study in oil palm refineries

Case	Strategy	Cost	Quality	Reliability	Responsiveness	Utilization
A	Push	9.1	22.7	22.7	31.8	13.6
B	Pull	27.8	16.7	11.1	11.1	33.3
C	Push	14.3	23.8	23.8	23.8	14.3
D	Push	13.6	18.2	27.3	27.3	13.6

#### 4. Discussion

Downstream sector is affected by entities that has collaboration and also depends on pushing of upstream sector. Thus, the effect of strategy that is adopted by a downstream industry influences on all entities in supply chain relationship. In the past, most studies on downstream industry analyzes supply chain strategy through internal performance to do an assessment (Circita & Glaser-segura, 2012; Amponsah & Opei, 2014). The primary contribution if this study was to provide a process reference to define the supply chain relationship in the downstream sector, which serves as a tool to analyze the collaboration between entities based on effect of supply chain strategy at an entity in the downstream sector. The result of this study shows that process reference of SCOR model analyzes supply chain strategy in an industry based on reengineering of business process. Furthermore, this method develops performance indicator from the literature to adopt supply chain attribute. Then, it has found the attribute that are suitable for analysis the supply chain relationship involving reliability, responsiveness, cost, quality and utilization. Therefore, supply chain strategy that adopts in a system has different parameters or attributes to evaluate the business process (Bala & Kumar, 2011). To conduct the collaboration between entities, this study has analyzed the ability of an entity to influence other entities based on power position on supply chain strategy.

This study has found two types of supply chain relationship based on the case study involving pull and push strategies. In addition, the relationship between entities in downstream sector show there are several attributes to analyze the supply chain strategy. The results have shown that push strategy emphasized on optimization the attributes in terms of responsiveness, reliability and quality. Furthermore, the supply chain relationship in pull strategy has shown that the strategy in this model focuses on optimizing the utilization and cost. It means that this industry manages the effective resources of production system and optimizes the cost of the supply chain. Nevertheless, the customer satisfaction is still low because strategic collaboration with the supplier and other third-party show there is a shortage in order to provide the finished products to the customer. The collaboration entities in this study described supply chain relationship downstream sector. It aims to analysis how the supply chain strategy affects an industry to influence other entities in the downstream sector. As the orientation to win the market, industries manage their businesses to provide the finished products based on their own resources and another entity in order to strength the network in supply chain strategy. Therefore, the collaboration entities are expected to optimize the ability of the industry to efficiently and effectively run the business (Kähkönen, 2014). Thus, this study identified that there are dominant actors in this collaboration involving the refinery, distributor and the buyer because all of them can influence the entities as it has a high-power position in running the business process. Indeed, analyzing of supply chain relationship has shown that there was ability of an entity to push other entities follow their requirements.

#### 5. Conclusion

The finding of this study gives several implications and the cases have shown that a process reference of leverage SCOR model could be useful for analyzing the relationship between entities within

downstream sector. In addition, this study takes place in the oil palm refinery as central analysis of supply chain strategy in the oil palm downstream sector. This industry connects directly with all entities in this sector involving milling, crushing, and oleochemical to join in supply chain strategy. Oil palm refineries in Malaysia have different strategies in running the business process. Consequently, it will influence the power collaboration in supply chain relationship. Thus, this study also gives the implication for manager and stakeholder to identify their pattern of business process especially in the oil palm refinery. Therefore, they can manage the business into effective collaboration with their supplier, distributor and buyer. Qualitative approach which is adopted in this research describes the business process of supply chain relationship in more details. Nevertheless, it is difficult to implement in order to improve the system. Therefore, an improving in the supply chain can be done by measuring the performance system. Further research can be conducted to measure the effect of pull and push strategies. We can propose to run discrete event simulation approach since this method ensures the system that represent the actual situation in the business process as more tactical techniques to optimize the business process. In addition, this method improved the overall performance in the supply chain configuration and supports the relationships among entities within a network. Therefore, simulation techniques can solve the problem as randomness and interdependence.

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