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Determination of Performance Indicators For Cooking Oil Logistic Using Fuzzy-Delphi Method

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Abstract: Logistic issues are still become a serious matter for Indonesian society. This problem should be seriously considered by Indonesia. Many sectors that support logistic growth should be arranged properly in order to increase the value of performance of logistic in Indonesia. Agriculture sector is one of the sectors that has important role in national development integration. Unfortunately, production growth for this sector is still relatively low compared to some other sectors with value 1.85%. One of the agricultural sectors in Indonesia was palm oil plantations that produces cooking oil. Currently, Indonesia was suspected by having problems on the cooking oil distribution. Cooking oil distribution margins are tending to increase, while margin is one of the efficiency indicators in distribution system. The increasing of distribution margin indicates that the distribution of the commodity is inefficient. Thus, we need to improve efficiency and effectiveness in all logistics activities. The issue is, what are the relevant indicators to manage the logistics of cooking oil in an effort to improve the efficiency and effectiveness. Determination of performance indicators can be done by getting the opinion and consensus of the experts who understand the logistics of cooking oil. The method used is the Delphi method that will integrated with fussy method. The method is called Fuzzy-Delphi method.

Keywords: Cooking Oil, Fuzzy Delphi Method, Logistic, Performance Indicators.

INTRODUCTION

Indonesia's logistic cost is even the highest one among the other ASEAN countries with the value against Gross Domestic Product (GDP) is 28,4% or 1.820 billion rupiahs, while ideally the value of logistic cost is should not be more than 15% (Kemenperin, 2016). This statistic shows clearly that the cost of logistic Indonesia is still very expensive, due to the inefficient of enterprise's logistic activities.

This problem should be seriously considered by Indonesia. Many sectors that support logistic growth should be managed properly in order to raise the value of logistic performance in Indonesia. In Table 1 below, it is shown the growth of business sector in Indonesia from 2014 to 2016, with 2010 as the base year.

Table 1. Business Sector Growth (in %)

Business Sectors	2014	2015	2016
Agriculture, Forestry, and Fishery	4.24	4.02	1.85
Mining and Digging	0.72	-5.08	-0.66
Manufacturing	4.61	4.25	4.59
Procurement Electricity and Gas	5.57	1.21	7.5
Water Supply, Waste Management, Recycling	5.87	7.17	4.84
Constructions	6.97	6.65	7.87
Wholesale and Retail Trade; Repair Cars and Motorcycles	5.16	2.47	4.04
Transportation and Warehousing	7.36	6.68	7.73
Provision Accommodation, Food and Beverages	5.77	4.36	5.62
Communication and Information	10.1	10.06	8.28
Finance and Insurance Service	4.68	8.53	9.1
Real Estate	5	4.82	4.87
Company services	9.81	7.69	8.14
Administration, Defense and Compulsory Social Security	2.38	4.75	4.94
Educational Services	7.96	7.1	8.52
Health Services and Social Activities	5.55	7.45	5.26
Others	8.93	8.08	7.92

Source: Kemenperin, 2016

Agriculture sector is one of the sector which has important role at the integration of national development. It is because about 37,75 million of Indonesia's society are working as farmers. Unfortunately, in 2016, the production growth for this sector is still relatively low if it's compared to some other sectors with value 1.85%.

One of the agricultural sub-sectors is palm oil plantations. Palm oil is one of the major vegetables-oil-producing commodity which play an important role in the Indonesia economy. Aside from being a source of income for millions farmer's families, country's foreign exchange source, provider of employment, and trigger of growth of new economic centers, palm also plays a role in encouraging the growth and development of downstream industries based on palm oil in Indonesia (Kemenperin, 2016). One derivative product of palm oil is called Crude Palm Oil (CPO).

Based on the Presidential Regulation No. 28 in 2008 about national industrial policy, palm oil processing industry (CPO derivative) is one of the priorities to be developed and has higher added value. Crude palm oil is used as raw material by other industries as derivative products, such as cooking oil. Based on Kemenperin data in 2012, about 37% of total production of CPO is used to produce cooking oil, 52% is exported and the rest is for margarine, soap, and oleo chemical industry.

Cooking oil is one of the staple foods consumed by all levels of Indonesian society (both rural and urban areas), that makes the demand of cooking oil increases continually. Domestically, the growth of household demand does not only source from population growth, but also from the consumption per capita, because Indonesia has relatively high rate of cooking oil consumption. Those things are indicated by the average amount of cooking oil in Indonesia which reach 5,5 million tons every year. The latest data by 2015, demand of national cooking oil is 5,2 million tons (Hadinata, 2015).

Currently, Indonesia allegedly is having problems on the distribution of cooking oil. This allegation is based on the price disparity between the producers and the consumers, especially in the cities. In Jakarta, the capital city of Indonesia, there is a different in price of cooking oil between consumers and producers. The average price of cooking oil at a market in Jakarta is Rp 12 384 per kg. This price is far above the factory price of Rp 10,050 per kilogram (kg). When cooking oil reach the market, ideally with the calculation of the profit and the cost of transportation, the price should not be more than Rp 11,000 per kg based on Kementerian Perdagangan regulation (GIMNI, 2016). In one side, the production of palm oil

is only existed in certain region, while the producing factory is spread across several regions in Indonesia (see Table 2).

Table 2. Palm Oil Plantation VS Cooking Oil Factory

Palm Oil Producers		Cooking Oil Factory	
Province	**Production (thousand tons)**	**Province**	**Percentage**
Riau	6.499,8	North Sumatera	30,46 %
North Sumatera	4.147,7	Riau	24,83 %
Central Kalimantan	3.055,1	DKI Jakarta	13,01 %
South Sumatera	2.552,4	East Java	9,62 %
West Kalimantan	1.942,1	South Sumatera	7,18 %
Jambi	1.760,4	North Sulawesi	5,28 %
East Kalimantan	1.393,4	West Java	3,38 %
South Kalimantan	1.279,7	West Sumatera	1,97 %
		Lampung	1,74 %
		Central Sulawesi	0,70 %
		West Kalimantan	0,64 %
		Jambi	0,59 %
		Central Java	0,59 %

Source: BPS, 2014

In West Sumatra region, there are price fluctuation and price disparity between consumer and producer from 2010 to 2014 that can be seen in Table 3 and Figure 1.

Table 3. Consumer and Producer Price in West Sumatera (in Rp)

Staple Food	Consumer Price					Producer Price				
	2010	**2011**	**2012**	**2013**	**2014**	**2010**	**2011**	**2012**	**2013**	**2014**
Premium Rice	7,354	9,312	9,490	9,622	10,716	6,483	8,242	8,244	8,663	9,597
Medium Rice	6,879	8,351	8,446	8,639	9,475	5,854	7,349	7,233	7,718	8,517
Red Chili	26,660	27,608	26,903	35,502	34,854	18,936	20,961	19,596	31,286	30,502
Onion	13,557	14,892	12,813	27,787	17,834	8,089	12,043	9,334	24,615	14,483
Beef	64,437	71,208	78,164	91,683	102,184	45,597	64,411	56,661	80,846	90,234
BroilerChicken Meat	20,732	22,118	22,070	21,942	22,979	14,761	18,491	18,537	18,875	20,237
Eggs	927	1,055	1,039	1,123	1,159	728	921	908	971	1,008
Freshwater Fish	20,395	24,329	24,199	24,431	27,031	15,597	20,379	20,748	20,801	23,666
Sugar	11,224	11,114	12,282	12,470	11,622	5,155	9,969	8,543	11,135	10,575
Cooking Oil	9,540	10,551	11,273	10,435	11,587	4,357	9,275	8,100	9,405	10,445

(Source: BPS, 2015)

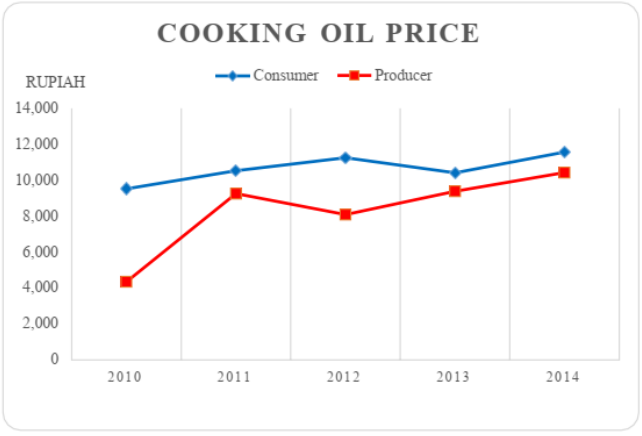

Figure 1. Cooking Oil Prices in West Sumatera (Source: BPS, 2015)

By these conditions, there are indications that the price fluctuation of cooking oil is due to the differences in cost of distribution. Gabungan Industri Minyak Nabati Indonesia (GIMNI) said that the distribution cost of cooking oil increases about 20%. It will affect the increasing of cooking oil's price (Amri, 2015). Cooking oil distribution margins are tending to increase, while margin is one of the efficiency indicators in distribution system. The increasing of distribution margin indicates that the distribution of the commodity is inefficient (BPS, 2015).

Thus, we need to improve efficiency and effectiveness in all logistic activities. The issue is, what the relevant indicators and metrics to manage the logistics of cooking oil in an effort to improve the efficiency and effectiveness. Indicator is a determinants of decision makers and information for planning and controlling logistic (Hadiguna, 2015). For enterprises, performance appraisal helps them to diagnose whether the adopted strategy and organizational structure will help them to achieve their goals. And the construction of performance appraisal indicators is also the first step for enterprises to conduct practical evaluations (Kuo, 2008). The performance indicators are used as the basis for assessing the performance in planning stage, implementation and thereafter. Determination of logistic performance indicator needs to be investigated in order to fulfill the main objectives of logistic assessment which are cost reduction, capital reduction and service improvement (Krauth, 2005).

LITERATURE REVIEWS

Indicator

Indicators are used as a reference marker for assessing a situation. Indicators can be quantitative or qualitative. Quantitative means, indicators give a signal to decision makers in the form of numbers, whereas qualitative provides in the form of signal. In logistic, indicators are useful as a reference in measuring performance. The indicators in the performance measurement known as the key performance indicators that are useful to determine the level of achievement of logistic performance (Hadiguna, 2016).

Something is eligible as an indicator when it meets the following criteria (Krauth, 2005):

1. Valid, which can be used to measure an object that want to be assessed.
2. Reliable, which can be trusted. Means that it is able to demonstrate consistent results when performed measurement repeatability both today and the future.
3. Sensitive, which has a high level of sensitivity when used to measure so that it can minimize the number of indicators needed.
4. Specific, which has a clear scope that can prevent overlapping.
5. Relevant, which is related to the object to be measured.

Performance Measurement

Performance measurement needs to be done so that the company can determine the level of their performance. By measuring performance, companies can find out the existing problems so it can find a solution and improve the company's performance going forward. In practice, performance measurement can be done by using a relevant scoring system (rating). Two aspects are often used in assessing the performance is efficiency and effectiveness. The efficiency describes the relationship between input and output, effectiveness describes the relationship of output at a particular purpose (Khair, 2014).

Logistic

Logistics is the flow of material, information, and money between consumers and suppliers. The logistical activities comprise freight transport, storage, inventory management, materials handling and all the related information processing. The main objective of logistics

is to co-ordinate these activities in a way that meets customer requirements at minimum cost (Frazelle, 2002).

According to Gattorna and Walters, logistics is an aspect of strategic management that is responsible for managing the acquisition, movement and storage of raw materials, semi-finished materials, finished goods inventory and information accompanying within an organization and marketing channel to meet customer expectations in order to achieve the profit companies targeted. Logistics mission is to meet the needs of the goods corresponding to the place, at the right time and in the desired conditions, thus providing benefits to the enterprise (Mulyadi, 2011).

Fuzzy Method

Fuzzy logic is a proper way to map an input space to the output space. For a very complicated system, the use of fuzzy logic is one solution. The traditional system is designed to control a single output that comes from multiple inputs that are not interconnected. Because of this independence, the addition of new input will complicate the process control and process requires recalculation of all functions. In contrast, the addition of new entries in the fuzzy system, a system that works based on the principles of fuzzy logic, requires only the addition of new membership functions and rules associated with it (Ponangsih, 2011).

In general, the system is suitable for fuzzy reasoning approach, especially for systems that deal with difficult issues defined by using a mathematical model example. Input values and parameters of a system are inaccurate or unclear, it makes difficult to define the mathematical models. The starting point of the modern concept of the uncertainty is made by Lofti A Zadeh (1965), which introduced the theory that has objects of fuzzy set that has restrictions that are not precise and its membership is not in the form of logic true or false, but is expressed in degrees. The concept is called the fuzziness and his theory called the Fuzzy Set Theory. Fuzziness can be defined as fuzzy logic with respect to the semantics of an event, phenomenon or the statement itself. It is often found in a statement made by a person, an evaluation and a decision (Ponangsih, 2011).

METHOD

Preliminary study is the first step performed in carrying out this research. Preliminary study is used as background in selecting the topic and implementing the research. Preliminary study is done by searching issues that related to the topic that would be like to be appointed. It carried out by reading various news related to logistics problems. After found the issues about the logistic, then the researcher performed a literature study to solved the problem accurately. The literature study conducted in this study focused on constructing logistics performance indicators of cooking oil. After reviewing the relevant literature and developing a theoretical logistic system, this study began screening the indicators.

This part provides how this research will be executed. It consists of object determination, data collection, Delphi's instrument design and Delphi method's step. The object of this study are the experts who know about the logistics especially the logistics of cooking oil. Experts included academics lecturers and company related to cooking oil logistic.

Every indicator remains will be analyzed about the correlation with the logistic concept. The highest indicators value is discussed and why it impacts to the logistic of cooking oil in Padang. The further application for the indicators also suggested. After every step of this research is done, then it is needed a summary of all things undertaken and suggestion for better future research.

RESULTS AND DISCUSSION

Logistic Activities

Logistics activities consists of the following five, customer response, management and inventory planning, supply management, distribution and transportation management and warehousing. These logistics activities have sub- activities that support the performance of the company.

Customer response activities consists of product marketing, negotiating with customers about the price or any other trading agreements. Monitoring customer satisfaction, receives and response the feedback about service quality. Providing contract sale and purchase agreement with the customer, and providing an invoice that contains transaction information. These activities are interrelated with each other, the provision of an invoice cannot be done if the negotiations with the customer has not reached common ground.

Management and inventory planning has activities including designing the order size of the CPO to the supplier parties, plan and control the stock levels in cooking oil inventory. These activities affect the stability of the company because it relates directly to the company's production process where each company has set minimum standards of production for each period. If the raw materials are not available or insufficient, then the operations will be disrupted.

Supply management discusses the activities of setting the amount of supply demand to suppliers, both internal supplier that work directly under the auspices of the company and external suppliers from outside the company. For example, analyzing palm oil purchases to suppliers, knowing the amount of palm oil supplies received and needed, palm oil purchases to suppliers.

Distribution management and transportation activities includes, CPO shipments to the company by suppliers and cooking oil shipments by the company or a transportation service provider to the customer. The overall goal in transportation should be to connect sourcing locations with customers at the lowest possible transportation cost within the constraints of the customer service policy. This distribution activity should be maintained because it deals directly with the product that will be delivered to customer. In order to enhance customer satisfaction delivered products must comply with the specifications requested by the customer in terms of both quantity and quality. Therefore, the distribution management and transportation is required to avoid the worst possibilities that may occur.

Warehousing activities includes, accepting CPO of suppliers, storing CPO in warehouse, controlling and reporting the remaining stocks of raw materials and finished goods in the warehouse.

Based on the explanation of the five of the logistics activities above, each activity has relation to one another. Thus, all logistics activities must be executed properly to maintain the continuity of the company's activities.

Logistic Indicators

The calculation results showed that 21 indicators were chosen based on their importance to the logistic system. They consist of 8 indicators of lean logistic, 8 indicators of agile logistic and 5 indicators of green logistic.

1. Lean Logistic Indicators

   Lean focuses on reducing logistic costs, waste elimination, inventory minimization and increase value added. Based on the research results, there are 8 selected indicators related to lean logistics in Table 4.

Table 4. Lean Logistic Indicators

Indicator	Explanation	Value
Total Response Cost	Total cost used for customer response activity	0.70

Total Inventory Cost	total cost used for inventory	0.70
Total Supply Cost	all the costs related to supply planning, supplier management, and procurement execution	0.70
Total Transportation Cost	total cost used for transportation activity	0.70
Logistic Profit	profit gained from logistics activities	0.75
Logistic Cost-sales ratio	the ratio of total logistic cost to corporate revenue	0.75
Total Logistic Cost	expense and capital costs in the five logistics processes	0.75
Warehouse Damage Percentage	Value of warehouse damages per year	0.70

Table 4 shows that the highest value are indicators Logistic Profit (LP), Logistic Cost-Sales Ratio (LCR), and Total Logistic Cost (TLC) with a value of 0.75. This indicates that the two are considered the most important indicator in assessing the performance of lean logistics.

2. Agile Logistic Indicators

Agile focuses on accuracy and speed, means fast and precise. Fulfill the customer demand within the specified time and in accordance with customer needs. Based on the research results can be seen in Table 5, there are 8 Selected indicators related to Agile logistics.

Table 5. Agile Logistic Indicators

Indicator	Explanation	Value
Order Entry Accuracy	Orders entered exactly as specified by the customer	0.80
Order Status Communication Accuracy	Orders for which order status is communicated correctly	0.70
Invoice Accuracy	Invoices with perfect match of items, quantities, prices, and totals	0.70
Order Entry Time	elapsed time from order placement until completed order entry and capture for processing	0.750
Order Processing Time	the elapsed time from order entry until release to the warehouse for order picking	0.700
On-time Arrival Percentage	The percentage of shipments that arrive on- time for each driver, carrier, and lane	0.700
Shipping Accuracy	The percent of order lines shipped without errors	0.700
Perfect PO Percentage	the percentage of all purchase orders that are delivered perfectly	0.750

Based on the Table 5, it can be seen that the indicator that has the highest value is Order Entry Accuracy (OEA) with value 0.8. This indicates that OEA is considered as the most important indicator in assessing the performance of agile logistics. OEA is the principal quality of customer response. OEA calculate the orders that entered if they are have the exact criteria that have been specified by the customer. The higher percentage of OEA, the better performance of company be.

3. Green Logistic

Green logistic consist of all activities taking into account environmental issues and integrating it into supply chain management in order to change the environmental performance. Table 6. shows that there are 4 chosen indicators of green logistic.

Table 6. Green Logistic Indicator

Indicator	Explanation	Value
Recycling Level	level of recycling activity	0.700
Number of Notices Violation Received	number of violation based on the policies	0.650

Water Usage	total water consumed for logistic activities	0.650
Environmental Charity	cost expense for environmental necessity	0.650

Table 6 shows that the highest value is indicator Recycling Level (RL) with a value of 0.70. This indicates that it considered the most important indicator in assessing the performance of green logistics.

Indicator's Formulation and Implementation

The indicators obtained from the study are appropriate with the logistics of cooking oil in Padang. The structuring of the indicators has started from the study of literature related to logistics, then grouped based on the concept of logistic lean, agile and green. Logistic indicator grouping involving several lecturers of industrial engineering. Then, the screening process of indicators involving the cooking oil producing company in Padang and some experts who understand the logistic conditions of cooking oil in the city of Padang.

Indicators that have been retained then formulated. Structuring performance indicators consist of components of the assessment indicators, measures (in the form of formulas or size), and the continuous implications which shows the emphasis on improving the performance of each indicator, equipped with a standard unit of measurement. Implications-based structuring is useful to help determining what actions to take, either strategically or operationally. Continuous implications consist of three types of quantitative indicators which are, larger the better, smaller the better and on target. Continuous implications related to the formulation of performance measures. Performance measures are formulated in the form of numerical or quantitative computing and qualitative. These formulations are acquired by doing interview with the company and from some literatures. Results of structuring for each indicator that can be seen in Appendix E.

If these indicators are implemented by company, it is worthwhile to assist companies in developing strategies for improving enterprise performance and can be used as a standard of performance assessment. The performance indicators can also be the first step in making the design of decision support of sustainable performance measurement. In the application of performance indicators which have been formulated, a company can use several methods of performance measurement that are typically used to evaluate the performance of companies such as Balanced Score Card (BSC), Performance Prism Method (PPM), the Tableau de Board (TDB), Productivity Measurement and Enhancement System (ProMES), and many more.

Government's Role about Logistic

In accordance with logistic problems faced by Indonesia, the government basically still do not have laws that specifically discuss about logistics (Avisena, 2016). But the government has issued a number of regulations and laws that can be related to cooking oil logistic and overall logistic, including:

1. UU RI No.7 of 1996 about Food. The law consists of 14 chapters, which contains general provisions, food safety, quality and nutrition, income and expenses of food and others. Including production, transport, distribution, trading and food sanitation. This regulation can relate with indicator transportation cost and shipping accuracy.
2. Presidential Regulation number 26/2012 on the blueprint for the development of the National Logistics System (Sislognas), which focuses on reducing logistics costs and logistics performance improvement. This regulation will have the same purpose with indicator TRC, TSC, TTC, TIC and TLC.

3. Presidential Regulation number 71/2015 on the establishment and storage of basic goods and essential items. Discussing about the determination of the pricing policy, stock management and logistics as well as the control of imports and exports.
4. Government Regulation number 8/2011 on Multimode Transport. It discussing about the rules regarding the use of modes of transport and logistic systems.
5. In addition, the government was preparing the Economic Policy XV of Logistics and Indonesia Single Window (INSW) are still in the stage of completion. This policy will include a set increase in logistic industry sector, including efforts to reduce the dwelling time (http://translogtoday.com/2017/01/04/).

In an effort to improve the performance of logistics, the government can play a role as observers in the assessment of each company's logistics. With the standard in the measurement of performance, the government can determine which sectors should be improved in order to maintain the stability of the overall logistic system.

CONCLUSION

This final project resulted a set of performance indicators of cooking oil logistic in Padang and some academics are involved. Every system or organism uses feedback for continuous learning and adaptation. The role of performance indicators determination is the feedback in one's logistic. Monitoring the performance indicators reveals the gap between plan and execution and helps to identify and correct potential problems and issues. This paper presented a proposing indicators and approach to logistic performance measurement by offering a set indicators of logistic five activities: customer response, supply, inventory and management planning, transportation and warehousing and also related to logistic concepts: lean, agile and green. By using the Fuzzy-Delphi method this research then proposed 20 indicators that derived from total 34 indicators which divided into 8 lean indicators, 8 agile indicators and 4 green indicators. The companies can benefit from adopting or adjusting them to their specific environments.

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