PERFORMANCE MEASUREMENT AND ANALYSIS OF COFFEE SUPPLY CHAIN WITH SCOR METHOD (CASE STUDY OF NORTH SUMATERA COFFEE)

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Abstract: *Coffee is the one of the commodities that push the economy of Indonesia. Almost all provinces have coffee plantations. North Sumatera is one of the 10th largest coffee producer in Indonesia, especially Dairi, Humbang Hasundutan, and North Tapanuli district. But the reality coffee plantation is unstable year by year and cause the farmers move to plant other commodities, such as orange and horticulture agriculture. This study measured performance of North Sumatera Coffee supply chain with SCOR method to overcome the problem in supply chain. The measurement is performed with several stage: SCOR matrix identification, Key Perfomance Identification (KPI) identification, normalixation score, and KPI weighting using Analytical Hirerchy Process (AHP) method. The result show that the score of supply chain performance is 48.224 with marginal category with the lowest final value is in delivery business process. This process can be improved by means of upgraded the quality of delivery products, required and shipped quantities must be the same, on time delivery of raw materials.*

Keywords: *Performance measurement, Coffee Supply Chain, SCOR Method, North Sumatera Coffee*

1. INTRODUCTION

According to the ICEA (Indonesian Coffee Exporter Association) Indonesia is the top 10 coffee producers in the world. Indonesia has a suitable climate to coffee plantation. Therefore, coffee from Indonesia attracted by international and domestic market. According to ICEA, Indonesia coffee export from 2007 to 2015 have fluctuated, both in volume and value. To be able to carry out the export process, it must be through institution which has been registered as an exporter that has regulated in the minister of Trade Regulation No 10/M-DAG/PER/5/2011 concerning provisions on the export of coffee. Almost all province in Indonesia produced coffee with each characterization. Table 1 shows the area of land and production yield of coffee plantation in Indonesia from 2012 – 2014. It is showed that production yield in North Sumatera has a high volume and tend to increase year by year. The land area and production yield of coffee in North Sumatera year 2011 – 2014 show in table 2.

TABLE 1

Production Yield and Area of Coffee Plantation in Indonesia

Province	Total Production (Ton)			Plant Area Ha)		
	2012	2013	2014	2012	2013	2014
ACEH	54.31	48.28	54.90	121.67	123.76	123.76
SUMATERA UTARA	**57.98**	**58.35**	**59.98**	**81.19**	**81.46**	**81.46**
SUMATERA BARAT	30.93	32.56	30.93	40.36	42.57	42.57
RIAU	2.52	2.60	1.85	4.86	5.42	5.42
JAMBI	13.09	13.33	12.91	25.75	25.94	25.94
SUMATERA SELATAN	143.33	139.75	144.88	252.41	249.29	249.29
BENGKULU	55.79	56.45	56.24	91.15	90.88	90.88
LAMPUNG	134.72	127.07	131.52	160.68	161.24	161.24
KEP. BANGKA BELITUNG	0.00	0.00	0.00	0.03	0.03	0.03
KEP. RIAU	0.00	0.00	0.00	0.04	0.05	0.05
JAWA BARAT	15.54	16.65	17.01	30.61	32.31	32.31
JAWA TENGAH	19.80	20.31	20.29	38.89	39.75	39.75
DI YOGYAKARTA	0.80	0.74	0.65	1.76	1.73	1.73
JAWA TIMUR	54.19	56.99	59.09	100.85	102.66	102.66
BANTEN	2.53	2.61	2.55	6.90	6.74	6.74
BALI	18.88	17.33	15.30	35.82	36.62	36.62
NUSA TENGGARA BARAT	5.10	4.31	4.02	12.88	12.74	12.74
NUSA TENGGARA TIMUR	21.50	21.80	21.73	72.11	72.10	72.10
KALIMANTAN BARAT	3.85	3.84	3.94	12.41	12.05	12.05
KALIMANTAN TENGAH	1.44	0.83	1.45	4.43	2.05	2.05
KALIMANTAN SELATAN	1.34	1.39	1.25	4.43	4.17	4.17
KALIMANTAN TIMUR	1.85	0.81	0.81	9.54	5.48	5.48
KALIMANTAN UTARA	-	0.00	0.55	-	2.57	2.57
SULAWESI UTARA	3.23	3.02	3.03	8.01	7.77	7.77
SULAWESI TENGAH	3.22	3.16	3.35	7.53	7.76	7.76
SULAWESI SELATAN	33.08	30.24	23.64	73.64	74.14	74.14
SULAWESI TENGGARA	3.63	2.87	3.60	9.89	9.59	9.59
GORONTALO	0.81	0.83	0.83	1.79	1.43	1.43
SULAWESI BARAT	5.19	6.78	6.35	13.19	17.43	17.43
MALUKU	0.46	0.40	0.41	1.49	1.17	1.17
MALUKU UTARA	0.46	0.43	0.43	2.63	2.48	2.48
PAPUA BARAT	0.13	0.13	0.13	0.50	0.50	0.50
PAPUA	1.47	1.47	1.49	7.85	7.85	7.85

(Source : Central Bureau of Statistics, 2015)

TABLE 2

Land Area and Production yield of Coffee Plantation in North Sumatera Province Year 2011-2014

No.	Year	Land Area (ha)		Production (Ton)	
		Arabika Coffee	Robusta Coffee	Arabika Coffee	Robusta Coffee
1	2011	58 852,67	20 976,39	49 347,53	8 393,18
2	2012	60 652,60	20 758,95	48 063,49	8 430,03
3	2013	59 578,00	21 080,00	49 052,00	8 620,00
4	2014	61 231,00	20 854,00	49 271,00	9 041,00

(Source : Plantation Office of North Sumatra Province , 2014)

The table above show that land area and coffee production in North Sumatera has fluctuated from 2011 until 2014. The table above also show that many arabica coffee farmers and robusta coffee farmers. According to Herawati as Head of North Sumatera Plantation Office, she said that North Sumatera will boost coffee production because the market is still very wide and ccoffee from North Sumatera for Arabica is included in premium coffee, but there are various problems about coffee development in North Sumatera, such as productivity and quality is still low. This causes the number of coffee farmers who move to plant horticulture, oranges, and others.

Therefore, this is important to measure the performance of coffee supply chain in North Sumatera and to determine the main factor that can be improved its performance. There are many research coffee supply chain, such as Rachman Jaya (2013) studied Gayo Coffee supply chain and discusses the attachment of relationships between actors in the social dimension of the Gay Gayo coffee supply chain. Bustanul (2005) discussed about relationship between farmers initiative policies or institutional changes to supply chain organization and standards set by the private sector and non-governmental organizations on the Coffee Supply Chain in Lampung.

Many methods are used to measured performance, such as Balanced Scorecard, PRISM, IMPS, etc. However, this method only focused on internal activity of a business. If we look overall in supply chain, the ultimate goal from performance measurement not only from internal business, but the overall success of supply chain. Therefore, we need a method that can be specifically used to measure the supply chain performance that is SCOR (Supply Chain Operations Reference) method. There are research about SCOR method, such as Vembri (2012) show the model of performance measurement system of IFRS PKU Muhammadiyah Temanggung by using SCOR method. While some research about SCOR has been done on several companies, including tobacco companies (Nikita et al, 2015) and sugar company (Darojat, Elly W.Y, 2017).

There are has never done research about performance measurement North Sumatera coffee supply chain while doing the development SCOR method in coffee supply chain, especially for three stakeholder that is farmers, collectors, and wholesalers is an advantages on this research. Furthermore, the development of metrics or supply chain performance indicators for North Sumatra coffee by combining the performance metrics of SCORs with Key Performance Index.

The goal on this research are to know performance of North Sumatera supply chain, therefore the research aims to measure performance supply chain in North Sumatera with SCOR approach. The implementation of SCOR method of measuring the performance of North Sumatera coffee supply chain provides integrated observation and measurement supply chain. SCOR is reference model of supply chain operations. SCOR able to map supply chain parts. According to Pujawan (2005), SCOR is model based on process. Within SCOR, supply chain was defined as plan, source, make, deliver, and return.

2. LITERATURE REVIEW

Research on coffee have been examined earlier in some earlier research by Bustanul (2005) and Rachman (2013). The results of research conducted Bustanul (2005) showed results that required integration policies are driven by buyers in the coffee industry to become a global initiative that has structured the supply chain in the region of production. In addition to that required initiative between peasants and institutional change in the supply chain and sustainability standards set by governmental and private organizations. Rachman, et al in his studies of the Gayo coffee supply chain showed results that index Gayo coffee supply chain requires re-engineering that is used to improve the sustainability of the supply chain to improve the productivity of each attribute.

But the lack of coffee research is just measuring the level of continuation of the coffee, without looking further the cause of the decline in the earnings of coffee happens. This decrease can be caused by many things, and can be analyzed using several methods, including methods of SCOR. SCOR method has been widely used in measuring performance as in research conducted by Adriana (2012), indicates the performance assessment of supply chain using SCOR help companies to perform repair services in the Department of production and services to consumers. Aramyan (2007) in her research indicates that performance measurement indicators measured in a chain which are not measured in other chains. This shows the difference perfomance indicators used in the different criteria in the supply chain. The performance component for the agri-food supply chain efficiency, flexibility, responsiveness, and food quality. Research conducted by Darojat (2017) showed that supply chain by using SCOR to sugar company of 75.35 performance showed that the company is in good shape. Where with the perspective with the highest score on the perspective of make-up and perspectives with the lowest score is the plan. Nikita H (et al, 2015) in her research showed the results of supply chain performed as a whole have not achieved satisfactory results, although nearly reached. So it requires a precise production forecasting, fulfillment of raw materials, the suitability of the materials you received with the message, a reduction in the number of complaints from consumers.

Based on previous studies that have been conducted, there has been no research that does performance measurement in some sectors using SCOR. It is therefore expected that with this research can help provide other viewpoints over the broader decline coffee supply chain in Northern Sumatra.

Supply Chain Management

Bowersox et al. (2001) define supply chain management as a systematic, strategic coordination of the functions of traditional business tactics and the entire business functions in a particular company and the whole business in its supply chain with the aim to improve the long-term performance of the respective companies and supply chains as a whole.

Supply Chain Operation Reference (SCOR)

Supply Chain Operations Reference (SCOR) is a model developed and managed by Supply Chain Council (2008). This SCOR model of is a model of reference which can be used to map the benchmark and improve supply chain operations. Supply Chain Council (2008) States in the process of SCOR form from 5 levels. Level 1 focuses on the 5 key process which is the basis of the performance target i.e., process planning (plan), procurement (source), manufacturing (make), delivery (delivered), and return (return). The fifth element of the process have the following functions:

1. Plan, i.e. the process of balancing demand and supply to determine the best course of action in fulfilling the needs of procurement, production and shipping. The plan includes a process to assess the needs of distribution, planning and inventory control, production planning, material planning, capacity planning and aligning the supply chain with the unity plan financial plan.
2. Source, i.e. the process of procurement of goods or services to meet the demand. Processes covered include scheduling delivery from supplier, receive, check and authorize payment for the goods delivered supplier, choose suppliers, evaluating the performance of suppliers and so on. This type of process can be different depending on whether the goods purchased include stocked, make-to-order, or engineer-to-order products.

3. Make, i.e. the process to transform raw materials or components into the desired product for customers. Activities make or production can be done on the basis of the forecast to meet the target inventory (make-to-stock), on the basis of orders (make-to-order), or engineer-to-order. The process involved here include scheduling production, production activities and perform quality testing, managing intermediate goods (work-in-process), maintain production facilities, and so on.
4. Deliver is a process to meet the demand for goods or services. Usually includes order management, transportation, and distribution. The process involved are handling orders from customers, service delivery, choose a company to handle the activities of warehousing finished products and send bills to customers.
5. Return, namely return process or accept returns of products for various reasons. The activities involved include identification of the condition of the product, ask for a return authorization, scheduling and refund do returns. Post-delivery customer support is also part and the process of return.

Analytical Hierarchy Process (AHP)

KPI weighting can be done by several methods, such as with the Analytical Hierarcy Process (AHP). According to the Bourgeois (2005) AHP is generally used for the purpose of drawing up the priorities of the various existing options/alternatives and choices that are complex or multiple criteria. In general, using the AHP, the resulting priorities will be consistent with the theory, logical, transparent, and participatory. With the increasingly high demands with regard to transparency and participation, the AHP will be very suitable for the preparation of public policy priority that demands transparency and participation.

3. METHODOLOGY

This research includes the types of descriptive research, i.e. research which describes a number of the data which is then analyzed by using certain methods and then interpreted based on the current reality (Mardalis, 2008). While the method of data collection method survey. According to Sugiyono (2009), survey method is used to get the data from a specific place, the conduct of data collection with circulate a detailed questionnaire, test or interview.

An early stage in the study, researchers conducting a preliminary survey is the first step in the research that aims to find out the background of the SCM North Sumatra coffee at this point. After that the researcher is looking for a the theories that support the direction of this research. This research focuses on North Sumatra coffee supply chains so that the theories are sought is about about supply chain management and also the method for measuring performance of SCOR supply chain.

In this research, there is a collection of data that is in the form of the data of the interview with coffee farmers, the Ministry of transportation, and also a bevy of coffee farmers cooperative. Other secondary data obtained from several sources, such as literature such as the Central Bureau of statistics and the Office of North Sumatra Plantations. In addition, there are data retrieval by using a detailed questionnaire where questions in the questionnaire represents the level of the method of SCOR. After getting the results of the questionnaire then the researchers did identify Key Performace Indicators (KPI) and design metrics were identified on the basis of existing supply chain activity in North Sumatra coffee supply chain. After getting the data then, researchers conduct process validity and reabilitas to find out if a KPI that is used for such research. If the statement is valid then used for the next stage, if not then the statement should be

removed. Then perform the measurement of each indicator stakeholders aiming to find out the value of the job performance of each stakeholder. The value of this performance will be seen between plan, source, make, deliver, and where assets if the value has a value that is high or low, caused by a few things. After that is done through the normalization of data previously used to equate the units of data where the data that existed previously have different data. After the normalization of weighting is performed by using AHP. Weighting is done by using AHP because this weighting can determine a more important priority.

Then the result is multiplied by the weighting score results from the normalization to determine whether the performance of supply chain of North Sumatra coffee it's already good or not.

After data processing done then we analyze and discuss, at this stage do the analysis and discussion of the results of the data processing has been done before. After getting the results of the analysis and discussion then do an evaluation and recommendation against the KPI that are still at the critical performance which is considered still need improvement. The next stage is the last stage of which was the conclusion of the research results obtained from the collection, processing and analysis of data. The last stage is the advice and recommendations, this stage aims to advise against research and recommendations for researchers who want to do similar research.

4. RESULTS AND DISCUSSIONS

In this research, aata are collected in a questionnaire. Data processing in this research generally consists of several stages. They are identified SCOR matrix, validity testing and reliability of the questionnaire, calculation of normalization score, weighted KPI with Analytical Hierarchy Process (AHP) method, and total value chain performance calculation.

SCOR Metric Design

SCOR matrix consists of three levels. In level 1, it called business process which consists of SCOR process (*Plan, source, make, deliver,* and *return*). In level 2, it called performance attribute (*reliability, responsiveness, cost*, and *asset*). In level 3, it called *Key Performance Indicator* (KPI) contains supply chain coffee indicators appropriate to the North Sumatera.

Testing Reliability and Validity of Measuring Instruments

The data will be processed with the help of spreadsheet, where the instrument coding system will follow the measuring scale that has been made that is with the interval ratio (1-4). Test Validity is a test to measure whether our instruments can precisely measure what we want to measure. Instrument Validation will be done by calculating Content Validity Indeks (CVI). Accoriding to Lawshe (1975) CVR index is an index used to measure whether the instruments we make measure what we want to measure. The CVR index will be calculated using the formula :

$$\text{CVR}= \frac{ne-(\frac{N}{2})}{N/2}$$

n_e = Number of respondents said “yes” (In this research, given a value of 3 or 4 in a closed statement)

N = number of sample

CVI = Average of CVR.

To know an instrument has been valid in the use of CVR indeks, Lawshe stated that the CVR index must qualify as a cutoff as in tabel 5.

According to Sekaran (1992), Reliability less than 0.6 is less good, whereas 0.7 is acceptable and above 0.8 is good.

TABLE 3
SCOR Metric Design

Bussiness Process (Level 1)	Attribute (Level 2)	Metric (Level 3)	Definition	Source	Unit	Formula
Plan	Reliability	Accuracy of raw material estimates	Estimated number of existing raw materials based on customer demand	Interview	%	-
		Accuracy of finished product inventory	PerEstimates of the number of finished products available in the face of a surge in demand	Interview	%	-
	Responsiveness	Timed production scheduling	Time needed to arrange production schedule	Interview	day	-
	Assets	*Cash-to-cash cycle time*	The time between the company pays the material to the supplier and receives payment from the customer for the product made from the material	Interview	day	Average inventory + Average account receiveable-Average debt
Source	Reliability	Fulfillment of product demand	Percentage of the number of requests that the supplier can meet	Febrina (2002)	%	(Order Quanity-Amount sent)/Amount sent x 100 %
		Performance of raw material suppliers	Percentage of consistency in supplying raw materials	Interview	%	-
	Responsiveness	*Lead time* product	Period of customer order	Interview	month	-
	Flexibility	Supplier availability	The number of suppliers available to sell coffee beans	Interview	people	-
	Assets	Daily product inventory	The number of products available in a day	Interview	ton/day	-
Make	Reliability	Production process	The time it takes to produce goods from raw materials to finished goods	Interview	day	Total time from land processing to processing
		Product packaging process	The time it takes to put coffee into the sacks	Interview	day	-
		Checking product quality	The time required to check coffee beans	Interview	day	-
	Responsiveness	Machine efiiciency/tools used	level of use tools	Interview	%	-
		Responsiveness produces consumer orders	The average time it takes to respond an order	Febrina (2002)	day	Time Company processes ordering - The initial time the company received the order
	Flexibility	Flexibility in producing	The number of days required to produce unexpected activities	*Supply Chain Council (2008)*	day	-
	Costs	Cost of production process	Costs incurred from raw materials to finished goods	Bolstroff (2003)	Rp	Total Cost of Product Production (Cost of seed procurement + fertilization + pruning + harvesting + processing + drying + tool purchase)
	Assets	Average length of machine life / tool	Average machine usage in processing coffee	Interview	Year	-
Deliver	Reliability	Fulfillment of ready-to-ship product inventory	Percentage of existing inventory quantities in accordance with customer demand	Wijayanti (2009)	%	(Number of products shipped/The amount ordered) x 100 %
	Responsiveness	Delivery of raw materials on time	The amount of time (days) required since the delivery of goods delivery letter until the product is received by the customer	Febrina (2002)	day	Total Delivery Time
	Costs	The cost of shipping raw materials	Total costs from supplier to wholesalers	Interview	Rp	-
Return	Reliability	Level of complaints from customers	The number of customer complaints to the collector	Febrina (2002)	costumer	Number of customers who complain per month
		Average product damage	Percentage of number of units returned / number of products shipped	Febrina (2002)	%	The number of product units returned/Number of products shipped) x 100 %
	Responsiveness	The speed of time in replacing a defective product	The time it takes to replace a defective product	Interview	day	-
	Costs	Cost in return / replacement of product	Direct and indirect costs are returned because the product is damaged	Bolstroff (2003)	Rp	Direct Cost + indirect costs
	Assets	Fixed Assets Return Cycle	Measures the return of a firm's earnings to the capital invested in the supply chain fixed asset	Supply Chain Council (2008)	%	(Acceptance of the supply chain-cost incurred)/Fixed assets of the supply chain) x 100 %
		Return of Working Capital	Measurements that assess the magnitude of the investment relative to the company's working capital compared to the revenue generated from the supply chain	Supply Chain Council (2008)	%	Acceptance of the supply chain-cost incurred)/(inventory+ account receivable-debt) x 100%

TABLE 4
Identify indicators of each level in SCM performance

Bussiness Process (Level 1)	Attribute (Level 2)	KPI No.	*Key Performance Indicator* (Level 3)
Plan	*Reliability*	KP-1	Accuracy of raw material estimates
		KPI-2	Accuracy of finished product inventory
	Responsiveness	KPI-3	Timed production scheduling
	Assets	KPI-4	*Cash-to-cash cycle time*
Source	*Reliability*	KPI-5	Fulfillment of product demand
		KPI-6	Performance of raw material suppliers
	Responsiveness	KPI-7	*Lead time* product
	Flexibility	KPI-8	Supplier availability
	Assets	KPI-9	Daily product inventory
Make	*Reliability*	KPI-10	Production process
		KPI-11	Product packaging process
		KPI-12	Checking product quality
	Responsiveness	KPI-13	Machine efiiciency/tools used
		KPI-14	Responsiveness produces consumer orders
	Flexibility	KPI-15	Flexibility in producing
	Costs	KPI-16	Cost of production process
	Assets	KPI-17	Average length of machine life / tool
Deliver	*Reliability*	KPI-18	Fulfillment of ready-to-ship product inventory
	Responsiveness	KPI-19	Delivery of raw materials on time
	Costs	KPI-20	The cost of shipping raw materials
Return	*Reliability*	KPI-21	Level of complaints from customers
		KPI-22	Average product damage
	Responsiveness	KPI-23	The speed of time in replacing a defective product
	Costs	KPI-24	Cost in return / replacement of product
	Assets	KPI-25	Fixed Assets Return Cycle
		KPI-26	Return of Working Capital

TABEL 5
***Cutoff* CVR**

N	*Min Value (CVR)*	*N*	*Min Value (CVR)*
5	0.99	13	0.54
6	0.99	14	0.51
7	0.99	15	0.49
8	0.75	20	0.42
9	0.78	25	0.37
10	0.62	30	0.33
11	0.59	35	0.31
12	0.56	40	0.29

(Source: Lawshe, 1975)

TABEL 6
Recapitulation of Test Result Validity and Reliability

Instrument	**CVI**	***Cut Off (>)***	**Valid/ Not Valid**
Farmers	0,51	0,49	Valid
Collectors	0,54	0,49	Valid
Wholesalers	0,59	0,49	Valid
Instrument	***Cronbach***	***Cut Off (>)***	**Reliable/ Not**

	Alpha		**Reliable**
Farmers	0,645	0,6	Reliable
Collectors	0,63	0,6	Reliable
Wholesalers	0,61	0,6	Reliable

Data processing shows that the data is valid and reliable. This is because the number of respondents 15 has a cut-off value of 0,49. The results of this research had a greater value than 0,49. Meanwhile, to see the data reliability, cut off data must be above 0,6. Then mapping the performance of the supply chain on each stakeholder based on the results of the existing questionnaire data. This depiction is depicted using 3 places, namely North Tapanuli, Dairi, and Humbang Hasundutan.

Stakeholder Mapping

1. **Farmers**

   Farmers are stakeholders who cultivate land, plant coffee seedlings, fertilize, prune, maintain, and sell to collectors and wholesalers.

FIGURE 1
The Performance Supply Chain Result of Farmers

Measurement of supply chain performance on farmers shows that the value of cost has the highest value that is, 3,133. This is because in making the production process, farmers need a very large cost where the process starts from the processing of land to harvesting and can cost as big as Rp 6.046.000. While at flexibility, has the lowest work performance value that is, 2,667.

This is due to the low flexibility of farmers in choosing suppliers of raw materials in which the raw materials that want to be used by farmers is a supplier that usually has become a farmer's subscription where sometimes the supplier's raw materials are up. Another thing is also because of the low flexibility in production where coffee plants are plants that take about 6 months or 1 year to grow well.

2. Collectors

Collectors are *stakeholder* who contacting farmers or coming directly to the site each harvest season to engage in purchasing activities.

Measurement of supply chain performance on the collectors shows that the value of flexibility and assets has the greatest value is 3.133. This is because the availability of supply product in collector is a lot where the suppliers of collectors are coffee farmers. Then the value of Assets is high because collectors have a daily supply of many products, the inventory of these products can be about 0.5 tons per day and has a fairly rapid return on working capital because collector are buying coffee from coffee farmers at the same price without taking into account the quality of coffee where purchases from farmers amounted to Rp 20.000,-/kg until Rp 25.000,-/kg, while the sales made by collector are Rp 27.000,-/kg. While the value of costs has the smallest value of 2,8667. Collector has least cost value beacause of cost of returning or replacing the product. . When purchasing coffee to farmers, collector doesn't pay attention to the quality of the coffee sometimes there is good quality or bad. This poor quality leads to the desire of wholesalers to replace with products of better quality and losses for collector because of poor quality coffee must be sold at a low price.

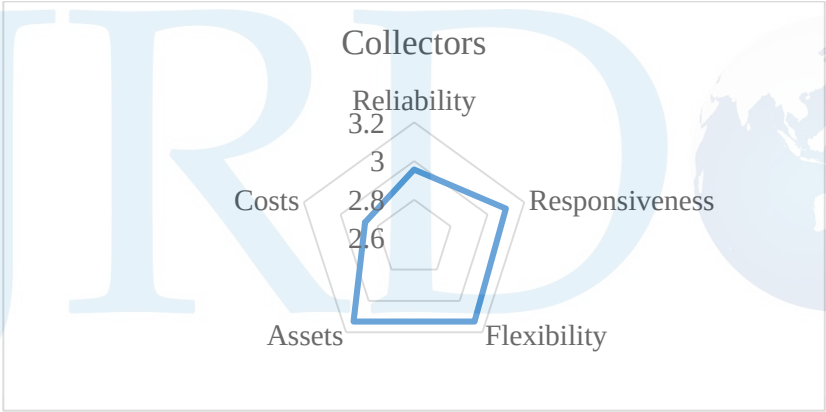

FIGURE 2
The Performance Supply Chain Result of Collectors

3. Wholesalers

Wholesalers are *stakeholder* who collect and process coffee from collectors. Measurement of supply chain performance on wholesalers has the greatest responsiveness value that is, 3.3. This is because wholesalers are very responsible in the lead time of the product, is time of delivery of the product to the customer. Wholesalers promise that coffee will be fast up to good quality so it costs a considerable amount in delivery thus affecting the return on working capital. Many wholesalers have become regular suppliers for large companies as well as being exporters to major countries such as Malaysia, Belgium, Japan and Italy so many wholesalers are quick to replace defective products. While the assets have the smallest value that is, 2,8667. Its because in assets factor, daily product inventory is about 0.62 tons per day. But, the lowest value of factor assets because of the return on working capital in collectors is long enough to be influenced by the acceptance of the coffee supply chain, costs incurred to buy coffee, accounts receivable, and debt. The acceptance of the coffee supply chain from collecting merchants is not sorted out so that the collector must first sort out the

coffee where the coffee has good coffee quality and considerable cost to send coffee to coffee enterprenuer and exporters thereby causing considerable debt even in the sale of wholesalers capable of selling ranges Rp 60.000,-/kg.

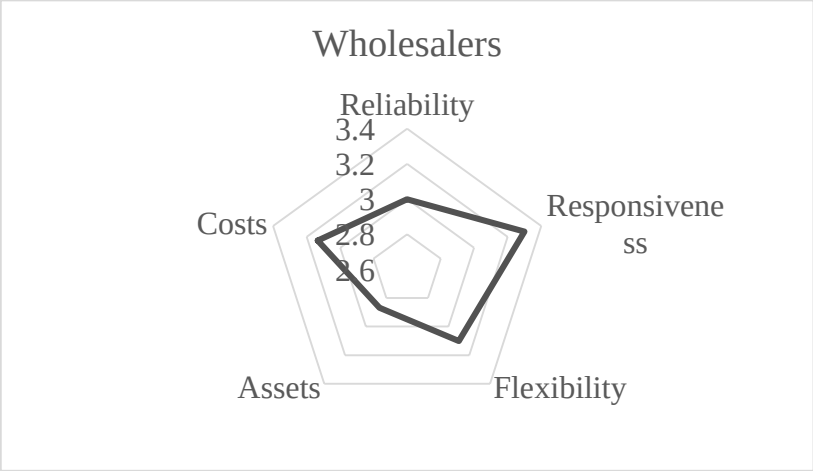

FIGURE 3
The Performance Supply Chain Result of Wholesalers

Normalization *Snorm De boer*

Each indicator has different weights with different size scales. Therefore, the process of parameter equation is needed, that is by normalization. The normalization process is done by the formula of *Snorm De Boer* normalization (Trienekens & Hvolby, 2000) are :

Larger is Better :

$$\text{snorm} = \frac{Si - S\,min}{(S\,\max - S\,\min)} x\ 100$$

Lower is Better :

$$\text{snorm} = \frac{Smax - Si}{(S\,\max - S\,\min)} x\ 100$$

Which is:

Si = The value of the actual indicator achieved
Smin = The worst performance value of performance indicators
Smax = The best performance value of performance indicators

TABLE 7
***Key Performance Indikator* Normalization**

KPI No.	*Key Performance Indicator*	Max	Actual	Min	Normalization Value (Score)	Explanation
KP-1	Accuracy of raw material estimates	90	84.333	80	43.33	higher the better
KPI-2	Accuracy of finished product inventory	95	85.82	80	38.80	higher the better
KPI-3	Timed production scheduling	7	5.86667	5	56.67	lower the better
KPI-4	*Cash-to-cash cycle time*	7	6.46667	6	53.33	lower the better
KPI-5	Fulfillment of product demand	22.22222	6.56122	2.22222	21.70	higher the better
KPI-6	Performance of raw material suppliers	95	87.6	80	50.67	higher the better
KPI-7	*Lead time* product	6	3.933	2	51.68	lower the better
KPI-8	Supplier availability	58	48.867	40	49.26	higher the better
KPI-9	Daily product inventory	0.68	0.53556	0.4	48.41	higher the better
KPI-10	Production process	320	282	240	47.50	lower the better
KPI-11	Product packaging process	3	2.17778	1	41.11	lower the better
KPI-12	Checking product quality	5	4.53	4	53.00	higher the better
KPI-13	Machine efficiency/tools used	85	80	75	50.00	higher the better
KPI-14	Responsiveness produces consumer orders	10	8.8	8	40.00	higher the better
KPI-15	Flexibility in producing	10	8.33333	7	44.44	higher the better
KPI-16	Cost of production process	6046000	5798933.33333	5600000	55.40	lower the better
KPI-17	Average length of machine life / tool	9	8.33300	8	33.30	higher the better
KPI-18	Fulfillment of ready-to-ship product inventory	100	96.35888	90	63.59	higher the better
KPI-19	Delivery of raw materials on time	8	7.40000	7	40.00	higher the better
KPI-20	The cost of shipping raw materials	300000	287533.3333	250000	24.93	lower the better
KPI-21	Level of complaints from customers	3	1.22	0	59.33	lower the better
KPI-22	Average product damage	4.51977	0.96594	0	78.63	lower the better
KPI-23	The speed of time in replacing a defective product	5	3.26667	2	42.22	higher the better
KPI-24	Cost in return / replacement of product	220000	109777.77778	0	50.10	lower the better
KPI-25	Fixed Assets Return Cycle	95	84.2	80	28.00	higher the better
KPI-26	Return of Working Capital	95	84.2	80	72.00	lower the better

AHP Calculation

The criteria and subcriteria used in this study are measurements arranged into SCOR hierarchy. AHP is used to obtain the weight of each criterion. The initial stage in this weighting is to make a pairwise comparison questionnaire filled by each respective respondent.

TABLE 8
Recapitulation Weight Value at each Level

Bussiness Process (Level 1)	Weight	Attribute (Level 2)	Weight	KPI No.	*Key Performance Indicator* (Level 3)	Weight
Plan	0.078	*Reliability*	0.111	KPI-1	Accuracy of raw material estimates	0.249
				KPI-2	Accuracy of finished product inventory	0.751
		Responsiveness	0.333	KPI-3	Timed production scheduling	1.000
		Assets	0.247	KPI-4	*Cash-to-cash cycle time*	1.000
Source	0.128	*Reliability*	0.079	KPI-5	Fulfillment of product demand	0.124
				KPI-6	Performance of raw material suppliers	0.876
		Responsiveness	0.311	KPI-7	*Lead time* product	1.000
		Flexibility	0.301	KPI-8	Supplier availability	1.000
		Assets	0.309	KPI-9	Daily product inventory	1.000
Make	0.505	*Reliability*	0.262	KPI-10	Production process	0.110
				KPI-11	Product packaging process	0.260
				KPI-12	Checking product quality	0.630
		Responsiveness	0.080	KPI-13	Machine efficiency/tools used	0.124
				KPI-14	Responsiveness produces consumer orders	0.876
		Flexibility	0.198	KPI-15	Flexibility in producing	1.000
		Costs	0.166	KPI-16	Cost of production process	1.000
		Assets	0.293	KPI-17	Average length of machine life / tool	1.000
Deliver	0.052	*Reliability*	0.120	KPI-18	Fulfillment of ready-to-ship product inventory	1.000
		Responsiveness	0.331	KPI-19	Delivery of raw materials on time	1.000
		Costs	0.549	KPI-20	The cost of shipping raw materials	1.000
Return	0.236	*Reliability*	0.359	KPI-21	Level of complaints from customers	0.124
				KPI-22	Average product damage	0.876
		Responsiveness	0.075	KPI-23	The speed of time in replacing a defective product	1.000
		Costs	0.156	KPI-24	Cost in return / replacement of product	1.000
		Assets	0.41	KPI-25	Fixed Assets Return Cycle	0.24906015
				KPI-26	Return of Working Capital	0.75093985

Final Value Calculation of SCOR

The calculation of the final value of supply chain performance is done by multiplying every normalization score that has been obtained from the normalization formula of snorm de boer with the weight of each key performance scope Indicator, dimension, and process. Table 8 shows the level of performance indicators.

TABLE 8
Level of Performance Indicator

Performance Values	Level of Performance
<40	*Poor*
40-50	*Marginal*
50-70	*Avergae*
70-90	*Good*
>90	*Excellent*

(Source : Performance Measurement and Improvement Trienekens dan Improvement in Supply Chain Hvolby, 2000 in Sumiati, 2006)

The determination of the value of KPI at level 3 is used for the calculation on each attribute in the performance measurement metrics. This calculation is done because an attribute is not only influenced by a single performance but by many performances. The reliability of the plan consists of two KPIs, which are the accuracy of raw materials estimates and the accuracy of finished product inventory. This calculation is used to obtain the total value of both KPIs. The value may indicate which values are lower and higher and that the value can be attempted to fix. For example, the lowest value in the plan is reliability. Therefore, the accuracy of the raw material estimates and the accuracy of the raw material inventory of the estimated accuracy percentage should be further enhanced by looking at historical data and forecasting.

TABLE 9
Performance Value Recapitulation of Key Performance Indicator (Level 3)

Bussiness Process (Level 1)	Attribute (Level 2)	KPI No.	*Key Performance Indicator* (Level 3)	Score	Weight	Performance Value (ScorexWeight)	Total of each dimension
Plan	*Reliability*	KPI-1	Accuracy of raw material estimates	43.33	0.249	10.792	39.928
		KPI-2	Accuracy of finished product inventory	38.80	0.751	29.136	
	Responsiveness	KPI-3	Timed production scheduling	56.67	1.000	56.667	56.667
	Assets	KPI-4	*Cash-to-cash cycle time*	53.33	1.000	53.333	53.333
Source	*Reliability*	KPI-5	Fulfillment of product demand	21.70	0.124	2.688	47.077
		KPI-6	Performance of raw material suppliers	50.67	0.876	44.389	
	Responsiveness	KPI-7	*Lead time* product	51.68	1.000	51.675	51.675
	Flexibility	KPI-8	Supplier availability	49.26	1.000	49.261	49.261
	Assets	KPI-9	Daily product inventory	48.41	1.000	48.413	48.413
Make	*Reliability*	KPI-10	Production process	47.50	0.110	5.225	49.304
		KPI-11	Product packaging process	41.11	0.260	10.689	
		KPI-12	Checking product quality	53.00	0.630	33.390	
	Responsiveness	KPI-13	Machine efiiciency/tools used	50.00	0.124	6.195	41.239
		KPI-14	Responsiveness produces consumer orders	40.00	0.876	35.044	
	Flexibility	KPI-15	Flexibility in producing	44.44	1.000	44.444	44.444
	Costs	KPI-16	Cost of production process	55.40	1.000	55.396	55.396
	Assets	KPI-17	Average length of machine life / tool	33.30	1.000	33.300	33.300
Deliver	*Reliability*	KPI-18	Fulfillment of ready-to-ship product inventory	63.59	1.000	63.589	63.589
	Responsiveness	KPI-19	Delivery of raw materials on time	40.00	1.000	40.000	40.000
	Costs	KPI-20	The cost of shipping raw materials	24.93	1.000	24.933	24.933
Return	*Reliability*	KPI-21	Level of complaints from customers	59.33	0.124	7.352	76.238
		KPI-22	Average product damage	78.63	0.876	68.886	
	Responsiveness	KPI-23	The speed of time in replacing a defective product	42.22	1.000	42.222	42.222
	Costs	KPI-24	Cost in return / replacement of product	50.10	1.000	50.101	50.101
	Assets	KPI-25	Fixed Assets Return Cycle	28.00	0.249	6.974	61.041
		KPI_26	Return of Working Capital	72.00	0.751	54.068	

TABLE 10
Performance Value Recapitulation of Key Performance Indicator (Level 2)

Bussiness (Level 1)	Attribute (Level 2)	Score	Weight	Performance Value (ScorexWeight)	Total of each Process
Plan	*Reliability*	39.928	0.111	4.449	36.498
	Responsiveness	56.667	0.333	18.889	
	Assets	53.333	0.247	13.160	
Source	*Reliability*	47.077	0.079	3.717	49.577
	Responsiveness	51.675	0.311	16.067	
	Flexibility	49.261	0.301	14.818	
	Assets	48.413	0.309	14.975	
Make	*Reliability*	49.304	0.262	12.932	44.013
	Responsiveness	41.239	0.080	3.307	
	Flexibility	44.444	0.198	8.797	
	Costs	55.396	0.166	9.209	
	Assets	33.300	0.293	9.768	
Deliver	*Reliability*	63.589	0.120	7.604	34.546
	Responsiveness	40.000	0.331	13.249	
	Costs	24.933	0.549	13.694	
Return	*Reliability*	76.238	0.359	27.385	63.387
	Responsiveness	42.222	0.075	3.154	
	Costs	50.101	0.156	7.819	
	Assets	61.041	0.41	25.029	

TABLE 11
Performance Value Recapitulation of Key Performance Indicator (Level 1)

Bussiness Process (Level 1)	Score	Weight	Final Value (ScorexWeight)
Plan	36.498	0.078	2.860
Source	49.577	0.128	6.366
Make	44.013	0.505	22.216
Deliver	34.546	0.052	1.802
Return	63.387	0.236	14.980
Total			48.224

This performance measurement with SCORE method yields a score of 48,224 where this value is in the marginal position with the lowest final value deliver is 1,802 and the highest final value make is 22,216. This indicates that the delivering business process needs to be improved. Delivery business processes can be improved by means of fulfillment of upgraded delivery product inventory where required and shipped quantities must be the same, delivery of raw materials on time, sorting and pressing raw material delivery costs.

In the previous table, the return value has a value greater than the value of make, but make has a larger value. This is because it is influenced by the weights in which the weights are based on the importance of supply chain performance. In addition, local governments should provide a place which distributes between coffee suppliers and coffee farmers. If this is done then it will improve performance especially in terms of source. In addition, farmers pay more attention to the supply of coffee seeds, so do not depend on only one type of supplier.

The performance of make also can still be improved. Make is a performance value that values the coffee making. In making coffee, there are still many problems. If seen in table 4.8 performance of coffee production process still have low KPI value because coffee farmer in North Sumatera area still less aware of concern from quality of coffee beans where coffee planter owner does not want to listen to government. The government is actually willing to provide a facility to hold a procurement of superior coffee seeds as well as compost and has a specific guideline for cultivating coffee, but the farmers do not want to follow the way of cultivation

established by the government. In addition, the owner of this coffee plantation itself is negligent in the working method in which some farmers rarely provide fertilizer that makes coffee less good growth.

In terms of return, although already has a fairly good performance value but the existence of things that still need to be improved, for example collectors are lazy to sell coffee beans by sifting through good coffee beans and sometimes there are complaints from wholesalers to get a good coffee beans in which collectors never distinguish the price in buying coffee beans from farmers. Therefore, Collectors should pay more attention to the quality of coffee by sifting through the small and large coffee beans. If the collectors perform a sorting process then the asset factor on the wholesalers will be better which will affect the return on capital at the Collector will be faster.

5. CONCLUSIONS

Conclusions can be taken from this research are two folds, first Supply chain structure in North Sumatera are farmers-colletors-wholesalers and then from wholesalers can go to exporters or coffee enterprenuer. Second, supply chain performance of coffee in North Sumatera using SCOR method are 41,298 with Marginal category and the lowest score performance is deliver with 1,802.

6. RECOMENDATION FOR FUTURE RESEARCH

This research can be extended by add more KPI and more *stakeholder* to have more comprehensive performance measurement of coffee supply chain of in North Sumatera.

REFERENCES

Adriana P. R., et al. (2012). Implementation of SCM Procurement Process In PT. Semarang Garment Manufaktur. *International Journal of Computer Application,* 45(3).

Aramyan, L., et al. (2007). Performance Measurement in agri-food supply chains : a case study. *Supply Chain Management: Emerald International Journal,* Vol. 12 (4) : 304 - 315.

Bourgeois, R. (2005). *Analytical Hierarchy Process: an Overview*. Bogor : UNCAPSA-UNESCAP .

Bowersox et al., (2001). Material Logistics Management. *Internal Journal of Physical Distribution and Logistical Management*, 15(5): 27-35.

Bustanul, A. (2010). Global Sustainability Regulation and Coffee Supply Chains in Lampung Province, Indonesia. *Asian Journal of Agriculture and Development*, Vol. 7 (2).

Danish, I., et al. (2008). A SCOR Reference Model of the Supply Chain Management System in an Enterprise. *The International Arab Journal of Information Technology* 5(3).

Darojat, Elly W.Y. 2017. Performance Measurement Enterprises with Supply Chain Operation Reference (SCOR) Method. *Seminar and Konferensi Nasional IDEC.*

Erkan, T. E. (2011). Supply Chain Performance Measurement: A Case Study About Applicability Of Scor Model In A Manufacturing Industry Firm. *International Journal of Business and Management Studies*, Vol. 3 (1).

Fernando S., et al.(2012). Final Review of the Application of the SCOR Model: Supply Chain for Biodiesel Castor – Colombia Case. *Journal of Technology Innovations in Renewable Energy* 1 : 39 - 47.

Jaya, R., et al. (2013). Sustainability Analysis for Gayo Coffee supply Chain. *International Journal on Advanced Science, Engineering and Information Technology,* 3 (2) : 24 - 28.

Lawshe. (1975). A Quantitative Approach to Content Validity, *Journal of Phersonnel Psychology*, 28 : 563-575.

Lukmandono, Reza P.P. (2015). *Performance Measurement Analysis to Enhance the Competitiveness of enterprises with Supply Chain Operation Reference (SCOR) Method.*

M. Rizal U., et al. (2014). Performance Analysis Supply Chain with Supply Chain Operation Reference (SCOR) Method. *Journal of Scientific Innovation*, 15(3) : 66 - 74.

Mardalis. (2008). *Research Methods (A Proposal Approach)*. Jakarta: PT. Bumi Aksara.

Maziyar G, Mehdi S. (2009). Application of SCOR Model in an Oil- producing Company. *Journal of Industrial Engineering,* 4: 59 - 69.

Nikita H., et al. (2015). *Performance Analysis Supply Chain With with Supply Chain Operation Reference (SCOR) Method Based on Analytical Hierarchy Process (AHP) and Objective Matrix (OMAX).*

Pujawan, I. (2005). *Supply Chain Management*. Surabaya: Guna Widya.

Qayyum, R., et al. (2013). Effects of SCOR on Management of Supply Chain. *International Journal of Management & Organizational Studies*, Vol. 2 (1).

Sekaran, Uma. (1992). *Research Methodology for Business*. Jakarta: Salemba Empat.

Sugiyono. (2009). *Research Methodology for Business (quantitative, qualitative, and R&D Approach)*. Bandung: Alfabeta.

Sumiati. (2006). *Performance Measurement Enterprises Supply Chain with Supply Chain Operation Reference (SCOR)Method at PT. Madura Guano Industri (KAMAL-MADURA).* Faculty of Industrial Engineering : UPN Veteran Jawa Timur.

Supply Chain Council. (2008). *Supply Chain Operations Reference Model Version 8.0*. Working Paper.

Trienekens, J.H. dan Hvolby, H.H,. (2000). *Performance Measuruement and Improvement in Supply Chain.* CINET Conference.

Velychko, O. (2015). Integration of SCOR-Modeling and Logistical Concept of Management in the System of Internal Transportation of Milk Cooperative. *Mediterranean Journal of Social Sciences*, Vol. 6 (1).

Vembri N, H. (2012). Designing and Performance Measurement Supply Chain (Case Study : In PKU Muhammadiyah Temanggung Hospital in Installation Division). *Journal of Industrial Research* 11(2) : 123-134.