Evaluation of Supplier Performance using AHP (Analytical Hierarchy Process) in PT. PGI

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ABSTRACT

This study aims at evaluating the performance of suppliers in PT PGI. As a new company, PT PGI does not have a system for evaluating the suppliers used and only rely on intuition. Therefore, a periodically evaluation should be taken into account to repair the supply chain system from the upstream line. The evaluation is conducted for the accessories supplier such as interlining, thread, buttons, labels, and zipper with the assessment criteria of quality, price, delivery, flexibility and responsibility. The method used in this research is the Analytical Hierarchy Process (AHP) based on the weight of priority. The results show the priority weight for each criterion are the price (0.431), shipping (0.242), quality (0.229), responsiveness (0.066) and flexibility (0.032). The analysis of supplier performance in the group suggest PPC Indonesia (0.823) as an interlining supplier, MJM (0.885) as a supplier of thread, copyright Button (0.327) as the supplier of button and Golden Labelindo (0.722) as a supplier label, and YKK (0.732) as the supplier of the zipper.

Keywords *: Supplier, Performance, AHP, Garment*

1. Introduction

Supply Chain is a network of companies that jointly work to create and deliver a product into the hands of end users. The flow of enterprise networks are from upstream to downstream, consisting of suppliers, manufacturers, expedition companies, distributors, retailers, and end customers.

Recently, the concept of supply chain is in the spotlight in the world of industry, one of which is the aspect of supplier. Problem supplier especially in the supplier selection is an important issue, because it has a great influence on the continuity of the production of manufacturing enterprises. One way to resolve the problems of the supplier is to evaluate the performance of suppliers that had been used by the company. Through evaluation activities it is expected that consideration of whether the supplier is worth keeping or should change another supplier can be conducted.

PT PGI is a new company that is engaged in the garment. In the production process, companies need a variety of raw materials to meet consumer demand. The raw material is in the form of fabric and accessories such as interlining, thread, buttons, labels, and zipper. For fabric materials, PT PGI get it through the buyer, while the companies that got through several suppliers who have a subscription.

As a new company, PT PGI does not have a system for evaluating the used suppliers and only rely on its intuition. By doing so, a supplier performance evaluation should be done periodically to repair the supply chain from upstream. Based on these problems, the supplier's performance is evaluated using Analytical Hierarchy Process (AHP) in which a calculation based on weighted priorities is taken into account.

There are some studies about implementation of AHP in supply chain e.g. [1], [2], [3] and [4]. These studies focusing the fundamental theory of green Supply Chain Management (SCM) in manufacturing industry,

small and medium size enterprizes supported by bibliometric study. Implementation AHP in procurement process can be found in [5] and [6]. Based on these studies, AHP can be concluded as a usefull and effective method of decision making especially in a procurement system.

Based on the formulation of the problem, the purpose of this study it to analyze the performance of the suppliers based on the criteria weight in the AHP.

2. Literature Review

2.1 *Supply Chain Management*

Supply Chain is a series of business that flows the goods to downstream. In general, companies that often practice the supply chain is a manufacturing company that makes a product and send it to the end consumer through the supply chain from producers with raw materials and its components, assembling products, wholesale, agent retail, and transportation companies. All of these are members of the supply chain [7]. Lambert, Stock, and Ellram [8] defines the supply chain as an alliance of several companies that deliver goods or services to the market. In this case it can be underlined that both the concept of supply chain include the end consumer as part of the supply chain. To manage the Supply Chain, we need a tool, method, or the right approach known as Supply Chain Management (SCM).

Supply Chain Management as a management network of relationships within the company and between interdependent organizations and business units are comprised of a material supplier, procurement, production facilities, logistics, marketing, and related systems that facilitate the flow of materials in forward and reverse, service, finance and information from manufacturers to end customers with benefits that add value, maximize profits through efficiency and achieve customer satisfaction [9].

Supply Chain Management becomes a single best solution to improve the productivity between different firms. The main purpose of the SCM is the delivery or shipment of products in a timely manner in order to satisfy customers, reduce costs, improve all the results of the entire supply chain, reducing the time, centralize the planning and distribution [10].

2.2 Strategy Type of Purchasing Contract

The relationship between the company and the supplier and the type of contract the company wants is a related things. The location of products in the supply chain positioning model influences the type of contract the company wants. Various types of contracts between the company and suppliers as well as the differences are described in Figure 1 and Table 1 [11].

2.3 Supplier Appraisal

Assessing and selecting suppliers is one of the tasks of procurement management. Selecting suppliers can be time and resources consuming if the supplier in this matter is a key supplier. For key suppliers that have the potential to establish a long term relationship, this selection process involves an initial evaluation, inviting them to excel, field trips, and so on. This process will take time and considerable expense. Therefore, the supplier selection must always monitored the performance through periodic assessment. The results of this study are used as input for the supplier to improve their performance.

There are two factors used in designing the relationship with the supplier [12]:

1. The strategic importance level of purchased items for the company / Supply Chain. The more strategic position of an item in the company, the need to create a close relationship and long-term oriented with the supplier of the item.
2. The level of difficulty of managing the purchase of the item. The higher the difficulty level, the more investment is required from the management According [12] every company has different criteria for assessing supplier, depending on the objectives to be achieved by the company. Many companies make a fatal mistake in choosing a supplier. Most companies assess supplier focused solely on the price of goods, goods quality and speed of delivery time are given without seeing the influence to the total cost. Often the supplier selection requires a range of other criteria that are important to the company.

2.4 Metode AHP (Analytic Hierarchy Process)

Analytical Hierarchy Process (AHP) developed by [13]. This method is a framework to take decisions effectively on complex problems by simplifying and accelerating the decision-making process to solve the problem into its parts, arranging parts or these variables in a hierarchical arrangement, giving a numerical value to the consideration of the subjective importance of each variable and synthesize these considerations to set the variables which have the highest priority and act to affect the outcome of the situation. AHP helps solve complex problems by structuring a hierarchy of criteria, the competent authorities, with interesting results and various considerations for the development of weight or priority. This method also combines the strength of feeling and logic that are concerned on various issues, and then synthesize a variety of diverse considerations into results matched our estimate intuitively, as presented on considerations that have been made [13].

According[14], the advantages of this analysis are:

1. Unity
   AHP make broad issues and not structured into a model that is flexible and easy to understand.
2. Complexity
   AHP solve complex problems through a systems approach and integration deductively.

3. Interdependence
   AHP can be used on the system elements are independent and do not require a linear relationship.
4. Hierarchy Structuring
   AHP represents a natural thought that tends to group elements of the system to the different levels of each level contains elements that are similar.
5. Measurement
   AHP provides a measurement scale and the method to get priority.
6. Consistency
   AHP consider logical consistency in the assessment used to determine the priority.
7. Synthesis
   AHP leads to an overall estimate of how he wanted each alternative
8. Trade Off
   AHP consider the relative priority of factors on the system so that people are able to choose their destination based on the best alterntif.
9. Judgement and Consensus
   AHP does not require the existence of a consensus, but combining the results of different assessment.
10. Process repitition
    AHP is able to make people who refine the definition of a problem and develop assessment and understanding them through the process of repetition.

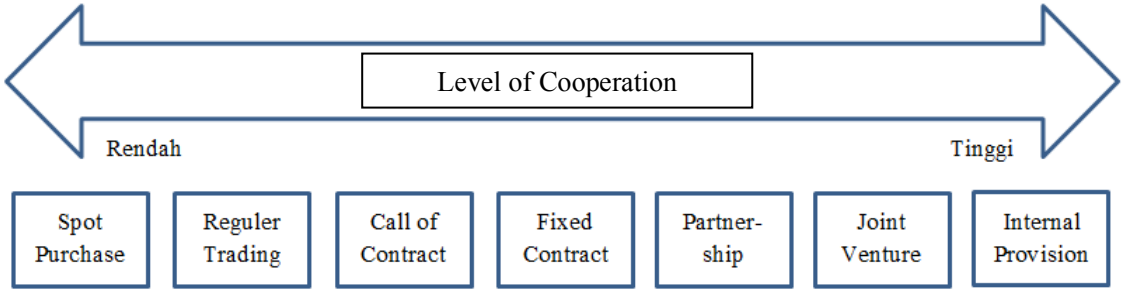

Figure 1 Various contract types [11]

Table 1 The difference of each contract type [11]

Hal	*Spot Purchasing*	*Reguler Trading*	*Call of Contract*	*Fixed Contract*	*Partnership*	*Join Venture*	*Internal Provision*
Time focusing	Short-term	Medium-term	Medium-long term	Medium-long term	Long-term	Long-term	Long-term
Level of confidence	Very low	began to be developed	Developed on the basis of kinship	Developed on the basis of kinship	High	Does not depend on trust	Does not depend on trust
Priorities of the supplier to the company	Low	Medium	Medium	Medium to High	High	Very High	The Highest
Performance profiling by supplier companies	No	Basic	The main aspect of supply	The main aspect of supply	The main aspect of supply and relationship	The main aspect of supply and competitive benefit contribution aspect	Part of management system of the normal enterprise
conditions of purchase	Purchase once, significant expenditures and a lower turnover costs	Purchasing is very rare, unpredictable and capricious specification	Purchases are often, difficult to predict, and the price can be set	Purchases are often difficult to predict, and the price can be set	Collaboration with suppliers with the goal of competitive advantage	Controlling the source of supply with the goal of competitive advantage	Must maintain a competitive advantage, too many risks in the market supply

The weakness of the AHP method is as follows:

1. Require the participants who really know the problems that really exist, particularly in building a hierarchy of problems.
2. If there is a very extremme differences in the decision multipartisipan problem (can be seen from the analysis of consistency), the AHP is not directly applicable and need to be an attempt to unite opinion or problem.
3. AHP can not be viewed in terms of pure statistics or probability distributions for sampling was not random and can be either single participants and multipartisipan [13].

Steps in Analytical Hierarchy Process are as follows:

1. Determine the types of criteria used
2. Develop these criteria in a matrix form pairs

$$a_{ij} = \frac{wi}{wj}, i, j = 1,2, \ldots, n$$

Where n states the number of criteria compared, w_i weights to the criteria of i, and a_{ij} is the ratio of the weight of the criteria i and j

3. Normalize each column by dividing each value in the first column and row j with scattered values in column i

$$a_{ij} = \frac{a_{ij}}{\max a_{ij}}$$

4. Summing values in each column I, namely:

$$a_{ij} = \sum_i a_{ij}$$

5. Determine the priority weighting of each criterion to-I, by dividing each value of a number of criteria compared with (n), namely:

$$w_i = \frac{a_i}{n}$$

6. Calculating the value of lambda max (eigen value) with the formula:

$$\lambda\, max = \frac{\sum a}{n}$$

7. Calculating the consistency index (CI)
   Calculation of consistency is to calculate the value of storage of consistency, of storage is called the Consistency Index by the equation:

$$CI = \frac{\lambda_{max} - n}{n - 1}$$

Where:

λ_{max} = eigen value maxsimum

n = matriks size

The code used for the application of AHP method are described in Table 2.

3. Methods

The study was conducted in February 2016 to March 2016 in PT PGI. Preliminary stages of research include studies, data collection, data processing and data analysis. Preliminary study is conducted to identify problems and focus the research as well as obtain a theoretical basis. Preliminary study is divided into two:

- Field study
  Field studies aimed at obtaining data directly. At this stage, the research was conducted in the logistics department of PT PGI. A field study was conducted by interviewing various related parties that occur in the condition of the company, namely logistics managers and purchasing staff. This interview focuses on the problem of performance of used supplier using some criteria
- Literature review
  Literature study is used to obtain the necessary information and to determine the appropriate method in processing the data. Beside, the literature was used for grounding theory or scientific studies that are required in this study. A literature study is done by looking at how to assess the performance of suppliers and set the method used namely Anaytic Herarchy Process (AHP).

Table 2. The numeric code used in AHP

Intensity interest	Information
1	Both elements are equally important
3	One elements is a little bit more important than another element
5	One elements is more important than another element
7	One elements is much more important than another element
9	One elements is absolutely more important than another element
2, 4, 6, 8	The values of a compromise between the two adjacent values
Reverse	If activity i get one point compared with activity j, then j has the reciprocal value compared with i

Data obtained from the interviews and questionnaires results of manager of logistics and purchasing staff. Interviews were conducted in the form of determining the criteria needed by the company to the supplier, while the questionnaires given in the form of the assessment criteria and supplier performance are assessed according to the criteria.

Supplier assessment that obtained from the questionnaire results form the basis for the use of AHP method to assess the performance of suppliers frequently used and have been assessed through questionnaires obtained. The questionnaire obtained is processed into a matrix of pairwise as the basis for the application of AHP.

In the analysis phase, it is explained the results of data processing that have been obtained, namely the analysis for each criterion and supplier groups as well as the overall supplier performance.

4. Result And Discussion

4.1 Determination of Performance Criteria

The identification of the supplier evaluation criteria was formed based on the results of interviews with the company. It conducted in order to see which one best fits well with the company's expectations. Those criteria are:

1. Quality
2. Cost
3. Delivery
4. Flexibility
5. Responsiveness

On the quality criteria, the points include the accuracy of the material order, the order of color accuracy, and specifications (size, weight, raw materials). At the price criterion, the noted criterias are the price of materials, flexibility of payment and shipping costs. As for the delivery criteria, attention to things such as the precise number of shipments, timeliness of delivery, and speed time to destination are required.

On the criteria of responsiveness, attention is focused to suppliers in responding to problems, respond to demand changes in the amount ordered, and respond to demand changes to the delivery time. As for the criteria of flexibility, the factors includes the fulfilling requests for changes in the amount ordered, the fulfilling requests for changes in delivery time, reject repair, and replacement because of damage.

From the results of the five specified criteria, then the weight of each criterio is obtained. This weighting is based on the results of questionnaires given to logistics managers and purchasing staff about the criteria which the priorities are presented through a matrix pairs.

The results of the questionnaire is to obtain the main criterion of the benchmark, which is the price criteria. The criteria followed by the delivery, then the third is quality, while in the fourth and fifty were occupied by the criteria of responsiveness and flexibility. Table 3 shows the position of the weight of each criteria.

Table 3 Recapitulation weight of each criteria

Nr.	Criteria	Weight
1	Cost	0.431
2	Delivery	0.242
3	Quality	0.229
4	Responsiveness	0.067
5	Flexibility	0.032

Each of these criteria was conducted pairwise comparisons which compares each element with other elements. At each level of the hierarchy, the pairs comparison was conducted to obtain the value of interest rate of decision element. For the pairwise comparison matrix between criteria can be seen in Table 4. Results recap of AHP calculations are presented in Table 5. Total Weight Global for each supplier as follows in Table 6.

Table 4 Pairwise comparison matrix between criterias

Kriteria	*Quality*	*Cost*	*Delivery*	*Flexibility*	*Responsiveness*
Quality	1	0.5	1	5	5
Cost	2	1	3	7	7
Delivery	1	0.33	1	7	7
Flexibility	0.2	0.14	0.14	1	0.17
Responsiveness	0.2	0.14	0.14	6	1

Tabel 5 Calculation recap for each criteria and each supplier

Alternative Supplier	Quality	Cost	Delivery	Flexibility	Responsiveness
	0.22919	0.431005	0.241784	0.032162	0.065858
INTERLINING *SUPPLIER*					
PCCI	0.9	0.75	0.9	0.5	0.9
KI	0.1	0.25	0.1	0.5	0.1
THREAD *SUPPLIER*					
MJM	0.9	0.9	0.9	0.75	0.75
CR	0.1	0.1	0.1	0.25	0.25
BUTTON *SUPPLIER*					
CB	0.534	0.2	0.323	0.4	0.419
SB	0.092	0.2	0.245	0.258	0.318
UB	0.222	0.2	0.185	0.166	0.138
WK	0.092	0.2	0.141	0.107	0.079
NFIMB	0.059	0.2	0.107	0.069	0.046
LABEL *SUPPLIER*					
GL	0.655	0.778	0.778	0.493	0.493
ML	0.095	0.042	0.042	0.196	0.196
SI	0.25	0.18	0.18	0.311	0.311
ZIPPER *SUPPLIER*					
YKK	0.6	0.808	0.719	0.643	0.778
FI	0.2	0.13	0.166	0.255	0.18
HSD	0.2	0.062	0.115	0.101	0.042

Table 6 Final calculation for each supplier

Supplier	Final value
INTERLINING *SUPPLIER*	
PCCI	0.823
KI	0.178
THREAD *SUPPLIER*	
MJM	0.885
CR	0.115
BUTTON *SUPPLIER*	
CB	0.327
SB	0.196
UB	0.196
WK	0.150
NFIMB	0.131
LABEL *SUPPLIER*	
GL	0.722
ML	0.069
SI	0.209
ZIPPER *SUPPLIER*	
YKK	0.732
FI	0.162
HSD	0.107

From the aforementioned table it can be seen that for the interlining suppliers, PCCI Indonesia has the most excellent performance. Then for the thread supplier, MJM has the most excellent performance. In addition to the suppliers of button, CB became the best suppliers. Next on the label supplier, GL being the order number one, and that of its supplier's zipper, YKK become a top performing supplier.

From the calculation of each supplier that exist above, it shows that there is a significant difference between the performances of each supplier. This is because the assessment given by decision makers when conducting interviews has subjective nature and is a unilateral decision. It can be seen from the weighted where decision makers are more concerned with price criteria than other criteria, even the quality criteria into third after delivery criteria.

PT PGI has make to order system in which the delivery criteria is an important factor in decision making. In this case, the delivery criteria are second, because this is a new company that is more concerned with price criteria. Based on the analysis carried out it can be said that the application of AHP for supplier performance assessment can support a smooth production process PT PGI.

5. Conclusion

Based on the analysis that has been done, it can be concluded that in evaluating the performance of suppliers, there are five main criterias namely the criteria of quality, price, delivery, flexibility, and responsiveness. The criteria that have weight biggest priority is the the price (0.431), followed by delivery of (0.242), third is the quality criteria (0.229). In the fourth and fifth there are the responsiveness and flexibility that have a thin value difference that are 0.066 and 0.032. Recommendations suppliers for each product is PCCI (0.823) for interlining supplier, MJM (0.885) for the supplier thread, CB (0.327) for button supplier, and for the most excellent supplier performance label owned by GL (0.722). YKK has the most excellent performance (0.732) for zipper supplier.

Based on observations, discussions and analysis were done, then some suggestions can be submitted in order to create the optimal performance that the management policy in the form of supplier evaluation used and done regularly, making SOP regarding assessment standards suppliers to be more objective and record the behavior of suppliers to evaluation.

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