Supplier Selection Framework for Dairy Industry in Indonesia

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Abstract

Dairy market in Indonesia has good demand trends. However, the domestic supply is still below the consumption level. Thus, this country used to import dairy product rather than use the domestic one. On the other hand, dairy supply chain has its own uncertainty both in upstream and downstream process due to the durability of raw materials, such as tropical climate, unpredictable seasons, and lack of cold storage. It raises challenges for overland transportation. Selecting right supplier is one of the upstream area which affected the quality of dairy product and mitigate the supply chain risks. This study aims to develop a framework for supplier selection process. It determined main criteria through interview, pair wise comparison using AHP method, then deployed into some sub-criterias based, then been ranked. The result is a supplier selection assessment based on local company requirements. It can be concluded that the main criteria for supplier selection are quality, quantity, delivery, warranty, and pricing with sub main criteria which already deployed. The output could help most of the Indonesia dairy industries, which mostly small to medium scale, to achieve competitive advantages by solving one of the critical stages.

Keywords
Dairy, Framework, Supplier Selection, Supply Chain, Risk Management

1. Research Background

Food supply chain, in which dairy is included, has its own characteristics of product because of the natural attributes that has a big impact on customer's health. It also has its own uncertainty both in upstream and downstream process (Aung, 2014) [1], (Pedrso, 2016) [2]. In the upstream, there are some uncertainty of supply due to some reasons. Chen et.al. (2013) [3] argued that the uncertainty of supply is caused by the difference of product quality on each supplier and different pricing due to currency. Based on Pujawan (2010) [4], the uncertainty of supply due to some reason, such as the seasonal of raw material, the capacity of supplier, delivery lead time by supplier and the quantity of available material. On the other hand, the downstream has several problems that affect the uncertainty of food supply chain. Dani (2015) [5] argued that food industry deals with uncertainties due to the durability of food product. The life time of food product is limited by period of time [5]. The uncertainty of customer demand and the capacity of warehouse also becoming one of this problem [4]. Currently, product safety and health becoming consumer awareness (Pant, 2015) [6]. For this industry, if a company can survive and dealing with these situations, it will give them competitive advantages.

Indonesia's dairy market have a good trend, because its supply is still below the consumption level. According to Global Business Guide Indonesia (2015) [7], the domestic stock fulfill less than a fifth of national demand per year by the end of 2015. A research, which had been done by Ministry of Industry, showed that the demand of dairy

products in Indonesia almost 3.3 million tonnes per year, but Indonesia importerd more than 70% in 2009 [7]. There are some raw material such as skim milk powder that have to be imported. These imported material come from Australia, New Zealand, United States, and Europe. As domestic market fails to fulfill the demand, local industries choose to use imported milk. Furthermore, there are several problems occur in the upstream activities on dairy supply chain. The tropical climate, unpredictable seasons, some lack of refrigerator or cooling facilities and inadequate roads, challenges it much. Domestic dairy industry faces many challenges on assuring the freshness of raw materials, as categorised as perishable goods.

Commonly, in the supply chain selecting supplier needs longer time and resources, especially for the main suppliers that supply the primary product [4]. [3] conducted a research the analysis of supplier selection benefits are mitigate supply chain risk, increasing competitive advantage, and forming strategies for company. Supplier selection also help the decision makers to determine the best solustions. By choosing the important one and related to the problems (Saaty, 2008) [8]. AHP could integrate between the existing condition of the company and criteria which company really needs to be developed [8].

Based on the existing condition, this study aims to help local dairy industries, which mostly dominated by small to medium scale enterprises, to solve their upstreams problem. A local company, categorised as medium scale industry, was chosen as a representative of dairy industry in Indonesia. The PPIC manager and purchasing supervisor are using another form of supplier selection. Also, this company using the level of approval as the standard of supplier selection. The standard used in these companies throughout the years. It used two scales which the suppliers were doing performance or not. However, this scale is still too general for supplier selection. Furthermore, there are only main criteria on their form. Thus, for detail information on supplier selection and developing their supplier performance become easier, this study also identify each sub criteria of their main criteria. This research will forming supplier selection form using AHP method and sensitivity analysis. By determining the main and sub criterias, the author is trying to develop a framework to select the right supplier effectively.

2. Literature Review

In this chapter, the dairy supply chain, supplier selections, supply chain risk management, and AHP methods will be briefly explained. The review of previous researches that related to this study also has been stated.

2.1 Dairy Supply Chain

Dairy supply chain or food supply chain have different characteristic from other supply chain due to product freshness change overtime, process, and information flow to supply chain actors (Trienekens, 2011) [9]. Refers to [1], dairy supply chain is a process with six main activities such as the production of raw milk into dairy product, transportation of the product, processing, packaging the product that match with the characteristic of product, storage and consumption by consumer.

2.2 Supplier Selection

As stated in Damian (2008) [10], supplier selection have three main steps, which are identify, evaluate and contract. Getting information from suppliers that refer to company needs for identifying potential suppliers, setting and negotiating contract, and evaluating their performance. Weber (1991) [11] argued that price, on time delivery, quality of resources, and production ability are four categories for selecting supplier. Dickson (1966) [12] mentioned that there are 23 criteria for supplier selection. Based on Dey (2014) [13], supplier performance evaluation is needed for organisational system for measuring supplier performance effectively. Supplier performance is one of mitigate system for manufacturing organisation especially in procurement.

2.3 Supply Chain Risk Management

COSO (2004) [14] explained that risk is related to impact of negative events and possibility of having unwanted events. There are four categories of risk based on Wu (2008) [15]. Risk as hazard, possibility, consequence, and potential adversity or threat. [15] research considered supply chain risk management focus on relation between each organizational processes to identify the goals and mitigate the risk of uncertainty events. There are four process of supply chain risk management that are risk identification, risk assessment, risk avoidance and risk mitigation [15].

2.4 Analytical Hierarchy Process (AHP)

The research of [8] found Analytical Hierarchy Process theory, which the decision making is a fundamental things after getting the right information. Not all of information is used, only the important ones. Making decision is better if all aspects are transparent. It is involves a lot of criteria and sub criteria refer to company requirements. Priority of many options will be determined as a decision. Here are the following steps for AHP.

1) Determine the problem and sources of information
2) Develop the decision hierarchy's structure with the goals on the top.
3) Specify the objectives and how to accomplish it.
4) Set the comparison matrices. Each criteria in the upper level will compare to the immediate level.
5) Priorities needs for comparing the priorities using fundamental scale.

Table 1. Fundamental scale

Intensity of Importance	Definitions	Explanation
1	Equal Importance	Two activities contribute equally to the objective
2	Weak or slight	
3	Moderate importance	Experience and judgement slightly favour one activity over another
4	Moderate plus	Experience and judgement strongly favour one activity over another
5	Strong importance	
6	Strong plus	
7	Very strong or demonstrated importance	An activity is favoured very strongly over another, it is dominance demonstrated in practice
8	Very, very strong	
9	Extreme importance	The evidence favouring one activity over another is of the highest possible order of affirmation

2.5 State of The Art

There were some researches related to supply chain risk management in dairy industry. Chen et.al. (2014) [16] developed an analytical study to monitor product quality, which combined centralized and decentralized supply chain. On the other hand, Mendoza (2014) [17] redesigned his company supply chain structure using AHP and SCOR model. Another study by [6] developed a traceability and transparency framework for Indian dairy industry. Subburaj et.al (2015) [18] proposed key factors for strengthening the operational efficiency in dairy supply chain. The objects were in Tamilnadu, India. Mylan (2014) [19] proposed an innovation framework consist of comparative study and qualitative analysis for three indutry sectors in United Kingdom, meanwhile Mandolesi (2015) [20] identified critical point of supply chain risk management for increasing dairy industry competitiveness both in financial and ecological. In 2016, Anggrahini [21] developed a risk mitigation strategy for dairy supply chain in Indonesia. It analysed the case on local suppliers, manufacturers, and distributors.

Researches on supplier selection for dairy supply chain were established as well. Dweiri et.al. (2016) [22] designed an integrated AHP based decision support system for selecting suppliers in Pakistan automotive industry. The study deployed four main categories, and it shown that supplier selection has main role on increasing supply chain performance by reducing cost and fulfilling customer needs [22].

This study also refers to several journals that only focus on dairy supply chain. Others focus on supplier selection using AHP method. Researcher aligned those research into designing supplier selection with AHP that fulfilling company requirement. There are two elements which are supplier selection, and dairy supply chain. Supplier selection is adopted by [22] and Bruno et al (2012) [23]. While Dairy supply chain deployed form [6] and Bourlakis et al (2013) [24].

3. Methodology

This research belong to case study empirical research in Flynn (1990) [25] as it will draw data from the company and will be analyzed to derivat recommendation. Data will be gathered through interviews with key managers as well as small questionnaires. As explained in the previous chapter, this research will largely follow the methodology set out in AHP. This framework explain about determining main and sub criteria for supplier selection until selecting

supplier based on AHP method. Interview is conducted for selecting main criteria refer to company requirements. After selecting main criteria, AHP model is developed and create questionnaire for pair wise comparison based on experts assessment. This steps is repeated for selecting and pair wise comparison sub criteria. Using AHP method, rank the supplier with AHP wise comparison.

4. Result and Discussion

In this part, the data collection process and research output will be analysed and discussed.

4.1 Identifying Criterias for Supplier Selection

A depth interview is conducted for identifying main and sub criteria for supplier selection. There are several main criteria and sub criteria for supplier selection, but as the progress is running, some of them are added or deleted due to experts point of view. Saphiro (2014) [26] stated that criteria for supplier selection or supplier performance evaluation is reflect on company condition, not just according to theory. Quality is important due to the characteristic of dairy material or product. It is affected by the product freshness and durability of dairy product. The life time of dairy product is limited by period of time [9;5].

During the interview with expert at the company, quality becoming the most important criteria rather than others because the quality will affect the taste and life time of their product. If the quality is under the standard of company, then it will reduce the product life time or ruin the product itself. Constantly, the cost will increase due to this problem, the warehouse schedule must be re-schedule due to fail products turnover, and consumer satisfaction will be decrease. If consumer satisfaction decrease, its products will be untrusted. Companies also implement ISO 9001:2008 for quality management, so this company consider quality as important aspect. Delivery become one of supplier selection criteria based on [11]. Dairy industry need material dairy product which are have their expired time. Because of the durability of dairy material, so the delivery must be on time. Beside, warehouse capacity is limited, so if delivery is not on time, then the warehouse schedule must be re-schedule. Quantity of dairy material supply is under the demand. So, it is important for supplier to fulfill the right amount of dairy material as company need. Pricing also one of supplier criteria based on [12]. Usually supplier already have price which are competitive on each other. Warranty contain some policies and quality standard which already standardized by company's research and development division, such as the amount of protein or fat in each milligrams of several materials.

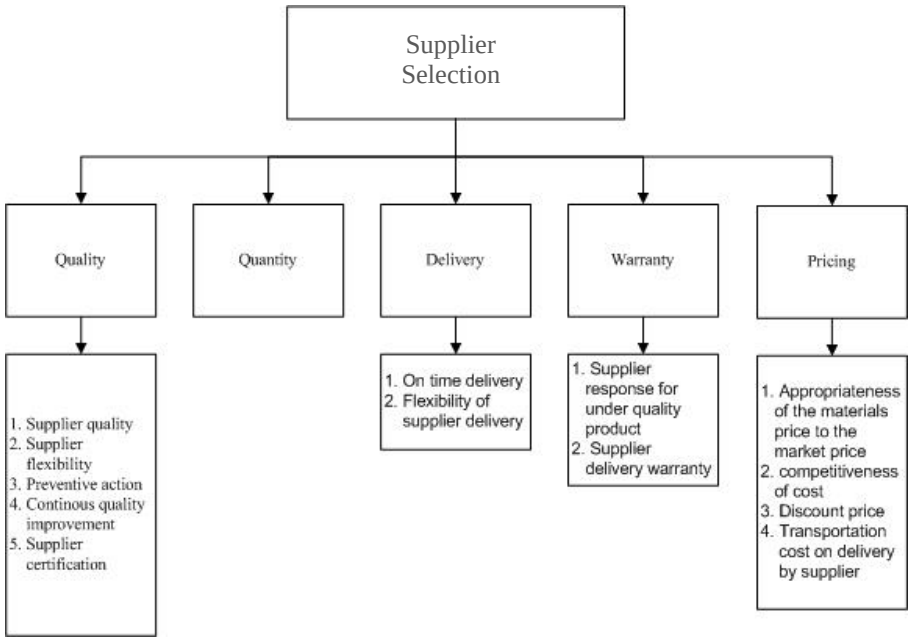

Figure 1. Final criteria after validation

4.2 Determining Criteria Weights

The weight of each criteria were derived from pairwise comparison following AHP methodology. Pairwise comparison was conducted using questionnaire. The respondents were PPIC Manager and Purchasing supervisor. The result of questionnaire were then inputed onto Expert Choice™ software. The inconsistency is 0.00661. It means, the data is valid because the inconsistency is under 0.1. Quality (0.42) is the first main criteria that company considerate for selecting supplier. Followed by delivery (0.326), quantity (0.092), pricing (0.088) and warranty (0.073).

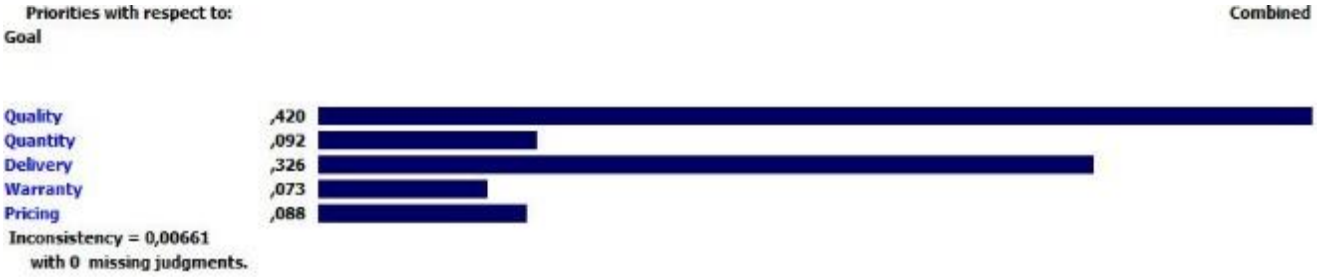

Figure 2. Ranking on main criteria for supplier selection

Furthermore, there are four main criteria which has their own sub criteria of Quality. The inconsistency for quality sub criteria is 0.08 with 0 missing judgements. Supplier quality (0.463) become the 1st rank. The 2nd rank is supplier flexibility (0.287), followed by supplier certification (0.134), preventive action (0.073) and continous quality improvement (0.043). On the other hand, delivery only have to sub criteria which are on time delivery and flexibility of supplier delivery. On time delivery is in the 1st place (0.846) and flexibility of supplier delivery is in the 2nd place (0.154).

Figure 3 Priorities on each sub criteria for supplier selection

Priorities with respect to warranty also contain two criteria which are supplier response for under quality product and supplier delivery warranty. Supplier delivery warranty (0.396) and supplier response for under quality product (0.604). The inconsistency is almost 0 with 0 missing judgements. However, they are competitiveness of cost (0.540), appropriatness of the materials price to the market price (0.291), transportation cost on delivery by supplier (0.053), and discount price if the company buy more than quantity as usual (0.117).

This study also determined the combination of some criterias to select the right supplier. The figure 3 shows the priorities of those criterias. Moreover, Based on the criteria and sub criterias evaluated, this study proposed a framework to select the best supplier which appropriate to the local dairy industries in Indonesia. The framework is figured out in figure 4.

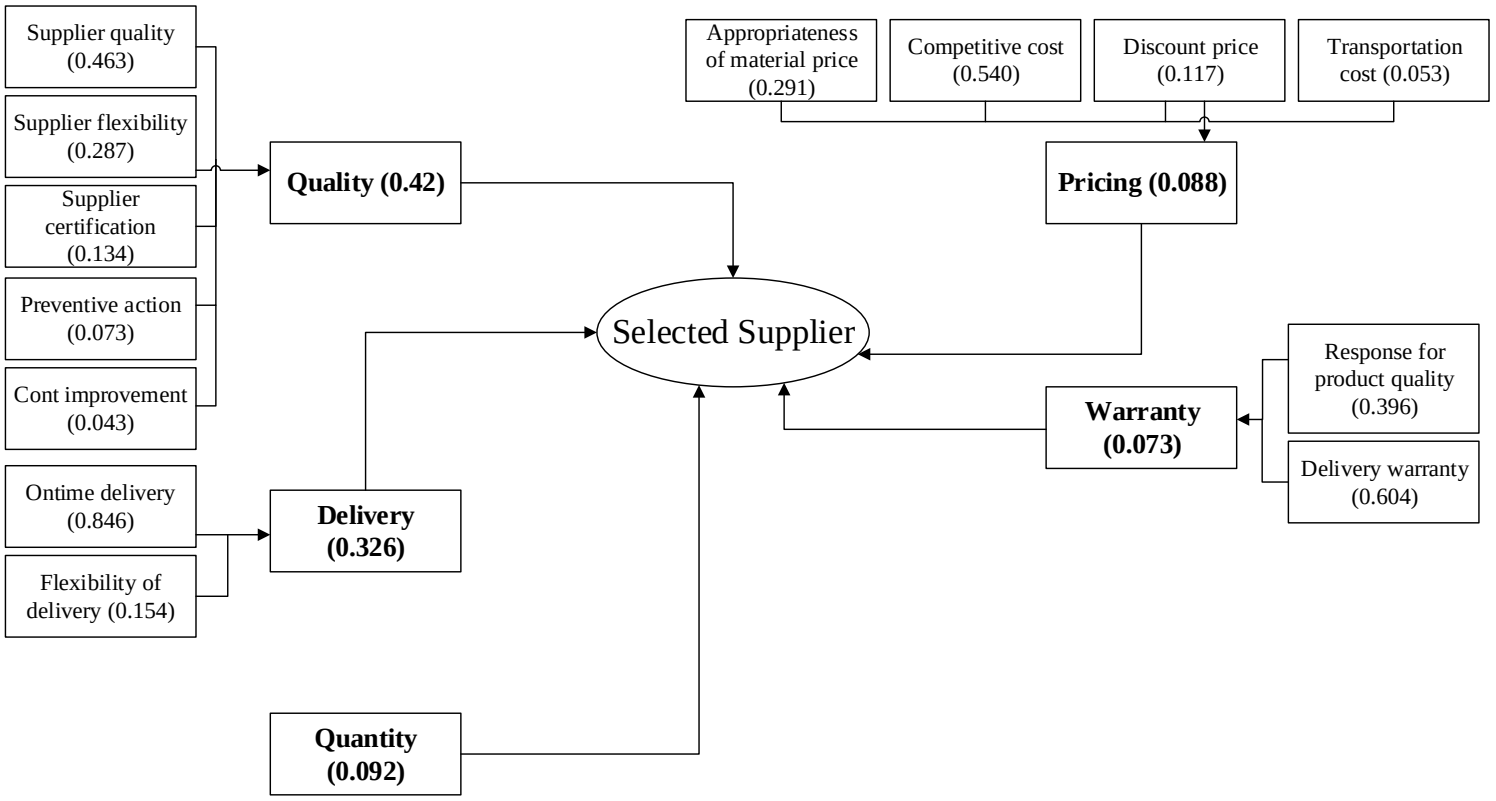

Figure 4. Supplier Selection Framework

In this study, there were two (2) suppliers who will be evaluated :

Table 2. Supplier information

No.	Supplier Name	Location	Company Sized
Supplier 1	Maltodextrin A	Downstream Industry, Surabaya	Large
Supplier 2	Maltodextrin B	Surabaya	Medium

Maltodextrin supplier which code into Maltodextrin A for 1st supplier and Maltodextrin B for 2nd supplier. It is coded due to confidential reasons. The company also got TOP BRAND for sweet condensed milk, it means that the supplier for condensed milk, which one of it is maltodextrin supplier has their verified quality. From all of scoring aspect, it can be concluded that A Maltodextrin will be choose rather than B Maltodextrin. Table 2. shown the global weighted score with their scoring.

4.3 Sensitivity Analysis – Supplier Selection

Sensitivity analysis is performed by changing the weight. The dynamic sensitivity will change ±10% into upward change or downward change to analyze the ranking of supplier will change or not change (robust). Regarding to those result in Figure 5 until Figure 10. It can be concluded that all of dynamic sensitivty analysis are remain the same.

a. Sensitivity analysis with respect to quality
   The rank of supplier is the same whether the dynamic sensitivity of quality is changed in upward mode.
b. Sensitivity analysis with respect to delivery
   The rank of supplier will not change (robust) regardless of any value.
c. Sensitivity analysis with respect to warranty
   The rank of supplier will not change (robust) regardless of any value.
d. Sensitivity analysis with respect to pricing

The rank of supplier is the same whether the dynamic sensitivity of pricing is changed both in upward and downward mode.

Table 3. Global weighted score with scoring

Main criteria/sub criteria	Weightened	A	B
Quality	**0.420**		
Supplier quality	0.19446	**0.265**	**0.265**
Supplier flexibility	0.12054	**0.164**	**0.021**
Supplier certification	0.05628	**0.076**	**0.076**
Preventive action	0.03066	**0.042**	**0.042**
Continous quality improvement	0.01806	**0.025**	**0.025**
Delivery	**0.32**		
On time delivery	0.2758	**0.453**	**0.453**
Flexibility of supplier delivery	0.0502	**0.012**	**0.083**
Quantity	**0.092**	**0.5**	**0.5**
Pricing	**0.08**		
Competitiveness of cost	0.04752	**0.420**	**0.060**
Appropriatness of the materials price to the market	0.02561	**0.227**	**0.028**
Discount price			
Transportation cost on delivery by supplier	0.0103	**0.091**	**0.091**
	0.00466	**0.041**	**0.041**
Warranty	**0.07**		
Supplier delivery warranty	0.04409	**0.302**	**0.302**
Supplier response for under quality product	0.02891	**0.198**	**0.198**
TOTAL WEIGHTED		**0.556**	**0.444**

From all of main criteria, it is accepted that A Maltodextrin is better chosen rather than B Maltodextrin.

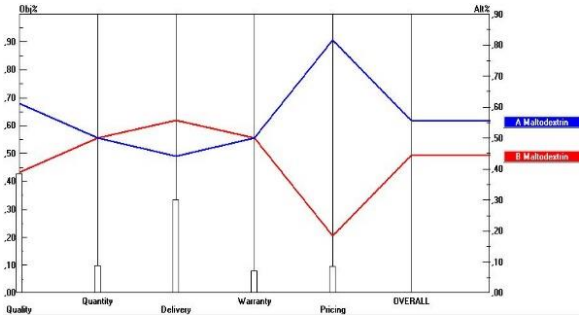

Figure 5. Overall sensitivity analysis

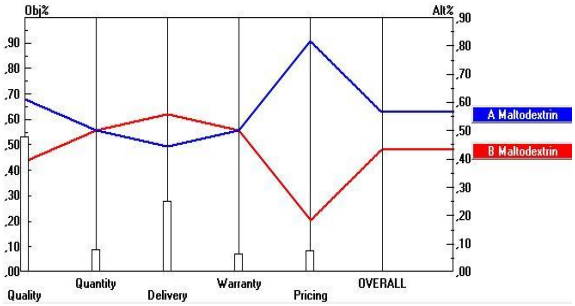

Figure 6. Sensitivity analysis with respect to quality (upward change)

Figure 7. Sensitivity analysis with respect to delivery (upward change)

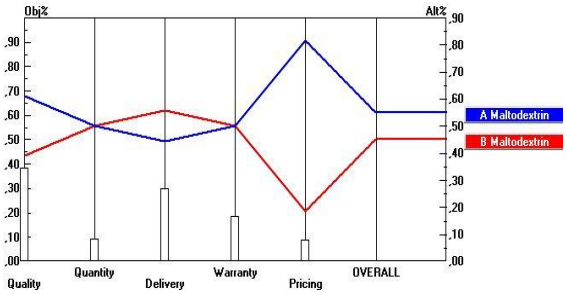

Figure 8. Sensitivity analysis with respect to warranty (upward change)

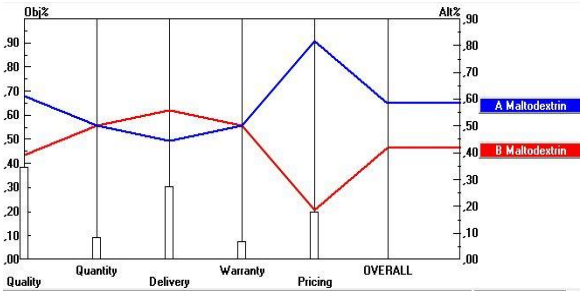

Figure 9. Sensitivity analysis with respect to pricing (upward change)

Figure 10. Sensitivity analysis with respect to pricing (downward change)

5. Conclusions

Regarding to the result of this study, it can be concluded :

1. Selecting the right supplier is a critical role in the beginning process of supply chain management.
2. The main criterias for supplier selection are quality, delivery, quantity, pricing, and warranty. In addition, the sub criterias are deployed from main criterias based on company requirement.
3. Warranty criteria only used in some conditional situation due to company terms and policies.
4. The sensitivity analysis is performed to describe the effect of changing weights in main criteria. All of the sensitivity analysis of supplier selection are stay robust.

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