Tropical Wetland Journal
Journal homepage: twj.ulm.ac.id | Published by Postgraduate Program - Lambung Mangkurat University | e-ISSN: 2654-279X

Original article
DOI 10.20527/twj.v7i1.103

Risk Analysis on The Siam Banjar Orange Supply Chain Distribution Channel

Karimal Arum Shafriani[1*], Hartoni Hartoni[2]

[1] Faculty of Agriculture, Lambung Mangkurat University, 70714, Banjarbaru, Indonesia
[2] Faculty of Agriculture, Nahdlatul Ulama Kalimantan Selatan University, 70552, Banjar, Indonesia
[*] Correspondence: karimal.shafriani@ulm.ac.id

Received: 27 February 2021; Accepted: 1 June 2021; Published: 30 June 2021

ABSTRACT

Siam orange is a horticultural commodity that is very suitable and suitable for soil conditions for cultivation in tidal swamps. Wrong one area for the development of the Siam Banjar orange in South Kalimantan is located in the Barito Regency Kuala. As one of the agricultural commodities, Siam Banjar orange has high enough risk, so it needs good management in terms of this is called risk management. This study aims to identify Siam Banjar orange distribution channels, identify and analyze risks that occur in the supply chain distribution channel of Siam Banjar oranges, as well measure the risk on each member of the supply chain and search for those members that have the greatest risk. The data analysis method used is descriptive analysis, methods Analytical Network Process (ANP) and Weighted Failure Mode and Effects Analysis (WFMEA) to analyze the risks that occur and find members supply chain that has the greatest risk in the supply chain distribution channel Siam Banjar oranges in Barito Kuala Regency. From this research, it is found that the distribution channel of Siam orange Banjar in Barito Kuala Regency generally consists of farmers and traders, collectors, wholesalers and retailers and applied through five structures. A more accurate risk analysis result with the WFMEA method, value WRPN obtained for price risk (151.424), transportation risk (52.875), risk supply (52.380), quality risk (51.858), production risk (50.165) and risk environment (5.888). The results of the priority assessment of the Siam orange supply chain actors Banjar with the ANP method, namely farmers (0.371), traders (0.128), wholesalers (0.360) and retailers (0.142). Thus, members of the supply chain farmers who have the greatest risk.

Keywords: risk analysis, supply chain, siam banjar orange, analytical network process.

1. Introduction

Siam orange (Citrus sinensis Tan) is a commodity that has had advantages in market developments in recent years. Siam orange is a horticultural commodity that is very suitable and suitable for soil conditions for cultivation in tidal swamps. Barito Kuala is one of the Regencys which is the development area of a horticultural area in South Kalimantan. The Barito Kuala Regency Government has shown enormous support in agricultural development, especially the development of horticultural commodities. One of the leading horticultural commodities in Barito Kuala Regency is Banjar siam oranges. This orange has long been cultivated in Barito Kuala Regency, almost all sub-Regency's in Barito Kuala Regency cultivate the siam orange plant. Based on BPS data from Barito Kuala Regency, the production of Siam Banjar Oranges in Barito Kuala Regency in 2019 was 943,716 quintals or 94,371.6 tons. Production in 2019 increased compared to 2018 which amounted to 938,975 quintals or 94,897.5 tons. The sub-Regency's that contribute the most to the Siam Banjar production in Barito

Kuala Regency are Mandastana District and Barambai District (Central Bureau of Statistics of Barito Kuala Regency, 2020).

The supply chain starts with raw materials actual and ending with the final product delivered to end users or end customers (Davis & Heineke, 2005). Agricultural commodities are products that have a high enough risk. This is related to the characteristics of agricultural products, including perishable products, seasonal products and highly dependent on nature, product diversity, storage occupies many places, and production sites are scattered. Suppliers, manufacturers, distributors, retailers can minimize costs incurred during the marketing process by carrying out good inventory management and distribution that is structured and integrated through the supply chain management process. The modern supply chain mechanism is formed by several things, including overcoming the weaknesses of the characteristics of agricultural product, increasing the demand for customer needs for quality product, and expanding the existing market share (Marimin & Maghfiroh, 2010).

As a result of too long distribution channels in the supply chain, with conditions of short storage times, minimal business capital, highly volatile prices, uncontrollable weather factors and difficulty handling crops with insufficient skills, these things This creates a very large number of risks in the distribution channel of the Siam Banjar orange supply chain. So this research aims to identify the distribution channel of Siam Banjar oranges, identify and analyze the risks that occur in the supply chain distribution channels of the Siam Banjar oranges, and measure the risk in each member of the supply chain and look for members who have the greatest risk.

2. Materials and Methods

The samples were determined by farmers and other supply chain actors using two methods: *proportioned random sampling* and *snowball sampling*. The data analysis method used is descriptive analysis, methods *Analytical Network Process* (ANP) and *Weighted Failure Mode and Effects Analysis* (WFMEA) to analyze the risks that occur and find members supply chain that has the greatest risk in the supply chain distribution channel Siam Banjar oranges in Barito Kuala Regency.

Descriptive analysis is carried out with the intention of providing scientific, systematic, structured and situational explanations based on facts in the field, so that it can provide a detailed understanding based on the objectives you want to see. Data tabulated from findings obtained in the field, in the form of respondent characteristics, distribution channel mechanisms, as well as various matters related to the operational risks contained in the supply chain of Siam Banjar oranges in Barito Kuala Regency.

To analyze the performance weights in the supply chain of Siam Banjar oranges based on the level of dependence between one group and another or between clusters, the method was used *Analytical Network Process* (Amalia, 2012). The stage carried out in ANP is selecting groups and elements to be compared according to the control criteria. Using a fundamental comparison scale then perform a pairwise comparison with a matrix between groups / elements to derive the *eigenvector* and to form a supermatrix. Comparisons are made based on the judgment of the decision maker by assessing the importance of an element. Some entries that show a zero relationship on an element mean there is no importance to that element. If this happens then the element is not used in a pairwise comparison to derive the *eigenvector*. So what is used are elements that generate non-zero importance (Saaty, 2005).

Failure Mode and Effect Analysis (FMEA) is a technique analyze which combines technology and experiences of people in identifying the causes of failure of the product or process and planning to eliminate the causes of failure (Huang & Xiao, 2011). Meanwhile, to answer the goal of obtaining a more precise and accurate assessment after the aggregation process of the relationship between risk factors that has been calculated the priority weights can use the Method *Weighted Failure Mode and Effects Analysis* (Chen, 2007).

3. Results and Discussion

Distribution Channels of the Siam Banjar Orange Supply Chain

Structures in the distribution channel of Siam Banjar oranges in general have the same characteristics. The Banjar Siam Orange distribution channel implemented in Barito Kuala Regency in general through a distribution pattern shown in Figure 1.

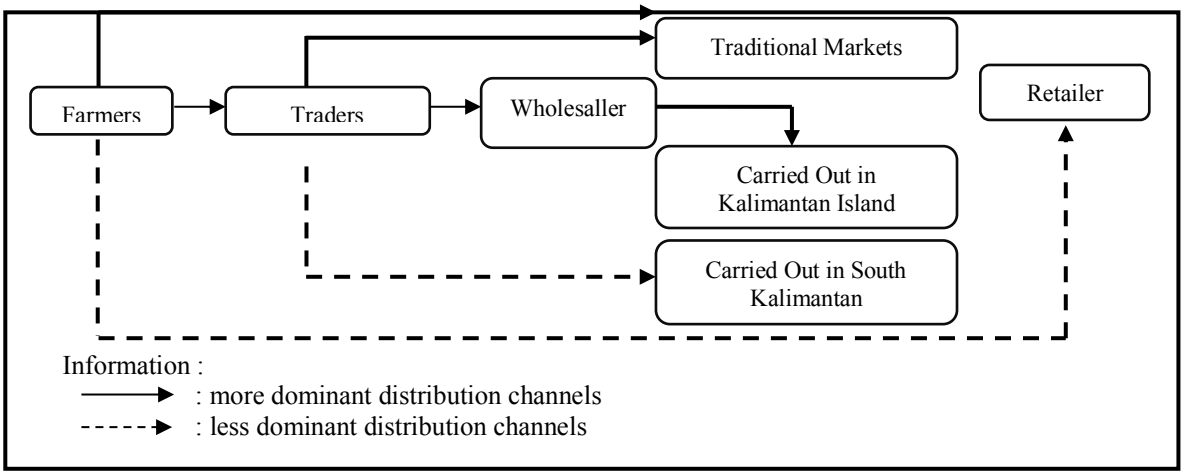

Figure 1. The distribution channel of Siam Banjar.

The distribution channel of Siam Banjar oranges in Barito Kuala Regency is implemented through five distribution structures, namely:

1. Distribution Structure I

In distribution structure I, the yield obtained by farmers from the land directly sold to traditional markets located in Barito Kuala Regency. Sales of Siam Banjar oranges are carried out in Regency markets, Regency markets, as well as on the edge of the Regency highway. In this distribution the actors / actors are involved only 1 person, namely farmers who deal directly with consumers.

2. Distribution Structure II

In distribution structure II, farmers harvest and do sales to retailers. In this distribution, farmers are not directly related with consumers so that further sales activities are carried out by retailers.

3. Distribution Structure III

In distribution structure III, it is traders who buy the produce harvest from some farmers then sell them to traditional markets located outside Barito Kuala Regency, such as selling to Banjarmasin, Banjarbaru, Martapura, Pelaihari, Hulu Sungai and other areas which are still in South Kalimantan Province.

4. Distribution Structure IV

In distribution structure IV, collectors buy crops oranges from farmers as well as distribution channels in the distribution structure III. However, the area for selling oranges by collectors is outside the South Kalimantan area, generally selling oranges by collectors in distribution IV carried out in Kalimantan Province Central areas such as Palangkaraya, Sampit, Kapuas, and so on.

5. Distribution Structure V

Distribution structure in the V distribution structure, collectors get oranges from the farmers' crops, then take it to large traders in the area Mandastana. Wholesaler owns an orange storage warehouse used as storage while waiting for wooden crates filled with oranges to be loaded onto a container / container truck for shipment. Delivery of orange containers is carried out by water to the island destination Java, based on information from wholesalers that the destination of delivery is Banjar oranges namely Yogyakarta, Surabaya, Jepara, and Pati.

Identification of Siam Banjar Orange Supply Chain Risks

The development of appropriate coordination processes in the agribusiness supply chain model is clearly required, the results of which will benefit both the industry and the end consumer. In addition, a spectrum of coordination mechanisms can help practitioners in the agricultural sector to improve their supply chain performance by carrying out proper coordination (Handayati, Simatupang, & Perdana, 2015). Supply chain risk identification is a key factor in risk management. The identification process includes a list of potential events that become problems in the performance of the supply chain it self (Faizal & Palaniappan, 2014).

Quality, production, price, supply, environment and transportation risks are identified risks in the cocoa supply chain (Aini, Syamsun, & Setiawan, 2014). In line with this, based on literacy studies, discussion and question and answer with several competent people, as well as from the results of

previous research, so that an ANP framework can be generated in order to identify risks that occur in the chain distribution channel supply of Siam Banjar oranges in Barito Kuala Regency. This structure consists of 3 clusters:

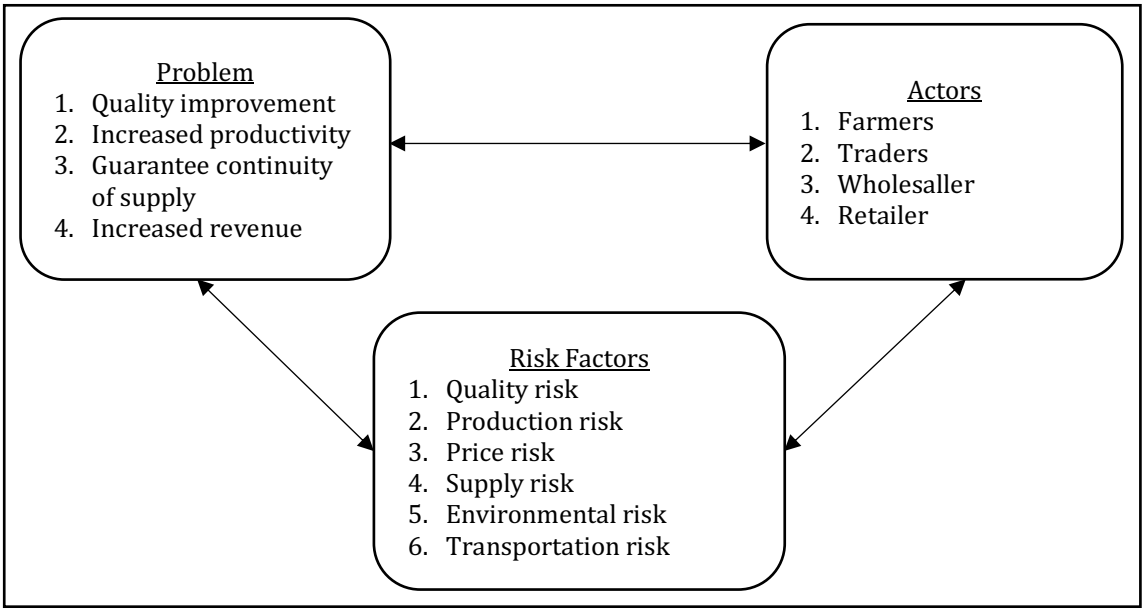

Figure 2. ANP structure concept.

Problems of Supply Chain Risk Management of Siam Banjar Orange

The results obtained are pairwise comparisons between one supply chain problem and another, and it can be seen that problems that have a very large influence, by examining the results of the questionnaire using *Analytical Network Process* (ANP). Increasing the continuity of a stable product for each actor in the supply chain process makes it a top priority in the supply chain problem of Siam Banjar oranges. Which is 0.337. This is due to the product of the Siam Banjar orange is seasonal and very dependent on nature, in one crop year Siam Banjar oranges produce from August to December, although on another month these orange plants produce but in small quantities. Thus, the problem of guaranteeing a stable product continuity becomes a problem main in the supply chain of Siam Banjar oranges in the Barito Kuala Regency. Continuity assurance problems can be minimized through assessment and the use of agricultural technology which is able to guarantee the continuity of Siam orange Banjar.

The difference is not too different from the first priority weight value, namely guarantee of product continuity, the problem of increasing income has a weight value of 0.333. Income increase problems arise because this can be due to the difference in reception that is too far between farmers and other members of the supply chain such as collectors, wholesalers and retailers. The reason for this difference is the price of Siam oranges Banjar at the farm level is relatively cheap compared to the current price of oranges at the merchant level. This problem can be suppressed by its existence negotiations between members of the supply chain so that the difference in acceptance is too the distance between the members of the supply chain can be suppressed, in other words farmers too have a good bargaining position. The weight value of the problems faced in the Siam orange supply chain The next Banjar, namely; an increase in quality of 0.172 and productivity amounting to 0.158.

Risk Factors in the Supply Chain of Siam Banjar Orange

Priority processing results using the ANP method, indicate that the risks are most influential as a whole and a top priority in the chain: the supply of Siam Banjar oranges is a price risk of 0.364. Price risk becomes the greatest risk that can be caused by price fluctuations that cannot be predicted by every member of the supply chain who plays a role in the marketing of Siam Banjar oranges, besides that, there is an excess of supply wherein the amount of oranges on offer is vast in comparison to consumer demand which tends to be less. There are fluctuations in the price of oranges. Siam Banjar is

likely caused by inflation, the rupiah exchange rate and rates bank interest and distortion of price and supply information.

Another risk that is the risk with the second largest weight is risk supply of 0.194. This supply risk is caused by the uncertainty of supply availability. This is closely related to seasonal production so that at certain times the Siam Banjar orange cannot be ascertained. Risk with the next total weight is the transportation risk, which is 0.141, this risk can be caused by the long haul distance, so that it may cause the product to be damaged during the trip. Furthermore, the quality risk is 0.129; the production risk is 0.127 and the environmental risk is 0.046.

Risk Analysis of Siam Banjar Orange Supply Chain Actors

The results of priority processing using the ANP method, show that the actors are most influential as a whole and become the actors most at risk in the supply chain of Siam Banjar oranges, farmers are 0.371. This matter because only farmers who bear the losses if the production results produced a little due to the incompatibility of cultivation or unpredictable and unpredictable environmental factors, pests and diseases causing crop failure to occur, and almost a thorough farmer has not insured his agricultural land.

Then, the data also shows a value that is not too far away for the position: the two actors who play a role and have a considerable risk are traders large, which is equal to 0.360. It's the same with farmers, big traders have a high enough risk due to the very capacity of the product being marketed Many, sometimes only wholesalers are at risk when it comes to quality orange fruits decreased due to several obstacles during product delivery arrived to Java Island due to the long distance.

The ANP method is used in calculating the weight comparison problems, risks and actors in the supply chain of Siam Banjar oranges have provided the result that the main problem faced is assurance of product continuity stability, the main risks faced are price and supply chain members farmers most at risk. The ANP method is developed on the basis of interdependent relationships between several components, therefore between components have an attachment to one another.

The main problem faced in the supply chain of Siam Banjar oranges is guaranteeing a stable product continuity, the Banjar Siam orange is one of them types of commodities that are seasonal, because they are seasonal, the amount the supply of oranges at certain times is very small causing excess demand. So, this is very influential on the price of Siam Banjar oranges and may result in fluctuations in price. Seeing that price is the main risk faced on the chain supply of Siam Banjar oranges, then the members of the supply chain who have weighed the greatest risk of price to price is the farmer.

Supply Chain Risk Analysis of Siam Banjar Orange

Minor risk is a risk that has a small negative impact on the supply chain process, so that it can be accepted by supply chain actors. Meanwhile, major risk is a risk that needs to be addressed in order to reduce it so that it becomes a minor risk that can be done by providing data to assist in the evaluation and risk control phase in the supply chain. The assessment of these minor and major risks can be done using the *Weighted Failure Mode and Effects Analysis* (WFMEA) method. S*everity*, *occurrence*, and *detection* are the three components in WFMEA multiplied by the risk weight, resulting in the value of *Weighted Risk Priority Numbers* (WRPN) (Surendro & Yaumi, 2012).

The results of data processing *Failure Mode and Effect Analysis* (FMEA), at The supply chain distribution channel of the Banjar Siam orange shows that it is at price risk, the element of the highest *Risk Priority Number* (RPN) is the fluctuation in the price of oranges by 160. On the quality risk, elements of the highest are pests and diseases that attack orange plants at 125. At risk production, the element of the highest RPN is the use of simple technology amounting to 150. At the risk of supply, elements of the highest RPN is the uncertainty of the availability of an orange supply of 150. At environmental risk, elements of the highest RPN are natural disasters that occur 98. While for transportation risk, the element of the highest RPN is the long haul distance, which is 125.

Table 1. FMEA calculation results of the supply chain of Siam Banjar Orange

Risk Factors	Risk Variabel	Severity (1-10)	Occurance (1-10)	Detection (1-10)	RPN
Quality	Erratic seasons and weather	4,0	6,0	4,0	88
	Low cultivation technique knowledge	4,2	5,0	4,1	84
	Inadequate storage facilities	6,0	4,0	4,0	105
	Pests and diseases	5,0	5,0	5,0	125
Production	Limited production capacity	6,0	5,0	4,0	120
	Ineffiicient production process	5,0	5,0	5,0	125
	Simple use of technology	6,0	5,0	5,0	150
Price	Inflation	4,0	6,0	4,0	96
	Rupiah exchange rate and bank interest	4,0	4,0	4,0	64
	Price fluctuation	8,0	5,0	4,0	160
	Distortion of price and supply information	6,0	4,0	4,0	96
Supply	Variety of quality of supply	5,0	6,0	4,0	120
	Uncertainty of supply availability	5,0	6,0	5,0	150
Environment	Natural disasters	7,0	2,0	7,0	98
	Social, cultural, political conditions	2,0	5,0	3,0	30
Transportation	Infrastructure damage	5,0	6,0	3,0	90
	Travel insecurity	5,0	4,0	4,0	80
	Availability transport times	4,0	5,0	4,0	80
	Long haul distance	5,0	5,0	5,0	125

Source: Primary data processing, 2020

The calculation produced by means of the *Weighted Risk Priority Number* (WRPN) can provide a more precise and accurate and continuous number of the process stages carried out to provide risk assessment from the previous, in order to obtain a weighting for each of these risks. WRPN calculation results are presented in Table 2.

Table 2. Results of the calculations WRPN Supply Chain Siam Banjar orange

Risiko	ANP (W)	Rating	RPN	Rating	WRPN	Rating
Quality	0.129	4	402	2	51.858	4
Production	0.127	5	395	3	50.165	5
Price	0.364	1	416	1	151.424	1
Supply	0.194	2	270	5	52.380	3
Environment	0.046	6	128	6	5.888	6
Transportation	0.141	3	375	4	52.875	2

Source: Primary data processing, 2020

The calculation results before and after weighting for the commodity Siam Banjar oranges show a slight difference in the sequence of risks. The result of RPN calculation before weighting the first risk is price, the second risk is quality, the third risk is production, the fourth risk is transportation, the fifth risk is supply and the last risk is the environment. Meanwhile, after weighted RPN calculation results, the first risk is price, the second risk is transportation, the third risk is supply, the fourth risk is quality, the fifth risk is production and the last risk is the environment. There are differences in the ranking of each risk due to a more accurate calculation so that we pay attention to the weight value of each of these risks.

Risk Evaluation of Siam Banjar Supply Chain Risk

Evaluation is carried out by comparing the level of risk which has been calculated at the risk analysis stage with standard criteria used. The evaluation results of the risks are presented in Table 3.

Table 3. The results of supply chain risk evaluation

Risiko	WRPN	Risk Category	Control
Quality	51.858	Low	Receive
Production	50.165	Low	Receive
Price	151.424	High	Mitigation
Supply	52.380	Low	Receive
Environment	5.888	Very Low	Receive
Transportation	52.875	Low	Receive

Source: Primary data processing, 2020

The results of the supply chain risk evaluation show that most of the risks that occur in the supply chain distribution channel of the Siam Banjar orange are still tolerable because they are classified as

low. Of the six risks, there are four risks that fall into the low category, namely quality risk, production risk, supply risk and transportation risk, and one environmental risk that is categorized as very low. So that control measures against this category can be done by accepting the risk. As for the price risk, it is included in the high category. This price risk requires mitigation measures. Mitigation actions that can be taken to deal with this price risk can be through marketing through online media or by increasing the added value of these oranges through post-harvest measures, thereby increasing the bargaining power of producers and reducing price fluctuations.

The risk category is based on the WRPN value sourced from *The Chartered Quality Institute* in 2010, the value of the four risks is in the low category, and one risk is categorized as very low because the WRPN value of each risk is in the interval 0-50 for the very low category and 50-100 for the low category, so the risk control is acceptable. Meanwhile, price risk is categorized as high risk because it has a WRPN value of 151,424, which means it is in the 150-200 interval so that the risk control that is carried out is mitigation.

4. Conclusions

The supply chain distribution channels for the Siam Banjar oranges generally consist of farmers, collectors, wholesalers and retailers which are implemented with five types of supply chain distribution structures. Risks that occur in the supply chain distribution channel of Siam Banjar oranges are quality risk, production risk, price risk, supply risk, environmental risk and transportation risk. The results of a more accurate risk analysis using the WFMEA method show that the highest WRPN value obtained is price risk, followed by transportation risk, supply risk, quality risk, production risk and environmental risk, respectively. The results of the priority assessment of the Siam Banjar orange supply chain actor using the ANP method obtained the highest weight results, namely farmers, then followed consecutively, namely wholesalers, collectors and retailers. Thus, the members of the supply chain who have the greatest risk are farmers.

References

Aini, H., Syamsun, M., & Setiawan, A. (2014). The risk of the cocoa supply chain in Indonesia with the integrated analytic network process method and failure mode effect analysis. Jurnal Manajemen & Agribisnis, Vol. 11. No.3 : 209-219.

Amalia. (2012). Design and Performance Measurement of Vegetable Supply Chain and Companies with Approaches Analytical Network Process and Data Envelopment Analysis. Bogor: Thesis : Bogor Agricultural University.

Central Bureau of Statistics of Barito Kuala Regency. (2020). Barito Kuala Regency in Figures. Marabahan: Central Bureau of Statistics of Barito Kuala Regency.

Chen, JK. (2007). Utility Priority Number Evaluation for FMEA. Journal of Failure Analysis and Prevention, 7(5):321-328.

Davis, M., & Heineke, J. (2005). Operations Management: Manufacturing and Services - Fifth Edition. New York: Mc Graw Hill.

Faizal, K., & Palaniappan. (2014). Risk Assessment and Management in Supply Chain. Global Journal of Researches in Engineering : Industrial Engineering, Volume 14 - Issue 2 (ISSN : 2249-4596).

Handayati, Y., Simatupang, T., & Perdana, T. (2015). Agri-food supply chain coordination: the state-of-the-art and recent developments. Logistic Research-Springer, 8:5-DOI 10.1007/s12159-015-0125-4.

Huang, H., & Xiao, N. (2011). Multiple Failure Modes Analysis and Weighted Risk Priority Number Evaluation in FMEA. Elsevier Engineering Journal of Failure Analysis, 18(2011) : 1162-1170.

Marimin, & Maghfiroh, N. (2010). Decision Making Techniques in Management Supply Chain. Bogor: IPB Press.

Saaty, T. (2005). Theory and Applications of the Analytic Network Process. Pittsburgh: RWS Publications.

Surendro, K., & Yaumi, N. (2012). The risk management model in the application of cloud computing for information systems in higher education uses the COSO ERM and FMEA frameworks. Journal of the Bachelor of the Bandung Institute of Technology of Electrical and Informatics Engineering, 1(2):1-6.