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INTEGRATION OF THE FUZZY FAILURE MODE AND EFFECT ANALYSIS (FUZZY FMEA) AND THE ANALYTICAL NETWORK PROCESS (ANP) IN MARKETING RISK ANALYSIS AND MITIGATION

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ABSTRACT

Marketing plays an important role in determining an enterprise's success. Inappropriate marketing strategy can lead to various risks, especially for SMEs that have not prepared their risk management. This research aims to identify and specify marketing strategy priorities in the production of potato chips, and to decide anticipationary action in determining risk mitigation. The research is a case study of XYZ company. The method used for risk analysis was Fuzzy FMEA, and that used to specify the strategic priorities was ANP. The results indicate that the most potential risks in potato chip marketing are promotion risk, which is caused by inappropriate steps with regard to promotion targets, and the absence of a brand image. The primary strategy in market risk mitigation is to improve sub-strategy promotion, which increases the effectiveness of promotion facilities and infrastructure, complies with the development of information and communication media, and maintains service quality in the sub-criteria of building and maintaining good relations with customers.

Keywords: ANP; Fuzzy FMEA; Marketing risk; Risk mitigation

1. INTRODUCTION

The Indonesian economy has developed rapidly in several sectors, especially in agroindustry. One of the contributing factors to this development has been Small and Medium Enterprises (SMEs). According to Wang (2016), SMEs play a part in economic development, as the employment providers in developing countries. One of their roles is to increase national foreign exchange in the export market (Berry et al., 2001).

Marketing is regarded as the primary factor in product survivability in the market (Vorhies et al., 2009). Its effectiveness can be seen from the possibilities of expansion, owner prosperity, and good business prospects; as stated by Kumar (2012), marketing is the main part of business success.

However, inappropriate marketing strategy can lead to risks for SMEs. Strategy and operational marketing are the accumulation of a company's capability of coordinating its strategic marketing activity (Krasnikov & Jayachandran, 2008). Customers' taste is considered as a black box, which is hard to figure out and is regarded as the source of uncertain demand towards their products (Solomon, 2006). Risks come from uncertainty (Eiser et al., 2012). Uncertain demand may also be caused by market uncertainty, which leads to various marketing risks.

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Risk management is defined as a process of identifying and assessing risk in order to minimize it to an acceptable level (Tohidi, 2011; Serpella et al., 2014). Risk management can help SME owners to identify significant risks that threaten their business (Falkner & Hiebl, 2014; Brustbauer, 2016).

Failure Mode and Effect Analysis (FMEA) was first developed to analyze systematic failure and the impact of product survivability, especially in the aviation sector (Bowles & Peláez, 1995). The main advantage of FMEA is its ability to identify critical points in order to help make corrective or preventative decisions (Segismundo & Miguel, 2008; Parsana & Patel, 2014; Cameron et al., 2017). Fuzzy FMEA is the developed version of conventional FMEA and has been implemented in several researches, such as those of Dagsuyu et al. (2016) and Silva et al. (2014).

Kumru and Kumru (2013) state that Fuzzy FMEA can be implemented to overcome the limitations of conventional FMEA, such as subjective and qualitative description, interest rate risk, and the difference in risk representation. There are several methods used to assess risk, such as the Monte Carlo method (Chaudary & Mohamed, 2017), fuzzy logic (Petrovic et al., 2014), and the Analytical Hierarchy Process (Aminbakhsh et al., 2013; Santoso et al., 2017). The Analytical Network Process (ANP) is the general form of AHP (Saaty, 1996). It is used to describe problems hierarchically, a process in which every element is considered independently, which was why ANP was developed to improve AHP (Saaty, 1996). Many studies have shown that the implementation of ANP leads to better results. The purpose of this research is to identify and assess potato chip marketing risks by using Fuzzy FMEA and ANP.

2. METHODOLOGY

The research comprises a case study conducted on the XYZ SME in Batu, Indonesia, which produces potato chips. The marketing risk variables were determined by considering previous research that has been verified in the field; these can be seen in Table 1. After the identification process, the next step was to specify the cause and effect of the risks (Table 2), which were identified by using Fuzzy FMEA (Table 3).

The Fuzzy FMEA procedure was adopted from Wang et al. (2009). The primary strategy in market risk mitigation was specified using the ANP method, a developed version of AHP which is able to make decision based on several complex criteria. The procedure of the ANP method was adopted from Saaty (1996).

Table 1 Market risk variables in potato chip marketing

Risk Variable	Indicator	Author
External	IDR rate	Kang & Feng (2009); Ghandi & Lawell (2017); Dhanani (2008)
	Price fluctuation	Dewi et al. (2015); Suryaningrat (2016); Weron, (2000); He et al. (2012); Henriques & Sadorsky (2010); Nie et al. (2016)
	Competitiveness	Cibinskienea & Snieskiene (2015); Rochman et al., (2011); Anggadwita et al. (2016)
Internal	Marketing strategy	Aghazadeh (2015); Hasan & Ali, (2015); Ryals and Knox (2005)
	Product	Astuti et al. (2015); Rider et al. (2009)
	Distribution	Abril & Rodriguez (2016); Dawes & Nenycz-Thiel (2013); Yoo et al. (2000)
	Promotion	Lowe (2010); Freixanet (2012); Bao & Chang (2014); Pauwels et al. (2016); Haddoud et al. (2016)

Table 2 Details of cause and effect of market risk in potato chip marketing

Parameter	Risk	Cause	Effect
Interest rate	Interest increase (R1).	Inflation.	Price increase of goods and services.
	IDR exchange rate decrease (R2).	Price increase of crude oil strengthens economic sectors in superpower countries and lowers exchange rates in developing countries.	Purchasing power decreases for goods and services.
Price fluctuation	Scarcity of raw materials (R3).	Unpredictable natural conditions (seasons or weather) and potato pests cause harvest failure.	Price increase of raw materials (potatoes) and disruption to production process activities.
	Energy cost increase (R4).	Certain government policies related to subsidy and tax.	High cost of energy (LPG, electricity, gasoline, etc.).
Competitiveness	Stiff competition between similar products (R5).	Competitors who produce similar products on a limited scale (small).	Production capacity difficulties in developing and dominating the market.
	New competitors (R6).	High demand from market for potato chip products.	Decrease in level of sales.
	Substitute goods (R7).	High price and limited availability of raw materials.	Decrease in level of sales; consumers buy substitute goods which are more affordable.
Marketing strategy	Inappropriate cost leadership strategy and services (R8).	Miscalculation of strategy or price determination focus, and services.	Consumers feel disappointed then decide to stop buying.
	Poor loyalty (R9).	Incompetence and company benefit- oriented.	Customers feel disrespectful and their needs are neglected.
Product	Low ability to launch new goods and services (R10).	No adequate or continuous market research and slow development of new goods and services.	Goods and services cannot meet the growing market demand and trends so consumers choose competitors' products.
	Decrease in quality of goods and services (R11).	No quality standardization or SOP of production process and services.	Different quality of goods and services.
Distribution	Inappropriate distribution process (R12).	No special team which is responsible for product distribution and limited retailers who promote the products (potato chips).	Disruption to product distribution and limited marketing areas.
	Limited distribution facilities and infrastructure (R13).	No computerized documentation of product distribution system and no SOP related to distribution.	Delivery delays and product damage during distribution.
Promotion	Ineffective promotion activities (R14).	No information technology involvement and limited promotion budget.	Promotions run slowly and are not well targeted.
	Absence of brand image (R15).	The company has yet to strengthen its brand image.	Lack of loyal customers and promotion is hard to conduct.
	Neglect of promotional activities (R16).	No specific team for marketing.	Enterprise lacks competitiveness.

3. RESULTS AND DISCUSSION

3.1. Assessing the Marketing Risk of Potato Chips

In order to investigate the market risk of potato chips, quantitative risk assessment (S: Severity; O: Occurence; D: Detection, RPN: Risk Priority Number) was conducted using fuzzy FMEA. The assessment refers to the 16 risk indicators previously identified. Based on the assessment results, three risk indicators have the highest FRPN and need to be managed and solved soon. The risk assessment results on potato chips can be seen in Table 3.

Table 3 Measurement results of marketing risk of potato chips

Risk		S	O	D	RPN	Rank	Fuzzy RPN	Rank
Interest Rate	Interest increase (R1)	2	2	9	36	9	2.76	10
	IDR exchange rate decrease (R2)	2	2	9	36	9	2.78	9
Price Fluctuation	Scarcity of raw materials (R3)	3	2	8	48	8	2.72	14
	Energy cost increase (R4)	3	2	8	48	8	2.71	15
Competitiveness	Stiff competition between similar products (R5)	5	4	8	160	2	4.85	2
	New competitors (R6)	5	3	7	105	5	4.1	5
	Substitute goods (R7)	4	3	8	96	6	4.19	4
Marketing strategy	Inappropriate cost leadership strategy and services (R8)	3	2	8	48	8	2.75	12
	Poor loyalty (R9)	3	2	8	48	8	2.73	13
Product	Low ability to launch new goods and services (R10)	3	4	9	108	4	3.91	7
	Decrease in quality of goods and services (R11)	8	2	8	128	3	4.05	6
Distribution	Inappropriate distribution process (R12)	2	2	9	36	9	2.77	11
	Limited distribution facilities and infrastructure (R13)	3	3	9	81	7	3.39	8
Promotion	Ineffective promotion activities (R14)	5	7	7	245	1	6.26	1
	Absence of brand image (R15)	5	4	8	160	2	4.83	3
	Neglect of promotional activities (R16)	2	2	8	32	10	2.64	16

Based on Table 3, there is a gap in the RPN score between conventional FMEA and fuzzy FMEA. For the first priority scale, the suggestion for improvement relates to the inappropriateness of the distribution system, with an RPN of 245 and FRPN of 6.26. This FRPN score is used to determine the specific rate because on RPN, the rate of risk subcriterion has a similar score. For example, if the interest rate and exchange rate subcriteria indicate 36 in RPN, the rate will also be similar; that is, 9. Therefore, the RPN is fuzzificated to obtain specific numbers; 2.78 as the exchange rate and 2.76 as the interest rate, ranked 9 and 10 respectively.

Table 3 shows that based on the FRPN there are 7 potential risks. The urgent risks are promotion risk caused by inappropriateness of the promotional activities and its promotion target (R14), and the absence of brand image (R15). The external factor due to competitiveness of the similar production (R5), and the presence of substitute products (R7) and new competitors (R6). The third risk is product risk, which is related to the declining quality of its product and service (R11), and low ability to launch new goods and services (R10). Thus, these risks are the most potential risks. Therefore, a new strategy needs to be assigned in order to solve them all. Strategy of risk mitigation is expected to reduce the risks, or even better to clear them up.

3.2. Mitigation Risk Strategy

The findings on risk priority were then used as references for the model strategy of market risk mitigation. Based on the previous analysis, the correlation between each criterion can be used to create this model strategy.

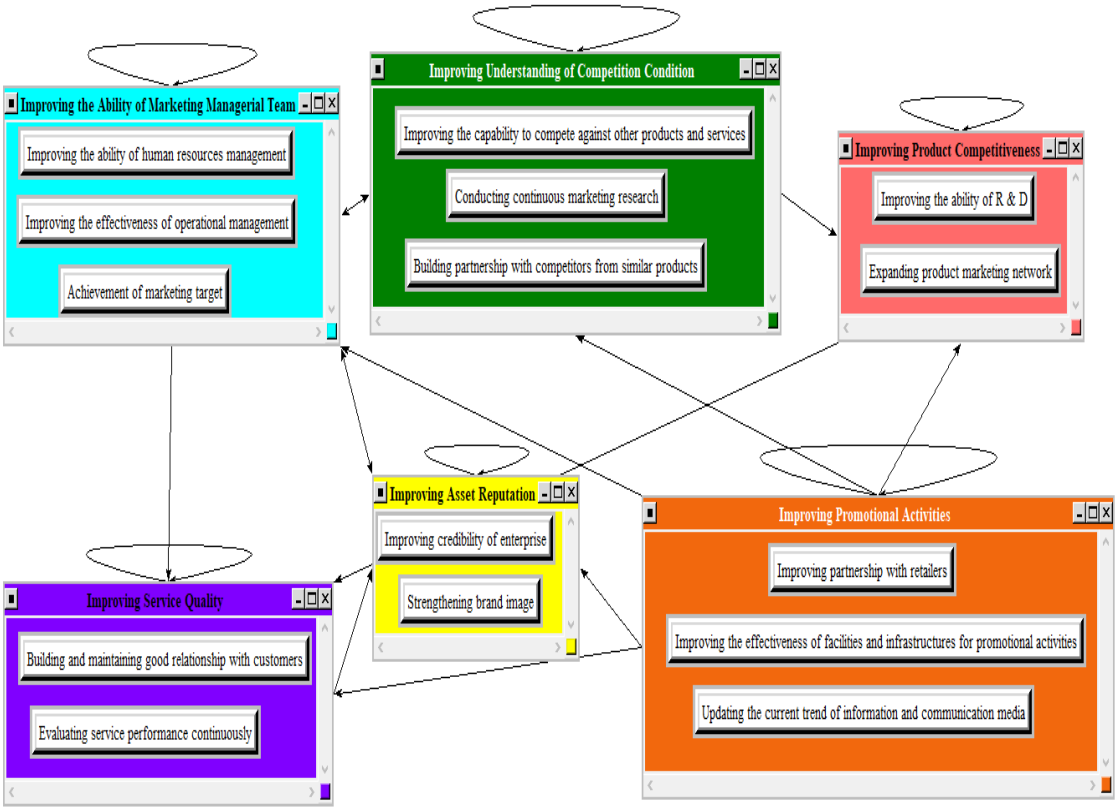

Figure 1 ANP model for structuring relationships between clusters

In ANP, there are two kinds of correlation: inner dependence and outer dependence. Inner dependence is a correlation between elements in the same cluster; this cluster will then relate to itself and make a loop. In this research, there was inner dependence in every criteria, therefore it

could be established that each subcriterion and each criterion was connected. Outer dependence is a correlation between elements in different clusters; these clusters will then relate to the other clusters. For example, company managerial development increases asset reputation, which then increase promotion, and so on. The ANP model for structuring the relationships between clusters can be seen in Figure 1.

After analyzing the correlation of each alternative strategy obtained from ANP, weighting was conducted to determine the priority rate for each alternative strategy. Based on the weighting process, it was found that the highest market risk mitigation was the improvement in sub-strategy promotion, which increased the effectiveness of promotion facilities and infrastructure (0.296); complied with the development of information and communication media (0.292); and maintained service quality in the subcriterion of building and maintaining good relations with customers (0.105). The detailed strategy priority of risk mitigation can be seen in Table 4.

Table 4 Priority results of market risk mitigation strategy for potato chip marketing

Criterion	Subcriterion	Weight	Priority
Improving the Ability of the Marketing Managerial Team	Improving the ability of human resources management.	0.070	4
	Improving the effectiveness of operational management.	0.013	10
	Achievement of marketing targets.	0.011	11
Improving Services Quality	Building and maintaining good relationships with customers.	0.105	3
	Evaluating service performance continuously.	0.049	6
Improving Promotional Activities	Improving partnerships with retailers.	0.036	7
	Improving the effectiveness of facilities and infrastructure for promotional activities.	0.296	1
	Updating the current trends in information and communication media.	0.292	2
Improving Asset Reputation	Improving the credibility of the enterprise.	0.007	12
	Strengthening brand image.	0.052	5
Improving Understanding of Competition Condition	Improving the capability to compete against other products and services.	0.007	13
	Conducting continuous marketing research.	0.023	9
	Building partnerships with competitors with similar products.	0.005	14
Improving Product Competitiveness	Improving the ability of R & D.	0.004	15
	Expanding the product marketing network.	0.030	8

These results indicate that the presence of infrastructure to support campaigns is a key strategy in mitigating the risk of marketing. This is in line with a number of previous research results (Samli & Hook, 1995; Lowe, 2010), emphasizing the importance of the optimization of various media to enhance promotional activities. In fact, the research results of Kiumarsi et al. (2014) indicate that SMEs should create and focus on appropriate promotion and advertising strategies. The implementation of these strategies could improve the effectiveness of marketing, increasing sales, making the products more popular, and expanding the market area.

4. CONCLUSION

Market risk assessment using fuzzy FMEA produces different results from conventional FMEA. They are more specific, and can therefore help to avoid the risks which are commonly encountered in marketing. The findings show that the most potential risks in potato chip marketing are promotion risk, caused by the inappropriateness of promotional activities; promotion targets; and the absence of a brand image. External factors are the competitiveness of similar products; the presence of substitute products; and new competitors. The third risk is product risk, which is related to the declining quality of the product and services, and the lack of innovation. This risk analysis was then considered as the basic formulation of risk mitigation strategy using the ANP method. Based on the weighting process, it was found that the highest market risk mitigation strategy lay in improvement in sub-strategy promotion to increase the effectiveness of promotion facilities and infrastructure (0.296); compliance with the development of information and communication media (0.292); and service quality maintenance in the subcriteria of building and maintaining good relationships with customers (0.105). The implementation of these strategies could improve marketing effectiveness, thereby increasing sales, making the products more popular, and expanding the market area.

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