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RISK MITIGATION IN DESIGN & PRODUCTION NEW PRODUCT DEVELOPMENT PROCESS (CASE STUDY: HIJAB COMPANY IN YOGYAKARTA)

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ABSTRACT

Indonesia is one of the biggest moslem country in the world. Besides its resources, Indonesia have big market in fashion, especially on moslem wear fashion. Today, Hijab has become a life style in moslem daily life. For entrepreneus, hijab is one of the big opportunities because the costumers are growing in Indonesia, especially in Yogyakarta. Every hijab that producted was pass through the new product development stage. But, this stage is not out of risk. This study aims to find and analyze the factors that cause problems in new produst development's design and production of new product in moslem fashion industries base in Yogyakarta. Besides that, aims to determine the appropriate mitigation strategy, the risk management can be applied. Interview base of quesitionnaire survey was designed and delivered to three companies: (1) Hijab Qiyada, (2) Salavian Hijab and (3) Nathijab. This research is using qualitative research method with questionnaires and interview. The

result of this study indicate that there are 20 risk events, 20 risk agents, 11 critical risk agent, and 11 risk strategy mitigation in design process and production process. This research aims help manager to make better decision when want to applied risk management and to make effective mitigation strategy in new product development especially in hijab industry.

Key words: Risk Management, New Product Development (NPD), Failure Mode Effect Analysis (FMEA), House of Risk (HOR)

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1. INTRODUCTION

Indonesian industrial fashion is progressing. Based on data from the survey of the Creative Economy Agency (Bekraf) and the Central Bureau of Statistics (BPS) released that the Creative Economy sector contributed 7.38% to the total national economy in 2016 Meanwhile, the fashion sector contributed as much as 18.15% or number two after culinary (TribunJogja, 2018). The fashion industry has donated about 50 percent of the country's revenues through the creative industries. In the fashion industry there are 2-3 percent export growth every year (Kementrian Perindustrian, 2018). Director General of Small and Medium Industry (IKM) of the Ministry of Industry, explained the citizens of Indonesian who use hijab reaches 20 million people. This is in line with the development of the Moslem fashion industry that reaches seven percent every year (Kementrian Perindustrian, 2018). According to data from Media Indonesia, in 2016 the Moslem population in Indonesia was 70% of about 250 million total population (Media Indonesia, 2018).

The New Product Development (NPD) project in the hijab company will not be separated from risk and needs to be managed and mitigated the risks that will increase in the NPD process. While the risk is almost certain to exist in any NPD project (Dewi, *et al*.,2015). NPD are the process of developing, producing and delivering new products to the market (Chaudhuri, *et al*., 2016). The success of the process of NPD depends on the factor of decision-making ability of the company in determining NPD to be produced (Krishnan, 1998 in Zabala, 2012) and have a good relationship with supplier (Sugandini, Wendry, & Muafi. (2017). Decision-making is an important activity in the development of new products as it will determine the quality of the final product, innovation and cost, as well as the overall efficiency of the company (Tsinopoulos and McCarthy, 2002 in Zabala, 2012, Muafi,2015a). To introduce new products (or services) in the market, the company can develop several activities called NPD (Haverila, 2010).

Fashion products have short product life cycles that enhance the challenges of the NPD process. Many NPD projects have been done by the company. But the success rate of the NPD project is still very little. This is due to increased time and cost, difficulty in scheduling, and short product life cycles. All of these factors can increase the risk of the NPD process. Therefore, risk management practices are needed to solve this issue (Dewi, *et al*., 2015). Risk management practices can suppress failure in NPD projects. According to (Dorfman, 2007) risk management is a preventive process used by businesses and individuals. Meanwhile, according to the COSO (Committer of Sponsoring Organizations of the Tread way Commission) risk management or Enterprise Risk Management (ERM) is a process that stakeholder involved in the company's management and other personnel to reduce risk. Risk

management is implemented to reduce, avoid, accommodate a risk through a number of sequential activities, Risk identification, Risk measurement, Risk control (Darmawi, 2014). New products introduced in the market will evolve through a series of stages, starting with initial product concepts or ideas that are evaluated, developed, tested until they can be launched on the market (Booz et al 1982 in Bhuiyan, 2011 and Diharto, Muafi., Resmi, Siswanti, Retnaningdiah, Ghofar & Kusumawati, 2018). It is necessary to apply risk management to suppress failure in each process.

Phase of process of NPD according to (Bandinelli *et al*, 2013) that is divided into 5 stages, namely: design process, modelling/prototype, engineering breakdown, material/material selection, production process and distribution. Currently, a few research focuses on NPD is included in the determination of risk mitigation. In this study the risk of NPD is analysed by using the integration of Failure Mode Effect Analysis (FMEA) and House of Risk (HOR) methods. FMEA is a structured action to identify as well as prevent as many modes as possible (Casadai, 2007). Potential failures are in the case of defects or failures in the design and conditions beyond the limits of the specifications that have more than one product different from the product. HOR method is a framework developed by Pujawan and Geraldin, 2005 by developing FMEA method. However, in the case of risk approach, Aggregate Risk Potential (ARP) calculations are obtained from the probability of the source of the risk and the impact of the risk-related damage occurring. In this case it is used to look for possible sources of risk and the severity of risk events (Trenggonowati, 2017).

The success of the process of NPD can be analysed. The success of NPD depends on market acceptance. If the risk of NPD production categories can be pressed then market acceptance will increase (Haverila, 2010). In addition the difficulty in making product design becomes a separate problem for the hijab company. Social media can be seen as an informal source to gain an understanding of customer preferences, competitors' activities, market trends, product feedback and in designing ideas (Bashir *et al*, 2017). NPD requires a technique that can take into account socio-economic factors that are incorporated into the cause of current assumptions about future demand conditions. (Derbyshire & Giovanneti, 2017). NPD that work together throughout the product development process with a balanced team has increased production activities (Kim & Kim, 2009). To improve the performance of NPD, managers must create conditions conducive to implementing appropriate systems to improve management capabilities required by NPD (Tai Ming, 2017).

In this study determine the risk management and mitigation of design and production risk in the process of NPD. Production activities are activities of creating goods and services. Operations management described as a series of activities that create value of goods and services by converting inputs into outputs or outputs (Heizer, Reider & Munson, 2017). This study applies integration between FMEA and HOR which creates a systematic and comprehensive framework that can help operational managers identify risks and develop more effective mitigation strategy plans. FMEA and HOR 1 will be adopted to identify and analyze risk factors of the NPD process. The results will be inputs to the HOR 2 used to establish appropriate mitigation strategies. From the process of risk identification and development of mitigation strategies will generate a lot of data. This data needs to be arranged in such a way that it is easy to present information for the decision-making process (Dewi, *et al* 2015). Based on the formulation of the problem, this research aims to identify risk factors and risk mitigation strategies on the design and production of NPD in the three hijab companies in Yogyakarta.

2. METHODOLOGY

This case research was conducted on three hijab companies in Yogyakarta. These are Hijab Qiyada, Salavian Hijab and Nat Hijab. The three companies are categorized of large companies, medium companies and small company based on monthly income turnover, number of employees and operational facilities of the company. Small and medium enterprises are included in the Micro industry. Large companies are included in SME. For small company entered in small industries of SMEs. The three companies have never conducted risk identification and analyzed risk factors to create risk mitigation on NPD.

The study use primary data through interviews, brainstorming and questionnaires with resource persons. Primary data is data collected first-hand for subsequent analysis to find a solution to the problem in detail (Sekaran, 2013). Sources of data obtained through interviews using questionnaires to respondents who is an expert in that company They are Owner, Personal Assistant and Poduct Design department. Data collection to look for critical risk events, critical risk agents and risk mitigation strategies. It starts with the risk identification stage by looking for risk factors in the design and production process in the NPD process.

In the process of risk assessment will be assessed in terms of the severity of the impact, the possibility of occurrence and control. The assessment process uses FMEA and HOR1 to determine the Aggregate Risk Potential (ARPj).

ARP is calculated based on formula ARP j = Oj Σ Si Rj (Dewi, *et al*, 2018 & Trenggonowati, 2017). This is derived from the calculation of Severity (Si), occurance (Oj) as well as the relationship between risk and risk agents (Rtj). Has a different scale that is 0, 1, 3, 9. The number 0 indicates there is no relationship between the two, the number 1 shows the weak relationship, the number 3 and the number 9 shows the relationship is medium and strong. Severity and honesty criteria are formed based on interviews with experts from the company. The criteria are shown in Table 1 and Table 2 which will become the reference in making Severity and Occurance questionnaires.

Table 1 Severity of Measurement of Risk Level

Level	Criteria	Production	Company Goals
1	Insignificant	Production activities stop <1 week	Impacts on achieving company goals can be ignored
2	Minor	Production activitiesstop ≥ 1 weekup to <3 weeks	Minor impact on the achievement of corporate goals
3	Moderate/ Medium	Production activity stops ≥ 3 weeks to <6 weeks	Medium impact on achieving company goals
4	Major	Production activity stops ≥ 6 weeks to <12 weeks	Significant impact on the achievement of company goals
5	Catastrophic	Production activity stops> 12 weeks	Very serious impact on the achievement of corporate goals

(Source: Dewi et al (2015) with adjustment)

Table 2 Occupational Probability Criteria (Occurance) Measurement of Risk Level

Level	Criteria	Description
1	Rare	Occurs only during extreme circumstances (1 time in 3 years).
2	Unlikely	It has not happened yet, but it can happen at any time (1 time in 2 years)
3	Possible	It should happen and may happen (1 time in 1 year)
4	Likely	Can occur easily and may appear in the most prevalent state (More than 5 times in 2 years)
5	Almost likely	Often occurs and most often occurs (More than 5 times in 1 year)

(Source: Dewi et al (2015) with adjustment)

The ARP calculation will produce the level of risk used as a result of risk mapping. For extreme risk, high, medium, and low risk with ARP value as follows: Extreme risk with ARP value 225, High risk with ARP value 99< ARP <225, Medium risk with ARP 50-99 and Low risk with ARP <50 (Dewi *et al*, 2015). To determine the appropriate risk mitigation strategies for critical risk agents, the objective risk response stageis needed that occurs in the business process and the stages of the NPD in the fashion industry based on literature, depth interviews and questionnaires with company experts. FMEA integration with HOR 1 are used to determine which risk sources are prioritized for precautions. The first thing to do is identify the correlation. The relationship between risk agents and other risk events is identified and assigned a value of 0 (zero), number 1 (one), number 3 (three) or number 9 (nine) as a sign of each relation/combination.

The next step is to calculate the ARP obtained from the multiplication of the probability of the source of the risk and the impact of the risk-related damage occurring. After identificating a correlation and performing ARP calculations, the final step is to create a risk priority by combining risk, risk agents, correlation and ARP data. ARP is calculated by the formula ARP j = Oj Σ Si Rj.

3. RESEARCH RESULT

In this case found there were 20 risk events, 20 risk agents, 11 critical risk agents, and 11 mitigation of risk strategy in the design process and production process. From the table is taken the main priority of critical risk agents of each company. The critical risk agent of Hijab Qiyada is (A9) the shortage of fabric supply with ARP = 396, (A8) supply of fabric to be thinning with ARP = 171, (A14) order planning not in accordance with ARP = 132, (A20) pattern cutting error with ARP=108. The critical risk agent of Salavia Hijab is (A3) lack of good coordination in the production team with ARP = 294, (A5) technical evaluation in less work procedures ARP = 168, (A6) facilities and limited resources with ARP = 144 & (A17) the identity of the goods is not appropriate with ARP=90. Nathijab critical risk agents is (A15) accumulation of production process ARP = 60 , (A10) choice of limited product model with ARP = 54 & less developed design concepts with ARP=27.

After completing the stages of calculation of risk priority, then the next step enter the phase of HOR phase 2 in the form of strategy design to give priority action. The first step is to measure the correlation value between the mitigation strategy and the selected risk agents. Here are the mitigation strategies that have been designed regarding the priority of risk agents.

Table 3 Strategies to be Designed

Mitigation Strategy	Code
1. Provide an alternative supplier outside the main supplier	PA1
2. Re-checking by delivery team	PA2
3. Increasing the provision of facilities & resources as needed	PA3
4. Improving production team communication	PA4
5. Make regular technical evaluation schedule in work procedure	PA5
6. Create timeline according to production capacity capability	PA6
7. Multiply product design coordination with design team	PA7
8. Build effective communication between companies and suppliers	PA8
9. Implement an active corporate culture	PA9

(Source: Dewi *et al*, 2015)

The next step is to measure the degree of difficulty (Dk). The purpose of measuring the degree of difficulty (Dk) is to know the degree of difficulty. Next is to calculate the total effectiveness. Total effectiveness is obtained from the multiplication of the correlation value between the risk agent (j) and the mitigation strategy (k). Total effectiveness calculation aims to assess the effectiveness of a mitigation strategy. Having obtained the total value of effectiveness, then after doing the calculation of the effectiveness of the difficult difficulty. The effectiveness of degree of difficulty is derived from dividing the total effectiveness value (TEk) by the degree of difficulty in carrying out mitigation strategies. The effectiveness of degrees of difficulty aims to determine the priority ranking of all mitigation strategies.

After planning the strategy, measuring the degree of difficulty (DK), the total effectiveness and the effectiveness of the degree of difficulty, the final step in the House of Risk 2 is to create a House of Risk 2 table by combining strategic planning data, risk agent, correlation, calculation result of ARP, degree of difficulty (Dk), total effectiveness and effectiveness of degree of difficulty into a table. Here is the House of Risk table 4.

The below data will be used to make of risk mitigation strategies that correspond to the critical risk agents of Qijada hijab companies, Salaviy hijab and Nat Hijab. It can be concluded that the highest priority ranking is PA4 (Improving production team communication)

Table 4 House of Risk 2

Company	Risk Agent	Strategies to be Designed									ARPj
		PA1	PA2	PA3	PA4	PA5	PA6	PA7	PA8	PA9	
Hijab Qiyada	A9	9							3		153
	A8		9								171
	A14				9						132
	A20			9							108
Salavia Hijab	A3				9						294
	A5					9				3	168
	A6			9							144
	A17		9								90
Nat Hijab	A15						9				60
	A10							9			54
	A4							3			27
Tek		1377	2349	1296	3834	1512	540	567	459	504	
Dk		4	3	5	4	3	4	4	4	4	
ETD		344,25	789	453,6	958,5	504	135	141,75	114,75	126	
Rank		5	2	4	1	3	7	6	9	8	

(Source: Primary data processed, 2018)

Table 5 ARP Calculation Result Critical Risk Agency Task Study Case Company Hijab to Stage Process New Product Development (NPD)

Company	Code	Critical Risk Agent	ARP	Stages of NPD Process					
				1	2	3	4	5	6
Hijab Qiyada	A9	Lack of fabric supply from suppliers	153						
	A8	Inventory of thinning fabric	171						
	A14	Planning order is not appropriate	132						
	A20	Pattern cutting error	108						
Salavia Hijab	A3	There is not enough coordination in the team	294						
	A5	Technical evaluation in less work procedures	168						
	A6	Facilities and resources are limited	144						
	A17	The identity of the goods is not appropriate	90						
Nat Hijab	A15	Stacking of production process	60						
	A10	The choice of product model is limited	54						
	A4	less developed design concepts	27						

- The stages of the NPD process in the hijab industry include: design process (1), modeling / prototype (2), detailed techniques (3), material selection (4), production process (5) and distribution (6).

(Source: Primary data processed, 2018)

The table above is the result of ARP calculation of critical risk agent of case study of hijab company to stages process of New Product Development (NPD).

From risk mapping it is known that Qiyada hijab has an extreme risk of 5%, high risk of 15% medium risk of 25% and low risk of 55%. Salavia hijab has an extreme risk of 10%, high risk of 15%, medium risk of 10% and low risk of 65%. Nat Hijab has a medium risk of 19% and low risk of 81%.

Table 6 Results of critical risk agents and risk mitigation strategies in New Product Development (NPD) business processes in three case studies

Company	Code	Critical Risk Agent	Risk Mitigation Strategy
Hijab Qiyada	A9	Lack of fabric supply from suppliers	PA1, PA8
	A8	Inventory of thinning fabric	PA2
	A14	Planning order is not appropriate	PA4
	A20	Pattern cutting error	PA3
Salavia Hijab	A3	There is not enough coordination in the team	PA4
	A5	Technical evaluation in less work procedures	PA5, PA9
	A6	Facilities and resources are limited	PA3
	A17	The identity of the goods is not appropriate	PA2
Nat Hijab	A15	Stacking of production process	PA6
	A10	The choice of product model is limited	PA7
	A4	less developed design concepts	PA7

(Source: Primary data processed, 2018)

Conclusion from the data, Hijab Qiyada has four critical risk agents. Lack of fabric supply from suppliers (A9), inventory of thinning fabric (A8), planning order is not appropriate (A14) and pattern cutting error (A20). For critical risk agents the lack of fabric supply from

suppliers (A9) is an appropriate risk mitigation strategy that provides an alternative supplier outside the main supplier (PA1) as well as establishing effective communication between the company and the supplier (PA8). Inventory of thinning fabric (A8) can affect production to be an appropriate risk mitigation strategy that is to re-check by the delivery team so that production can be fulfilled according to order (PA2). Planning order is not appropriate (A14) appropriate risk mitigation strategy is to improve the production team communication (PA4). Error of pattern cutting (A20) strategy appropriate risk mitigation that is improving the provision of facilities and resources as needed (PA3).

Salavia hijab has four critical risk agent. There is not enough coordination in the team (A3), technical evaluation in less work procedures (A5), facilities and resources are limited (A6) and the identity of the goods is not appropriate (A17) . The critical risk agents in the (A3) there is not enough coordination in the team. Appropriate risk mitigation strategies is to improve the communication of the production team (PA4). The problem in (A5) is technical evaluation in less work procedures. Appropriate risk mitigation strategy is to make a routine schedule of technical evaluation in work procedure (PA5) and implement an active corporate culture (PA9). Limited resource facilities (A6) appropriate risk mitigation strategies that improve the provision of facilities and resources as needed (PA3). The identity of the goods does not match (A17) the appropriate risk mitigation strategy is re-checking by the delivery team (PA2).

Nat Hijab hijab has three critical risk agents. The critical risk agents is stacking of production process (A15), the choice of the limited product model (A10) and less developed design concepts (A4). In the stacking of production process (A15) an appropriate risk mitigation strategy is to create a timeline according to the capacity of production capacity (PA6). For a choice of limited product model (A10) an appropriate risk mitigation strategy is to multiply product design coordination with the design team (PA7). Less developed design concept (A4) appropriate risk mitigation strategy is to multiply product design coordination with the design team (PA7).With risk mitigation, it is expected that the next process of NPD can be well without any significant risk in the fluency of the production process.

4. CONCLUSIONS AND SUGGESTIONS

New Product Development (NPD) is a risky process for the company. But innovation is also important part of business. It's a competitive environment out there. The risk management of the hijab industry is not a common thing companies do especially for small and medium micro businesses. The research found 20 risk events, 20 risk agents, 11 critical risk agents and 11 risk mitigation strategies in the design and production process in the three companies studied. Based on calculations, Qiyada hijab has an extreme risk of 5%, high risk of 15% medium risk of 25% and low risk of 55%. Salavia hijab has an extreme risk of 10%, high risk of 15%, medium risk of 10% and low risk of 65%. While Nat Hijab has a medium risk of 19% and low risk of 81%. The risk management framework used in this research can be applied to assist managers in implementing risk management and establish effective mitigation strategies in the NPD for the hijab industry. For future research can be expanded to analyze mitigation strategies that include all risk agents, not just critical risk agents. Analysis of mitigation strategies covering all risk agents is expected to be implemented at all stages of the NPD process. So the risks can be overcome for the success of NPD at the hijab company in Yogyakarta.

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