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Risk Assessment on Electric Motorcycle Product Development at PT VIS

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Abstract. PT VIS is a company engaged in the automotive industry of electrically powered vehicles. Currently, PT VIS is developing an electric motorcycle product to add to its existing product line. In developing new products, some risks and obstacles cannot be avoided. Therefore, a risk assessment and mitigation actions must be carried out, which can be done using the House of Risk method. Based on the data collection, 17 risk events are relevant to the company. From the data processing that has been done, two risk agents with the most significant Aggregate Risk Potential values were identified, namely the battery with a limited lifetime and poor cooperation between teams. Based on this, preventive actions were modeled to prevent risks. The selected mitigation actions are stock calculation following the demand forecasting carried out, proper battery storage SOPs, more supervision from the head of the department on the team's performance in the production process, more communicative use of language from the head of the department to the staff, market research more profound into the market trends and target, as well as appropriate calculation in demand forecasting within the market research carried out.

INTRODUCTION

PT VIS is a company engaged in the electric vehicle industry. The company, located in Semarang City, was founded in 2017 and started operating in 2018. At its inception, PT VIS planned to manufacture electric tricycle motorbikes. However, at present, the products that have been commercialized are electric bicycle products with a variety of features and specifications. PT VIS adopts technologies from China, and one of its owners is a Chinese foreigner. Currently, PT VIS is developing a new product, i.e., an electric motorcycle that has been developed and is in its prototype stage.

New Product Development is developing, producing, and delivering new products to the market [1]. The success of the new product development process depends on the company's decision-making ability in determining the New Product Development to be made as it will determine the quality of the final product, innovations, and costs, and efficiency of the entire company [2]. With new products, companies can maintain their growth and profits and have the opportunity to replace old products. A product is presented as new if it is newly known within the world products, is within new product lines, or has additions or improvements from the existing product lines [3]. A company generally carries out a new product development process because it is driven by increasingly complex market conditions where consumer desires are increasingly diverse. Competition with similar product companies to seize and defend the market also prompts this development to occur.

PT VIS is in the process of developing a product to maintain its presence within the industry. The product that this company is developing is an electric motorcycle. This product is classified as an additional product to the existing product line. Currently, the product from PT VIS that has been commercialized in the market is an electric bicycle. As with other companies, PT VIS, when running its business, faces obstacles and challenges. With the previous products, i.e., the electric bicycles discontinued production of certain electric bicycles had occurred. This discontinuity of production was caused by several factors that include insufficiency in meeting customer needs and

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unsuitable product price design. There was also a problem found at the business analysis stage, namely the inaccurate sales estimations resulting from fluctuating demand for electric bicycles while the supply of parts to make the products was insufficient. In the electric bicycle products, there were also defects because certain parts had not been installed, which emphasizes the necessity to double-check and repeat the assembly process. Learning from the experience of previous products, whose parts are similar to the new products, i.e., electric motorbikes, the company is required to prepare the new product development steps comprehensively. New product development projects are not free from risks and therefore need to be managed and analyzed for risks that will arise in the new product development process to reduce them. Risks are almost certainly present in every New Product Development project [4]. These possible constraints and risks make a risk analysis and design of mitigation actions in the product development process necessary to minimize the existing risk possibilities. Accordingly, a risk assessment using the House of Risk method is explicated in the present study.

This study used the House of Risk method. This method is an integration of the House of Quality and Failure Mode and Effect Analysis methods. The House of Risk method consists of 2 phases, namely HOR 1 and HOR 2. HOR 1 is a phase carried out to identify and analyze essential risks from the product development process. The HOR 1 will be used as input for HOR 2 to determine the appropriate mitigation strategies to minimize the possibility of risks occurring in the product development process. In previous research, product development risk management was carried out using the HOR and Failure Mode Effect and Criticality Analysis (FMECA) approaches in the hijab industry in Indonesia [4]. Research has also been done on the risk management of a yogurt drink product development using the HOR method [5]. There are also other studies on risk management using the HOR method. However, those studies were not focused on product development. As presented by the many research studies, the HOR method proves as a flexible method that can be applied to several objects. This study aims to identify the risks that exist in developing an electric motorcycle at PT.VIS.

LITERATURE REVIEW

The product development process is an activity carried out by a company when the company wants to develop and launch new products. This process, of course, requires several stages until the product can finally be traded on the market. This series of stages start from forming the initial product concept or idea that will be evaluated, tested, and then launched in the market [6]. Management must go through eight stages of product development to produce new products, namely idea creation, idea screening, concept development and testing, marketing strategy development, business analysis stage, product development stage, marketing trial, and commercialization stage [7].

Siegel and Shim in [8] define risk as to the condition that leads to a specific set of results, in which the results may be predicted upon decision making. Risk can also be interpreted as a variation in profits, sales, or other financial variables. According to [9], the risk is an uncertainty that may give rise to events that cause losses. The first stage in the risk management process is the risk identification stage. *Risk identification* is a systematic and continuous process to identify possible risks or losses to company assets, debts, and personnel. Risk identification can be made using several techniques, including brainstorming, questionnaires, industry benchmarking, scenario analysis, inspection, and checklists [10].

Risk management is a process of identifying, measuring, developing, selecting, and managing options for dealing with identified risks. Adequate risk management applies future possibilities and is proactive. Thus, risk management reduces the likelihood of the risk occurring and the impact that will arise from the occurrence of risk [11]. Risk management has an end goal. The ultimate goal of risk management is to identify and conduct the slightest risk, transfer of risk, and recovery from risk to optimize performance in the organization. According to [12], risk management is implemented to reduce, avoid, and accommodate a risk through several sequential activities. Techniques or approaches used in risk assessment include Barrier Analysis, Event Tree Analysis (ETA), Risk Matrices, and House of Risk (HOR). The House of Risk method is a framework developed by [13] developed from the FMEA (Failure Mode and Effect Analysis) method and the QFD (Quality Function Deployment) method. This method was initially used in supply chain risk management, which focused on preventive measures by reducing the occurrence of risk agents.

METHODOLOGY

The research method used in this research is descriptive research using a qualitative approach. According to Gay in [14], the descriptive research method is an activity that includes data collection in order to test a hypothesis. *Qualitative research* is a research procedure that produces descriptive data in written or spoken words from people as the source and behaviors that can be directly observed [15].

Data collection techniques used in this study include interviews, brainstorming, and questionnaires filled by several stakeholders of the company such as CEOs, Heads of the Production Department, and Managers. Interviews were conducted to find problems that exist within the company and risks in the development of new products in the company. Brainstorming was carried out to obtain information on the risk event (Ei) and risk agent (Ai) and the correlation between the two. Such an approach is vital to obtain information on the mitigation actions and their relationship with the risk agent (Ai).

The last data collection technique was the questionnaire in which company higher-ups were asked to fill out two questionnaires, one in the HOR phase 1 and another in the HOR phase 2. The questionnaire in the HOR phase 1 dynamic rating of the risk events (Ei) and the likelihood of risk agents (Aj) using a Likert scale of 1-5. The questionnaire in the HOR phase 2 was focused on the rating to measure the degree of difficulty in acting (Dk) in the application of PAk using a Likert scale of 1-5. According to [13], data processing was done divided into two main steps, namely House of Risk Phase 1 and House of Risk Phase 2.

RESULTS AND DISCUSSION

The interviews and brainstorming with company experts showed that there were 17 risk events with 16 risk agents. Based on the data processing carried out, a ranking order of 16 risk agents from the largest to smallest Aggregate Risk Potential value was obtained (Table 1) below.

TABLE 1. Recapitulation of ARP Values.

Rank	Risk Agent	ARP	Description
1	A9	515	Battery with limited lifetime
2	A14	465	Inadequate cooperation between teams
3	A16	453	Gradual SOP formulation process
4	A11	420	Lack of product knowledge
5	A1	416	Less than precise forecasting of demand
5	A5	416	Surge in demand in the market
7	A3	384	Fast growth of market trends
8	A2	294	Unestablished market
9	A6	288	Diverse consumer needs
10	A12	270	Poorly supervised production process
11	A10	213	Lack of communications between individuals
12	A7	204	Insufficient speed of response to market dynamics
13	A15	201	Lack of capabilities of the human resources in mastering software and hardware
14	A8	190	Lack of knowledge on consumer needs
15	A4	168	Inadequate research process on consumer needs
16	A13	64	Limited product feature

The calculation of ARP values as presented above was followed by the risk agent priority selection stage by looking at the cumulative percentage of each ARP value for each risk agent using the Pareto 80:20 Principle according to (Figure 1) below.

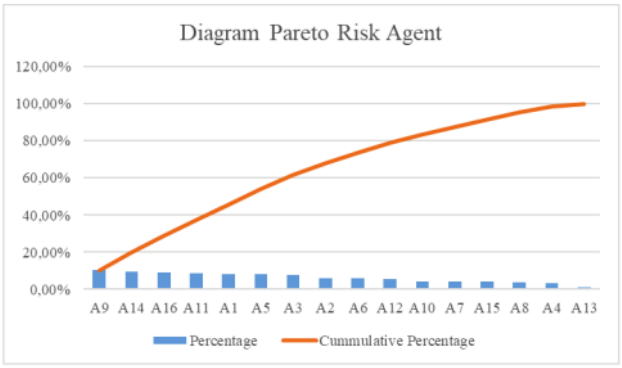

FIGURE 1. Risk Agent Pareto Diagram.

Priority risk agents were selected, based on Figure 1, to be handled and designed for their preventive actions, i.e., risk agents: A9 and A14. These risk agents were selected based on the 80/20 Pareto Principle, wherein 20% of the causes of problems with the most considerable ARP value are chosen to resolve 80% of the problems that occur. Preventive actions (PA) can be made.

The next step was to identify the preventive actions about the selected risk agents. The calculations produced eight Preventive Actions, which were ranked by looking at the value of Effectiveness to Difficulty Ratio (ETDk), which can be seen in (Table 2) below.

TABLE 2. Recapitulation of ETD Values.

Rank	PA Code	ETD	Description
1	PA3	1545	Stock calculation based on the demand forecasting
2	PA5	1545	Proper formulation of battery storage SOP
3	PA6	1395	Additional supervision from the head of the team on the performance of the team in the production process
4	PA7	1395	More communicative use language by the head of the department to the staff
5	PA1	1158.75	More in-depth market research on market trends and targets
6	PA2	1158.75	Appropriate calculation in the demand forecasting based on the market research carried out
7	PA8	1046.25	Team performance upgrading
8	PA4	103	Search for other battery supplier with a longer battery lifetime

Preventive action priority selection was made by looking at the cumulative percentage of each ETDk value from each PA using the Pareto Principle to identify the priority preventive actions appropriate for the risk agents in developing electric motorcycle products at PT Volta Indonesia Semesta. The preventive actions selected were PA3, PA5, PA6, PA7, PA1 and PA2.

CONCLUSION

Based on the calculation of the HOR phase 1, 2 risk agents were selected to be the priority based on the calculation of the most considerable ARP value. The risk agents chosen were the limited battery storage lifetime and the inadequate cooperation between the teams. From the results of the HOR phase 2 calculations, preventive actions were selected, namely the calculation of stock based on the demand forecasting, formulation of the correct battery storage SOP, additional supervision from the head of the department on the performance of the team in the production process, use of more communicate language by the head of the department to the staff, in-depth market research on market trends and targets, and calculation in demand forecasting that must be appropriate based on the market research conducted.

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