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Implementation and enhancement of risk management in frozen food Processing at UD. FFI Driyorejo Gresik

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ABSTRACT

Introduction: Indonesian SMEs are vital for economic growth. UD. FFI Driyorejo Gresik, a frozen food SME, faces production planning and efficiency challenges due to demand fluctuations and absent risk management. This research identifies and prioritizes risks, recommending mitigation strategies. **Methods**: Qualitative data was collected via interviews at UD. FFI. The House of Risk (HOR) method was used to identify, assess, and prioritize risk agents, utilizing SCOR mapping, severity/occurrence assessments, and Pareto analysis. **Results**: Eighteen risk events and twenty-four risk agents were identified. "Insufficient raw material supply" had the highest Aggregate Risk Potential (ARP). Pareto analysis revealed eleven priority risk agents comprising ~80% of total risk. Recommended mitigation included improved inventory, SOP monitoring, maintenance, training, and proactive management. **Conclusion**: UD. FFI is vulnerable in supply chain and production, primarily from raw material issues and process inconsistencies. Inventory management improvement is crucial for better efficiency, quality, and resilience. This study offers a risk management framework for frozen food SMEs. Future research could explore long-term effectiveness and external supply chain factors.

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INTRODUCTION

During the period of economic transformation, SMEs are recognized as engines of economic growth and a source of sustainable development. In addition, SMEs also play an important role in structuring the industry, creating new jobs, and generating income for the community (Jikrillah *et al.*, 2021; Abisuga-Oyekunle et al., 2020). The contribution of SMEs to the Gross Domestic Product (GDP) is 61.07% or IDR 8,573.89 trillion (Fajri, 2022). The existence of SMEs can be the backbone of a country's economy because its business form can revive an economy that is in decline (Budiarto *et al.*, 2022). Based on sources from the Cooperatives and SMEs Office, East Java has 1,153,576 units of SMEs, of which 21.80% of this number are engaged in processing. (East Java Provincial Discopukm, 2022) also states that raw materials for the processing industry can come from agricultural, forestry, fishery, mining, or quarrying products. One of the processed food products that has the potential to provide solutions to economic downturns is frozen processed food (Soleha *et al.*, 2022). It can be said that this is because the prospects in the frozen food processing business are very good and in great demand (Wati *et al.*, 2023).

Frozen food is a convenient instant food option for many consumers because it can be stored for a long period and reduces food waste (Wicaksana *et al.*, 2021). This opinion is in line with Novita (2022) who stated that in this practical era, frozen processed food products offer a viable solution for meeting daily consumption needs. This trend is strongly linked to increasingly dynamic lifestyles characterized by longer working hours, urbanization, and smaller household sizes, which collectively reduce the time available for traditional meal preparation (Setiawan & Soelistyo, 2017; Kemper et al., 2023). Consequently, consumers globally are shifting towards convenient meal solutions, including ready-to-eat and frozen foods, that fit demanding schedules without significantly compromising on perceived quality or variety (Halter, 2024). The high expenditure on ready-to-eat foods documented in Indonesia (Badan Pusat Statistik, 2021), therefore, reflects a broader international pattern where convenience has become a primary driver in food choice (Karanja *et al.,* 2022).

Based on the results of the "Survei Sosial Ekonomi Nasional" (SUSENAS) by "Badan Pusat Statistik" (BPS) in 2021 regarding the amount of consumption expenditure of the Indonesian population, it was found that the highest result lies in the consumption of ready-to-eat food and beverages with a percentage of 31.74%. This certainly provides a great opportunity for processed food and beverage producers to continue to develop their businesses (Pratama *et al.*,

2023). Gresik is one of the regencies in East Java that is famous for having many industries from several sectors, one of which is the home-scale food and beverage industry (Dinda *et al.*, 2023). UD. FFI is one of the frozen food factories in the Gresik area. This company was established in 2007 and since its inception, the company has focused on processing fishery products that offer product diversification to increase public consumption.

Every activity carried out starting from the planning stage, the provision of raw materials, production, to the receipt of goods by consumers has several risks that need to be handled (Alsaidalani & Elmadhoun, 2022). There was a change in production planning due to the presence of special consumers. These conditions make changes to production scheduling and estimated product manufacturing targets. In addition, the company has not implemented a risk management system so the potential risks that will arise affect other activities. These two aspects have a significant impact on product efficiency which creates uncertainty in terms of the number and type of products that need to be produced. From the emergence of these risks, of course, they need to be controlled to minimize the occurrence of severity (Irvanto *et al.*, 2024; Wulandari *et al.*, 2024).

Risks that arise cannot be avoided directly but can be managed through certain actions, one of which is risk management (Abdurrahman *et al.*, 2019). Risk management can be understood as a structured process to minimize and mitigate the impact of risks, or a proactive decision-making process that aims to minimize the consequences of future negative events, by identifying potential risks, analyzing them, and planning the necessary responses for their monitoring and control (Oliveira *et al.*, 2017). Based on research conducted by (Atmajaya *et al.*, 2020), the implementation of risk management is carried out using the HOR (House Of Risk) method to obtain the easiest to the most difficult mitigation actions. Thus, the implementation of risk management can help companies minimize the occurrence of risks with recommendations for mitigation actions provided. The objectives of this study are (1) Identify risk events and sources of risk in UD. FFI and sort them based on a priority scale. (2) Recommend risk mitigation actions in UD. FFI.

METHODS

The object of this research is UD. FFI is located in Driyorejo District, Gresik Regency, East Java. The determination of the research location was carried out purposively by considering that UD. FFI is one of the long-established frozen processed food manufacturers 2007 with a workforce of 48 people and a monthly turnover of approximately one hundred million Rupiah. According to Shanthana & Basana (2020) the longer the company is established, the more experience will be gained and the events experienced, so there is an urgency to conduct research related to risk management. By having a recommended risk mitigation action plan, UD. FFI can prepare itself to face various types of risks that may occur.

In collecting data, this study uses primary data. Primary data was collected directly through the interview stage (Kurniyanto *et al.*, 2023). There were 4 companies that were invited by the respondents consisting of managers, purchasing, assistant head of production, and marketing admins with questions prepared through questionnaires. The selection of the 4 companies was based on the qualifications of the alignment of the jobdesk with the SCOR model which includes plan, source, make, deliver, and return. The implementation of risk management until the determination of the strategy is carried out using the HOR (House Of Risk) method which focuses on preventive measures by measuring the level of the most optimal priority risk to reduce or eliminate risks with a strong system (Dara Lufika *et al.*, 2022). According to Atmajaya *et al.* (2020) the HOR stage consists of 2 phases as follows,

House of risk (HOR) phase 1

HOR phase 1 is used to determine which sources of risk are prioritized in preventive measures. In other words, this phase focuses on the process of identifying risks related to risk events and risk agents. Here are the steps of HOR phase 1 work:

1. Determine the company's supply chain process based on the SCOR (Supply Chain Operation Reference) model which can be done through mapping such as (plan, source, make, deliver, and return). The division of this process aims to find out where the risk comes from.
2. Determine the risk event (Ei) that exists in UD's business processes. FFI.
3. Assessing the severity (S) of the risk event uses a scale of 1-10 where the number 10 represents a very severe impact.
4. Determine the risk agent (Aj) as the cause of the risk event.
5. Assessing the likelihood of risk or occurrence (Oj) of risk *agents* uses a scale of 1-10, where 1 means rarely occurs and 10 means that it occurs frequently.
6. Determine the relationship between risk events and risk agents expressed as Rij (0,1,3,9) where a value of 0 indicates no correlation and 1, 3, 9 indicates a low, medium, and high correlation, respectively.

7. Calculating the potential risk value (ARP) as input to determine which priorities need to be prioritized in *the risk agent*, to provide a preventive management strategy. In calculating potential risk (ARP), the following formula can be used:

$$ARPj = Oj \sum SiRij$$

Information:
ARPj = Potential Risk Causes
Oj = Chance of occurrence of risk cause
Si = Severity of risk impact
Rij = Correlation value of Aj and Si

Table 1. HOR (*House of Risk*) calculation phase-1

Business Processes	*Risk Event* (Ei)	*Risk Agents* (Aj)					*Severity of Risk event* i (Si)
		A1	A2	A3	A4	A5	
Plan	E1	R11					S1
	E2						S2
Source	E3						S3
	E4						S4
Make	E5						S5
	E6						S6
Delivery	E7						S7
	E8						S8
Return	E9						S9
Occurrence		O1	O2	O3	O4	O5	
ARP		ARP1	ARP2	ARP3	ARP4	ARP5	
Rank							

Source : (Enderzon & Soekiman, 2020)

Table 1 illustrates the structure of the House of Risk (HOR) Phase 1 calculation, detailing the components used to identify and assess risk within UD. FFI's operations. This table outlines the key elements of the HOR framework, including the business processes being analyzed (Plan, Source, Make, Deliver, Return), the risk events (Ei) associated with each process, the risk agents (Aj) that could trigger these events, and the severity of the impact (Si) of each risk event. The table also includes columns for assessing the likelihood of occurrence of each risk agent (Oj), as well as the calculation of the potential risk value (ARP), which guides the prioritization of mitigation efforts. The matrix format allows for a structured overview of the risk landscape and facilitates the identification of the most critical areas requiring attention.

House of risk (HOR) phase 2

HOR phase 2 is used to identify the initial actions to be taken and select several management actions or strategies that are considered effective in reducing the likelihood of risk agents. The following are the working steps of HOR phase 2:

1. Select a number of priority risk agents that need to be overcome based on the ARP value of each risk agent using a pareto diagram.
2. Determine mitigation/management strategies that are considered effective in managing and minimizing the occurrence of risk agents. Where a management/mitigation strategy can manage one or more risk agent triggers.
3. Identify the relationship between each preventive measure and each risk agent through determining a correlation scale with a value (0, 1, 3 or 9) which means there is no correlation, low, medium and high.
4. Calculate the Total Effectiveness (TEK) value for each strategy using the formula:

$$\mathrm{TEk} = \sum_{\mathrm{j}} \mathrm{ARPjEjk}$$

Information:
TEk = Total effectiveness value
ARPj = Risk Cause ARP Value
Ejk = Correlation value of risk causes with mitigation actions

5. Calculate the total effectiveness (TEk) at the difficulty ratio (Dk) or *Effectiveness of Difficulty Ratio* (ETDK) with the formula:

$$ETDk = \frac{TEk}{Dk}$$

Information:
ETDk = Total effectiveness ratio
TEk = Total effectiveness value
Dk = Difficulty value

6. Determine the priority ranking in each strategy (Rk), where the first rank represents the strategy with the highest ETD value. After the ETD value is known, a strategy ranking can be carried out to show the strategic priorities that need to be implemented by the company's management to reduce the possibility of risk agent factors that cause risk events.

Table 2. The calculation of HOR (House of Risk) phase 2

Risk Agent (Aj)	*Preventive Action* (PA*k*)					*Aggregate Risk Potentials*
	PA1	PA2	PA3	PA4	PA5	(ARPi)
A1	E11					ARP1
A2						ARP2
A3						ARP3
A4						ARP4
TE*k*	TE1	TE2	TE3	TE4	TE5	
D*k*	D1	D2	D3	D4	D5	
ETD*k*	ETD1	ETD2	ETD3	ETD4	ETD5	
Rank	R1	R2	R3	R4	R5	

Source: (Enderzon & Soekiman, 2020)

Table 2 outlines the framework for House of Risk (HOR) Phase 2, detailing the process of developing and prioritizing preventive actions to mitigate the identified risk agents. This table presents potential preventive actions (PAK) that can be implemented to reduce the likelihood of each risk agent occurring. The table enables the calculation of aggregate risk potentials (ARP) for each action, along with the determination of total effectiveness (TEK) and effectiveness to difficulty ratio (ETDK), which guide the prioritization of the preventive actions to be implemented. By systematically evaluating the effectiveness and feasibility of each action, the table provides a structured approach for selecting the most appropriate risk mitigation strategies for UD. FFI.

RESULTS AND DISCUSSIONS

UD. FFI business overview

UD. FFI is an industry that was established in 2007 and engaged in processed fish, especially frozen processed products. Initially, product marketing was carried out by going around and distributing brochures to residents' homes and schools, so that the processed products were successfully known and marketed by the community at large. UD. FFI has a corporate organizational structure where the highest position is occupied by the company's director as well as the owner. Furthermore, there is a company manager who is assisted by 7 parts in carrying out his duties. These sections include delivery, marketing, HRD, RND, purchasing, production, and production admin.

Since its inception, UD. FFI focuses on becoming a processed fish producer that offers product diversification as an increase in public interest. The frozen processed food products produced amounted to 55 products with two categories. The first category is premium products totaling 41 variants with bestseller products consisting of miniekado, crispy, keichak, shripnest, and fish roll. Premium products are sold in the form of plastic packaging with a product weight of 250 grams which are then repackaged using cardboard. The second category is regular products totaling 14 variants with bestseller products consisting of kekian, tofu meatballs, fish siomay, scallops, and fish brain brains. Regular products are sold in the form of plastic packaging with a product weight of 500 grams. In the production process of UD. FFI implements Good Manufacturing Products (GMP) and has HALAL and BPOM certificates. UD. FFI has a motto "Customer Satisfied, We Are Satisfied" which shows that the company prioritizes customer satisfaction by providing quality products. The more satisfied customers, of course, the company will continue to provide the best quality products. In addition, this satisfaction will certainly increase the number of product requests for the company so it must be balanced with a good production planning system, the right selection of raw materials, a fast and precise production process, and product delivery on time.

House of risk (HOR) phase 1 (risk identification)

Identify UD risks. FFI was obtained from the results of interviews and filling out questionnaires to 4 companies consisting of managers, purchasing, assistant head of production, and marketing admins. In mapping company activities to identify risk events and risk agents using the SCOR (Supply Chain Operations Reference) model by dividing it into 5 parts consisting of plan, source, make, deliver, and return. The following is a mapping of risk events that occur in UD. FFI.

Table 3. Identify risk events through severity assessment (severity)

Process	Activities	Risk Event	Code	Severity
Plan	Production Planning	Inappropriate production scheduling	E1	7
		Changes in production planning	E2	6
		Incompatibility of financial calculations with planning	E3	5
		Peralatan produksi yang mengalami *obsolete*	E4	9
Source	Procurement of raw materials	Errors in raw material planning	E5	7
	Acceptance of raw materials by suppliers	Delay in receiving raw materials	E6	9
		The quality and quantity of raw materials are not suitable (Quantity/Brand)	E7	5
Make	Production Process	Occurrence of work accidents	E8	2
		The production process is not by SOP standards	E9	9
		Product damaged in storage	E10	9
		Production target not achieved.	E11	9
		Labeling or branding errors	E12	9
		Product quality does not meet the criteria	E13	5
Delivery	Product delivery	Packaging damaged during the shipping process	E14	2
		The product is damaged when stored in the *cold storage* of the car	E15	7
		Incomplete product shipping documents	E16	2
Return	Product Returns	The product does not meet customer expectations	E17	6
		Returns of products that have not been sold for a long time	E18	3

Source: Primary data (2024)

Table 4. Identify risk agents through emergence rate assessment (*occurrence*)

No	Risk agent	Code	Occurrence rate
1	Presence of special customers	A1	4
2	Limited qualified human resources	A2	3
3	Raw material stocks run out and there is no inventory in the warehouse	A3	2
4	Lack of precise information obtained from consumers	A4	2
5	Fluctuating raw material prices	A5	8
6	The price reference recorded is not accurate	A6	5
7	Under-care of production equipment	A7	5
8	Tidak adanya perencanaan dalam pembelian bahan baku	A8	5
9	Persediaan bahan baku dari *supplier* kurang (faktor alam)	A9	7
10	Perubahan spesifikasi atau permintaan pelanggan	A10	5
11	Kurang pedulinya pekerja terhadap K3	A11	5
12	Kurangnya pemahaman pekerja terkait SOP perusahaan	A12	5
13	Kesalahan dalam proses produksi atau kualitas produk	A13	9
14	Penggunaan Mesin di Luar Batas Kapasitas	A14	8
15	Suhu penyimpanan berubah	A15	4
16	Ketidakstabilan permintaan pasar	A16	4
17	Tekanan waktu dan kecemasan produksi	A17	2
18	Kesalahan dalam Pengukuran dan Pengujian Kualitas	A18	2
19	Penanganan muatan yang kurang baik	A19	2
20	Suhu diatas standar	A20	6
21	*Cheklist* kelengkapan dokumen tidak dilaksanakan	A21	2
22	Proses pengecekan barang kurang teliti	A22	4
23	Ketidaksesuaian antara deskripsi produk dengan kenyataan	A23	8
24	Kegagalan dalam kontrol kualitas	A24	7

Source: Primary data (2024)

Risk identification in the supply chain flow is carried out to determine risk events using severity measurements (severity), with an assessment scale of 1-10 where the higher the risk caused, the higher the severity value. Based on Table 3, it is known that the total risk events in UD. FFI consists of 18 points which are divided into 5 processes. The highest savings value in the production planning process (plan) is production equipment that is obsolete or obsolete due to a lack of attention to the maintenance of production equipment and the use of machines outside the capacity limit. In addition, in the process of procurement of raw materials and receipt of raw materials by suppliers (Source), the highest value of severity lies in the delay in receiving raw materials caused by an insufficient supply of raw materials from suppliers. This certainly affects the course of the production process so the best handling is needed to minimize the incident. Furthermore, in the production process (Make), the highest severity value consists of 4 risk events with each different risk cause, including the production process not by the SOP caused by the lack of understanding of workers related to the production SOP, damaged products in storage caused by changes in room temperature, production targets not achieved due to unstable market demand, as well as errors in providing labels or brands caused by time pressure and anxiety in the packaging process. Then in the product delivery process (Deliver), the highest saverity value is found in products that are damaged when stored in car cold storage due to changes in storage temperature and poor load handling. The last process, namely product return or (Return) with the highest saverity value is a product that does not meet customer expectations. This is due to the inconsistency of product descriptions with reality, lack of internal guidelines for employees, time pressure and anxiety when producing, and lack of understanding of workers regarding the company's SOP.

Each risk cause is identified with an occurrence rate on a scale of 1-10 where the higher the failure rate, the higher the occurrence rate. Based on the results of the risk cause mapping in Table 4, it is known that there are 24 risk *agents* with the highest failure rate being errors in the production process or product quality.

After assessing the level of occurrence of the risk agent is appropriate, the next step is to assess the relationship (correlation) between the risk event and the risk agent. The purpose of this correlation assessment is to find out the relationship between risk and the cause of risk because each risk event can cause many risk agents and vice versa. The correlation assessment between risk events and risk agents can use a scale of 0,1,3,9 which has the meaning of no relationship, low relationship, medium relationship, and high relationship.

To determine the Aggregate Risk Potential (ARP) value based on the value of severity, occurrence, and correlation between risk events and risk agents. The calculation of the ARP value can help determine the priority of risk agents in getting treatment first and providing preventive measures (Pertiwi & Susanty, 2017). Each ARP value can be generated through calculations with the following formulas:

$$ARPj = Oj \sum SiRij$$

ARP1 = 4 ((9X7) + (3X6) + (1X9))
ARP1 = 4 (90)
ARP1 = 360

The ARP1 calculation shows the number of 360 which is ranked six. This means that the higher the number generated from the ARP calculation, the higher the danger will be, and vice versa. The following are the results of the HOR phase 1 analysis presented in Table 5.

Table 5. House of Risk phase-1

Business Process	*Risk Event (Ei)*	*Risk Agent* (Aj)																							*Severity of Risk Event* (Si)
		A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	A12	A13	A14	A15	A16	A17	A18	A19	A20	A21	A22	A23	A24	
Plan	E1	9	1	3	1	0	0	0	0	1	3	0	0	0	0	0	1	0	0	0	0	0	0	0	0	7,0
	E2	3	9	9	1	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6,0
	E3	0	1	0	0	3	9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5,0
	E4	0	0	0	0	0	0	9	0	0	0	0	0	0	9	0	0	0	0	0	0	0	0	0	0	9,0
Source	E5	0	1	0	0	1	1	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7,0
	E6	0	0	0	0	0	0	0	0	9	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	9,0
	E7	0	0	0	0	0	0	0	0	9	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	5,0
Make	E8	0	0	0	0	0	0	3	0	0	0	9	3	0	0	0	0	0	0	0	0	0	0	0	0	2,0
	E9	0	1	0	0	0	0	0	0	0	0	0	9	0	0	0	0	0	0	0	0	0	0	0	0	9,0
	E10	0	0	0	0	0	0	3	0	0	0	0	1	1	0	3	0	0	1	0	1	0	0	0	0	9,0
	E11	1	3	1	0	0	0	0	0	1	1	0	0	1	0	0	3	0	1	0	0	0	0	0	0	9,0
	E12	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	9,0
	E13	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	3	0	0	0	0	0	0	5,0
Deliver	E14	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	9	0	0	1	0	0	2,0
	E15	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	1	1	3	0	1	0	0	7,0
	E16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	2,0
Return	E17	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	3	1	0	0	0	1	3	1	6,0
	E18	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	1	0	0	0	0	0	9	3,0
Occurrence		4,0	3,0	2,0	2,0	8,0	5,0	5,0	5,0	7,0	5,0	5,0	5,0	9,0	8,0	4,0	4,0	2,0	2,0	2,0	6,0	2,0	4,0	8,0	7,0	
ARP		360	423	168	26	176	260	570	105	1036	180	90	505	324	648	156	136	100	98	68	210	12	60	144	231	
Rank		6	5	13	23	12	8	3	17	1	11	20	4	7	2	14	16	18	19	21	10	24	22	15	9	

Source: Primary data (2024)

The results of the HOR phase 1 analysis presented in Table 5 show 18 risk events and 24 risk agents. The risk cause that has the highest ARP value is the supply of raw materials from suppliers is less (natural factors) (A9) with an ARP

value of 1,036. The cause of this risk has similarities with research conducted by (Fole, 2023) where the supply of raw materials is part of the dominant risk cause with the mitigation action provided to improve inventory management through safety stock and distribution of raw materials. In addition, a similar cause is also found in research conducted by (Atmajaya *et al.*, 2020) on Indochips Alesha Trimulya MSMEs with the dominant risk cause being the scarcity of banana raw materials due to natural factors with mitigation actions provided are clearing banana plantation land, searching for new suppliers, establishing supplier assessment policies, and making contracts with suppliers. The risk cause that has the lowest score is the checklist for the completeness of documents not implemented (A21) with an ARP value of 12. The results of this study show a difference in the number of risk events and risk agents with the research conducted by (Luin *et al.*, 2020) on UD. Karya Mandiri. The results of the study showed 26 risk events and 17 risk agents with the highest risk agent being fatigue employees (A10) with an ARP value of 396 and the lowest risk agent being only 1 known supporting material store (A7) with an ARP value of 9. This circumstance can lead to the conclusion that UD. FFI with UD. Karya Mandiri has different risk causes and the determination of risk mitigation actions is also definitely different.

This finding is not only relevant within the Indonesian context but also aligns with numerous international studies on food supply chain risk management. Global research consistently identifies raw material supply volatility and uncertainty as one of the most critical vulnerabilities facing the food processing industry, particularly for Small and Medium-sized Enterprises (SMEs) (Hassan *et al.*, 2024). Food SMEs are often more susceptible to this risk compared to larger corporations due to several factors, including a greater dependence on local or seasonal sources, limited storage capacity, lack of supplier diversification, and weaker negotiating power in global raw material markets (Abu Hatab *et al.*, 2021). Specifically, the natural factors (such as climate change, extreme weather events, or plant/animal diseases) highlighted in risk A9 are increasingly recognized as major disruptors of global food supply chains, disproportionately affecting small-scale producers with limited resources for mitigation (Devi *et al.*, 2024). Therefore, the high priority assigned to risk A9 at UD. FFI reflects a fundamental and widespread challenge faced by many food SMEs worldwide in securing vital and consistent production inputs.

House of risk (HOR) phase 2 (risk management)

Table 6 Priority calculation results from the Pareto diagram

Risk Agent	ARPj	ARP%	Cumulative Percentage	Category
A9	1036	17%	17%	
A14	648	11%	28%	
A7	570	9%	37%	
A12	505	8%	45%	
A2	423	7%	52%	
A1	360	6%	58%	Priority
A13	324	5%	64%	
A6	260	4%	68%	
A24	231	4%	72%	
A20	210	3%	75%	
A10	180	3%	78%	
A5	176	3%	81%	
A3	168	3%	84%	
A15	156	3%	86%	
A23	144	2%	89%	
A16	136	2%	91%	
A8	105	2%	93%	
A17	100	2%	94%	Non Priority
A18	98	2%	96%	
A11	90	1%	97%	
A19	68	1%	98%	
A22	60	1%	99%	
A4	26	0%	100%	
A21	12	0%	100%	

Source: Primary data (2024)

The prioritization of risk agents to be given treatment or mitigation is based on the calculation of ARP values using Pareto diagrams. The application of the Pareto diagram to find the priority of risk agents uses an 80:20 ratio which means that 80% is the number of risk events caused by 20% of the risk causes (Magdalena, 2019). Risk agents that

have a cumulative value of approximately 80% can be said to represent risk agents as a whole. Based on the results of the priority calculation in Table 6, 11 priority risk agents will receive risk handling.

Based on the ARP value that has been ranked it is known that the cumulative percentage will be converted into the Pareto chart below (Figure 1).

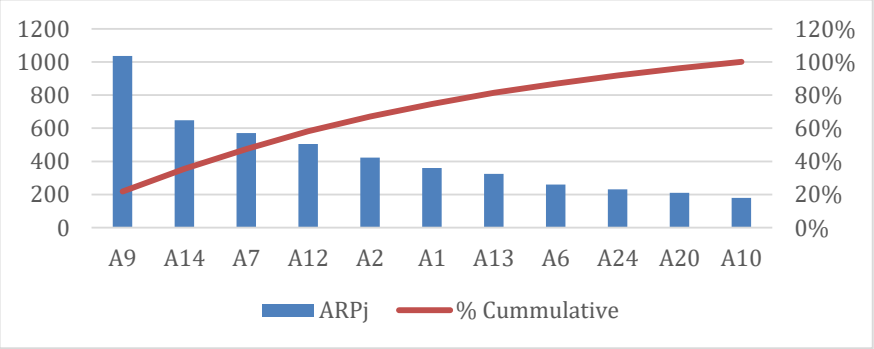

Figure 1. Risk agent value Pareto diagram

Based on the results of the Pareto diagram above, 11 risk agents are the main priority to be given mitigation actions, where risk agents cover the company's operations starting from raw material procurement, and production, to marketing. Income This number has similarities to research conducted by Arif *et al.*, (2020) In the fish processing industry where the priority risk agent obtained is 11. This is in line with research conducted by Maheshkar & Soni (2021) In the fish cracker UKM, Mrs. Hasnah the main problem of conducting risk analysis is the difficulty of obtaining raw materials.

There are 11 risk agents that are prioritized to get risk management where this number has similarities with research conducted by (Arif *et al.*, 2020) on the fish processing industry. The determination of mitigation actions was obtained from the results of interviews with related companies to obtain optimal handling results. There are 7 mitigation actions to deal with risks in UD. FFIs that can be seen in the following table 7.

Table 7 Risk mitigation actions based on priority risk causes

Mitigation Actions	Code	Risk Agent	Code
Improved more efficient raw material inventory management by storing reserve stock	PA1	Insufficient supply of raw materials from suppliers (natural factors)	A9
Monitoring and understanding related to the company's SOPs to employees	PA2	The use of machines outside the capacity limit, lack of understanding of workers related to SOPs, errors in the production process or product quality, failures in quality control	A14, A12, A13 and A24
Make a routine preventive maintenance schedule	PA3	Under-maintain of production equipment	A7
Creating clear and detailed contracts with customers	PA4	Presence of special customers, Changes in specifications, and customer requests	A1 and A10
Conducting workforce development and training	PA5	Limited qualified human resources	A2
Drafting a record-keeping procedure	PA6	The price reference recorded is incomplete	A6
Automatic temperature monitoring	PA7	Temperature above standard	A7

Source: Primary data (2024)

After determining the mitigation action against the priority risk agent, the next step is to assess the relationship (correlation) between the priority risk agent and the mitigation action. In determining the assessment of correlation relationships, a rating scale of 0,1,3,9 was used which had the meaning of no relationship, low relationship, medium relationship, and high relationship. After determining the correlation relationship, an analysis of the effectiveness level will be carried out which aims to show mitigation recommendations. Calculating the Total Effectiveness (TEK) value for each strategy can use the following formula:

$$TEk = \sum_{j} ARPjEjk$$

TE1 = (9x1036)

TE1 = 9.324

The calculation results show that the TE1 value is 9,324. The determination of the Effectiveness Score (TEK) has not been able to determine the suitability of risk mitigation actions to be handled. For this reason, it is necessary to hold a follow-up calculation with the Effectiveness of Difficulty Ratio (ETDk). Before calculating the Effectiveness of Difficulty Ratio (ETDk), it is necessary to conduct an assessment of the degree of difficulty to scale the level of difficulty in handling risks or mitigation actions. The calculation of the degree of difficulty uses a Likert scale of 1,2,3,4,5 in the order of stages of very easy, easy, moderate, difficult, and very difficult (Pertiwi & Susanty, 2017) Based on the calculation of the degree of difficulty, there is 1 mitigation action that has a degree of difficulty, namely PA7. Then the medium category consists of PA2, PA4, and PA5 and the last one is found in the easy category consisting of PA1, PA3, and PA6.

After the identification of the degree of difficulty is carried out, the next step is the calculation of the Effectiveness of Difficulty Ratio (ETDk) to determine which priority mitigation actions are urgent to be handled. Calculating the total effectiveness (TEk) at the difficulty ratio (Dk) or Effectiveness of Difficulty Ratio (ETDK) using the following formula:

$$ETDk = \frac{TEk}{Dk}$$

$$ETD1 = \frac{9324}{2}$$

$$ETD1 = 4.662$$

According to (Kurniawati, 2017) the greater the ETDK value obtained, the risk handling given must be prioritized first. Based on the calculation of the ETD1 value, it was found that the result was 4,662 which was ranked 1st. It can be said that ETDK1 in UD. FFI has a priority level to be handled in the first order. The following are the results of the House of Risk (HOR) phase 2 calculation in full.

Table 8 Analysis Results (hor) *of* House of Risk Phase 2

Risk Agent (Aj)	*Preventive Action* (PA*k*)							*Aggregate Risk Potentials*
	PA1	PA2	PA3	PA4	PA5	PA6	PA7	(ARPi)
A9	9							1036
A14		3						648
A7			9				3	570
A12		9						505
A2					9			423
A1				3				360
A13		3						324
A6						3		260
A24		3						231
A20								210
A10				9				180
TE*k*	9324	8154	5130	2700	3807	780	1710	
D*k*	2	3	2	3	3	2	4	
ETD*k*	4662	2718	2565	900	1269	390	427,5	
Rank	1	2	3	5	4	7	6	

Source: Primary data (2024)

Table 8. The results of the calculation in the House of Risk (HOR) phase 2 can show that the priority of mitigation actions that can be immediately handled is to improve more efficient raw material inventory management by storing reserve stock (PA1), if previously the company kept a reserve of raw materials of 30% of each production, it can be increased to 50%, to minimize the risk of lack of raw material inventory. In line with research (Kurniyanto *et al.*, 2024) raw material inventory is a half part of a meshy business operation. Effective inventory management is the key to smooth production and meet customer demand (Soeltanong & Sasongko, 2021), conducting monitoring as well as an understanding of the company's SOPs to employees (PA2) which aims to smooth the company's production process in maintaining quality products, making routine preventive maintenance schedules (PA3) to maintain the safety and quality of production equipment so that it can minimize things that are less desirable, one of which is work accidents, conducting workforce development and training (PA5) with the aim of fulfilling human resources who are qualified in producing quality products, creating clear and detailed contracts with customers (PA4) with the aim of minimizing changes in specifications and customer requests, automatic temperature monitoring (PA7) which can be done by

providing alarms as warnings of temperature changes so that product quality can be well maintained, developing recording procedures (PA6) which aims to align the recorded price reference with market reality. For this reason, the priority of handling risk mitigation actions that can be prioritized lies in finding raw material supplies from other suppliers (PA1). The handling action is a priority because raw materials are the main process in carrying out the production process, if the supply of raw materials is insufficient, the production process will also not run optimally. The results of this study are different from the research conducted by (Pratama *et al.*, 2023) on the Naisha frozen food business where the prioritized mitigation actions are sorted starting from using stronger containers. Designing material handling systems for manufacturers, providing training to employees, designing storage SOPs, adjusting warehouse layouts, designing loading process SOPs, and using automation systems in moving goods for manufacturers.

CONCLUSION

The results of the study show that the risks have been successfully identified based on the SCOR model on UD. FFI consists of 18 risk events and 24 risk agents. The risk agent that has the highest ARP value is the lack of raw material supplies from suppliers (natural factors). There are eleven risk agents selected based on the largest ARP calculation value through a cumulative percentage. The eleven risk agents are priorities representing the overall risk agents who will be given mitigation actions.

There are seven risk mitigation actions in the second phase of the HOR calculation which are sorted by the highest to lowest priority to overcome the eleven risk agents, including the following, improving more efficient raw material inventory management by storing reserve stock, monitoring as well as understanding related to the company's SOPs to employees, creating a routine preventive maintenance schedule, conducting workforce development and training, creating clear and detailed contracts with customers, automatic temperature monitoring and lastly, drafting record-keeping procedures. Suggestions that can be given to UD. FFI focuses on the procurement of raw materials where this risk needs to be handled mainly by improving raw material inventory management by identifying demand patterns, estimating inventory needs, avoiding shortages of raw materials, and storing reserve stocks so that the lack of raw material inventory can be overcome. This mitigation action recommendation is proposed as a consideration for the company to manage risk. With these mitigation actions, it is hoped that the company can reduce risk events that may interfere with the company's goals. For this reason, risk management needs to be carried out periodically to minimize the occurrence of risks, and supervision of risk management remains under monitoring so that it runs effectively and efficiently.

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