Analysis of Risk Management Improvement of Tapioca Flour Product in The Supply Chain Using The House of Risk Method

Irma Nurmala Dewi[1], Arta Rusidarma Putra[2], Sri Sukmawati[3], Welly Desriyati [4]

[1*,2*,3] Universitas Bina Bangsa
[4]Sekolah Tinggi Teknologi Dumai
*Corresponding Author: irmanurmaladewi5@gmail.com[1] ,artar.putra@gmail.com[2]

Abstract

When present in a supply chain activity process, there are many different risks that can disrupt the supply chain flow to the point where it cannot operate effectively. As a result, it is necessary to improve supply chain performance in stages and be carried out continuously (sustainably). It is essential to reduce and get around the various risks. This study aimed to mitigate risks in the supply chain activities of tapioca flour products at PT Starch Solution International, Tbk Karawang, West Java, which identified possible risks that may arise in the tapioca flour supply chain. The method used in this study is the Failure Mode and Effect Analysis and Quality Function Deployment methods developed to identify and evaluate problems. The Supply Chain Operation Reference dimensions use to determine the business process criteria. Following the completion of the research, Incorporated The finding into the development of potential risk values. These values then establish the priority of risk agents to be mitigated using the House of Risk methodology. The outputs of House of Risk one (1) Utilize as inputs for the subsequent stage of the process. House of Risk two (2) is a framework for risk reduction strategies applicable to various risk sources (risk agents). According to the findings of the research conducted and the calculations performed by House of Risk two (2), eight risk reduction strategies should implement as quickly as possible. The highest priority is determining proper storage conditions in raw material warehouses, strengthening and standardizing invoice-making agreements with suppliers, and being more selective in choosing raw materials suppliers. It reminds suppliers to prioritize the soil suitable for planting, cassava quality standards according to needs, carrying out work and operational routes, and scheduling.

Keywords: Risk Management, Supply Chain, House of Risk

Abstrak

Dalam suatu proses aktivitas rantai pasok terdapat berbagai risiko yang dapat mengganggu alur rantai pasok sehingga tidak dapat berjalan dengan baik. Oleh karena itu, diperlukan adanya upaya perbaikan dari kinerja rantai pasok secara bertahap dan dilaksanakan secara terus-menerus (berkelanjutan) guna mengurangi dan mengatasi berbagai risiko yang terjadi tersebut. Tujuan penelitian ini adalah untuk memitigasi risiko pada aktivitas rantai pasok produk tepung tapioka PT Starch Solution International, Tbk Karawang Jawa Barat yang teridentifikasi

adanya kemungkinan risiko yang muncul dalam rantai pasok tepung tapioka. Metode yang digunakan dalam penelitian ini adalah metode Failure Mode and Effect Analysis dan Quality Function Deployment yang dikembangkan untuk mengidentifikasi dan evaluasi permasalahan dan dimensi Supply Chain Operation Reference yang digunakan untuk menentukan kriteria dalam bisnis prosesnya. Hasil dari metode penelitian tersebut, kemudian dikembangkan dalam formulasi nilai potensi risiko untuk menentukan prioritas agen risiko yang dimitigasi dengan pendekatan House of Risk. Hasil output House of Risk 1 dijadikan input pada tahap selanjutnya. House of Risk 2 merupakan kerangka strategi mitigasi untuk sumber risiko (risk agent). Hasil penelitian yang didapat dari perhitungan House of Risk 2 adalah terdapat 8 strategi mitigasi yang menjadi prioritas untuk segera direalisasikan, yaitu penetapan standar bahan baku yang akan dikirim, penentuan kondisi penyimpanan yang tepat pada gudang bahan baku, penguatan dan standarisasi pembuatan invoice kesepakatan dengan supplier, lebih selektif dalam memilih supplier bahan baku, mengingatkan supplier agar tetap mengutamakan jenis tanah yang sesuai untuk ditanam, standar kualitas singkong sesuai dengan kebutuhan, melakukan rute pekerjaan dan rute operasional, serta melakukan penjadwalan.

Kata Kunci: Manajemen Risiko, Rantai Pasok, House of Risk

PRELIMINARY

Background

In a supply chain process, many risks can disrupt the flow of the supply chain so that it cannot run properly. The disruption of the flow of information and resources in the supply chain network due to stoppages and variations in which these events cannot ascertain represents the risk associated with the supply chain in question. Damage or disruption caused by an event that can hurt business processes frequently occurs in multiple companies and is referred to as supply chain risk. This risk can occur in any one of these companies. Many tapioca flour companies experience disruptions that often happen in supply chain business risks in their supply. Tapioca flour, or starch, is derived from cassava root extract.

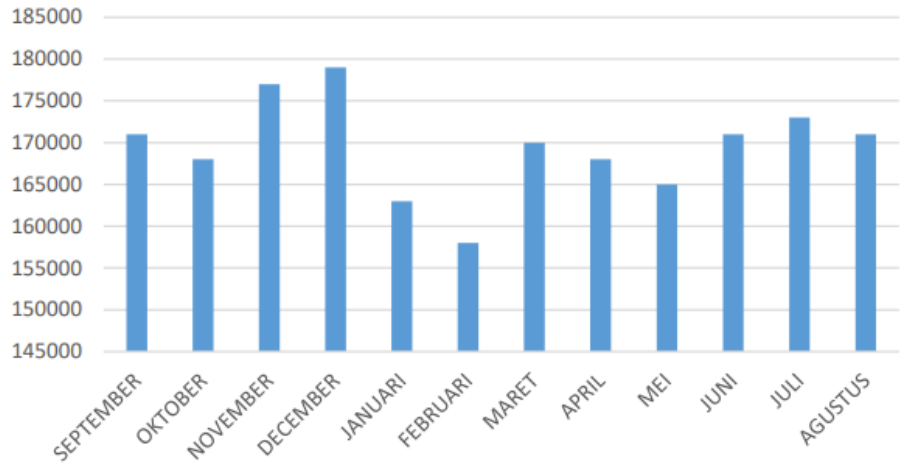

Figure 1. Production Data for the Period 2000 to 2001

The level of uncertainty or fluctuation in tapioca flour production over the past year can see to have occurred over the course of field observations, as shown by the production data in Figure 1, which can find above. This danger arises from the high degree of volatility within the movement fluctuations. This instability level can signify several risks in the production process cycle and customer requests.

The stakes in the tapioca starch manufacturing cycle will directly affect the company. Therefore, it can conclude that the tapioca flour production company PT Starch Solution International needs an improvement in risk management in the supply chain. In addition, it is necessary to improve supply chain performance in stages and continue to overcome and prevent various risks.

The supply chain of risk management model at PT Starch Solution International in this study uses the House of Risk (HOR) model, which consists of HOR one (1) and HOR two (2), where HOR one (1) uses as a technique in the process of identifying, analyzing, and evaluating risks. Meanwhile, HOR two (2) is risk management or mitigation (Ulfah, M, 2017). According to research carried out by (Pujawan 2010), identifying risks and sources of risk based on the Supply Chain Operations Reference (SCOR) model consists of five dimensions. These dimensions are as follows: plan, source, make, deliver, and return. The presence of risk in supply chain management necessitates the essential function of risk management in the upkeep of the supply chain system to ensure that there is no interruption in the chain's operations. Because it is impossible to predict what will occur in the future, managing risks plays a very significant part in the supply chain system. Risk management is an inseparable part of process management which must run to minimize losses and increase the company's opportunities. This risk management process can initiate with the process of risk identification, the process risk assessment, the method of risk evaluation, and finally, the process of how to carry out risk mitigation (Ulfah et al., 2016).

LITERATURE REVIEW

Operational Management

One of its many applications is the application of operational management as a method for directing and supervising the processes that convert inputs into output goods and services (Krajewsky and Ritzman in Hatani, 2008). In this context, "process" refers to the organization's primary activities to achieve common goals.

Supply Chain

The term "supply chain" refers to a collection of activities related to a network of facilities and distribution options. These activities include interactions between suppliers, companies, manufacturers, distributors, and consumers responsible for acquiring and processing these materials into semi-finished and finished materials. Finished goods, as well as the distribution of said finished goods into the possession of customers (Sustiyana, 2013).

In the context investigation, the movement of goods along the supply chain begins originator of the raw materials in the form of a supplier of cassava,

then put into storage before being ground into flour. Suppose the company's production target or demand for tapioca flour products exceeds the raw material capacity. In that case, the company must order or repurchase cassava raw materials from the raw material supplier.
The results of an agreement reached between the company and the raw material supplier will serve as the basis for determining the price at which the company will purchase this raw material.

Risk

Risk is proportional to the degree of ambiguity surrounding an event and the magnitude of its consequences (Sinha et al., 2004). According to Juttner (2005), the risk that can occur in the supply chain can define as disruptions in the flow of information and resources in the supply chain network due to terminations and uncertain variations. This definition finds in the same source as the previous one. Risk also interpret as something that leads to uncertainty over events during a specific time interval where these events cause a loss, both small losses that are not such significant and large losses that significantly affect a company's survival (Wajdi et al., 2012). Goh et al. (2007) state that there are two types of risk in the supply chain based on their sources: threats originate from the internal supply chain network and arise from the external environment of the supply chain. In their research, Chopra and Sodhi (2004) grouped nine risk categories: disruption, forecasting, procurement, inventory, capacity, delays, system breakdown, receivables, and material property properties. In the meantime, (Pujawan and Geraldine, 2009) define risk by mapping business processes in advance. These business processes include the area plan, source, make, delivery, and return. They successfully identified as many as 31 risk events and the business process that identified these various risks.

Risk Management in Supply Chain

The current situation in the supply chain, which involves an increasing risk, is brought about by one of the factors contributing to the network's complexity. Outsourcing businesses create for themselves because their services often render for external clients. Supply chain risk management or supply chain risk management is a potential event that originates from an accident or failure to seize opportunities from inbound supply resulting in loss or reduced income in the company's financial sector (Sari et al., 2015).

Managing the risks associated with the supply chain typically involves several steps, including locating a chance, analyzing the risk, assessing the risk, and determining how to reduce the risk. A preventative approach to reducing or managing risk, supply chain management involves identifying, analyzing, and managing all potential risks a company may face in its operations (Lai and Lau, 2012).

House Of Risk Method (HOR)

A model development carried out by (Pujawan and Geraldine, 2009) in their research is known as the House of Risk Method. This model is a

development model of the HOQ and FMEA methods. HOQ determines the priority of risk agents that must address first, while FMEA is used to carry out risk assessments. The HOQ process divides into two parts: HOR 1, which use to select and determine risk agents who will prioritize first for mitigation actions, and HOR 2, which use to prioritize what actions are most effective and which ones need to consider correctly in terms of resources, power, and finances.

Framework of thinking

The framework stages used in this research include identification, analysis, evaluation, and risk mitigation. Research phases are used as a conceptual framework in this investigation, as depicted in the following diagram:

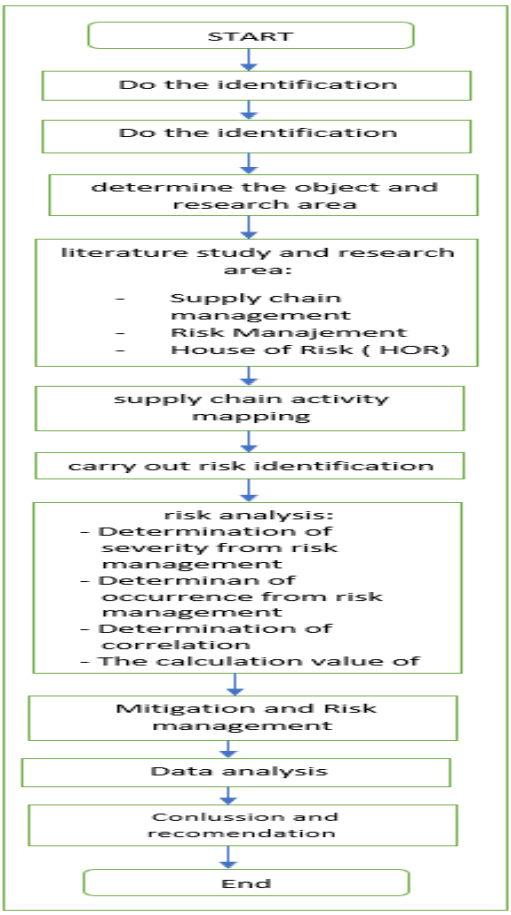

Figure 2. Framework of thinking

RESEARCH METHODS

Data Types and Sources

The quantitative descriptive approach uses in this study. However, both primary and secondary sources are employed. Secondary data comes from studies of literature, books, the internet, and company documents, while primary data is collected firsthand through interviews and observations.

Operational definition

Potential Risk Events

The House of Risk (HOR) approach is used to identify potential risk events qualitatively so that each process can remember as a whole based on the results of interviews and direct field observations. A possible risk event can be anything that has the potential to occur as a risk event or that has already happened as a risk event.

Risk Agent (Risk Cause)

Risk agents are various sources of causes for the occurrence of a risk related to the level of frequency or not the source of risk occurs, or what is a term used frequently to as the probability of an event. Risks can cause by some different factors.

Risk Prevention Measures (Risk Mitigation)

Several respondents mentioned the preventive actions and the results of the risk agent priority analysis that had to carry out before being selected for improvement. These preventative actions are the company's mitigation strategy in preventing the emergence of risk agents from mitigating the risks at PT Starch Solution International.

RESULTS AND DISCUSSION

Data collection

Interviews with company representatives regarding their business procedures carry out as part of the process of collecting data from the company. The purpose of carrying out risk identification is to discover what risks are posed by the company's activities. The identification process carries out starting with looking for various risks that have the potential to occur and can affect the company's supply chain activities to the process of identifying the causes of these risks. The SCOR method identifies based on supply chain activities, namely by using plan, source, make, deliver and return, which carry out by interviewing the company related to the company's business processes. PT Starch Solution International's supply chain activity presenting in the following table:

Table 1. SCOR activities of PT Starch Solution International.

Process	Activity	Code
Plan	Planning procurement of production raw materials	C1
	Planning and scheduling of production processes	C2
	Production machine maintenance planning	C3
	Product distribution planning	C4
Source	Supplier selection procedures and contracts	C5
	Fulfillment of raw materials according to production standards	C6

	Checking the legality of cassava raw materials	C7
Make	Execution of production according to the plan	C8
	Finished product quality inspection	C9
	Finished product storage (tapioca flour)	C10
Deliver	Selection of logistics service provider for shipping services	C11
	Delivery of goods	C12
Return	Handling raw materials returned to suppliers	C13

Identifying potential risks (risk events) and the causes of risk (risk agents) is carried out after considering the supply chain activities listed in table 1. The next thing that needs to do is an analysis, during which the severity, occurrence, and correlation values will determine. Thirty-one risk events discover through the process of identifying risk events. During this time, 26 risk agents find while they research. The following table provides a comprehensive overview of the risk events and risk agents that identify within PT Starch Solution International's supply chain:

Table 2. Potential Risks at PT Starch Solution International

Process	Activity	Risk Events	Code
	C1	Miscalculations in the planning of the production of raw materials	E1
		Inaccuracies in budget planning to be used	E2
Plan		Uncertainty in consumer demand	E3
	C2	There is a sudden change in production planning	E4
		There was an error in production planning	E5
	C4	Irregular machine maintenance planning scheduling	E6
	C5	Unilateral termination of the contract	E7
		Poor communication with suppliers	E8
	C6	There are no supporting documents on the legality of cassava raw materials	E9
Source	C7	Difficulty in getting cassava according to production standards	E10
		Delay in incoming raw materials	E11
		The quality of cassava raw materials is still below standard	E12
		Negligence in carrying out inspections of cassava raw materials	E13
	C8	Occurrence of work accidents	E14
		Lack of workers	E15
		Lack of cassava raw material supplies	E16
		Stop production process	E17

Make		Cancellation of orders made by consumers	E18
		There was a sudden number of requests from consumers	E19
		The condition of the machine or supporting equipment that is damaged (downtime)	E20
	C9	Many defective products occur as a result of production	E21
		Less thorough in conducting product quality inspections	E22
		Error in the stamping/labeling process	E23
	C12	There was a delay in product delivery	E24
Deliver		Delivery of products that are not following consumer demand	E25
		Product damage occurred while in transit.	E26
	C13	The occurrence of defective products that consumers return	E27
Return		There is a delay in returning products to consumers	E28
		Unexpected additional expenses	E29
		Accidents that occur during product returns	E30
		Natural disasters that occur at the time of product return	E31

Table 3. Risk Agent Identification Process

Risk Agent/Risk Agent	Code
Lack of accuracy in production planning	A1
There is an uncertain number of orders (up and down/fluctuating)	A2
The management system used is not aligned between the lines	A3
Suppliers who do not meet quantity targets in providing cassava raw materials	A4
Human error occurred	A5
There was an error in planning the number of human resource requirements	A6
An error occurred in warehouse management	A7
There was a delay in the production process	A8
There was an error in production machine maintenance planning	A9
There are fewer strong work agreements/contracts with suppliers	A10
The production of raw materials process under standard quality	A11
Type/age of cassava that can affect the levels of aci	A12
Inexperienced workers	A13
Inventory of finished goods in the warehouse cannot meet consumer demand	A14
Raw cassava supplies run out	A15
There was a delay in the arrival of raw materials	A16

There is an indirect increase in costs	A17
The occurrence of quality inspection errors during the process of loading goods	A18
Means of transportation in unsuitable condition	A19
Cassava raw materials are seasonal (rare)	A20
Cassava raw materials keep for too long (during the season)	A21
Uncertain weather conditions	A22
The condition and type of soil are not good	A23
There was a power outage	A24
Employee awareness of the implementation of K3	A25
Workers do not comply with SOP	A26

Source of Risk and Risk Assessment

At this point in the process, a risk assessment carries out, which starts with determining the level of severity, the frequency of risk events, and the correlation between risk events and risk causes. On a scale from one to ten, where one indicates that there has been no impact or disruption and ten indicates that there will be an impact or disorder, the severity value use to measure how much this risk event can disrupt business processes within the company. It is filling in this scale using a questionnaire filled out by respondents in the production section who consider understanding all business processes in the production section. Likewise, for occurrence values using a scale of 1 to 10, a scale of 1 means that it seldom happened, while on a scale of 10, it almost certainly happened. Respondents from the production section, presumed to understand the business processes carried out in the production section, are also responsible for filling in this scale.

Table 4. Severity Assessment

Ratings	Impact	Description
1	None (None)	No effect
2	Very few	Minimal effect on performance
3	So little	The little effect it has on performance
4	Very low	It has a meager impact on performance
5	That's low	It has an intense effect on performance
6	Currently	It has a moderate impact on performance
7	Lofty	Influences performance
8	Very high	It has such a high effect that it cannot operate
9	Serious	It has severe effects, and a warning precedes failure
10	Dangerous	Have harmful effects and failure without preceded by a warning

Table 5. Occurrence Rating

Ratings	Probability	Description
1	Seldom happens	Failure is impossible
2	Thin (very small) happens	A rare number of failures occur
3	Very little happens	Very few failures occur
4	Little happened	Several failures occurred
5	Small happened	Occasional failures occur
6	Is going	The number of failures is happening
7	It's high enough	Quite an increased number of incidents occurred
8	High happened	A high number of failures occurred
9	Very high happened	A very high number of failures occurred
10	It's almost certain to happen	Failure is almost certain

Table 6. Severity Assessment of Risk Events

Code	Risk Event/Risk Event	Si
E1	Miscalculations in the planning of the production of raw materials	8
E2	Inaccuracies in budget planning to be used	6
E3	Uncertainty in consumer demand	9
E4	There is a sudden change in production planning	6
E5	There was an error in production planning	7
E6	Irregular machine maintenance planning scheduling	9
E7	The contract terminate unilaterally	7
E8	Poor communication with suppliers	8
E9	There are no supporting documents on the legality of cassava raw materials	5
E10	Difficulty in getting cassava according to production standards	8
E11	Delay in incoming raw materials	10
E12	The quality of cassava raw materials is still below standard	7
E13	Negligence in carrying out inspections of cassava raw materials	5
E14	Occurrence of work accidents	9
E15	Lack of workers	6
E16	Lack of cassava raw material supplies	9
E17	Stop production process	10
E18	Cancellation of orders made by consumers	8
E19	There was a sudden number of requests from consumers	4
E20	The condition of the machine or supporting equipment that is damaged (downtime)	10
E21	Many defective products occur as a result of production	10
E22	Less thorough in conducting product quality inspections	7
E23	Error in the stamping/labeling process	9

E24	There was a delay in product delivery	4
E25	Delivery of products that are not in consumer demand	4
E26	Product damage occurred while in transit	7
E27	The occurrence of defective products returned by consumers	4
E28	There is a delay in returning products to consumers	3
E29	Unexpected additional expenses	4
E30	Accidents that occur during product returns	4
E31	Natural disasters that occur at the time of product return	4

Table 7. Occurrence Assessment on Risk Agent

Code	Risk Agent	Oi
A1	Lack of accuracy in production planning	7
A2	There is an uncertain number of orders (up and down/fluctuating)	7
A3	The management system used is not aligned between the lines	5
A4	Suppliers who do not meet quantity targets in providing cassava raw materials	6
A5	Human error occurred	4
A6	There was an error in planning the number of human resource requirements	6
A7	An error occurred in warehouse management	2
A8	There was a delay in the production process	3
A9	There was an error in production machine maintenance planning	4
A10	There are fewer strong work agreements/contracts with suppliers	5
A11	The production of raw materials process under standard quality	8
A12	Type/age of cassava that can affect the levels of aci	9
A13	Inexperienced workers	5
A14	Inventory of finished goods in the warehouse can not meet consumer demand	3
A15	Raw cassava supplies run out	7
A16	There was a delay in the arrival of raw materials	7
A17	There is an indirect increase in costs	8
A18	The occurrence of quality inspection errors during the process of loading goods	6
A19	Means of transportation in unsuitable condition	2
A20	Cassava raw materials are seasonal (rare)	6
A21	Cassava raw materials keep for too long (during the season)	3
A22	Uncertain weather conditions	8
A23	The condition and type of soil are not good	5
A24	There was a power outage	4

A25	Employee awareness of the implementation of K3	7
A26	Workers do not comply with SOP	6

If a risk cause can lead to a risk event, then it is said that there is a correlation between the risk event and the risk cause, where the correlation illustrate by the filling scale that respondents have filled in. The next step is to determine the magnitude of the correlation value (Rij) between the risk event and the risk cause to state that if a risk cause can lead to a risk event, then it is said that there is a correlation between the risk event and the risk cause. If the respondent fills in with a scale of 0, then there is no correlation; scale 1 indicates a low correlation level, scale 3 indicates a moderate correlation level, and scale 9 indicates a high correlation level.

- Data processing

The next step, data processing, will involve identifying risks using the House Of Risk phase 1 method. At this stage, the ranking of the risk agent, determined by its "Aggregate Risk Potential," is selected. Scale can be seen in Figure 3 Pareto Aggregate Risk Potential (ARP) diagram.

Table 8. House Of Risk Phase 1

	Risk Events			Risk Agents (Aj)					Severity of risk events
Business Processes	(Ei)	A_1	A_2	A_3	A_4	A_5	A_6	A_7	I (Si)
plan	E_1	R_{11}	R_{12}	R_{13}					S_1
	E_2	R_{21}	R_{22}						S_2
Source	E_3 E_4	R_{31} R_{41}							S_3 S_4
make	E_5 E_6								S_5 S_6
deliver	E_7 E_8								S_7 S_8
return	E_9								S_9
Occurrence of Agent j		O_1	O_2	O_3	O_4	O_5	O_6	O_7	
Aggregate risk potential j		ARP_1	ARP_2	ARP_3 ARP_5		ARP_4	ARP_6	ARP_7	
Priority rank of agent j									

Source: (Pujawan, 2010).

Information:
A1, A2, A3...An = Risk Agent
E1, E2, E3...En = risk Event
O1, O2, O3...On = Occurrence value of risk agent (Ai)
S1, S2, S3...Sn = severity value of the risk event
(Ei) ARP1, ARP2, ARP3...ARPn = Aggregate Risk Priority

P1, P2, P3...Pn = Risk agent rating based on ARP value

Aggregate Risk Potential (ARP) Analysis Results

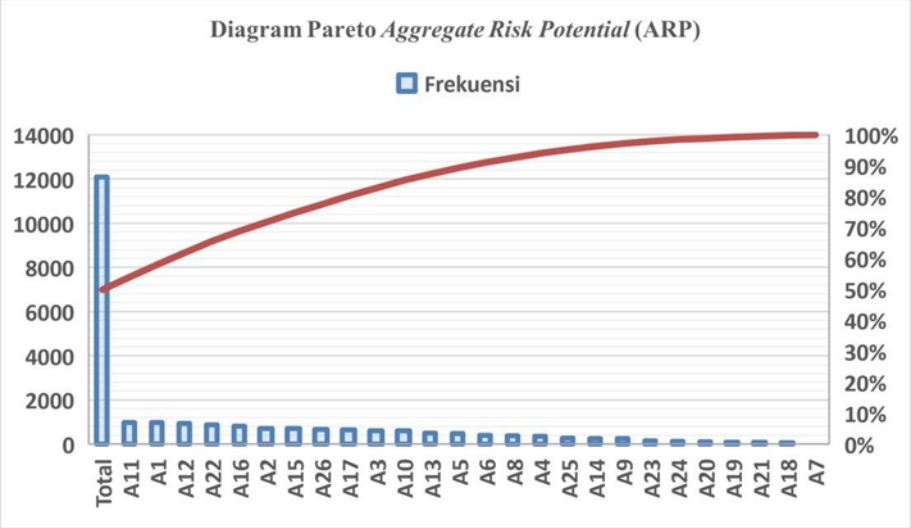

Figure 3. Pareto Diagram Aggregate Risk Potential (ARP)

The Aggregate Risk Potentials (ARP) calculation obtain by multiplying the probability of the source of the risk and the impact of the damage related to the risk occurring. Sources of risks that arise can cause several risk events to occur. This calculation is essential for calculating the ARP value of risk sources. This ARP value uses to determine the priority of which risk sources need to carry out in a mitigation design strategy. This ARP value obtains from the results of ARP calculations for each risk source. Then the ARP value from the risk source can be calculated by the following formula:

$$ARPj = Oj \sum i \; Si \; Rij$$

Information:
ARP = Aggregate Risk Potential Value
Oj = Occurrence risk agent value
Si = Severity risk agent value
Rij = Correlation value between the i-th risk event and the jth risk agent i = 1st, 2nd,…n risk events
j = 1st, 2nd,…n risk causes

The findings of the ARP pareto of the diagram shown in Figure 3 were used in this study to guide the development of a handling strategy to influence the improvement of 63% of other risk agents. This strategy involved selecting 39% of the risk agents or causes and their subsequent implementation. PT Starch Solution International determines five reasons for risk with a percentage of 39%, based on the company's previous experience with mitigation strategies for various risks that often arise. The five sources of risk count as the most common, with the highest

occurrence rate. As for other responses from the company regarding the five risk agents that will design in the handling strategy is the desire of the company to be more focused on preparing strategies for handling the causes of these risks.

House Of Risk Analysis Phase two (2).

After processing the House Of Risk phase 1 and getting the value from the ARPj calculation, the next stage is the risk mitigation stage using the House Of Risk phase 2, namely by carrying out risk treatment. Phase 2 of the House of Risk involved identifying the priority risk agent and formulating a strategy to mitigate the risk posed by that agent, with the ARPj value for that agent being the input. Using the ARPj value as a guide, the following is a list of risk agents that will address by a mitigation strategy based on the Pareto diagram.

Table 8. Ranking Risk Agent from ARP Value

ARP rank	Code	Risk Agent	ARP value	Oj	Si
1	A11	Production of raw materials process under standard quality	985	8	6
2	A1	Lack of accuracy in production planning	978	7	7
3	A12	Type/age of cassava that can affect the levels of aci	938	9	10
4	A22	Uncertain weather conditions	884	8	5
5	A16	There was a delay in the arrival of raw materials	812	7	5

The next step, determining the priority risk agent, is determining the risk's mitigation strategy. Based on the five (5) risk agents currently known, many different designs for mitigation strategy will select. These designs anticipate lessening or even doing away with the possibility of emerging risk agents. The following is the design phase of the mitigation strategy, which uses the House Of Risk phase 2 to determine the planning of the mitigation strategy that will carry out. The following is the table that appears in House of Risk phase two (2):

Table 9. House Of Risk Phase 2

To be treated risk agent (A_j)	PA_1	PA_2	PA_3	PA_4	PA_5	(ARP_j)
A_1	E_{11}	E_{12}	E_{13}			ARP_1
A_2	E_{21}					ARP_2
A_3						ARP_3
A_4						ARP_4
The total effectiveness of the action k	TE_1	TE_2	TE_3	TE_4	TE_5	
Degree of difficulty performing action k	D_1	D_2	D_3	D_4	D_5	

Effectiveness difficulty ratio	to	ETD_1	ETD_2	ETD_3	ETD_4	ETD_5
Rank of priority		R_1	R_2	R_3	R_4	R_5

Source: (Pujawan and Geraldin, 2009)

In the House Of Risk matrix phase 2, the value of the Effectiveness To Difficulty ratio (ETD) is determined using the following formula:

$$TE_k = \Sigma jARPjEj_k$$

$$ETD_k = TE_k/D_k$$

Information:
A1, A2, A3,...An = Risk agent selected for handling
P1, P2, P3,...Pn = Handling strategy to be carried out
E11, E12, E13, ...Enn = Correlation between coping strategies and risk agents
ARP1, ARP2, ARP3,...ARPn = Aggregate risk priority of the risk agent
TE1, TE2, TE3,...Ten = Total effectiveness of each treatment action
D1, D2, D3,...Dn = difficulty in implementing countermeasures ETD1, ETD2, ETD3,...ETDn = Total effectiveness divided by degree of difficulty
R1, R2, R3,...Rn = Rating of each action in order of highest ETD value
Mitigation strategy planning carried out to mitigate risk agents found some eight mitigation strategies which each risk agent can see in the following table:

Table 9. Risk Agent Mitigation Strategy

No.	Risk Agent	Mitigation Strategy	Code
1.	Production of raw materials process under standard quality	The selection of raw materials for suppliers must do more selectively Determination of standardization of raw materials to be sent	PA1 PA2
2.	Lack of accuracy in production planning	Carry out work routes and operational routes (routing) according to applicable SOPs Perform scheduling management	PA3 PA4
3.	Type/age of cassava that can affect the levels of aci	Have cassava quality standardization by production needs Always remind suppliers to prioritize the type of soil that is suitable for planting	PA5 PA6
4.	Uncertain weather conditions	Determination of storage conditions of raw materials Proper cassava in the raw material warehouse (mainly room	PA7

		temperature warehouse)	
5.	There was a delay in the arrival of raw materials.	Strengthening and standardizing invoice-making agreements with suppliers	PA8

Table 10. Order of Priority Treatment Strategy

No.	Handling Strategy	Code
1.	Determination of standardization of raw materials to be sent	PA2
2.	Determination of proper cassava raw material storage conditions in raw material warehouses (especially warehouse room temperature)	PA7
3.	Strengthening and standardizing invoice-making agreements with suppliers	PA8
4.	The selection of raw materials for suppliers must do more selectively	PA1
5.	Always remind suppliers to prioritize the type of soil suitable for planting.	PA6
6.	Have cassava quality standardization by production needs	PA5
7.	Carry out work routes and operational routes (routing) according to applicable SOPs	PA3
8.	Perform scheduling management	PA4

CONCLUSION

Research on the management of supply chains and risks can reach the following conclusion based on the findings of the study, which are as follows:

1. Based on the risk identification process using the House of Risk approach, there are 31 risks and 31 risk sources identified in all stages of the supply chain activity process at PT Starch Solution International, which obtain using the SCOR model.
   Which consists of five business processes (plan, sources, make, deliver and return), and the calculation of HOR 1 shows that a cause (risk agent) can also cause various risk events (risk events) with a specific correlation weight value.
2. Based on the results of HOR 2 calculations, it knows that five priority mitigation actions must realize based on the ranking.
   Raw material production that fails to meet quality standards (A11), inaccurate production planning (A1), cassava varieties or ages that affect acid content (A12), unpredictable climate (A22), and late raw material deliveries are all factors that can negatively impact production.
3. House Of Risk Phase 2 carry out to obtain handling strategies to reduce the possibility or even eliminate the occurrence of risk agents. Based on the House of Risk phase 1, there were five risk agents, so eight mitigation strategies can propose.

On the basis of the findings from the calculation of the ETD value for each proposed handling strategy, the handling strategy's priority order is as follows: determining the standardisation of raw materials to be sent (PA2); determining the proper storage conditions for cassava raw materials in raw material warehouses (especially warehouse room temperature); and determining the appropriate handling of cassava raw materials (PA7), Improving the quality of, and bringing consistency to, the process of entering into invoice agreements with suppliers (PA8), It is imperative that suppliers exercise greater discretion when selecting raw materials (PA1), and it is essential that suppliers be reminded to place a higher priority on varieties of soil that are amenable to planting (PA6), Has standardised the quality of the cassava in accordance with the requirements for production (PA5), will carry out work routes and operational routes (routing) in accordance with the SOPs that are applicable, and will finally carry out scheduling management (PA4).

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