AGROMIX, Volume 15 Number 1 (2024), Pages 16-26

AGROMIX
pISSN (Print): 2085-241X; eISSN (Online): 2599-3003
Website: https://jurnal.yudharta.ac.id/v2/index.php/agromix

Identification of supply chain risks in the tobacco products industry in Pasuruan Regency using the supply chain operations reference (SCOR) and house of risk (HoR) model approaches

Supriyadi [1*], Abdul Wahib Muhaimin [2], Silvana Maulida [2]
[1] Badan Riset dan Inovasi Nasiona (BRIN), Indonesia
[2] Fakultas Pertanian, Universitas Brawijaya, Indonesia
*Correspondence E-mail: supri43@brin.go.id

Original article

Article history
Received : July 25, 2023
Accepted : March 25, 2024
Published : March 30, 2024

Keyword
risk mitigation, supply chain, tobacco products industry, tobacco

ABSTRACT

Introduction: This research aims to identify types of risks and sources of risks, analyze risk priority levels, and formulate mitigation strategies for the tobacco products industry supply chain in Pasuruan Regency. **Methods**: This research was conducted at the tobacco products industry PT. XZ in Pasuruan Regency. Respondents focused on company managers (focal firms), namely product development, raw material management, research and development pilot plant and tobacco clue management who knew about supply chain risks. Supply chain network integration uses a snowball method approach. Data collection methods use primary and secondary data. At the interview stage, the Delphi method was used to identify risk events and risk sources. Furthermore, the results of the interview were identified using the Supply Chain Operation Reverence (SCOR) and House of Risk (HoR) models. **Results**: There are 39 risk events and risk agents in the IHT in Pasuruan Regency. There are eight risk priority levels for tobacco supply chain risk agents using the SCOR approach and the Pareto diagram, namely workers not paying attention, problems with machines, high rainfall/high rainfall, production machines need to be repaired, workers' skills are not good, production machines are old, handling bad goods, and errors in the machine. **Conclusion**: The results of the IHT supply chain risk mitigation strategy formulation are tightening the use of work SOPs, checking production machines regularly, strengthening information between agents and factories, checking machines every 4 hours, conducting worker training, using Google Maps technology in delivering goods, cleaning machines, maintaining product quality, drying/air-drying tobacco leaves, improving quality control during transactions with farmers, and increasing coordination with the Government

Cite this article:
Supriyadi, S., Muhaimin, A. W., & Maulida, S. (2024). Identification of supply chain risks in the tobacco products industry in Pasuruan Regency using the supply chain operations reference (SCOR) and house of risk (HoR) model approaches. *Agromix*, *15*(1), 16-26. https://doi.org/10.35891/agx.v15i1.4123

INTRODUCTION

Tobacco agribusiness is one sector that plays an important role in the economic development of Indonesia. Indonesia is a country ranked as the 4th biggest tobacco producer in the world with a production total average of 261.071 tonnes in 2020 and approximated to increase to 262.007 tonnes in 2022. The land area, according to statistical data forecasted in 2022, is 227.672 ha. Employment in the tobacco sector in 2022 was 5129 persons. On the other hand, the tobacco agribusiness sector can give state foreign exchange income through the excise tax in the amount of 165,47 trillion rupiahs in 2019 or 79,24% of the state budget's target of 2019 in the amount of 208,82 trillion rupiahs, increased to 188,8 trillion rupiahs in 2021 (Direktorat Jenderal Bea dan Cukai, 2019). The increase in land area, production, and employment made tobacco agribusiness hold an important role in the national economy. Saifuddin dan Fahrizal (2020), stated that tobacco plays a role in supporting Indonesia's economy, as one of the sources of the state foreign exchange income through tax revenues (excise), farmer's income, and employment.

Land expansion and tobacco production show that the raw materials needed for the tobacco products industry are great. The needs of the Tobacco Products Industry (IHT) range between 360 to 400 thousand tonnes per year (equivalent to 360 to 400 billion cigarettes). The increasing need for raw materials shows that the development of the tobacco products industry is increasing year by year. The increasing industrial development can be followed by various risks ranging from the supply chain, namely from the upstream to the downstream. Those risks can affect the raw material availability, product quality, operational efficiency, and compliance with government regulations (health regulations in the form of the smoking ban, increase in cigarette excise, and tightening government regulations) as well

as the increased public awareness regarding health. On the other hand, there is a competition of cigarette products namely the switching of tobacco products to electric nicotine.

The emergence of risk from the tobacco agribusiness' supply chain needs management and risk management that must be done by the tobacco industries so that they can ensure their operational and business continuity. A risk is a disruption event in the supply process that hurts the business process of the company (Bier *et al*., 2019). According to Bannor *et al*. (2023), global agribusiness in the agricultural sector has various levels of risk that need to be followed up with prevention. The supply chain is a process of activities and integrated decisions between supplier, manufacturer, warehouse, retailer, transportation service, and consumer efficiently (Rantung et al., 2016). The management flow in a company's supply chain has one integrated unit in the form of material, cash, and information flows (Butdee and Phuangsalee, 2019).

Supply chain management is an integrated process of activities from the distribution of goods, management of goods, and procurement of raw material to the final producer. According to Ho *et al*. (2015), supply chain management is an effort to manage, collaborate, and integrate between organizations involved in the supply chain activities. Risk management is an effort of prevention with a risk identification approach and risk evaluation to reduce supply chain vulnerability (Sugathadasa *et al*., 2020). Asrol *et al*. (2021) stated that risk management is a complex activity that involves identification, monitoring, assessment, and prevention. Supply chain management is also a prevention process for disruption in information and material flow in a supply chain (Kraude *et al*., 2022). Risk management in a company is very important as a method to improve a company's technical performance, schedule, cost, and product development (Oehmen *et al*., 2014). The main goal of risk management in the supply chain is to identify and minimize risk potential along the supply chain through a coordinated approach between stakeholders (Asrol *et al*., 2021).

One of the approaches that can be used in risk management of supply chains is through the House of Risk (HoR) model and Supply Chain Operations Reference (SCOR). SCOR is used as an approach to know the chain of process in the supply chain of tobacco agribusiness. According to Ntabe *et al*. (2015), SCOR is a model of approach to understanding the business in the organization and as an equipment for identifying customer satisfaction. SCOR can also be called an approach dimension of a company in mapping the supply chain activity (Murniati *et al*., 2019). SCOR is a model that is used by companies to measure the performance of supply chain operations (Abrori, 2017). There are three main components in the supply chain, namely upstream, internal, and downstream. Upstream is a source or origin of where the product was procured. On that component, the supply chain manager had a supplier that could deliver goods or services of the company that were needed as a raw material to produce the company's product. The internal component is related to the packing, assembling, or production of finished goods. Downstream is everything about product distribution that is mostly done by external parties (Apriyani *et al*., 2018). Indicators used in SCOR include the process of planning (plan), an indicator of source, an indicator of production (make), an indicator of delivery (deliver), and an indicator of return (Nugroho dan Pariasa, 2017).

The model of HoR was established as a tool to identify, analyze, risk evaluation, and risk management strategy planning in a company's supply chain (Ulfah, 2022). Pujawan and Geraldin (2009) stated that HoR is a method in risk management that focuses on risk prevention by reducing the risk agents and events that cause risk. HoR is also a modified model of the House of Quality (HoQ) model and Failure Mode and Effects Analysis (FMEA). According to Kurniawan *et al*. (2021), SCOR is an approach model for business supply chain processes, while HoR is an approach model to identify and prevent risks through structured procedures. In strategy planning, HoR is divided into 2 phases, namely phases 1 and 2. Phase 1 of HoR is used to analyze the risk priority and evaluate the risk as well as determine the risk agents who prioritize the risk mitigation action. Phase 2 of HoR aims to help the management/company in providing effective risk management priorities. In HoR Phase 2, a determination of acts that can be done to the source of risk is conducted, by effectively taking resources into account (Rizqiah, 2017; Putri, 2020). Hence, the goal of this research is to identify the risk and the source of risk, analyze the priority level, and plan the supply chain mitigation strategy in a tobacco agribusiness. This research is expected to be useful in providing mitigation strategies, developing supply chain management risk, helping tobacco farmers manage the risk of tobacco cultivation, and providing inputs for decision-makers in tobacco industries.

METHODS

This research is *Explanatory Research*, namely taking a research object that was based on phenomena that occur. The method to select the location was done purposively, namely in Pasuruan Regency. Pasuruan Regency was chosen with the consideration that the regency is the largest tobacco industrial area in East Java. This research was started from June to December 2022. The respondent of this research is tobacco product industry PT. XZ in Pasuruan Regency. Then, respondent choosing was focused on the company management (focal firm). The group of focal firms is a part of product development, raw material management, research and development pilot plant, and tobacco clue management that understands the risk of the supply chain. Integration of supply chain network using the snowball approach method.

The method for data collection was by using primary and secondary data. Primary data is data directly obtained from interviews and questionnaires carried out by the researcher from primary sources, namely the expert respondents. Secondary data is data obtained by collecting information from various research papers, books, and articles, and by utilizing the internet to support the research and the formation of theory basis in this research.

In the interview step, the Delphi method was used to identify the risk event and the risk agent. Then, the result of the interview was identified by utilizing the Supply Chain Operation Reverence (SCOR) model and the House of Risk (HoR) model. SCOR was utilized to measure the activity in the company so that the risk agent that must be prioritized and prevented could be determined. Variables used in SCOR include plan, source, make, deliver, and return. The HoR method was used to determine the risk agent that should be prioritized and prevented.

RESULT AND DISCUSSION

Risk identification and cause of risk

Supply chain risk identification in the tobacco product industry was done through an in-depth interview with managers who know about the supply chain. The interview was done through a questionnaire as a tool to gather information from the respondents. Respondent mapping was done with the Delphi method, which is a method that groups the respondents based on their field of expertise. According to Sukwadi (2013), the Delphi method is a method of gathering experts who understand the problem of the supply chain in the company. Then, the SCOR approach was used to map the business flow on the supply chain of the tobacco product industry. Based on the interview result, a result found that the risk potential that could occur is in the number of 39 risk events and 39 risk agents on each SCOR process that cause a risk. 39 risk events on the SCOR method begin from the planning are 1) production plan, namely the delay of production schedule; 2) supply planning, namely the decrease in supply, tobacco damage because of mold, tobacco damage as the result of pest, wet tobacco, raw material requirement is not met, and the quality that is not suitable; 3) Marketing planning, namely the uncertain price, lost in competition to the competitor, and decreasing in sale.

The process to fulfill the raw material (source) consists of 1) the fulfillment of industrial raw material, namely the difficulty to get the chopped tobacco, high raw material price, fraud in the grade of the raw material by the supplier, and the lack of fertilizer in supporting the increasing production of raw material; 2) quality control, namely the goods are not in accordance to the quality, decrease in the raw material's quality, or mixed varieties. The production process includes the filler of the cigarettes that are not average, the machine not operating optimally, sudden stop in the production, damaged product and the ambry paper, the glue that's not neat, and packaging that is not following the SOP. The goods or product delivery is cigarette-filled truck robbery, traffic accident, shipping error to major agent, damage of product during the delivery, and delivery delays to major agent. The return process is the return of cigarettes from the agent and the return of tobacco from the seller because the quality doesn't fulfill the requirements. There are 39 risk agents, includes the uncertain economic condition, an intense competition, the government regulations that don't support the tobacco product industry, crop failure, high cigarettes demand by people, high humidity, pest attack, poor agent's financial performance, difficulty to get the raw material as the result of competition with another tobacco product industry in the tobacco procurement process, wet tobacco, moldy tobacco, unpredictable rain, high rainfall, uncertainty in the harvesting schedule, social distancing regulation by the government, COVID-19 pandemics, worker's skills not good, workers are not paying attention to the SOP, the worker's mood is not good, the worker's is not satisfied with the reward or the salary, the worker's want to go home quicker than the specified working hours, old production machine, the machine maintenance aren't carried out, poor packaging process, the season aren't suitable for tobacco planting, tobacco not available in the farmer, the location of the raw material is far away from the production plant, the distributor place the worst grade on the bottom and the good grade on the top, the error of the machine, low cigarettes quality, natural factors, increase in price as the result of excise, dosage and application time of the fertilizer that is not suitable, mixed raw material, inadequate marketing plan, problem on the machine, the production machine need repairing, and the driver is lack of discipline.

Assess the risk priority level on house of risk (HoR) phase 1

The next step after knowing the risk events and the risk agents is to assess the risk level according to the severity using the HoR level 1. HoR level 1 is used to identify risk events and assess the degree of severity, assess the degree of occurrence frequency, assess the correlation, and calculate the value of aggregate risk potential. The result list of risk events identification and assessment of severity degree is shown in Table 1. According to Savitri (2022), to estimate the effect of several risk events (severity), criteria of 1 to 10 were used in this case, where 1 shows that there is no effect occurred while the higher number shows a bigger effect. Criteria 10 shows an extreme effect and is stated as severity (Si). Based on the result of the first interview on the assessment of the risk events identification and degree of severity, 39 risk events were obtained with the severity assessment to the business continuation low to medium. That means

the company has a risk event with the medium category. The result of the risk event investigation and the assessment can be seen in Table 1.

Table 1. The result of the risk events identification and the severity assessment

Main Process	Sub Process	Risk Event	Severity (Si)	Code
Plan	Production Plan	Delay in the production schedule	4	E4
		Increasing demand for cigarette	3	E5
		Production target not achieved	4	E6
		Change in production plan	5	E7
	Inventory Plan	Reduction in the supply of raw material	4	E8
		Damaged tobacco due to mold	4	E9
		Damaged tobacco due to pest attack	4	E10
		Wet tobacco	4	E11
		Raw material requirements not fulfilled	4	E12
		The sample does not match	4	E14
	Marketing Plan	Uncertain product price	4	E1
		Lost in competition with the competitor	4	E2
		Change in highest retail price	4	E3
		Decrease of sales	5	E13
Source	Raw material procurement	Difficulty in obtaining chopped tobacco	4	E15
		High raw material price	5	E16
		Grade fraud from the raw material distributor	4	E18
		Lack of fertilizer	5	E20
	Quality control	The goods do not follow the quality standard	4	E21
		Decrease in raw material quality	4	E17
		Mixed varieties	4	E19
Make	Production process	Uneven cigarette content	4	E22
		The machine doesn't operate normally	4	E23
		Production stopped suddenly	4	E24
		The raw material delivery machine is damaged	5	E25
		The hardness of cigarette rolling	4	E26
		Unclean product	3	E27
		Decreasing product quality	4	E28
		Damaged product	5	E29
		Damage on Ambri paper	3	E30
		The glue is not neat	4	E31
		Packaging that's not following SOP	4	E32
Delivery	Product delivery	Cigarette-filled truck robbed	5	E33
		Traffic accident	5	E34
		Shipping error to a big agent	4	E35
		Damage to the product during delivery	4	E36
		Delay in delivery to a big agent	3	E37
Return	The product returned from the agent	Cigarette returns from the agent	4	E38
	Raw material returned from the factory	The quality of the tobacco is not good	4	E39

Source: primary data processing

The next step is to identify the risk agents and determine the assessment of possible opportunities for the emergence of every risk agent. The assessment of the opportunities for emergence, in this case, uses the criteria of 1 to 10, where 1 means it rarely occurred and 10 means that it often occurred, so it leads to failure. The goal of this assessment is to identify the emergence of risk agent opportunities that cause the failure of the company to achieve the target of the company's performance. The result of the interview shows that the event that occurs came from rare to has a low chance of occurring. The list of risk agents and the assessment of occurrences can be seen in Table 2.

Table 2. List of risk agents and the assessment of events

Risk Agent	*Occurrence*	Code
Uncertain economic situation	3	A1
A tight competition	5	A2
Government regulation doesn't support the tobacco product industry's company	3	A3
Farmer's crop failure	3	A4
The increasing demand for cigarettes from people	3	A5
High humidity	3	A6
Pest attack	3	A7
Financial performance is not good	5	A8
Difficulty in obtaining the goods, there's competition between the tobacco product industry on the tobacco procurement	5	A9
Wet tobacco	5	A10
Moldy tobacco	5	A11
Unpredictable rain	5	A12
High rainfall	5	A13
Harvest schedule not on time	4	A14
Social distancing regulation from the government	3	A15
COVID-19 pandemic	3	A16
Worker's skills not good	4	A17
The worker not paying attention to the SOP	5	A18
The worker's mood is not good	3	A19
The workers are not satisfied with the reward or the salary	5	A20
The workers want to be home earlier than the specified working hours	3	A21
Old production machine	5	A22
Maintenance of the machine is not conducted	5	A23
Bad packing	5	A24
Poor handling of goods	5	A25
The seasons aren't suitable for tobacco	5	A26
Tobacco is not available in the farmer	3	A27
The location of the raw material is far away from the production	3	A28
Distributor stacks the poor grade on the bottom and the good grade on the top	4	A29
Error on the machine	4	A30
Cigarettes poor quality	3	A31
Natural factors	4	A32
Price increase as the result of excise tax	5	A33
Incorrect dosage and application time of the fertilizer	3	A34
Mixed raw material	3	A35
Inadequate marketing planning	4	A36
Problem with the machine	4	A37
The production machine needs to be repaired	4	A38
The driver's lack of discipline	2	A39

Source: primary data processing

The next step after obtaining the occurrence value of each risk agent from the respondent is to develop the relationship between risk events and risk agents. The development of this correlation is by utilizing the assessment criteria 0, 1, 3, and 9 where 0 shows there is no correlation. Values 1, 3, and 9 show low, medium, and high correlation respectively. The correlation between risk events and risk agents occurs when one risk agents cause the occurrence of risk events. Maulidah (2020) stated that the higher the correlation value, the stronger the correlation between the risk event and the risk agent is stronger. Next, the Aggregate Risk Potential (ARP) value needs to be calculated to assess the likelihood and impact of an event caused by the risk agent and the resulting impact of each risk event caused by the risk agent. The value of ARP was obtained from the calculation of data input between the severity value (Si), occurrence value (Oi), and correlation value (Rij) from risk events and risk agents. The equation to calculate the ARP is as follows:

$$ARPj = OjΣSiRij$$

Note:
Oi = *Occurance Level Risk*
Si = *Severity Level Risk*
Rij = Correlation between risk agent j with the risk

The resulting risk ARP value is then used to determine the priority risk agent that needs to be addressed based on the highest value. ARP value is then summarized in a Pareto diagram. The Pareto diagram is used to sort the value that is the priority based on the principle of the Pareto diagram, namely 80/20, where the value of 20% risk identified can cause an 80% loss to the company. The result of the ARP value on the Pareto diagram can be seen in Figure 1.

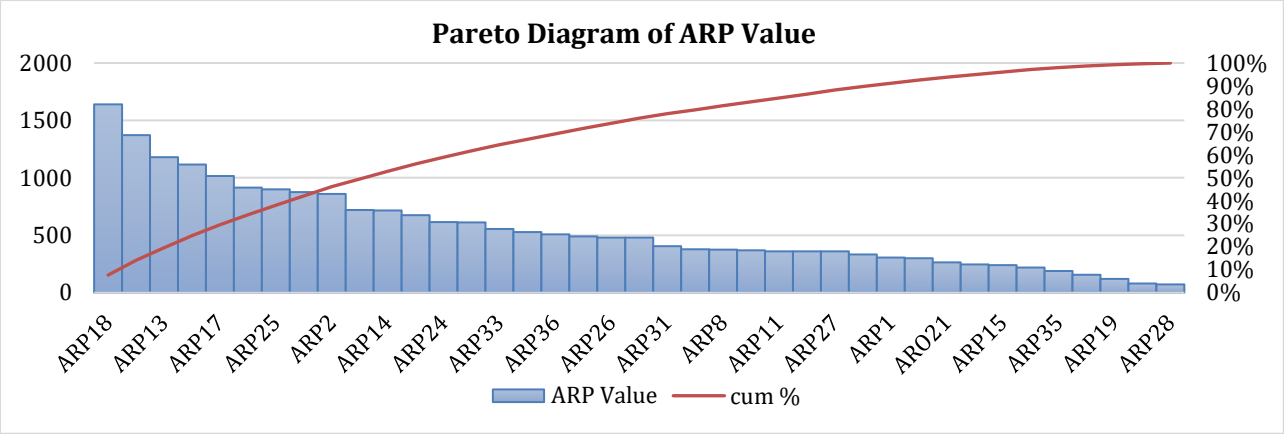

Figure 1. Pareto diagram of the aggregate risk potential (ARP)

The Pareto diagram in Figure 1 shows that 39 risks need to be addressed by the tobacco product industry. If referring to the principle of the Pareto diagram, namely 20/80, then 20% of 39 identified risks were found to be around 8 (rounded value) top risks that will be causing the biggest effect on the company and in need of a prevention act. Zasadzien (2014) stated that the Pareto diagram helped in choosing the priority of defects or risks that occur in the company's business. Islam *et al*., (2017) also stated that from the Pareto diagram, it can be seen the degree of defects that should be followed up so that it won't affect the company's economy.

In this research, after getting the risk agent and the risk events from the result of the interview, the correlation is assessed based on the criteria that have been made, then the value of the ARP is calculated. The ARP value from the Pareto diagram that becoming the priority to take preventive action includes the worker that doesn't pay attention to the SOP (A18), problems with the machinery (A37), high rainfall (A13), production machine needs to be repaired (A38), skill of the worker that's not good (A17), old production machine (A22), poor handling of the goods (A25), and the error of the machine (A30).

Risk mitigation strategy in the tobacco product industry's supply chain

Phase 2 of the HoR aims to help the company's management determine the priority mitigation act that should be conducted early by addressing the effectiveness, resource, and difficulty level of the implementation. (Rizqiah, 2017). Based on the result of HoR phase 1 and the Pareto diagram, there are 8 potential risk agents found that have the largest ARP value and should be addressed as the main potential risk agent so that the appropriate mitigation measures can be taken so that there won't be any mistakes occurred. The eight potential risk agents are workers not paying attention to the SOP (A18), problems on the machine (A37), high rainfall (A13), production machine needing to be repaired (A38), lack of worker skills (A17), old production machine (A22), poor handling of goods (A25), and error of the machine (A30).

Identification of relevant preventive actions (PAs) chosen to avoid the occurrence of risk factors. According to Savitri (2022), a risk agent can be prevented with more than one act and, vice versa, a mitigation action can prevent the occurrence of a risk agent. The next step is to determine the relationship between preventive action (PA)and the risk agent (Aj). This relationship was obtained from the result of the interview with the expert by using the Delphi method. The degree of difficulty (Dk) is the degree of difficulty in the IHT in implementing the mitigation strategy. The degree of difficulty is assessed using a scale, namely from 1 to 5, where 1 means that it's very easy and 5 means that it's very difficult. The assessment of Dk is conducted after the calculation of Pak (Maulidah, 2020). The result of the preventive act and the assessment of the degree of difficulty can be seen in Table 3.

Table 3. The result of preventive action and the assessment of difficulty level

Preventive action	Difficulty level value	Etdek value	Code
Tightening the use of the work SOP	2	31276	PA6
Conducting production machine checking periodically	2	21614	PA8
Strengthening the information between the agent and the factory	2	19524	PA3
Machine checking every 4 hours	2	18392	PA15
Conducting worker's training	2	14214	PA2
Utilizing Google Maps in the goods delivery	2	11640	PA9
Machine cleaning	2	10620	PA18
Maintaining the product's quality	2	10620	PA12
The tobacco leaves are dried in the sun or air-dried	1	9280	PA13
Increasing the quality control when doing the transaction with the farmer	2	7830	PA5
Increasing the coordination with the government	1	6510	PA1
Provide the highest price	1	5820	PA4
Packing with a thick cardboard box	1	5378	PA10
Gluing machine wiping with a wet cloth	2	2228	PA17
Set the delivery time target for the driver	2	1940	PA11
Changing the production materials	2	1350	PA16
Provision of superior seeds	2	1040	PA14
Conducting routine maintenance of the machine and transportation	2	508	PA7

Source: primary data processing

Based on the interview result, there were 18 preventive actions obtained and there are 8 risk agents from the result of the Pareto diagram that become the priority to be addressed. From 18 prevention acts and 8 priority risk agents, then correlations were made. The higher the value of the correlation means the more effective the risk managing is. Risk management is very helpful in preventing failures in the company's business. Risks are events that hurt the company's business process and should be prevented (Melly *et al*., 2019). To assess the correlation between the risk agent and the preventive action, the scales of 0, 1, 3, and 9 were used, where the value of 0 means that there is no correlation while the numbers 1, 3, and 9 show low, medium, and high correlation, respectively.

The next step is to calculate the Total Effectiveness (TEk) value of each mitigation act. The equation of the Total Effectiveness calculation is as follows:

$$TEk = \sum ARPjEjk$$

TEk = (9 x 1640) + (9 x 1372) + (1x 1180) + (9 x 11116) + (9 x 915) + (9 x 900) + (9 + 876)
= 62551

Note:
TEk : Total of Effectiveness
ARPj : Aggregate Risk Potential
Ej : Correlation value

The result of the Total Effectiveness (TEk) calculation with the value of 62.551 shows the degree of effectiveness of the prevention act in reducing the effects of the risk agents. The higher the value of the TEk, then the more effective the act that's done to the cause of risk. After obtaining the value of TEk, the next step is to calculate the Effectiveness of Difficulty (ETDk) that results in the ratio of TEk and Dk. ETDk calculation aims to help determine the priority of the Prevention Act strategy (Kusrini *et al*., 2022). After obtaining the value of ETDk, then the prevention act was chosen based on the effectiveness of the mitigation act in solving the problem related to the risk event that was caused by the risk agent. The mitigation act was chosen from the highest ETDk value then the preventive action was taken. The equation for the calculation and the example is as follows:

$$\text{ETDk: ETDk} = \boldsymbol{TEk/Dk}$$

$$= \frac{62551}{2}$$

$$= 31276$$

The EDTk calculation uses value, where ETDk is a ratio of effectivity to the difficulty and Dk is the degree of difficulty in conducting the act. The calculation of ETDk PA6 with the highest value of 31276 is the effectivity value to the difficulty that becomes the priority to get the act. From the risk event, risk agent, correlation, preventive action, and degree of

difficulty analysis then there are 18 mitigation strategies obtained. Based on the 18 mitigation strategies, 11 acts that obtained the highest value consecutively, listed as follows:

1. Tightening the use of the working SOP (PA6) has an ETDk value of 31276. This method is a strategy to increase the company's performance stated in the company's procedure. The goal of SOP is to make sure that the implementation in every process is carried out correctly in terms of actions, decision-making, procedure, and the utilization of the facility in the company. According to Soleha (2018), an SOP is a guideline filled with procedures that should be conducted in every process of an act and have an influence on the success of the company. The tightening of the SOP to the company is very important to conduct so that there will be discipline on every element involved in the company's supply chain. This mitigation strategy can reduce several risks including the worker not paying attention to the SOP (A18), the problem with the machine (A37), high rainfall (A13), the production machine needing to be repaired (A38), old production machine (A22), poor handling of goods (A25), and error on the machine (A30).
2. Conducting periodic checking on the production machine (PA8) has an ETDk value of 21614. This mitigation strategy reduces several risks, namely: the worker not paying attention to the SOP (A18), problem with the machine (A37), and error on the machine (A30). One of the facilities that support the increase in production is the machine performance and the operator as the human resource. The periodic machine checking can provide benefits that are listed as follows:
   a. The prevention and identification of the machine error and problems of the machine could be determined early so that the error will not occur again which could affect the company's performance.
   b. The increase of efficiency: periodic machine checking can increase the efficiency of the optimally working machine so that it can reduce production downtime, increase productivity, and optimize resources.
   c. The worker pays more attention to the OSP in using and maintaining the machine
   Machine checking is really important to identify the cause of errors in the machine from the beginning so that production quality and continuity can be maintained. Sihadi *et al*. (2018) explain that the performance of a machine that doesn't work optimally can cause problems in the disruption of production so regular control should be conducted. The problem with the machine that's not immediately addressed could hurt the company, especially the disruption in the production and the quality of the goods (Bowo, 2018).
3. Strengthening the information between the agent and the factory (PA3) has an ETDk value of 19524. This mitigation strategy could reduce the risk of poor handling of goods (A25). The supply chain needs 3 flows, namely financial flow, information flow, product flow, and cash flow. A strong information network between agents and the factory can have a positive effect in reducing the risk. The understanding of needs and the quality requirements of the tobacco that the company desires are also an act of reducing the risk so that the farmer can fulfill the quality based on the requirements of the company. The act of delivering the information can be done through counseling, cooperation in cultivation technical guidance, procedure, post-harvest handling, the use of chopping machines, and the importance of SOP application can reduce the handling of the bad tobacco. Natanelov *et al*. (2022) stated that the information flow that's time and reliable can shrink the flow of products and cash, so a good supply chain will be established.
4. Checking on the machine every 4 hours (PA15) has the value of ETDk of 18392. This mitigation strategy can reduce the risk of problems with the machine (A37), production machines needing to be repaired (A38), old production machines (A22), and errors in the machine (A22). The machine checks every 4 hours could help to determine the risk earlier so that the problem can be addressed, and a proper act and repair can quickly be done to reduce a severe risk. Meanwhile on the old production machine, checking every 4 hours was needed to reduce the high degree of damage. Machine identification, such as wear and tear or reduced machine performance and good machine maintenance, is a prevention effort so that the machine can operate optimally.
5. Conducting worker training (PA2) has an ETDk value of 14214. This mitigation strategy can reduce the risk of the worker not paying attention to the SOP, high rainfall (A13), and poor skill of the worker (A17). The worker's training is very important to conduct so that the skills and knowledge of the worker will increase and could be applied to the work in the company or the supplier (farmer or merchant). The training could be done by the government, in this case, from the Department of Agriculture, by training the farmer to do good and proper tobacco cultivation according to the SOP, including when facing unpredictable weather such as high rainfall. During high rainfall, farmers can use the high bunds technology on the field, other than that the company could also be given information from the Meteorology, Climatology, and Geospatial Agency. If high rainfall occurred during the post-harvesting, then the optimization act by building an artificial drying area using solar technology could be provided so that the drying process still can be conducted.
6. The usage of Google Maps technology in goods delivery (PA9) has an ETDk value of 11640. This mitigation strategy will help to reduce the risk of worker's skills not being good (A17). This will help the worker's skill during the goods delivery, whether from the farmer to a big merchant or from the company to the agent and retail outlet. The Google Map technology can help to provide information on the delivery address quickly and accurately. The quick and accurate delivery of the goods to the consumer will have a good effect on customer satisfaction. Customer

satisfaction is the assessment of betting reputation and crucial variable for the company to achieve business success (Khan *et al*., 2020).

7. Machine cleaning (PA18) has an ETDK value of 10620. This mitigation strategy could reduce the risk of old production machines (A22). The cleaning of the machine is beneficial in maintaining the old production machine so that it can work properly and has a long life. Machine cleaning is beneficial to maintain the cleanliness from dust and material residue that could affect the machine's performance, reducing the operational cost, and increasing production. The residue in the production of cigarettes includes the dirt or liquids from the sauce that drips to the machine which could affect the quality of the cigarette. As an example, the dripping of the sauce that's not cleaned up can cause spots in the cigarettes and a bad smell as well as a decrease in the cigarette's flavor. This can cause loss to the company as the consumer thinks that the quality of the cigarettes is reduced and switches to another product that has a better quality. Therefore, periodically cleaning the machine before or after use can prevent serious damage and more severe risks.
8. Maintaining the quality of the product (PA12) has an ETDk value of 10620. This mitigation strategy can reduce the risk of poor handling of goods (A25). The quality of the product is really important to be maintained by the company to maintain the success of the business. Good quality of the product can affect the customer satisfaction. The strategy in maintaining the product quality can be done through:
    a. Quality supervision from the upstream, namely the tobacco from the farmer is being graded by a grader so that the quality of the tobacco will be following the company's standard. A good quality tobacco could be used as the raw material of the cigarette with the mixture of clove and sauce as well as other materials so that the quality of the cigarette will have a good flavor. The supervision of the product should be done strictly and by implementing the appropriate SOP.
    b. Good product packaging that could attract the consumer.
    c. Avoiding contamination with other materials so that the quality of the product is maintained.
    d. Evaluating with a tracking system so that the problem during the goods delivery to the consumer could be identified and handled quickly.
9. The tobacco leaves are dried in the sun or air-dried (PA13) and have an ETDk value of 9280. This mitigation strategy can help to reduce the risk of poor handling of goods (A25). The drying process is important to reduce the poor handling of the foods. Good drying can increase the quality of tobacco. Conversely, a not optimum drying can reduce the quality of the tobacco as it can cause the mold to grow, the color is not bright, poor flexural strength of the tobacco, and a musty aroma (Tirtosastro & Musholaeni, 2015). The steps of post-harvest handling in the drying process of the tobacco are as follows:
    a. The drying location. The location should have good air circulation, be free from dust, and get optimum sunlight.
    b. Tobacco leaves. Ensure that the tobacco leaves have gone through sortation, ripening, handle removal, and rolling process.
    c. Drying time setting. Drying is done when the sun starts to get hot, around 8 a.m. to 4 p.m.
    d. handling of the leaves during the drying process. The handling during the handling process should be done carefully by controlling the density between the "widig" so that the tobacco won't be damaged. At midday, the chopped tobacco should be flipped for even drying. The drying process is over if the chopped tobacco feels rough when touched and easy to break. Then, "wide" and the tobacco above it are stacked in a closed room for 1 to 2 days so that the chopped tobacco becomes weak again before the leaves are rolled and packaged.
    e. Supervision during the drying process. The supervision was done to ensure the leaves that were in the middle of the drying process were not damaged and were free from the Non-Tobacco Related Material (NTRM). The example of NRTM is grass, straw, pieces of mat, plastic, string of raffia, etc.
    f. Packaging. Packaging is used to maintain the quality of the tobacco. Packaging of tobacco can be done in two ways, namely the packaging using the banana stem and using plastic.
10. The increase in quality control while doing transactions with the farmers (PA5) has an ETDk value of 7830. This mitigation strategy could reduce the risk of poor handling of goods (A25). The managing of the quality control while doing transactions with the farmer is really important to reduce the poor handling of goods. Communication with the farmers should be done to provide them with the knowledge of a quality standard for good tobacco.
11. The increased coordination with the government (PA1) has a value of ETDk 6510. This mitigation strategy can reduce the risk of poor handling of goods (A25), workers not paying attention to the SOP (A18), and high rainfall (A13). Increased coordination with the government is necessary for harvest and post-harvest assistance. It involves implementing standard operating procedure (SOP) training for cultivation and post-harvest practices based on the SOP and Good Agricultural Practices (GAP), as well as training to manage cultivation related to climate change in preparation for high rainfall or extreme weather, in collaboration with the Meteorological, Climatological, and Geophysical Agency.

Consecutively, the other ETDk values that have a low value are PA4 with the ETDk value of 5820, PA10 with the ETDk value of 5820, Pa10 with the ETDk value of 5378, PA17 with the ETDk value of 2228, PA11 with the ETDk value of 1940, PA16 with the ETDk value of 1350, PA14 with the ETDk value of 1040, and PA7 with the ETDk value of 508 are lower than 11 prevention acts listed above. This means that those 7 acts are not effective as the mitigation act in the supply chain of the tobacco product industry. This is by Tama *et al.* (2019) which explains that the bigger ETDk value of a mitigation strategy shows higher effectiveness in addressing the risk and has a bigger priority compared to the one with lower ETDk value.

CONCLUSION

Based on the analysis result and the discussion in this research, it can be concluded that: There are 39 risk events and 39 risk agents in the tobacco product industry in Pasuruan Regency. The risk priority degree of supply chain risk agent with the SCOR approach and the Pareto diagram shows that there are 8 agents, namely: the workers are not paying attention, the problem on the machine, high rainfall, production machine that requires repairing, the lack of worker's skill, old production machine, poor handling of the goods, and error of the machine. The mitigation strategy of the tobacco product industry's supply chain are as follows: tightening the use of work SOP, conducting machine checking periodically, strengthening the communication between agent and factory, checking the machine every 4 hours (PA15), conducting workers training, utilizing the technology of Google Maps in the delivery of goods, machine cleaning, maintaining the quality of the product, the tobacco leaves are dried in the sun or air-dried, increasing the quality control when doing transaction with the farmer, and increasing the coordination with the government.

REFERENCES

Abrori, F. (2017). *Identifikasi dan pengelolaan risiko rantai pasok rumah produksi tahu apu dengan metode house of risk*. Universitas Muhammadiyah Surakarta.

Apriyani, D., Nurmalina, R., & Burhanuddin. (2018). Evaluasi kinerja rantai pasok sayuran organik dengan pendekatan Supply Chain Operation Reference (SCOR). *Jurnal Ilmiah Manajemen*, *8*(2), 312–335. https://dx.doi.org/10.22441/mix.2018.v8i2.008 312

Asrol, M., Marimin, Machfud, Yani, M., & Taira, E. (2021). Risk management for improving supply chain performance of sugarcane agroindustry. *Industrial Engineering & Management Systems*, *20*(1), 9–26. https://doi.org/10.7232/iems.2021.20.1.9

Bannor, R. K., Oppong-Kyeremeh, H., Amfo, B., Kuwornu, J. K. M., Kyire, S. C. K., & Amponsah, J. (2023). Agricultural insurance and risk management among poultry farmers in Ghana: an application of discrete choice experiment. *Journal of Agriculture and Food Research*, *11*, 1–12. https://doi.org/10.1016/j.jafr.2022.100492

Bier, T., Lange, A., & Glock, C. H. (2020). Methods for mitigating disruptions in complex supply chain structures: a systematic literature review. *International Journal of Production Research, 58*(6), 1835-1856. https://doi.org/10.1080/00207543.2019.1687954

Bowo, D. S. (2018). Analisis perbaikan proses produksi pada PT Sumber Teknik Sentosa. *Jurnal Manajemen Bisnis*, *8*(1), 19–28. https://doi.org/10.22219/jmb.v8i1.7049

Butdee, S., & Phuangsalee, P. (2019). Uncertain risk assessment modeling for bus body manufacturing supply chain using AHP and fuzzy AHP. *Procedia Manufacturing*, *30*, 663–670. https://doi.org/10.1016/j.promfg.2019.02.094

Direktorat Jendel Bea dan Cukai. (2019). *Laporan kinerja Direktorat Jenderal Bea dan Cukai Kementerian Keuangan 2019*. Jakarta

Ho, W., Zheng, T., Yildiz, H., & Talluri, S. (2015). Supply chain risk management: a literature review. *International Journal of Production Research*, *53*(16), 5031–5069. https://doi.org/10.1080/00207543.2015.1030467

Islam, T., Khan, S. A., & Sakib, A. (2017). Analysis of major defects position and percentage in sewing lines of a garments factory with the help of a Pareto chart, cause-effect diagram, and sigma level. *International Journal of Scientific & Engineering Research*, *8*(7), 1885–1890.

Khan, R. U., Salamzadeh, Y., Iqbal, Q., & Yang, S. (2020). The impact of customer relationship management and company reputation on customer loyalty: the mediating role of customer satisfaction. *Journal of Relationship Marketing*, *21*(1), 1–26. https://doi.org/10.1080/15332667.2020.1840904

Kraude, R., Narayanan, S., & Talluri, S. (2022). Evaluating the performance of supply chain risk mitigation strategies using network data envelopment analysis (forthcoming). *European Journal of Operational Research*, *303*(3), 1168–1182. https://doi.org/10.1016/j.ejor.2022.03.016

Kurniawan, S., Marzuky, D., Ryanto, R., & Agustine, V. (2021). Risk and Supply Chain Mitigation Analysis Using House of Risk Method and Analytical Network Process (A Case Study on Palm Oil Company). *The Winners*, *22*(2), 123–136. https://doi.org/10.21512/tw.v22i2.7056

Kusrini, E., Safitri, K. N., & Fole, A. (2022). Mitigasi risiko di distribusi sustainable supply chain management menggunakan *metode House of Risk* (HOR). *Integrasi Jurnal Ilmiah Teknik Industri*, *7*(1), 14–23. http://jurnal.um-palembang.ac.id/index.php/integrasi

Maulidah, S. (2020). Risk mitigation of tobacco supply chain: business process model. *HABITAT*, *31*(3), 149–160. https://doi.org/10.21776/ub.habitat.2020.031.3.18

Melly, S., Hadiguna, R. A., Santosa, & Nofialdi. (2019). Manajemen risiko rantai pasok agroindustri gula merah tebu di Kabupaten Agam, Provinsi Sumatera Barat. *Industria: Jurnal Teknologi dan Manajemen Agroindustri*, *8*(2), 133–144. https://doi.org/10.21776/ub.industria.2019.008.02.6

Murniati, W., Kurnia, W. I., Handayani, S., & Ishak, S. (2019). Pengukuran kinerja supply chain pada industri UKM kerajinan (studi kasus: industri kerajinan ketak, Lombok Tengah, Nusa Tenggara Barat, Indonesia). *Journal Of Industrial Engineering Management*, *4*(1), 1–8. http://dx.doi.org/10.33536/jiem.v4i1.262

Natanelov, V., Cao, S., Foth, M., & Dulleck, U. (2022). Blockchain smart contracts for supply chain finance: Mapping the innovation potential in Australia-China beef supply chains. *Journal of Industrial Information Integration*, *30*, 1–14. https://doi.org/10.1016/j.jii.2022.100389

Ntabe, E., Lebel, L., Munson, A. D., & Santa-Eulalia, L. A. (2015). A systematic literature review of the Supply Chain Operations Reference (SCOR) model application with special attention to environmental issues. *Intern. Journal of Production Economics*. https://doi.org/10.1016/j.ijpe.2015.08.008

Nugroho, T. W., & Pariasa, I. I. (2017). Pengukuran kinerja manajemen rantai pasok kopi amstirdam di Kabupaten Malang dengan pendekatan SCOR (Supply Chain Operation Reference). In *Prosiding Seminar Nasional Pembangunan Pertanian II*, 160–165.

Oehmen, J., Olechowski, A., Kenley, C. R., & Ben-Daya, M. (2014). Analysis of the effect of risk management practices on the performance of new product development programs. *Technovation, 34*(8), 441-453. https://doi.org/10.1016/j.technovation.2013.12.005

Pujawan, I. N., & Geraldin, L. H. (2009). House of risk : a model for proactive supply chain risk management. *Business Process Management Journal*, *15*(6), 953–967. https://doi.org/10.1108/14637150911003801

Putri, I. N. (2020). Analisis risiko kegagalan produk mempengaruhi kualitas pelayanan menggunakan house of risk dan supply chain operations reference. *Jurnal Optimasi Teknik Industri*, *2*(1), 19–23.

Rantung, M. L., Adolfina, & Wenas, R. S. (2016). Analisis kinerja rantai pasok komoditas kacang tanah di pasar tradisional beriman kota Tomohon. *Jurnal EMBA*, *4*(2), 849–858.

Rizqiah, E. (2017). *Manajemen risiko supply chain dengan mempertimbangkan kepentingan stakeholder pada industri gula*. Surabaya: Institut Teknologi Sepuluh Nopember.

Saifuddin, & Fahrizal, A. (2020). Analisis produksi pendapatan dan kelayakan usahahatani tembakau (studi kasus Desa Palengaan Laok Kecamatan Palengaan Kabupaten Pamekasan). *Al-Iqtishod Jurnal Ekonomi Syariah*, *2*(2), 149–170.

Savitri, R. L. (2022). *Analisis dan mitigasi risiko rantai pasok pengecoran logam menggunakan metode house of risk (HOR) (studi kasus: PT. Mitra Rekatama Mandiri)*. Universitas Islam Indonesia.

Sihadi, I. P., Pangemanan, S. S., & Gamaliel, H. (2018). Identifikasi kendala dalam proses produksi dan dampaknya terhadap biaya produksi pada UD. Risky. *Jurnal Riset Akuntansi Going Concern*, *13*(4), 602–609.

Soleha, S. N. (2018). Peranan SOP dalam menciptakan efektivitas dan efisiensi kerja di hotel SR Bali. *Tourism, Hospitality and Culinary Journal*, *3*(1), 67–73.

Sugathadasa, P. T. R. S., Perera, H. N., & Liyanage, A. K. (2020). Effective management of manufacturing supply chain risks: A Sri Lankan perspective. *Engineer*, *LIII*(3), 63–76. http://doi.org/10.4038/engineer.v53i3.7421

Sukwadi, R. (2013). Pengembangan model integrasi delphi-AHP-markov dalam perencanaan kebutuhan sumber daya manusia. *Spektrum Industri*, *11*(2), 227–242.

Tirtosastro, S., & Musholaeni, W. (2015). Penangananpanen dan pasca panen tembakau di Kabupaten Bojonegoro. *Buana Sains*, *15*(2), 155–164.

Ulfah, M. (2022). Mitigasi risiko rantai pasok industri kue menggunakan house of risk. *Journal Industrial Services*, *8*(1), 63–70. http://dx.doi.org/10.36055/jiss.v8i1.14315

Zasadzien, M. (2014). Using the pareto diagram and FMEA (failure mode and effects analysis) to identify key defects in a product. *Management Systems in Production Engineering*, *4*(16), 153–156. https://doi.org/10.12914/MSPE-02-04-2014