

# Risk Identification in Potato Chips Production using Supply Chain Operation Model (SCOR)

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## ABSTRACT

Currently, small and medium enterprises (SMEs) contribute 60.34% of the Gross Domestic Product. Batu City has the potential for a significant increase in MSMEs by 90.74% in 2019. Potato chip SMEs in Batu City can be classified into 2 micro and small-scale clusters based on production capacity, sales turnover, length of production operation, and the number of workers. Agronas Gizi Food is an SME producing potato chips with the brand of "Gizi Food". The problems faced by the supply chain include the lack of comprehensive planning, unstable quantity and quality of raw materials, fluctuations in raw material prices, and technological limitations. These factors may have an impact on the supply chain risk. The purpose of the study was to identify and map the supply chain risk activities of "Gizi Food" potato chips using the Supply Chain Operation Reference (SCOR) method. The supply chain members consisted of potato farmers, suppliers, and SMEs which are interconnected by information, product, and financial flow. This study found number of risk activities in Plan (5), Sources (10), Make (10), Delivery (5), and Return (1). The result form the risk identification showed potential of 31 risk events and 22 risk agents that may appear in the supply chain.

**Keywords:** *potato chips, risk, supply chain*

## 1. INTRODUCTION

Currently, the agro-industrial development in Indonesia is filled with competitiveness along with technology changes supported with the high potential of agriculture. Based on the Ministry of Industry, from 2015 to 2019, the agro-industrial growth has reached 6.34%, especially in the food and drink industries that has the highest value with the average growth value of 8.16%. The agro-industrial in Indonesia has an important role in the economy. This was proved in 2020, agro-industrial contributes to the Gross Domestic Income with the value of 52.13%. When other industries were collapsed due to the Covid-19 pandemic, agro-industrial just had positive growth in the period of January to August with the export value reaching 29.27 million US dollars [1].

Batu City is one of agrotourism cities in East Java with the largest horticultural productivity potential. Based on the data from Agriculture Agency Batu City in 2018, the potential of horticultural vegetables was amounted at approximately 61.245 tons, fruits at 79.586 tons, ornamental plants at 142.233.611 stalks, and biopharmaceutical plants at 411 tons. This potential is sufficient to be utilized by Batu City's society by pushing the agro-industrial food production development through utilizing local ingredients to increase the added value of horticultural products. In 2018, the most dominant vegetable production in Batu City was potato, accounted for 9.137 tons, which then further processed by local manufacturers, then established small potato chips industries (SMEs) [2].

Agronas Gizi Food SME (AGF) is one of the potato chips business in Batu City established since 2002 and has a production capacity of 50.000 kg per month. Agronas Gizi Food SME produces potato chips in 3 sizes include large, medium, and small. Agronas Gizi Food SME needs to carry out evaluation and improvement in order to compete with other competitors. Currently, there are 30 SMEs producing potato chips in Batu City with diverse scale, product variety, and market share with high competitiveness. Agronas Gizi Food SME is one of the pioneers in the potato chips business with middle to high scaled business, has a higher production capacity, and wider market share compared to other SMEs. Nowadays, Agronas Gizi Food SMEs' marketing area consists of East Java, Batu City, Malang City, and surroundings as well as West Java.

Competitiveness is an economic concept related to market competition. To maintain the contending with the competitor, one of the keys is to maintain the competitiveness [3]. By concentrating on the supply chain strategy improvement, efforts to maintain competitiveness can be done [4]. The organization also needs to focus on the external operation and keep improving the internal operation that leads to the management concept of the supply chain [5]. Responsive supply chain management could react effectively and efficiently towards the market change [6]. Planning the supply chain management collaboratively is proven to give positive impacts such as 1) increasing the company's competitiveness, lowering the production cost, delivery, and distribution, 2) decreasing the stock, and 3) increasing manufacturing flexibility and higher productivity achievement. An effective supply chain management can increase the market share and sales, as well as create a solid customer relationship [5].

However, the relationships between the supply chains have some risks that may impact the business, leading to the financial loss. To prevent the risks, the supply chain management is needed. Managing the supply chain risk includes identification, analysis, evaluation, and mitigation of risks. The results of risk's mitigation are expected to help the business to avoid the risks and suppress the impacts [7]. Supply chain evaluation and risk management of Agronas Gizi Food SME starts from mapping the supply chain to get the ideal process.

Agronas Gizi Food SME supply chain involves several parties include farmers, suppliers, producers, and distributors. Each of the supply chain agents has issues that can cause supply chain risk. The farmers have issues related to raw material availability because of seed quality and potato cultivation

technology limitations. These limitations caused unfulfilled demands and potato price fluctuation. The suppliers also have similar issues with the farmers. Supply chain issues in Agronas Gizi Food SME is inconsistent raw material's quality which impacts the inconsistent potato chips' quality (i.e. not standardized quality), as shown from the size consistency, color, crunchiness, and packaging quality. Related to the delivery, the potential issues were related to the delay in the delivery and product damage during the distribution process. The interaction between the risks in the supply chain can cause comprehensive loss. Therefore, the risk control measures are needed in Agronas Gizi Food SME's supply chain and supply chain risk analysis.

The method used in this research was Supply Chain Operations Reference (SCOR). SCOR is a systematic combination method that includes business techniques, benchmarking, and best practice which blueprint can be used as a reference for improving the supply chain's performance [8]. The advantages of SCOR method include its ability to measure the performance of the supply chain objectively based on the data available to all the business process, as well as to identify which part needs to be fixed. The SCOR approach divided the supply chain management scope into 5 business processes i.e. plan, source, make, deliver, and return for identifying the risk event and the risk agent in every supply chain flow [9]. The purposes of this research were to (1) investigate issues occurred in the supply chain of Agronas Gizi Food SME and (2) identify the risk events and risk agents in the supply chain of Agronas Gizi Food SME.

## **2. MATERIAL AND METHODS**

This research was carried out in Agronas Gizi Food SME located in Sidomulyo, Batu City. Scope of research used include (1) this research was only for identifying the supply chain activity to farmers, suppliers, and Agronas Gizi Food SME's production, (2) it did not taken into account the cost calculation, and (3) SCOR method was only used until the modelling process.

The first step of the data analysis was mapping the activities of supply chain. The mapping process started from identifying supply chain flow through interviewing the supply chain agents i.e. farmers, suppliers, and Agronas Gizi Food SME. Next is mapping using SCOR approach through 5 business activities i.e. plan, source, make, delivery, and return. This mapping may ease the supply chain risk identification of Agronas Gizi Food SME in the next step.

In the second step, the risk events and risk agents identification of the supply chain was done with interviewing the farmers, suppliers, and the manager of Agronas Gizi Food SME about what risk that could potentially happen, source of the risk, and how the risk emerges. In this risk identification step, SCOR approach method was used in 5 business activities. The outcome of this step was the events or factors and agents that caused the risk in every business process.

### 3. RESULTS AND DISCUSSION

#### 3.1. Profile of Agronas Gizi Food SME

Agronas Gizi Food SME is located in Sidomulyo, Batu District, East Java. The SME is one of the potato chip businesses in Batu City established in 2002 with production capacity reaching 50.000 kg/month. Agronas Gizi Food SME produced potato chips in 3 different sizes i.e. large, medium, and small.

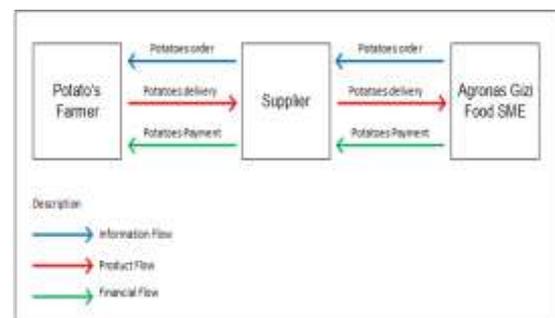
#### 3.2. Supply Chain Identification in Agronas Gizi Food SME

The supply chain activity of Agronas Gizi Food SME starts from planning the potato plantation until it is ready to be distributed to the consumer. Supply chain agents in Agronas Gizi Food SME include farmers, suppliers, and Agronas Gizi Food's production. Supply chain mapping was done with SCOR approach divided into 5 business activities for identifying the risk event and risk agent in each supply chain flow [8, 9]. The result of supply chain activity mapping of Agronas Gizi Food SME can be seen in Figure 1. The supply chain activities have 3 process flows i.e. information flow, material flow, and financial flow [5]. Supply chain activities and process flow of Agronas Gizi Food SME is shown in Figure 2.

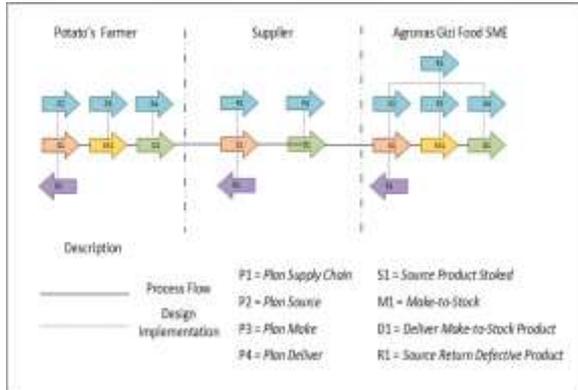
Farmers are the first members of the supply chain to act as suppliers. The supply chain activities by the SCOR method in farmers were as follows. Plan includes potato land planning, the amount of potatoes that need to be planted, potato production, cultivation process, and caring for the potato plants. Source includes ordering seeds, retrieving the seeds, payment for the seeds, ordering fertilizers, retrieving the fertilizers, and payment for the fertilizers. Make includes potato cultivation process, caring for the potato plants, and harvesting the potatoes. Delivery includes harvesting information relay to the suppliers, production information relay to the suppliers, retrieving payment from the suppliers, and delivering the potatoes to the suppliers. Return includes

suppliers returning the potatoes. The most risky activity in farmer is potato cultivation because farming activities rely on climate [11]. Information flow include the farmers receive the information about the amount of the potato demand by the supplier responding with land availability information, planting time, harvest time, and production to the suppliers. Product flow was happening during the potato delivery from the farmers to the suppliers and suppliers receive the potatoes. Financial flow was when the farmer receives payment from the supplier after delivering the potatoes with transaction systems that have been approved by both sides.

Suppliers in this supply chain act as second-level suppliers after farmers. Supply chain activities on the suppliers based on the SCOR approach was started from plan i.e. planning the potato purchase on the farmers, information gathering about harvest on the farmers. Then, source by ordering potatoes from the farmers. Next was make which include keeping the potatoes. Then, deliver by delivering the potatoes to the SMEs' production, and receiving payment from the SMEs. Finally, return, where the SME was returning the potatoes. Describing the process flow from the suppliers, consists of information flow that explains the suppliers receiving information about the potato demand from SMEs that responded with stock information and delivery time to the SMEs. Product flow is potato delivery from the suppliers to the SMEs and SMEs receiving the potatoes from the supplier. In financial flow, the suppliers received payment from the SMEs after delivering the potatoes with transactions that have been approved by both sides. The most risky activity for suppliers was distribution. Large potential losses can be triggered by the marketing channels management due to inadequate quantity of potatoes and the fluctuated price of potato. Also, a lack of the suppliers' ability to dominate the market can make it difficult to increase the distribution scale [12].



**Figure 1** Mapping supply chain activity Agronas Gizi Food SMEs



**Figure 2** Flow in the supply chain of Agronas Gizi Food SME

SMEs in this supply chain act as manufactures. Supply chain activity in Agronas Gizi Food SME described based on SCOR approach include i.e. plan consists of supply chain planning, planning to order the raw material, potato processing plans, and delivery planning. Source is consisted of ordering the raw materials, receiving the raw materials and storage. Make is consisted of producing the potato chips, packing the potato chips, and storing the potato chips. Deliver is consisted of delivering the potato chips to the distributor or retailer and receiving payments from the consumer. Finally, return is consisted of returning defective products from consumers to Agronas Gizi Food SME. Based on this supply chain activity in Agronas Gizi Food SME, there was an information flow which gathers information of the number of potato chips demanded from the consumer to SMEs and responds with potato needs to the supplier. Product flow consists of delivering the potato chips from SMEs to the distributor or retailer and receiving potatoes from the supplier. Financial flow consists of SMEs receiving payment from the consumer after delivering the potato chips. The transaction system is approved by both sides: SMEs and consumers. The most potential risk in SME activities is related to the quality of the product and this risk may found in the make process [9].

### 3.3. Risk Event Identification

Based on the supply chain activity mapping in Agronas Gizi Food SME using SCOR (Figure 1), risk identification can be done in each activity. Risk identification was done through discussion with the

owner or the person responsible for each supply chain agents. Discussion was done regarding all the risks that potentially emerged in supply chain flow. Risk identification results can be seen in Table 1.

Based on Table 1, there are 31 risk events in 5 core processes in Agronas Gizi Food SMEs' supply chain. Whole risk events have details: 5 risks in the planning process (1 farmer, 4 SME), 10 risks in the sourcing process (3 farmers, 4 suppliers, 3 SME), 10 risks in the making process (2 farmers, 9 SME), 4 risks in the delivery process (All SME), and 1 risk in the return process (SME).

Plan processes have 3 supply chain activities that cause risk events i.e. planting and cultivation of the potato by the farmers, planning to order the raw materials by the SMEs, and production scheduling arranged by the SMEs. Source processes has 7 activities that take part in the 10 risk events i.e. farmers ordering the seeds, paying the seeds, ordering and paying the fertilizers by the farmers, ordering potato by the supplier, ordering raw materials by the SMEs, receiving the raw materials, and storing the potatoes done by the suppliers. There were 2 activities that take part in the risk event in the make process i.e. cultivation process and caring for the potato plants by the farmers, as well as production of potato chips by Agronas Gizi Food SME. In the delivery and return process, each has 1 activity that causes risk events i.e. delivering the potato chips to the distributor done by the SMEs (deliver) and returning the defective products to the SMEs (return). Those risk events, closely related to the communication process and information relay between the farmers, suppliers, and Agronas Gizi Food SME. Necessary calculation is needed to fulfil the demands and anticipate any defect, starting from raw materials to the finished products. Those are related with the relayed information of needed planning among supply chain agents [5]. Managing the supply chain includes raw material availability, production schedule, and distribution systems. These three aspects need to be supported by the information flow. The consumer demand can be fulfilled by a shorter order cycle. This order cycle was generated based on the information given. The information flow that allows the members to make decisions effectively was created by the information exchange among the supply chain members. Based on operational area (i.e. demand estimation, order status, production plan, sales, and inventory), the information flow can be distinguished [5].

**Table 1.** Risk identification

SCOR Process	Code	Supply Chain Activities	Risk Event
<b>Plan</b>	E1	Planting and cultivating the potatoes (farmers)	Mistakes in buying the seeds (quantity/species/ age)
	E2	Planning to order the raw materials (AGF SME)	Mistakes in planning the raw material availability
	E3	Production scheduling (AGF SME)	Mistake in production scheduling
	E4		Mistake in planning the raw material delivery time
	E5		Mistake in planning the potato chips delivery time
<b>Source</b>	E6	Ordering the seeds (farmer)	Low quality potato seeds
	E7	Seeds payment (farmers)	Fluctuating seeds price
	E8	Ordering and paying for the fertilizers (farmers)	Fluctuating fertilizer price
	E9	Ordering the potato (supplier)	Mistake in storing the potatoes
	E10		Suppliers cannot fulfill the raw material demands
	E11		Fluctuating raw material price
	E12	Ordering the raw material (AGF SME)	Delay in delivery from the supplier
	E13	Ordering and receiving the raw materials (AGF SME)	The amount of raw materials arrived doesn't match with the order
	E14		The raw material's quality is low
	E15	Potato storing (supplier)	Decreasing quality after storing
	<b>Make</b>	E16	Cultivating and caring for the potatoes (farmers)
E17		Bad weather or disasters	
E18		Potato chips production (AGF SME)	Delayed production process
E19			Damaged tools in the production process
E20			Work accident
E21			Receiving defective product
E22			Product contamination
E23			Size variation in one package
E24			Imperfect packaging
E25			Damaged product while storing
E26			Fluctuating potato chips sales
<b>Deliver</b>	E27		Delivering the potato chips to the distributor (AGF SME)
	E28	Damaged product in delivery	
	E29	Accident and delay happened in delivery	
	E30	Delayed payment by the consumer	
<b>Return</b>	E31	Defective product return (AGF SME)	Returning unfixable defective product

### 3.4. Risk Agent Identification

Based on the risk event identification of Agronas Gizi Food SMEs' supply chain (Table 1), the next stage was tracing the causal agents that caused each of those risks. Risk agent identification was carried out through interviews with the owner or the person

responsible in every supply chain agent, refers to the existing risk event. A risk agent can cause one or more risk events, or vice versa [9]. Risk agent identification results can be seen in Table 2.

**Table 2.** Risk agent identification

Code	Risk Agent
A1	Lack of supervision and knowledge
A2	Careless workers
A3	Inexperienced workers
A4	Bad communication with other supply chain agents
A5	Dependent on one supplier
A6	Unstable raw material availability
A7	Mistake in raw material treatment
A8	Lack of internal communication
A9	Tools that needs maintenance
A10	Human error in workers
A11	Workers did not wear protective clothes
A12	Simple packaging methods
A13	Rat infested storage room
A14	Changing market demands
A15	Competitors
A16	Disasters
A17	Traffic
A18	Damaged packaging
A19	Damaged transportation
A20	Workers not in a good condition
A21	Expired products
A22	Damaged products

Risk agent identification in Table 2 shows that there are 22 risk agents (A1-A22) that take part in the 31 risk events. These 22 risk agents generally can be classified into several categories such as risk agent caused by the human factor, communication, measurable risk agents, production facility related risk agent, and unmeasurable external factors. Risk agent that belongs to the human factor category i.e. lack of supervision and knowledge (A1), careless workers (A2), non-experienced workers (A3), mistake in storing the raw materials (A7), human error in workers (A10), did not wear protective clothing (A11), and the worker is not in a good condition (A20). Improving supply chain management is closely related to the human factor as superior competency that takes part in the supply chain. The workers' professionalism is one of the key factors in producing good quality products as well as fulfilling the standards and consumer demands. To lower the potential risk in the supply chain, motivation management of worker needs to be improved [10].

Risk agents in the communication include bad communication with other supply chain agents (A4) and lack of internal communication (A8). Indirectly, this category is also closely related to the human factor's ability. Various types of risk that could

happen in the supply chain, such as relationship between individual/members of the supply chain, information flow, item product, and service [10]. Maintaining the competitiveness can be achieved by improving the communication in the supply chain strategy [4]. A good information flow allows the members to make decisions effectively [5].

Risk agents in the measurable risk include dependent on one supplier (A5), unstable raw material's availability (A6), changed market demands (A14), competitors (A15), damaged packaging (A18), expired products (A21), and damaged products (A22). Those seven agents are seems to be uncontrolled aspects of the supply chain, but it still measurable and predictable. Risk concept in supply chain can be defined as the possibility of emerging unwanted situations; a dangerous situation; series of factors that caused material loss or damage; a certain event's unpleasant consequences; as well as a negatively impactful to the supply chain event and in the same time also take effect on the performance indicator (i.e. order execution, reaction time, customer service level) [10].

Risk agents in the production facilities consisted of tools that need maintenance (A9), simple packaging method (A12), and rat-infested storage room (A13). One of the fundamental risks in the supply chain related to logistics in the company is operational risk. Operational risk includes unwanted events that could happen during the production process [10]. Production is one of factors that can be used on the managing supply chain [5].

Risk of disaster happening (A16), traffic (A17), and broken transportation (A19) includes in the external factors category or out of supply chain agent's reach, also known as unpredictable event. Therefore, analysis needs to be done for unpredictable events that influence supply chain risk. The analysis result next will be used as a basis for arranging anticipation and controlling to minimize the risk of damage. The unwanted event in the distribution process and influenced order placement probability also fluctuating order is some of the fundamental risks category in the supply chain, demand risk [10].

#### 4. CONCLUSION

Agronas Gizi Food SME supply chain has 3 agents include farmers, suppliers, and Agronas Gizi Food SME. Mapping the Agronas Gizi Food's supply chain activity using SCOR method consisted of plan process (i.e. planning the supply chain, source, make, and delivery), source process (i.e. source product

stocked method), make process (i.e. make to stock), deliver (i.e. deliver stocked products), and return process (i.e. return the defective product). The study found that there were 31 risk events in Agronas Gizi Food SME supply chain composed of 5 risks in plan, 10 risks in source, 11 risks in make, 4 risks in deliver, and 1 risk in return process. There were 22 agents causing the risk events were observed in this study. Through risk identification and risk source, it is expected to minimize the potential risk, thus reducing the potential damage may arise in the Agronas Gizi Food's supply chain.

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