

# Supply Chain Risk Analysis Using House of Risk Model on Digitizing of Warung Tegal

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Warung tegal in Indonesia is one of the SMEs that needs to adapt to digitalization because its existence remains intact so that it's able to advance the country's economy. The strategy that can be done to develop SMEs warung tegal is to manage the supply chain by implementing industry 4.0. This condition can create a risk that could have a negative impact on business processes over a long period of time. This research was conducted to identify, analyse, and provide strategies for handling risks that may arise in the supply chain in digitizing warung tegal. The method use is the House of Risk to determine the priority of the handling strategy, and the Supply Chain Operation Reference (SCOR) method to identify risks in each activity. The results of this study indicate that there are 20 risk events and 38 risk agents. There are 15 risk agents are prioritized for handling strategies using the Pareto 80/20 principle, and there are 22 treatment strategies proposed to reduce the possible risks that occur in the supply chain activities of warung tegal.

## Keywords

Supply Chain, House of Risk, Supply Chain Operation Reference

## 1. Introduction

In 2017, the number of SMEs in Indonesia is more than 62,922,617 units. The President of Indonesia declared SMEs those with high resilience will be able to sustain the country's economy, even in times of global crisis. Hence, development in the resilience of SMEs, it's especially important in facing the industrial era 4.0. The progress of SMEs is carried out by technological developments increasingly growing. One of the successes of business is alimony good technology and right on target.

One of the SMEs that need to adapt to the direction of digitization is warung tegal. Warung tegal at Indonesia is one of the SMEs whose existence remains intact from time to time era.

The strategy that can be done to develop warung tegal towards digitization is by managing the supply chain appropriately. Supply chain management by implementing Industry 4.0 isn't easy, because will involve several parties, from external and internal parties. The complexity of the supply chain structure involving several parties, it is vulnerable to risks that can have a negative impact on a long-term business process. Therefore, it is necessary conducted research to identify and analyze those risks may arise in the supply chain on the digitization of these warung tegal as well as to mitigate these risks by applying the House of Risk method.

## 2. Literature Review

### 2.1 Digitalization

The era of digitalization was born with a series of features and benefits presented. Various facilities can be obtained by applying digitization both in the daily lives of individuals and in an operation organization or company. According to Sukmana (2005), digitization is a process transfer of media from printed form, audio, and video to digital form. Digitalization is done to create a digital document archive for functions, photocopying, and for creating digital library collections. Digitalization is equipment such as computers, scanners, media source operators, and software supporter (Raza, Sabaruddin, & Komala, 2020).

## 2.2 Industry 4.0 Revolution

Prof. Klaus Martin Schwab in Ghufon (2018), in his book *The Fourth Industrial Revolution* (2017) states that now we are at the beginning of a revolution that fundamentally changed the way of living, working, and related to each other. The digital revolution and the era of technological disruption are other terms from industry 4.0 It is called the digital revolution because of the proliferation of computers and automation of records in all areas. Industry 4.0 said to be an era of disruption technology because automation and connectivity in a field will create the movement of the industrial world and job competition is not linear. (Raza, Sabaruddin, & Komala, 2020).

## 2.3 Supply Chain Management

Supply Chain is a network of companies that work together to create and deliver a product to the hand last user. Supply Chain Management is a management activity in order to obtain these raw materials become work in progress or semi-finished goods and later finished goods deliver these products to consumers through a distribution system (Pujawan, 2010).

Supply Chain Operations Reference (SCOR) model is a language supply chain, which can be used in a variety of contexts to design, describe, configure, and reconfigure various types business commercial activities (I.N.Putri, 2020).

## 3. Research Methodology

### 3.1 Study Literature

The study literature stage is the activity stage to collect information relevant to this topic that is the object of this research. The study literature of this research are supply chain theory, risk management theory, Supply Chain Operations Reference (SCOR) model theory, and House of Risk method theory.

### 3.2 Data Collection

The data needed in this study is the supply chain process at warung tegal, it is plan, make, source, and delivery. The data that the authors get from the results of the author's interview with the owner of warung tegal. The next data, is risk agents and risk events, the authors obtained data from the interview results, the experts from study literature, and distributing questionnaires that the author compiled for the Indonesian people who have or often buy food at the warung tegal and use food delivery service.

As for the assessment data on the assessment of severity, occurrence, correlation to the risk agents with risk events; correlation assessment risk agents with preventive action measures; determine effectiveness; degree of difficulty; and the ratio of effectiveness to difficulty level (ETDk) is done by brainstorming with the owner of warung tegal.

### 3.3 Data Processing

Data processing in this study is use House of Risk method. The steps of implementing House of Risk method are as follows:

1. House of Risk 1:
  1. Identification of risk events ( $E_i$ ) and risk agents ( $A_j$ ).
  2. Severity and occurrence assessments for  $E_i$  and  $A_j$  variable.
  3. Build a correlation matrix for the correlation of  $E_i$  and  $A_j$  with the condition, 0 no there is a correlation, 1: weak correlation, 3: moderate correlation, and 9: strong correlation.
  4. ARP value calculation from  $A_j$  use formulas:

$$ARP_j = O_j \cdot \sum S_i \cdot R_{ij}$$

5. Rank the ARP of each  $A_j$ .
  6. Create Pareto chart of  $A_j$  (priority selection of  $A_j$ ).
2. House of Risk 2:
  1. Preparation of preventive action based on priority selection of  $A_j$ .
  2. The correlation between  $A_j$  and  $Pak$  with the condition, 0, 1, 3, and 9.
  3. Calculation of the total effectiveness value for each  $Pak$  use formulas:

$$TEk = \sum (ARPj \cdot Ejk)$$

4. Measuring the degree of difficulty in applying *PAk* with a difficulty scale application of 3: low, 4: medium, and 5: high.

5. Calculation of effectiveness to difficulty ratio with formulas:

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

6. Rank priority of *PAk* based on *ETDK* value.

### 3.4 Discussion and Analysis

The data that has been processed before is analyzed so that it gets mitigation of risks so that they can be implemented by warung tegal so that warung tegal business can continue to run well.

### 3.5 Conclusions and Suggestions

Making conclusions on the answers to the formulation of the problem against data that has been processed and analyzed, and provides suggestions that will be submitted to several SMEs warung tegal in Indonesia.

## 4. Results and Discussions

The method used for mapping business processes in the supply chain, namely the Supply Chain Operations Reference (SCOR) method. Based on the mapping done with SCOR method and based on the results of interview with the owner of one of warung tegal in Indonesia. Supply chain digitization activities at warung tegal can be seen on Table 1.

Table 1 The Production Process of Digitizing Warung Tegal

Major Processes	No.	Sub Processes
Plan	1.	<ul style="list-style-type: none"> <li>• Production planning</li> <li>• Calculation of materials</li> <li>• Control of materials inventory</li> </ul>
Source	2.	<ul style="list-style-type: none"> <li>• Purchase of materials through online application</li> <li>• Materials quality control</li> <li>• Receive order from customers through online application</li> </ul>
Make	3.	<ul style="list-style-type: none"> <li>• Planned food production</li> <li>• Food production quality control</li> <li>• Prepare the product</li> </ul>
Delivery	4.	<ul style="list-style-type: none"> <li>• Data information of product availability</li> <li>• Prepare products that have been ordered by customers through online application</li> <li>• Product delivery to customers</li> </ul>

Through our research we have selected the risk outcomes that have been approved by experts (80% of experts). These are the risks of the application of industry 4.0 to SMEs that have been identified by experts (Moeuf, Lamouri, Pellerin, Giraldo, Valencia, & Eburdy, 2020):

1. The main risk is the lack of expertise of SMEs business owners. We identify that SMES are less prepared with competencies in supporting functions, because industry 4.0 uses technology new and requires a lot of skills.
7. The second risk, experts have identified the importance of including 4.0 industrial projects as part of company's strategy. The experts determined that it was possible to consider a small project for local improvements.
8. The third risk, the speed with which technology advances, brings risk of obsolescence of an investment in technology. At a time of technology which is chosen will eventually be applied and controlled, another thing, namely the more efficient part of the technology may already be used by competitor. However, this risk is taken into consideration the speed of SMEs and their responsiveness to change.

9. The fourth risk, identified by experts, is fear of the source human resources who perceive industry 4.0 as a means increase supervision of their work. Experts suggest communication and transparent about the use of captured data.

Through the study literature, interview, and questionnaire, 20 risk events were obtained and the severity value as shown in the Table 2. These risk events have a negative impact on warung tegal which can cause the quality of warung tegal to decrease.

Table 2 Risk Events and Severity

<b>Risk Events</b>	<b>Severity</b>
Sudden change in production plans	1
Incompatible materials ordered	1
Additional expenditure budget	2
Condition of the damaged material	1
There is a delay in delivery of material from supplier	1
Error received the order	1
Service becomes late	1
Warung tegal management becomes disorganized	2
Consumer misconceptions in choosing food	1
Increase of product prices	3
Excessive use of plastic	4
Inconvenience for consumers eating dine in	1
The production process is interrupted	1
Product quality is not stable	2
There is a delay in the delivery of products to consumers	2
Errors in product delivery to consumers	1
Product damage during delivery to consumers	5
Product delivery address does not match	1
There is a work accident	1
Consumer dissatisfaction with the product	5

The presence of risk events caused by risk agents. Through the interview and questionnaire, 38 risk agents were obtained and the occurrence value as shown in the Table 3.

Table 3 Risk Agents and Occurrence

<b>Risk Agents</b>	<b>Occurrence</b>
Sudden product demand	2
Procurement of materials is late	2
Supplier error in entering order data	1
There are additional postage costs	3
Material quality is not good	1
There is a natural disaster or accident during the delivery of the material al quality is not good	1
Procurement of materials is late	2
Misinformation on quantity estimation data from user to purchaser	1
Supplier didn't send the goods as requested	1
Negligence of labor	1

Lack of human resources	2
Work procedures are less clear	1
The limited ability of warung tegal owners to use online applications	4
Less maintenance at warung tegal	2
The difference in the photo of the product menu in the application is different from the original	2
Difficulty on the part of the seller to always update the menu on the application	4
Consumers cannot see directly the product menu in warung tegal	2
There are additional postage costs	3
Use a plastic bag as a product wrapper	4
A small of warung tegal	1
Warung Tegal is becoming more crowded with food delivery service drivers	3
Relatively high production target	2
Quality ingredients are not fresh	1
The workforce is less conscientious	2
The driver has difficulty reading the map	1
Environmental conditions during the shipping process (rain/traffic density)	1

Data processing starts from looking for the Aggregate Risk Potential (ARP) value. Using the HoR 1 table for each risk agents that be benchmark to get the cause of the priority risk, where the risk is a risk that has a bad impact so it needs to be given preventive action. HoR 1 table can be seen in Figure 1. ARP value is obtained by multiplying the occurrence value with the total multiplication of each correlation with severity.

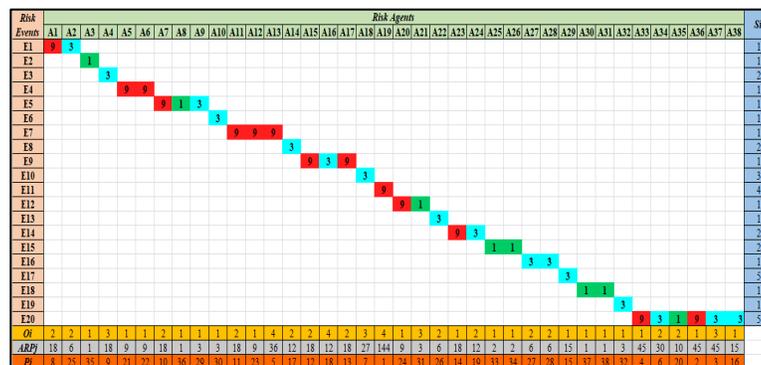
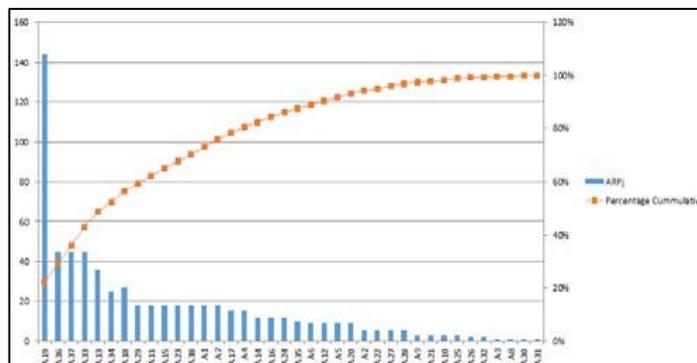


Figure 1 House of Risk 1

The resulting of ARP values that have been sequenced are then entered into the Pareto chart to determine which risk agents will be given treatment in advance. The Pareto principle is known as the 80-20 rule, states that 80% of risk events originate from 20% of the risk agents cause it. Pareto diagram can be seen in Figure 2.

Figure 2 Pareto Chart



Based on this principle, it is known that there are 15 risk agents out of 38 most risk agents causing problems that have up to a percentage with 80%, namely A19, A36, A37, A33, A13, A34, A29, A11, A15, A23, A38, A1, A7, A17. Risk agents priorities can be seen in Table 4.

Table 4 Risk Agents Priorities

Code	Risk Agents	ARPj	Pj	Percentage Cummulative
A19	Using a plastic bag as product packaging	144	1	23%
A36	Difficulty for customers to submit order requests	45	2	31%
A37	Menu in application not complete	45	3	38%
A33	Customers cannot see the freshness and cleanliness of the product	35	4	44%
A13	Limited ability of the seller to use online application	32	5	49%
A34	Increase in product costs	25	6	53%
A18	There is a delivery fee	27	7	57%
A11	Lack of human resources	18	9	62%
A15	The difference between the product photo in the application and the real one	18	10	65%
A23	A less conscientious worker	18	11	68%
A38	Late delivery process	18	12	71%
A1	Sudden product demand	18	13	73%
A7	Procurement of materials is late	18	14	76%

Experts identify four critical success factors in implementing industry 4.0 on SMEs. Here are the four factors (Moeuf, Lamouri, Pellerin, Giraldo, Valencia, & Eburdy, 2020); the first is the importance of human resource

training, the second success factor is the need to conduct a study before starting an industrial 4.0 project, the third success factor is the use of technology, the experts are very supportive of the use of data and simulation tools, the fourth success factor is that experts note that the critical success factor is simplifying industry 4.0 tools in SMEs.

There are 24 preventive action obtained through brainstorming with warung tegal owners according to references from books and journals. Then, each preventive action is given an assessment of the correlation between the preventive action and the risk agents and assessment of the degree of difficulty of the preventive action to be implemented according to the ability of the owner of warung tegal. This ability is seen in terms of costs owned by the owner of the warung tegal, and the ability to source human power. Sequence precautions are have been sorted, so that from the most important namely PA1, PA4, PA3, PA6, PA7, PA10, PA11, PA13, PA2, PA16, PA22, PA5, PA8, PA19, PA9, PA12, PA14, PA15, PA17, PA18, PA20, PA21. HoR 2 table can be seen in Figure 3.

Risk Agents	Preventive Action																						ARP
	PA1	PA2	PA3	PA4	PA5	PA6	PA7	PA8	PA9	PA10	PA11	PA12	PA13	PA14	PA15	PA16	PA17	PA18	PA19	PA20	PA21	PA22	
A19	9																						144
A36		3																					45
A37			3																				45
A33				9	3																		35
A13			9			9	9																32
A34								3															30
A18									3														27
A29										9	9												20
A11											3	9											18
A15				9																			18
A23													3	3									18
A38																9	3						15
A1																		3	3				14
A7																			3	3	3		14
A17				9																		9	14
Effectiveness (TE)	1296	135	423	603	105	288	288	90	81	180	180	54	162	54	54	135	45	42	84	42	42	126	
Difficulty (D)	2	3	3	2	3	3	3	3	3	2	2	3	3	3	3	3	3	2	3	2	2	2	
TEk to Dk Ratio (ETD)	648	45	141	301,5	35	96	96	30	27	90	90	18	54	18	18	45	15	21	28	21	21	63	
Rank Priority (R)	1	9	3	2	12	4	5	13	15	6	7	16	8	17	18	10	19	20	14	21	22	11	

Figure 3 House of Risk 2

After that, the last stage, choose the best preventive action that have cumulative less than 80% in accordance with the Pareto principle, namely PA1, PA4, PA3, PA6, PA7, PA10, PA11, PA13, PA2. The best preventive action can be seen in the Table 5.

Table 5 Best Preventive Action

Priority	Code	Best Preventive Action
1.	PA1	Replace plastic with rice paper as product packaging
2.	PA4	Use original product photos on the menu in the online application
3.	PA3	Conduct training on warung tegal owners in using online applications regularly
4.	PA6	Simulate the supply chain digitization process for the seller
5.	PA7	More selective recruitment process
6.	PA10	Choose the safe packaging
7.	PA11	Test the packaging until get the right packaging
8.	PA13	Recruiting human resources until it is sufficient
9.	PA2	Provides the request order feature in the online application

## 5. Conclusion and Suggestion

### 5.1 Conclusion

The following are the conclusions of this study:

1. The process of digitizing the supply chain at warung tegal has 20 risks events can be detailed, namely there is 1 risk events in the plan process, 4 risk events in the source process, 9 risk events in the make process, 6 risks events in the deliver process.
2. There are 38 risk agents that cause risk events to occur, with using House of Risk phase 1 and the Pareto diagram method obtained 15 priority risk agents, where the risk is bad impact so precautions must be taken. 15 risk agents these are A19, A36, A37, A33, A13, A34, A18, A29, A11, A15, A23, A38, A1, A7, A17.
3. Determine preventive action using the House of Risk method phase 2, and the determination of preventive action ranking as level determination prioritites sorted from largest to smallest value. Preventive actions that have been sorted, so that the most important ones are PA1, PA4, PA3, PA6, PA7, PA10, PA11, PA13, PA2, PA16, PA22, PA5, PA8, PA19, PA9. After that, the last stage, the best preventive action is chosen has a cumulative percent 80% namely PA1, PA4, PA3, PA6, PA7, PA10, PA11, PA13, PA2.

### 5.1 Suggestion

Suggestion of this study is warung tegal should mitigate risks before digitizing the supply chain process.

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## **Biographies**

**Gladysa Valerie** is an undergraduate student from BINUS University. She was the student chapter's vice president from the world's largest professional society that supports the industrial engineering profession and individuals involved with improving quality and productivity, called the Institute of Industrial and Systems Engineers (IISE). She achieved Gold Award from IISE Center in Georgia, because of her chapter improvements. She improved member growth to 16%, member engagement, relationship, value proposition, and loyalty. She sustained the chapter, constructed a strategic plan, increased financial development to 20.8% than before. Her chapter also awarded 3rd place for Most Members between United Arab Emirates, Jordan, Mexico, and Ecuador.

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