

# Supply Chain Risk Evaluation Information System Design using Fuzzy House of Risk in Wooden Toy Industry

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**Abstract.** In the continuity of business processes, companies cannot avoid the possibility of disruptions in their supply chains. This disorder is referred to as risk. The problem often faced by companies today is a poor internal control system in the production process in the supply chain channel. Therefore it is necessary to propose solutions in the form of new procedures that meet all the criteria of good internal control in the company. To minimize risk events, analysis and design of supply chain risk information systems has been made using a DFD based approach. In this study, the observation of risk in the supply chain path of one of the wooden toy industries, namely CV. Atham Toys. Aims to minimize the risks that occur by creating a DFD-based information system to identify priority risks that occur in the company. Based on observations, there are 25 risk agents that can cause 6 risk events. Then the priority risk chosen using the Fuzzy House of Risk method is price or cost risk with an ARPj value of 499.

**Keywords:** supply chain risk management, fuzzy, house of risk, information systems

## 1. Introduction

A company's business processes are inseparable from the risks that can cause harm to the company. Risk is something that leads to uncertainty over the occurrence of an event during a certain time interval where the event causes loss [1]. For this reason, with the development of existing computer technology, especially in business, information systems can be created to minimize this loss. The information system is designed based on data flow diagrams (DFD) with the fuzzy house of risk (FHOR) approach. This information system is designed to determine priority risks that occur in a company, so that the risks that exist in the company can be minimized or even eliminated.

## 2. Literature Review

### 2.1. Risk Management

Risk is the probability of an event that results in a loss when the event occurs during a certain period. The effect of risk can be measured by multiplying the frequency of events and the impact of those events. Risks can arise from any event, but can be managed based on organizational needs. The



approach to managing risk is called risk management. Generally used to avoid, reduce, transfer, divide or accept these risks [2].

## 2.2. Supply Chain Risk Management

SCRM is the identification of potential sources of risk and implementation of appropriate strategies through a coordinated approach between members of the supply chain with the purpose to reduce the vulnerability of the chain of supply. Supply chain risk management seriously pays attention to sources of risk along the supply chain and how to deal with or minimize these risks [3].

## 2.3. Fuzzy

Some aspects in the real world always or usually are outside the mathematical model and are inexact. This uncertainty is the basic concept of the emergence of fuzzy logic [4]. The key idea of fuzzy theory is that an element has a degree of membership (membership degree) in an uncertain state. The membership function shows the membership value of an element in a set. The membership value of an element ranges from 0 and 1 [5].

## 2.4. House of Risk

This House of Risk (HOR) is a modification of FMEA (Failure Mode and Effects Analysis) and the House of Quality (HOQ) model to prioritize which sources of risk are first selected to take the most effective actions to reduce risk [6]. In the house of risk approach, the calculation of the value of ARP<sub>j</sub> (Aggregate Risk Potential of risk agent j) can be calculated by the formula [7]:

$$ARP_j = O_j \sum S_i R_{ij} \quad (1)$$

Information:

ARP<sub>j</sub> : Aggregate Risk Potential

O<sub>j</sub> : Occurance

S<sub>i</sub> : Severity

R<sub>ij</sub> : Relationship between Risk Event and Risk Agent

## 2.5. Data Flow Diagram

Data flow diagrams are a logical model of data or processes created to illustrate where the data originates from, and where the data goes out of the system, where the data is stored, what processes produce the data, and interactions between the stored data, and the processes imposed on that data [8].

## 3. Methodology

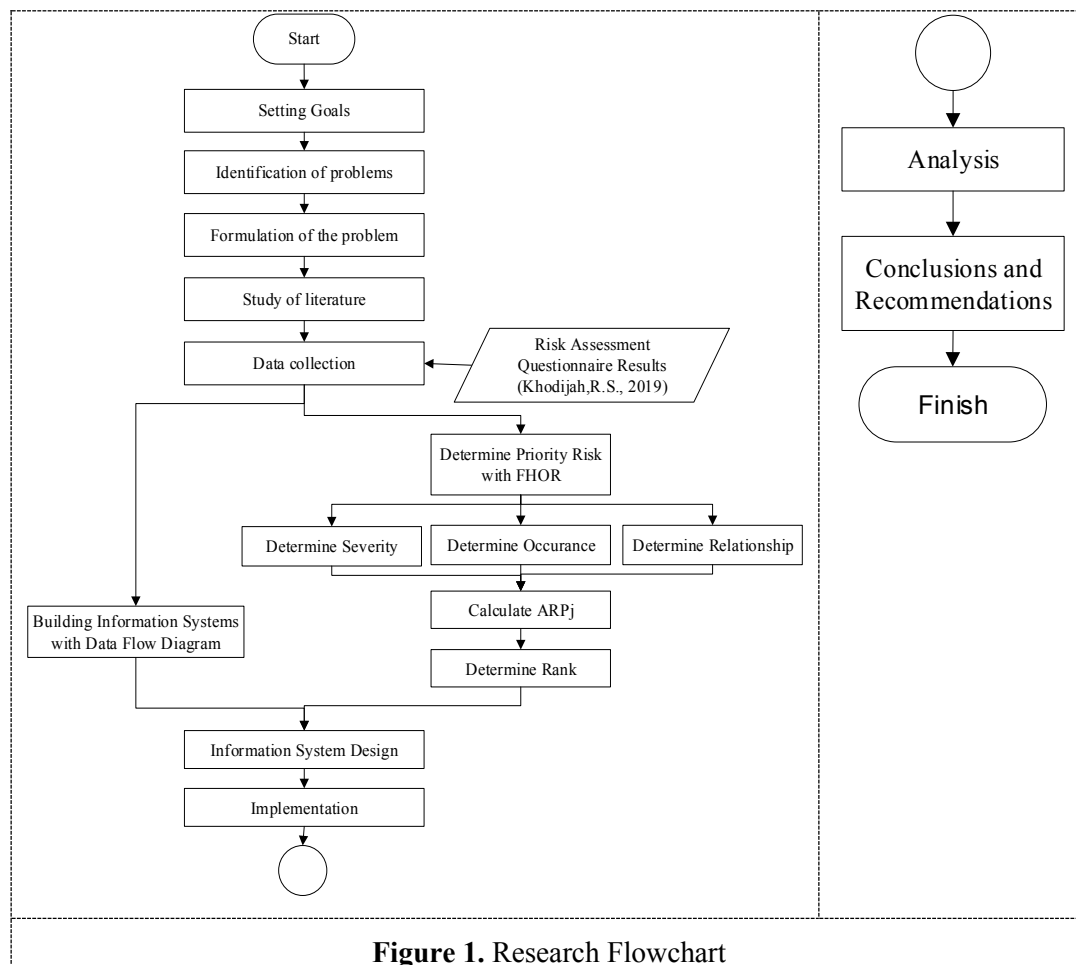
The research flowchart can be seen in Figure 1.

## 4. Result and Discussion

### 4.1. Data Collection

The data needed in this study is qualitative judgment data. This assessment comes from a questionnaire that was asked to experts related to the assessment of risks in the company's supply chain lines.

*4.1.1. Supply Chain Risk Identification Based on Literature and Interviews.* Risk identification is carried out based on reference journals according to (Jafarnejad, et al., 2014) about risk categories in supply chain lines that are generally found in companies and then adjusted to company conditions through discussions with company experts [9]. The risk classification can be seen in Table 1.



**Figure 1. Research Flowchart**

**Table 1. Risk Classification**

Risk Event	Risk Agent	Risk Event	Risk Agent
Demand Risk	Competitor Moves Delays in Delivery to Customers <i>Forecast Error</i> Market Saturation	Operational Risk	Capacity Inflexibility Design Changes Disruption in Production Inventory Risks
Environment Risk	Macroeconomic Uncertainty Natural Disasters Policy Uncertainty Social, Culture & Politic Uncertainty	Supply Risk	Variability in Production Process Dependency on Single Supplier Inflexibility of Supplier Poor Delivery Performance
Financial Risk	Cost/Price Risks Exchange Rate Risk		Supplier Poor Quality Supplier Bankruptcy
Information Risk	Breakdown of IT Infrastructure Distorted Information Inadequate Information Security Information Delay <i>Wrong Choice of Communication</i>		

The risk classification is carried out based on the activities carried out by the company in the supply chain line. Then do the compilation based on sub-risk or in this study referred to as a *risk event* or risk events. The risks are classified as *risk agents*. Risk agents are risks that cause risk events to occur. Based on the results of risk collection contained in Table 1, 25 risk agents were obtained from 6 risk events.

**Table 2.** Results of the Risk Assessment Questionnaire [10]

Risk Event	Risk Agent	Mr. Thamrin			Mrs. Hera			Mrs. Weni		
		S	O	R	S	O	R	S	O	R
Demand Risk	Competitor Moves	7	10	1	6	5	3	4	1	1
	Delays in Delivery to Customers	7	8	9	6	3	9	4	5	9
	<i>Forecast Error</i>	7	8	3	6	7	1	4	8	3
	Market Saturation	7	2	9	6	5	3	4	3	9
Environment Risk	Macroeconomic Uncertainty	7	8	1	3	7	3	7	8	9
	Natural Disasters	7	2	9	3	1	9	7	8	3
	Policy Uncertainty	7	8	3	3	5	1	7	2	1
	Social, Culture & Politic Uncertainty	7	8	3	3	4	3	7	2	1
Financial Risk	Cost/Price Risks	7	5	9	7	7	9	5	10	9
	Exchange Rate Risk	7	1	3	7	6	3	5	2	3
Information Risk	Breakdown of IT Infrastructure	5	1	9	7	2	1	4	5	3
	Distorted Information	5	6	3	7	3	1	4	2	3
	Inadequate Information Security	5	4	3	7	4	1	4	2	3
	Information Delay	5	5	3	7	5	3	4	3	3
	<i>Wrong Choice of Communication</i>	5	5	3	7	2	1	4	5	1
Operational Risk	Capacity Inflexibility	7	7	3	5	4	3	7	7	3
	Design Changes	7	5	9	5	4	3	7	10	9
	Disruption in Production	7	5	9	5	5	9	7	5	9
	Inventory Risks	7	6	3	5	3	1	7	8	1
	Variability in Production Process	7	5	3	5	7	1	7	1	1
Supply Risk	Dependency on Single Supplier	7	2	3	7	5	3	5	3	3
	Inflexibility of Supplier	7	2	3	7	6	3	5	8	3
	Poor Delivery Performance	7	1	9	7	6	3	5	2	9
	Supplier Poor Quality	7	1	9	7	5	9	5	8	9
	Supplier Bankruptcy	7	1	9	7	3	9	5	8	9

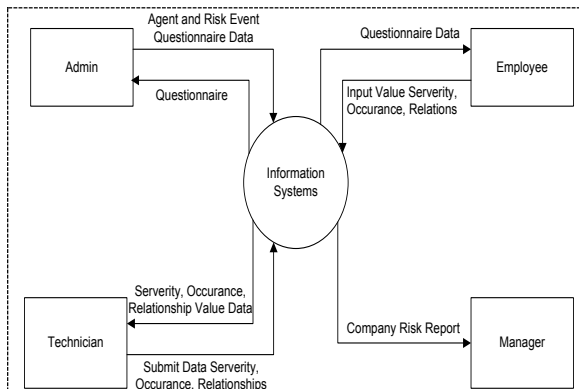
## 4.2. Data Processing

### 4.2.1. Designing Data Flow Diagrams

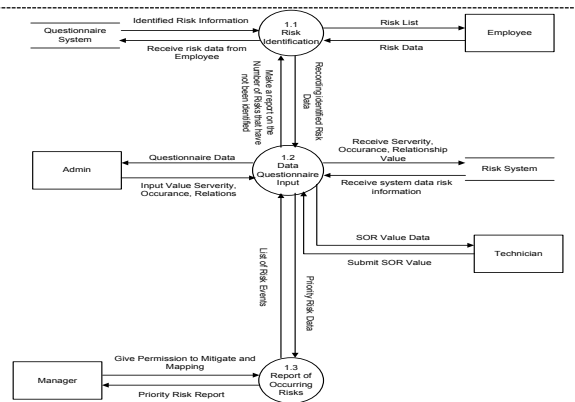
Through interviews and conducting a study of the division of labor in the supply chain activities CV. Atham Toys, it can be identified several actors who are directly related to the system. The following is a grouping of the actors identified in the risk management information system in the supply chain.

Can be seen from the context diagram (Figure 2), that there are 4 actors who play a role in the risk management information system in the supply chain CV. Atham Toys namely admin, employees, technicians and managers. At this level, the risk management information system carried out by admins, employees, and technicians gets feedback.

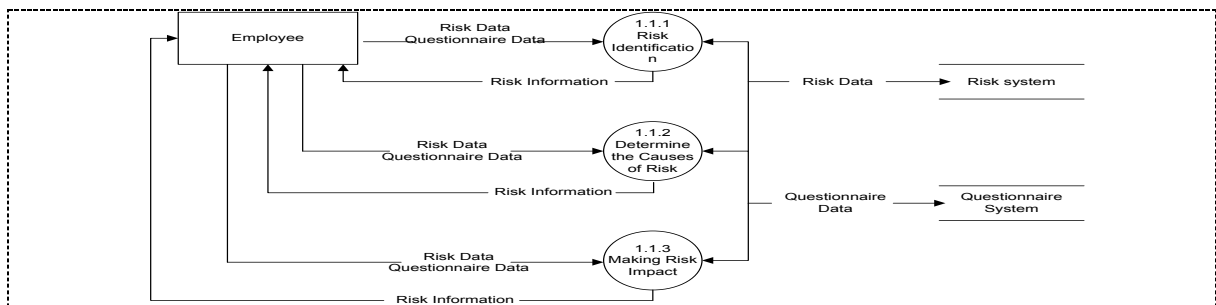
In *Data Flow Diagram* Level 1, there are 3 activities carried out namely risk identification, questionnaire data input and risk reports that occur. For risk identification activities, there is one actor who has a role, that is admin and has a *data store* that is a risk system. In the questionnaire data input activity the actors in charge are employees and there is a *data store*, the questionnaire system. Actor technicians act as submit data on SOR values that have been inputted by employees. While the last activity is a risk report that occurs in a company. Actors who play a role in this activity are company managers.



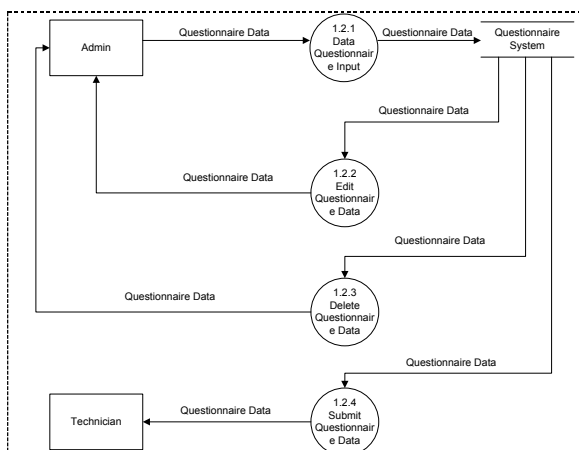
**Figure 2.** Context Diagram of Risk Management Information Systems



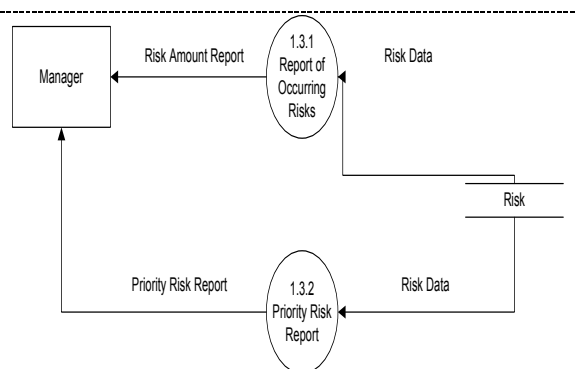
**Figure 3.** Level 1 DFD Risk Management Information Systems



**Figure 4.** Level 2 DFD Risk Identification of Risk Management Information Systems



**Figure 5.** Level 2 DFD Data Input Questionnaire Risk Management Information System



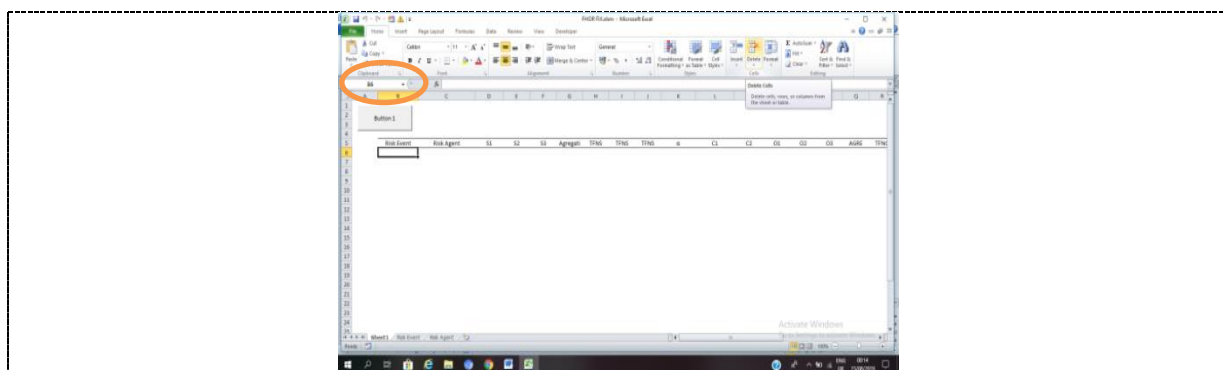
**Figure 6.** Level 2 DFD Risk Management Information System Risk Report

*Data Flow Diagram* (DFD) level 2 is an activity in detail or detail of each activity. In DFD level 2 risk identification, the activities carried out are risk identification, determining the cause of risk, and making risk impact. The actor in charge is the admin and there are 2 *data stores*, namely the risk system and the questionnaire system. At DFD level 2 input questionnaire data, the activities carried out

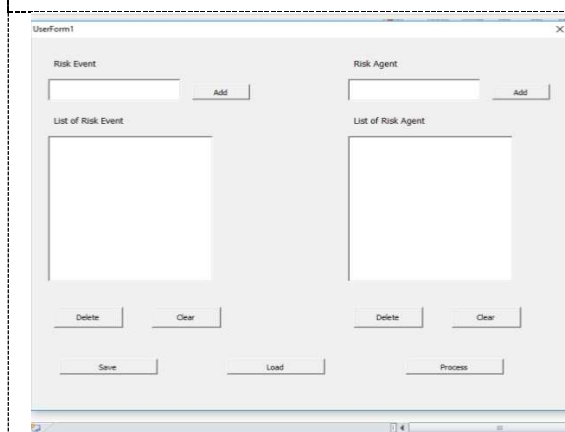
are input questionnaire data, edit questionnaire data, delete questionnaire data, and submit questionnaire data. Actors in charge are employees and technicians and there is one *data store*, the questionnaire system. In DFD level 2 risk reports, the activities carried out are risk reports that occur and priority risk reports. The acting actor is the manager of the company and there is 1 *data store*, namely risk.

#### 4.2.2. Data Processing Using Methods FHOR

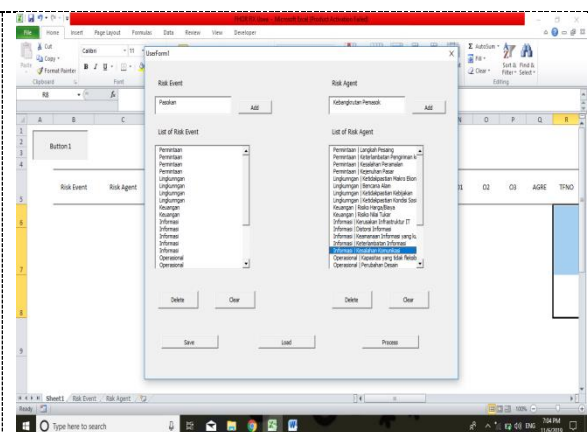
When the user enters or opens Microsoft Excel for the first time, the initial program will appear as shown in Figure 7. On the program's start screen, there is a Button 1 button that functions to continue the program. If you want to continue the program, it will click the Button 1 button and if you want to exit the program then click the x button in the upper right corner.



**Figure 7.** Initial Display of Information Systems Using the FHOR Method



**Figure 8.** Risk Event and Agent List Form



**Figure 9.** Input Event Risk and Agent Risk

After clicking the *Command Button 1* button, a risk event and agent risk list form will appear. In this form, the user is expected to input the agent's risk and risk events that occur in a company. In the case of a risk and risk agent list form there is a clear button that functions to delete all the lists that have been entered, the delete button to delete one of the lists that have been entered, the save button to save the list, and the process button that is useful for processing the list. After resolving the company's risk events and risk agents, the user is expected to press the process button so that it appears as shown in Figure 10.



## **5. Conclusion**