IOP Conf. Series: Earth and Environmental Science **106** (2018) 012018 doi:10.1088/1755-1315/106/1/012018

Knowledge management system for risk mitigation in supply chain uncertainty: case from automotive battery supply chain

I A Marie[1*], D Sugiarto[2], D Surjasa[1], A Witonohadi[1]

[1]Industrial Engineering Department, Faculty of Industrial Technology, Universitas Trisakti, Jakarta, Indonesia
[2]Information System Department, Faculty of Industrial Technology, Universitas Trisakti, Jakarta, Indonesia

*Corresponding Author : iveline.annemarie@trisakti.ac.id

Abstract. Automotive battery supply chain include battery manufacturer, sulphuric acid suppliers, polypropylene suppliers, lead suppliers, transportation service providers, warehouses, retailers and even customers. Due to the increasingly dynamic condition of the environment, supply chain actors were required to improve their ability to overcome various uncertainty issues in the environment. This paper aims to describe the process of designing a knowledge management system for risk mitigation in supply chain uncertainty. The design methodology began with the identification of the knowledge needed to solve the problems associated with uncertainty and analysis of system requirements. The design of the knowledge management system was described in the form of a data flow diagram. The results of the study indicated that key knowledge area that needs to be managed were the knowledge to maintain the stability of process in sulphuric acid process and knowledge to overcome the wastes in battery manufacturing process. The system was expected to be a media acquisition, dissemination and storage of knowledge associated with the uncertainty in the battery supply chain and increase the supply chain performance.
Keywords : automotive battery, risk mitigation, supply chain, uncertainty

1. Introduction

The application of knowledge management to the industry has been widely studied by researchers. Its utilization then evolves into a wider range of industries such as clusters [1] and supply chains [2], [3]. At the supply chain level, knowledge management can also occur due to a common interest in buyer and seller relationships that both want to improve their quality and efficiency. Articles by [4], [5] conducted a more specific study of simulating the application of specific knowledge management regarding knowledge of uncertainty to anticipate uncertainty in the supply chain. High market dynamics and market uncertainty have created a high risk for automotive industry companies. The article written by [6] explained that there are 14 categories of uncertainty in the supply chain. Some of them are supply uncertainty, demand and manufacturing process.

Automotive battery supply chain include battery manufacturer (PT. XYZ), sulfuric acid suppliers (PT. IAI), polypropylene suppliers, lead suppliers, transportation service providers, warehouses, retailers and even customers. Due to the increasingly dynamic condition of the environment, supply chain actors were required to improve their ability to overcome various uncertainty issues in the environment.

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The aim of this paper was describe the process of designing a knowledge management system to support knowledge codification and knowledge sharing in order to mitigate risk of the uncertainty in the battery supply chain. Knowledge codification converts tacit knowledge to explicit knowledge in a usable form for the organizational members. Tacit knowledge is identified and leveraged through a form that is able to produce highest return for the business. Explicit knowledge is organized, categorized, indexed and accessed. Explicit knowledge through knowledge codification often includes decision trees, decision tables, production rule, concept map etc. [7], [8]. Codification will support training and decision-making areas.

2. Research Method

The design methodology begins with the identification of the key knowledge area based on the dominant source of uncertainty in the supply chain and the uncertainty handling strategy that needs to be done. Knowledge strategy is aligned with uncertainty and risk management strategy. Clear process steps of risk management was explained by [9] The next step were knowledge capture by interviewing the expert in the related industry and knowledge codification using decision tree and concept map and finalized by system analysis and design process. Stages of knowledge management system design began with the analysis of the needs of knowledge management system implemented by interviewing the user and then proceed with the design of data flow diagrams (DFD) level 0, level 1 and knowledge portal using Drupal content management system. Stages of research can be seen in Figure 1.

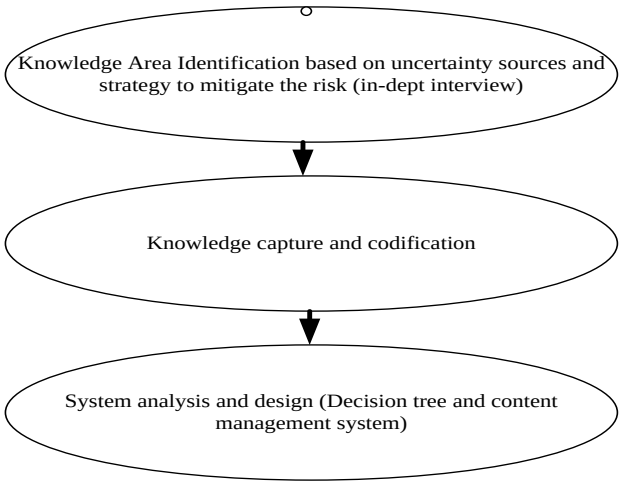

Figure 1. Research steps.

3. Results and Discussion

3.1. PT. XYZ Supply C.hain

PT. XYZ supply chain (Figure 2) started from the customer (for example PT. TY) that provides information in the form of orders to Marketing. Then Marketing will do input data process order and do forecast. Process orders and forecasts are then given to Production Planning Control (PPC). Production Planning Control (PPC) will calculate the capacity and plan production. The data is then supplied to Material Planning Control (MPC) to input the Material Requirement Planning (MRP) data and make the order planning of raw materials to be given to Purchasing. Purchasing will purchase raw materials to suppliers according to the data provided by Material Requirement Planning (MRP). Supplier will deliver the goods to the raw material warehouse and delivered to the Plant to be processed into finished goods. Then the battery packed will be sent to the finished goods warehouse to be shipped to the customer.

3.2. Knowledge Area Identification

Based on in-dept interviews, it is known that the uncertainty in the manufacturing process was prioritized to be captured, codified and shared. Therefore, strategies related to the sources of uncertainty are lean strategy (including waste elimination) and process stabilization [10]. Elimination of waste was a priority for PT. XYZ that require risk mitigation. While for one of its suppliers that is PT. IAI, the priority was in stabilization of the sulfuric acid process due to failure of the production machine that can cause delays in supply and air pollution.

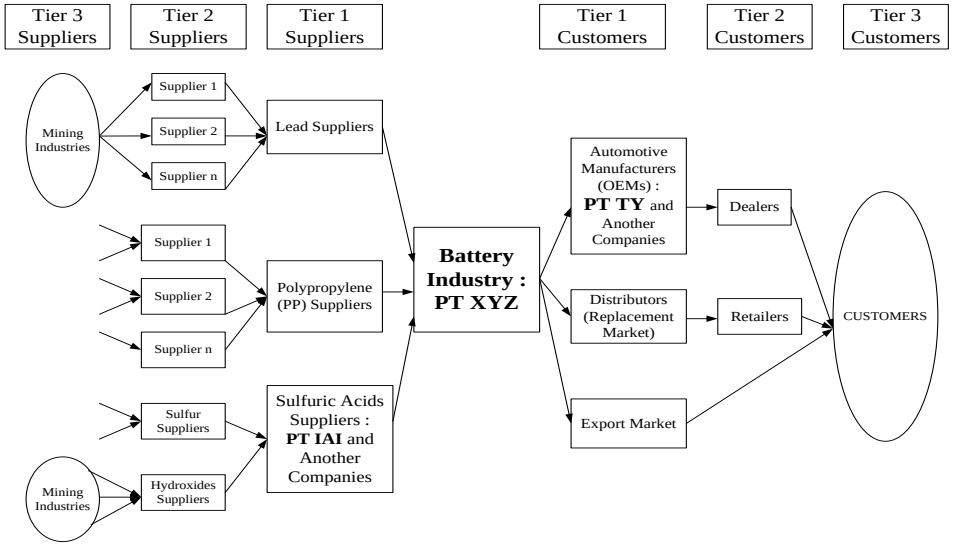

Figure 2. Supply chain network structure for battery industry.

3.3. Knowledge capture and codification

Related to the design of knowledge management system to mitigate the risk of uncertainty that occurs in the battery industry supply chain, codification process is based on the knowledge that has been obtained. The following is an example of a decision tree to mitigate the occurrence of machine breakdowns in the sulfuric acid production process associated with the smoke characteristics produced.

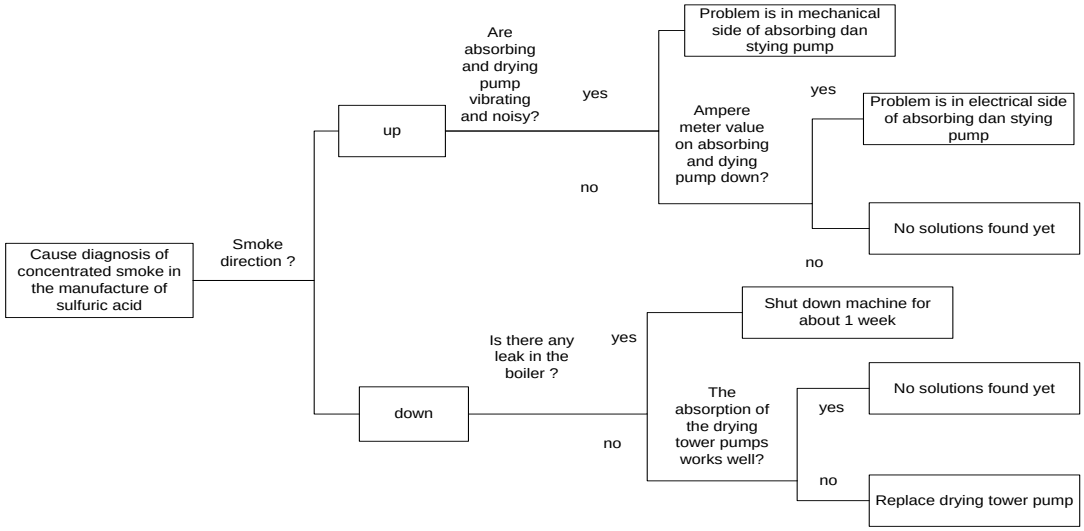

Figure 3. Decision tree for cause diagnosis of concentrat.ed smoke in sulphuric acid manufacturing process.

Uncertainty that occurred in PT. XYZ due to waste in the supply chain flow. Here is a table that contains a summary of several wastes that occurs in the supply chain PT. XYZ (Table 1).

Table 1. Example of waste at PT. XYZ.

Type	Location	Example at PT. XYZ
Defects	Casting	Defect occurs in the form of a fragile grid, broken, tilted and excess material.
	Assembling	Defect occurs in the checking process performed by the machine that makes the half-finished battery out of the process if there is a disability.
	Supplier	Defect occurs upon receipt of defective raw materials.
	Cutting Plate	Defect occurs during plate inspection at the end of the cutting plate process.
	Finishing	Defect occurs after checking done before packing
	Store Warehouse	Defect occurs when the battery is too long kept in warehouse so it requires rework.
Unnecessary Inventory	Cutting Plate	Inventory occurs when the plate is generated more than the plate used in the assembling process resulting in work in process of plate
	Store Warehouse	Inventory occurs when the battery is produced exceeds the demand causing potential damage to the battery.

3.4. Knowledge Management System Design

The result of the identification of the need for development of knowledge management portal in the battery supply chain can be seen in Table 2. The acquisition and knowledge sharing process can be mediated through the page management module, decision tree module and the concept map module (mind map). The sharing process can be mediated through forums.

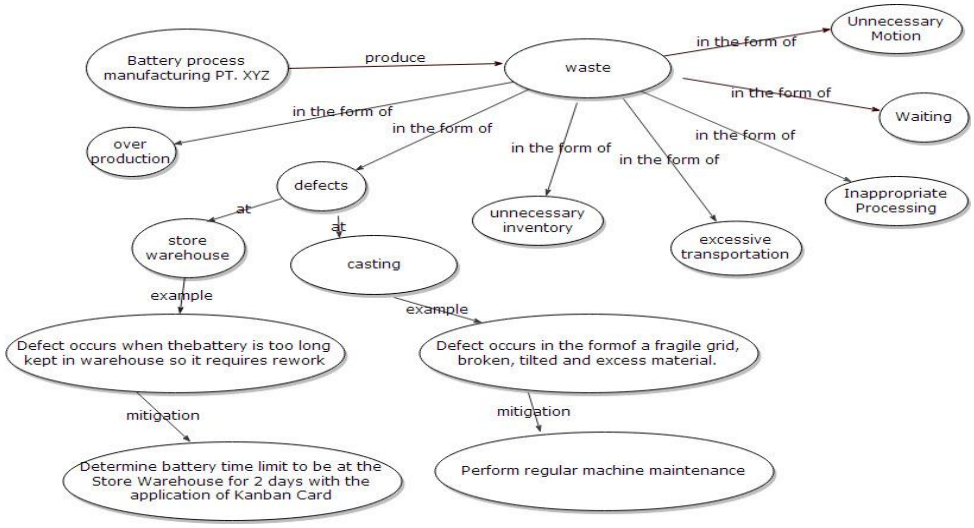

Figure 4. Risk mitigation knowledge concept diagram.

System functional requirements are the system can be used by administrators to enter and manage various sources of information and knowledge for its users, provides facilities for users to search and view various sources of knowledge, provides facilities for discussions and provides facilities for

managing users. Non-functional system requirements are system should be secure for the exchange of knowledge among members within only in PT. XYZ supply chain.

Table 2. Need of knowledge management system and technology support needed.

No	Knowledge Management System Need	Web tool
1	Media that can be used to write articles about best practice handling uncertainty and risk mitigation in the supply chain	Page management
2	Media that can be used for discussion among supply chain actors	Discussion forum
3	Media that can be used for knowledge codification and application	Decision tree and knowledge map module

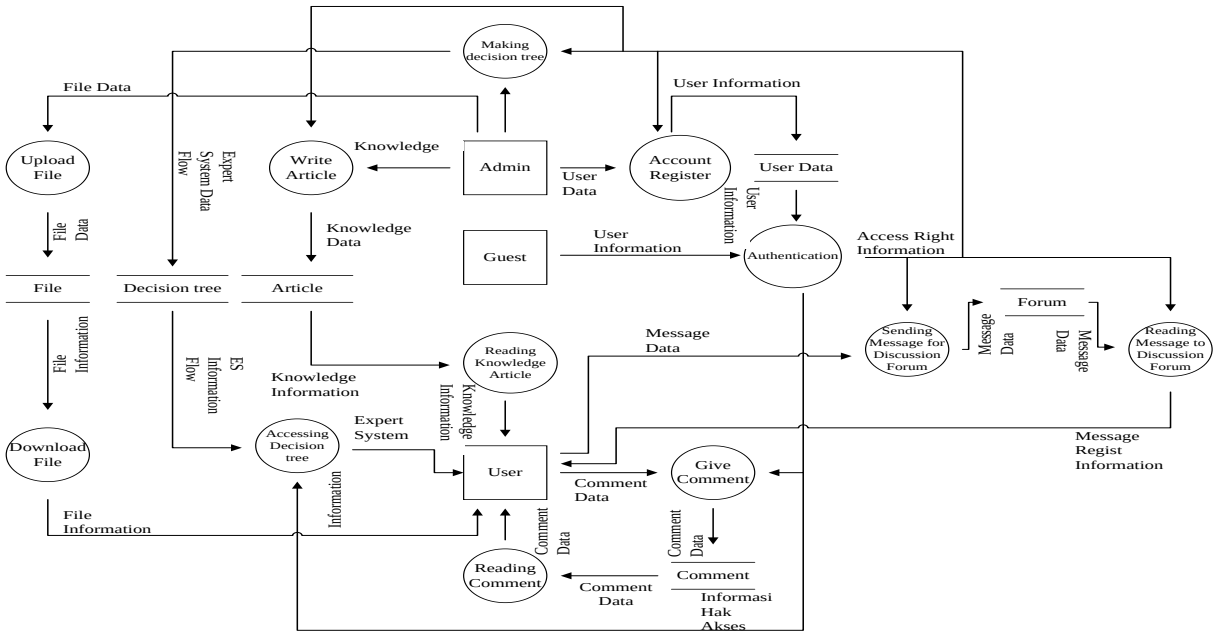

Figure 5. Data flow diagram level 1.

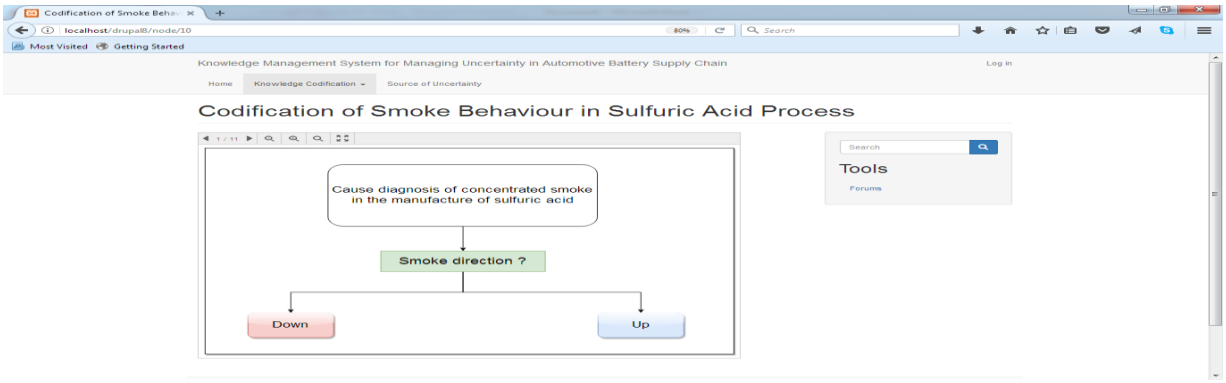

Figure 6. Example of knowledge management system menu display.

Based on interview, we collect information needs from the users of the knowledge management system. The knowledge management system has three types of users, i.e. Admin, User, and Guest. Admin is responsible for managing the system as a whole, including managing usernames and passwords, managing the knowledge stored in the system. Admins also have access to add and change

knowledge codification modul and knowledge articles. Users are those who utilize knowledge management systems actively, and can access knowledge articles and knowledge codification modules. Guest must have a username and password to be a user. The process details of the context diagram are presented in DFD level 1 in figure 5. Data Flow Diagram is a description of the flow of data flow and information flowing in the system. Decision tree for the knowledge management system can be seen in Figure 6. The categories of accessible knowledge can be articles, decision tree and concept map.

4. Conclusion

Key knowledge area that needs to be managed were the knowledge to maintain the stability of process in sulphuric acid process and knowledge to eliminate wastes in battery manufacturing process. Knowledge was captured through an expert interview process and codified in the form of a decision tree and concept map. Knowledge management system based on Drupal content management system was expected to be a media acquisition, dissemination and storage of knowledge associated with the uncertainty in the battery supply chain and increase the supply chain performance.

Acknowledgement

This research was supported by the Directorate General of Higher Education, Ministry of Education and Culture of the Republic of Indonesia. Contract Research : Superior Research of Higher Education Fiscal Year 2017 with contract No.135/A/LPT/USAKTI/IV/2017.

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