SUPPLY CHAIN DECISION MAKING IN CHEMICAL INDUSTRIES USING ANALYTICAL HIERARCHY PROCESS (AHP): A PALM OIL INDUSTRY CASE STUDY

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by

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Abstract

Nowadays, more development was done in all work fields to ensure they meet the customers need and market demand. Thus, supply chain was one thing that industries usually raised in their development plan in order to improve their process. The decision making supply chain was very important in industries to improve industry economies and flexibility of the process that was used. Therefore, in this study the development decision making of problem of supply chain at Felda Palm Industres Sdn. Bhd at Kilang Sawit Lepar Hilir in order to get the best alternatives by using Analytical Hierarchy Process (AHP) method was determined. Based on the analyses and results obtained, by introducing the high standard quality of selection of oil palm fresh fruits bunch the crude palm oil produced was followed the quality specification required.

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Abstrak

Kini, lebih banyak pembangunan telah dilakukan dalam semua bidang kerja untuk memastikan mereka memenuhi keperluan pelanggan dan permintaan pasaran. Oleh itu, rantaian bekalan adalah satu perkara yang industri biasanya bangkitkan dalam pelan pembangunan mereka dalam usaha untuk meningkatkan kualiti proses mereka. Membuat keputusan dalam rantaian bekalan adalah sangat penting dalam industri untuk meningkatkan ekonomi industri dan fleksibiliti proses yang telah digunakan. Oleh itu, dalam kajian ini, membuat keputusan pembangunan masalah rantaian bekalan di Felda Palm Industres Sdn. Bhd di Kilang Sawit Lepar Hilir untuk mendapatkan alternatif terbaik dengan menggunakan kaedah Proses Hierarki Analisis (AHP) telah ditentukan. Berdasarkan analisis dan keputusan yang diperolehi, dengan memperkenalkan piawaian pemilihan buah tandan segar kelapaa sawit, minyak sawit mentah yang dihasilkan akan mengikuti spesifikasi kualiti yang dikehendaki.

TABLE OF CONTENT

CHAPTER 1 - INTRODUCTION

CHAPTER 2 - LITERATURE REVIEW

CHAPTER 3 - METHODOLOGY

CHAPTER 4 - RESULT AND DISCUSSION

CHAPTER 5 - CONCLUSION AND RECOMMENDATION

LIST OF TABLE

LIST OF FIGURES

CHAPTER 1

INTRODUCTION

1.1   Background of Proposed Study

In this era of modern technology, the industries all over the world were always competed each other to give their best performances, products and services towards their customers. Therefore, more development was done to ensure that they meet customer's needs and market demand. Thereby, the communication between industry and company was very important to develop and enhanced their products by shared various information and data together. Supply chain was one thing that was often raised by the industry in their development plan. In other to improve the industry economies, supply chain indeed needed to be explored and improved. Generally, supply chains were included manufacturer and supplier, but there were also included transporter,

warehouse, raw materials, retailers and customers. Therefore, to improve the development of supply chain, the analytical hierarchy process can be used to help in order to make the best decision making to determine the best alternative to improved it.

1.2   Problem Statement

Every company has their own target in the improvement and development of their economies to provide huge profits for their companies and thus meet customer needs. In order to increase the economy, a lot of research and study were needed to improve the supply chain. Therefore, this study is to develop the decision making of supply chain by using analytical hierarchy process to get the best alternative of the supply chain.

1.3   Research Objective

1.3.1   To study the applicability of analytical hierarchy process (AHP) in the selecting the best supply chain alternatives.

1.4   Scope of Proposed Study

There were three main focuses in this study which are listed followed.

i)   To find the suitable case study of supply chain in industry.

ii)   To decomposed the problem of the case study

iii)   To apply the analytical hierarchy process (AHP) to solved the problem.

1.5   Thesis Layout

In this study, there were divided into five main chapters. In chapter two, the discussion will focus on the supply chain, analytical hierarchy process and the relationship between supply chain and analytical hierarchy process (AHP). Then, the detail of workflow and the research methodology that was carried out in this study are discussed in chapter three. In chapter four, it was covered the result obtained through out the research and discussion. Lastly, the conclusion and recommendation of the research was discussed in chapter five.

CHAPTER 2

LITERATURE REVIEW

2.1   Introduction

Nowadays, many approaches have been made in order to improve the development of supply chain. One of the approached was by used analytical hierarchy process (AHP) to help make the decision in finding the best alternative to supply chain. In this chapter the definition of supply chain and analytical hierarchy process (AHP) will be discussed thoroughly. Besides that, the relationship between supply chain and analytical hierarchy process (AHP) also will be discussed in this chapter.

2.2   Supply Chain

Nowadays, supply chain was explored widely in business management to ensure that they give the best serviced and product towards their customers besides to improved their economy. In supply chain, it consist all parties whether directly or indirectly to fulfilled customers need (Chopra, Sunil & Meindl, 2004). In a study by Lasschuit & Thijssen (2003), supply chain was included supply, manufacturing and distribution. But in a study by Chopra, et al., 2004, definition of supply chain was explained in detailed which state that supply chain were consist of the transporter, manufacturer, suppliers, warehouse, retailers, and customers. Besides that, Chopra, et al., 2004, also state that supply chain have a constant flow of information, product and funds between different stages. It is similar with the study by Pitty, Li, Adhitya, Srinivisan, & Karimi, 2008, supply chain have forward and backward flow of information. Besides that, according to a study by Pitty, et al., 2008, supply chain can be defined as a system of organization, people, activities, information, and resources the involved in transformed raw materials in to a finished product and delivered it to customers.

In the global markets requirements, supply chains play an importance role in enhancing and improving industrial economy. In addition, supply chain also plays an important role for environmental care. According to a study by Bloemhof-Ruward, et al., (1995) as cited in study by Sarkis, (1999) the emissions and waste that caused by supply chain was a main factor for critical environmental problems such as global warming and acid rain. Therefore, it is

important to understand the situation and issues that exist in the industry. It is similar with a study by Xia, Jia, & He, (2011), that environmental protection should be given a high attention such as a concern optimal allocation of resources, for example "low-carbon logistics" that can produced "low-carbon economy". According to a study by Xia, et al., 2011, to develop the "low-carbon logistics", the development of the recycling of waste products remanufacturing supply chain can be used. Besides that, the optimization of supply chain was needed to ensure the smooth and efficient operations, to reduced costs, improve the industries performances, and to manage the business amidst various unexpected problem (Pitty, et al., 2007).

Recently, more research has been done on the supply chain whether the supply chain impact on the economy or the importance of supply chain in economy, environment and community. For example, in a study by Rexhausen, Pibernik, & Kaiser, (2012) argue about the impact of demand and distribution management on supply chain success. Demand management was the new dimension of the new supply chain management, but it was not intensively explored and analyzed. Therefore, in their study, they want to provide an empirical evidence of whether or not demand management has positive impact on supply chain performance. In addition, there were also research on construction of supply chain partnership which was skills, knowledge and attitudinal requirements (Briscoe, Dainty, & Millet, 2001). According to a study by Briscoe, et al., (2001) to develop an efficient supply networks, the skills requirements were necessary especially when clients demand a better product and more reliable services. Besides that, in a study by Ofori, (2000) argue that since that construction activity has major impacts on the environment, thus by

applying the supply chain management, the environmental issues can be lowered. According to a study by Ofori, (2000) again, supply chain management can help to developed a green construction supply chain.

2.3   Analytical Hierarchy Process (AHP)

According to a study by Saaty, (2008) Analytical Hierarchy Process (AHP) was a theory of measurement through pair wise comparison and it relied on the judgement of experts to derive priority scales. Omasa, kishimoto, Kawase, & Yagi, (2004) argue that the Analytical Hierarchy Process (AHP) was applied in the operation research for do analysis of decision making analysis in a number of different area. In addition, in a study by Prasad & Somasekhara, (1990) the Analytical Hierarchy Process (AHP) was a multi objective multicriteria decision making approach that employs a method of multiple paired comparisons to rank order alternative solutions to a problem formulated in hierarchical terms. In a study by Lasserre, Bautista, Ponsich, & Huerta, (2009) agreed with a study by Saaty, (2008), Omasa, et al., (2004) that Analytical Hierarchy Process (AHP) was a strategy that commonly used in operation research for the solution of various kind of multicriteria decisions problem and allowing the apprehension of manager subjective judgment.

In a study by Saaty, (2008) there were four steps to make a decision in an organised way to generate the priorities. This method also agreed in a study

by Prasad & Somasekara, (1990), Omasa, et al., (2004). The first step of the Analytical Hierarchy Process (AHP) was defined the problem that need to be solved and determine the kind of knowledge sought. Next, the decision hierarchy was structured from the top which is start with the goal of the decision, then the objectives from a various perspective, through the intermediate level which is the criteria that the element depends on, until lastly the lowest level which is commonly was a set of alternatives. The third step was construct a set of pair wise comparison matrices, where for each element in an upper level is used to compared with the elements in the level immediately below with respect to it. Lastly, the priorities that obtained from previous step were used to weigh the priorities for every element. Then, for each element in the below add its weighted values and obtain its overall or global priority. The process of weighing and adding were continued until the final priorities of the alternatives in the bottom are obtained. A Table 2.1 show the scale of absolute numbers that used to weighting the elements (Saaty, 2008) and Figure 2.1 was shows the overall hierarchical structure of the AHP .

Table 2.1:   The Fundamental Scale of Absolute Numbers.

Intensity of Importance	Definition	Explanation
1	Equal Importance	Two activities contribute equally to the objective
2	Weak or slight	
3	Moderate importance	Experience and judgement slightly favour one activity over another
4	Moderate plus	
5	Strong importance	Experience and judgement strongly favour one activity over another
6	Strong plus	
7	Very strong or demonstrated importance	An activity is favoured very strongly over another, its dominance demonstrated in practice
8	Very, very strong	
9	Extreme importance	The evidence favouring one activity over another is of the highest possible order of affirmation
Reciprocal of above	If activity i has one of the above non-zero numbers assigned to it when compared with activity j, then j has the reciprocal value when compared with i	A reasonable assumption
1,1 – 1,9	If the activities are very close	May be difficult to assign the best value but when compared with other contrasting activities the size of the small numbers would not be too noticeable, yet they can still indicate the relative importance of the activities.
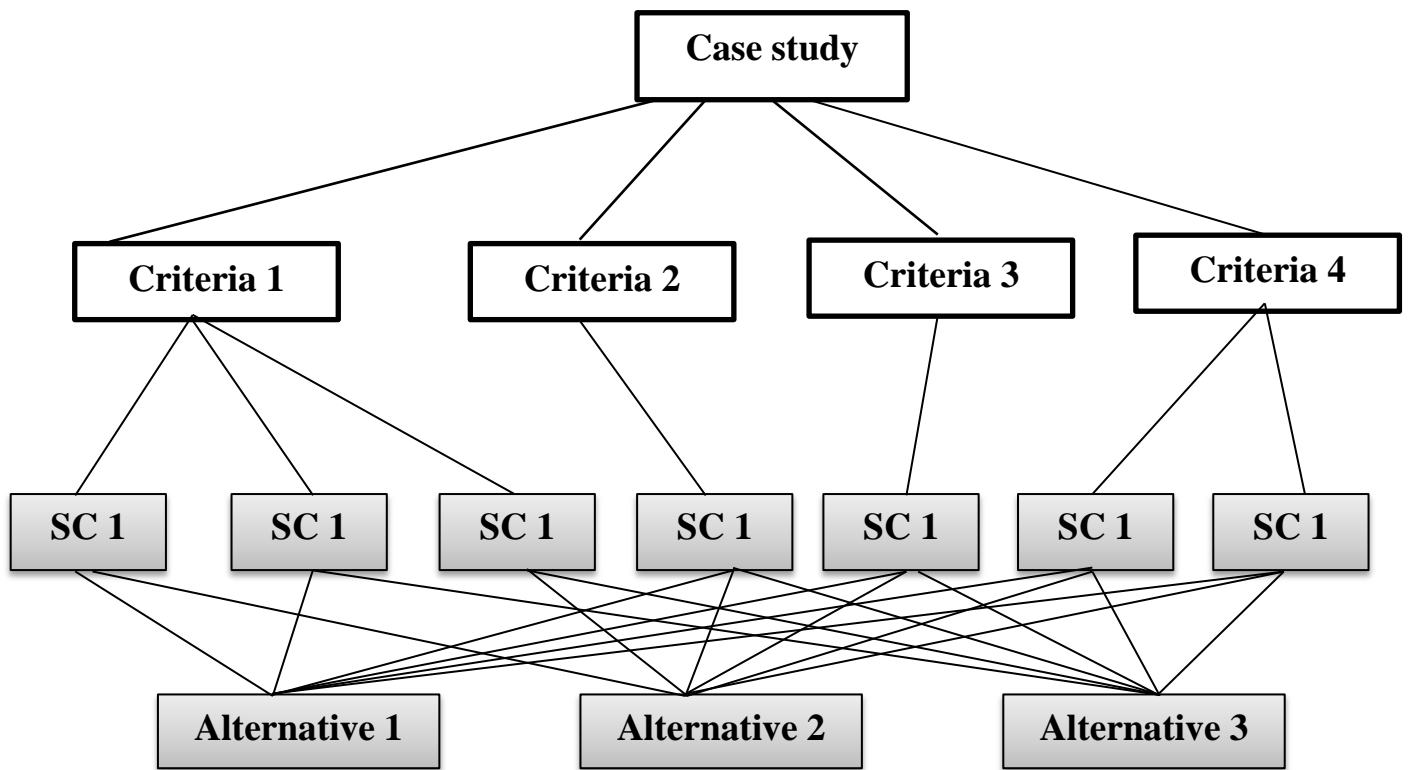
Figure 2.1:   Overall hierarchical structure of the AHP framework

Recently, lot of research used analytical hierarchy process (AHP) as a tool to help them to measure and make a decision in their study. For example, in a study by Lasserre, et al., (2009) also used AHP as a tool for the solution of multiproduct batch plant design problem under imprecise demand. In Lasserre, et al., (2009) study, AHP was applied to propose on problems of critical decision identification, including risk factors, for the development of an efficient system for global supplier selection which are the quality, service performance and supplier's profile. But in a study by Wong & Li, (2008) the analytical hierarchy

process (AHP) was applied in multi-criteria analysis of the selection of intelligent building systems. This study aims to form a particular combination of components to suit the needs of a specific intelligent building project in order to offer a comfortable, flexible building, thus also an efficient living environment at a minimal cost.

2.4   Relationship between Supply Chain and Analytical Hierarchy Process(AHP)

According to Pearson, (2001) as cited in a study by Schoenherr, Tummala, & Harrison, (2008), by used analytical hierarchy process (AHP) complex decision problems can be broke down into a set of manageable pair wise comparisons, aiding decision makers to arrive at the best alternatives. Therefore, to find the best solution, AHP was the best tools that can be used. For example supply chain, since nowadays all company all over the world want to improve and developed supply chain in order to satisfy customer needs and improved their economy. In a study by Schoenherr, et al., (2008) state that off shoring production can create a more complex supply network with heightened risks, most notably supply chain risks, which were included poor quality, higher transportation costs, lower reliability, supply disruptions, logistical failures, natural disasters and increased communication difficulties, must be recognized and traded off against the advantages of moving one's operations overseas. Thus, with the analytical hierarchy process (AHP) decision support helped, the best decisions for the off shoring production can be determined in order to have a lowest cost in their business.

CHAPTER 3

METHODOLOGY

3.1   Research Design

This study is intends to study the efficiency of analytical hierarchy process (AHP) in the development of decision making of problem in supply chain in palm oil production. Thus, this study was to prove that the analytical hierarchy process (AHP) can help in order to improved and develop the decision making of the decomposed problems that occurred in the supply chain which is in this research was the crude palm oil produced is out of specification after drying process.According to the manager of Kilang Sawit Lepar Hilir, the palm oil produced was out from it specification because the oil palm fresh bunch fruit

supplied was not quality. Besides, the humidity of the environment also effect the palm oil produced. For this study will be included primary and secondary research. Primary research is conducted by apply AHP in order to measured and have a decision of alternative on the decomposed problem. From the measurement by using AHP, the findings data are gathered and calculated to have a best priorities value of alternatives based on supply chain of case study's criteria. These studies totally base its findings through the quantitative research methods because these allow a flexible approach. Nonetheless, during data gathering the choice and design of methods are constantly modified, based on the on going analysis. Figure 3.1 below shows the Analytical Hierarchy Process for the case study in the oil palm production at Felda Palm Oil Industries Sdn. Bhd at Kilang Sawit Lepar Hilir that located at Lepar Hilir, Gambang, Pahang Darul Makmur. Figure 3.1 shows the Supply chain in the production of the oil palm at Kilang Sawit Lepar Hilir while, Figure 3.2 shows the problem diagram flow and followed with Figure 3.3 that shows the Analytical Hierarchy Process (AHP) of the decomposed problem.
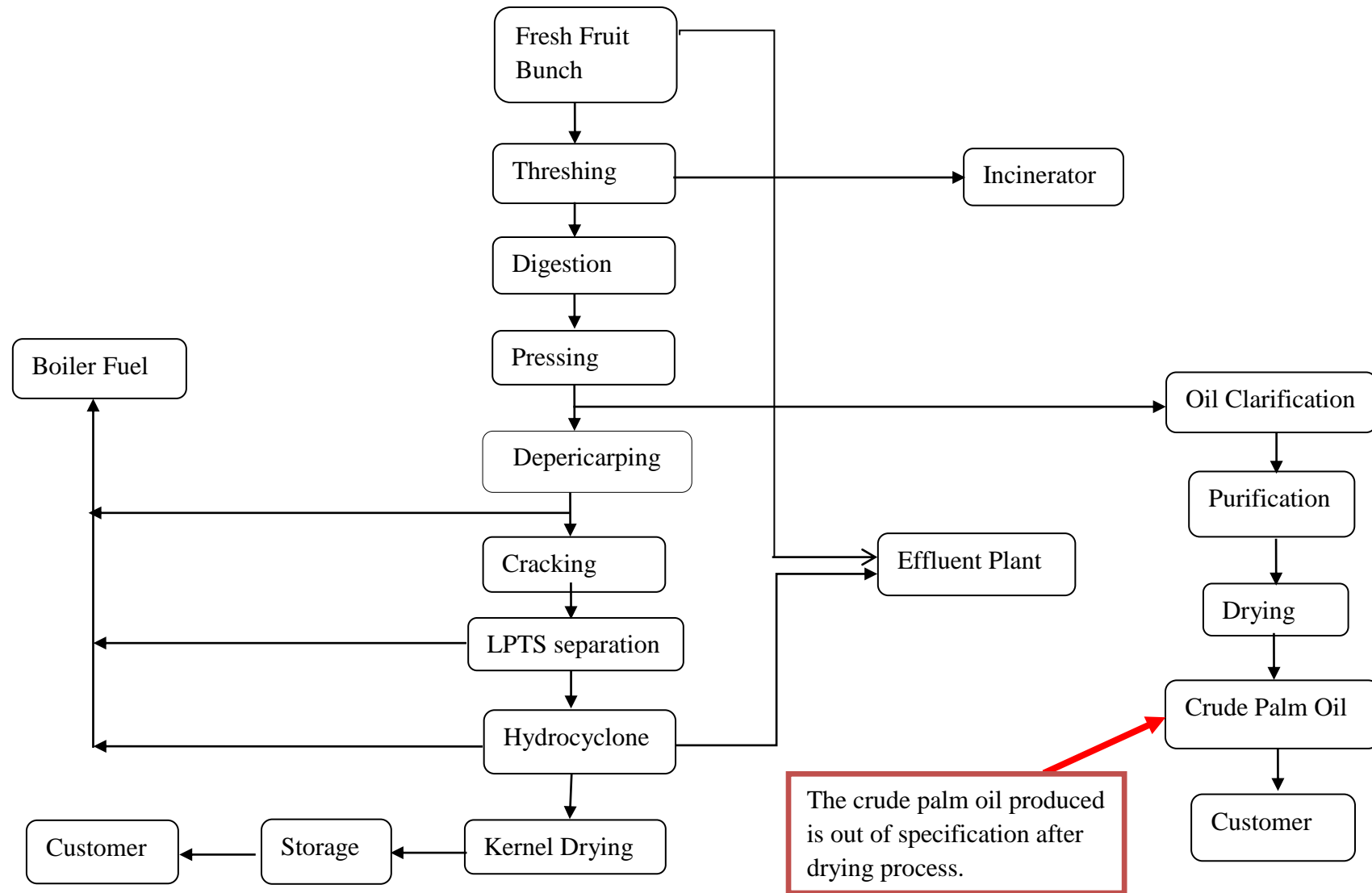
Figure 3.1   Supply Chain of Oil Palm Production at Kilang Sawit Lepar.