

PROCUREMENT IMPROVEMENT OF RAW MATERIALS IN A FOOD SEASONING  
PRODUCTION COMPANY

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วิทยานิพนธ์นี้ได้จัดทำขึ้นโดยมีวัตถุประสงค์ที่จะปรับปรุงประสิทธิภาพของกระบวนการจัดซื้อ ในด้านของราคาและความเสี่ยงของอุปทานสำหรับวัตถุดิบที่ใช้ในการผลิตในอุตสาหกรรมปรุงรส ทั้งนี้ในการวิเคราะห์ปัญหาจะวิเคราะห์โดยใช้ข้อมูลในอดีต รวมถึงการใช้โมเดลในการแบ่งประเภทของวัตถุดิบ และในท้ายที่สุดจะนำข้อมูลต่างๆมาใช้ในการสร้างกลยุทธ์และแผนการดำเนินงานที่เหมาะสม เพื่อนำมาใช้ในการปรับปรุงกระบวนการจัดซื้อ หลังจากการนำกลยุทธ์และแผนต่างๆไปใช้กับกระบวนการจัดซื้อจัดหา พบว่าค่าใช้จ่ายรวมของวัตถุดิบที่เลือกมาปรับปรุงลดลงจาก 238,667,100 บาทต่อเดือนเป็น 221,966,525 บาทต่อเดือน หรือคิดเป็น 7.42% ในด้านของความเสี่ยง จำนวนวัตถุดิบที่ถูกจัดให้มีความเสี่ยงสูงก่อนการปรับปรุงกระบวนการจัดซื้อมี 8 วัตถุดิบ หลังจากที่ได้มีการปรับปรุงกระบวนการจัดซื้อจัดหา พบว่าไม่มีวัตถุดิบที่ถูกจัดอยู่ในกลุ่มความเสี่ยงสูงแต่อย่างใด

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# CHAPTER I

## INTRODUCTION

### 1.1. Introduction

Lacking proper strategy in terms of sourcing and procurement raw materials can increase the cost of goods sold or contract price and supply risk. These two points are concerned as significant points for purchasing department to well plan and control. In terms of price, by not proper procure the raw material at the right time or proper strategy, the contract unit price might not be competitive when compare to the market price. In terms of supply, by having redundant transaction process, long supply chain with no value added or mono-supply source can create risks in terms of raw material scarcity and late delivery as well.

Procurement improvement of raw material is the main focus for reducing the contract unit price and minimizing the risk in terms of supply. There are five steps of procurement improvement. Classification the raw material by using the Pareto Analysis is the first step. Selection focusing group of raw material is performed then. Next, do the market analysis by using Five Force Model in order to know the market risk value in each selected raw material. After that, the strategy positioning of each selected raw material can be plotted by using the Supply Positioning Model and Purchasing Portfolio Matrix. The risk value from Five Force Model and relative expenditure from Pareto Analysis can be used as information for plotting raw material position in the model. Finally, the action plan and strategy are created in the final stage.

### 1.2 Background of Thesis

ABC (Thailand) Limited manufactures and supplies a wide variety of food products, including seasonings, processed foods, beverages, frozen food and edible oils as well as various amino acid-based products, pharmaceutical agents and cosmetics product expanding from Japan to the rest of the world. The main product is a food seasoning. There are four production plants which are PhraPradaeng plant (PPD), PathumThani plant (PTT), KamphaengPhet plant (KPP) and Ayutthaya plant (AYT).

In order to produce these selling products, several chemical raw materials, additive food and others are required. The total purchasing raw materials are 84 items (73

domestic and 11 import raw materials) with the total cost approximately 7,376 million baht per annual.

#### Raw material type

- Chemical raw materials      61 Items
- Additive food raw materials   11 Items
- Other raw materials            12 Items

In terms of the sourcing and purchasing, uninterrupted flow of raw materials and services for company operations, find reliable alternative sources of supply, buy at the most economic order quantities best value (a combination of right quality at right quantity at the best price with the best supplier service) and maintain good relations with vendors are significant points to concern. The threats of resource depletion, raw materials scarcity, intensified competition in terms of price and service are very significant points for purchaser to well operate and control. By shortage only one raw material, it can be trouble for the whole production line. Hence, the company especially for procurement department that not well manage their supply, they will not only unsmooth their production and operation but also increase their sourcing and raw material cost as well.

#### 1.2.1 Introduction to procurement improvement of raw material in a food seasoning production company

In order to achieve the improvement targets, the scheme processes can be set and divided into five phases as shown in Figure 1.1.



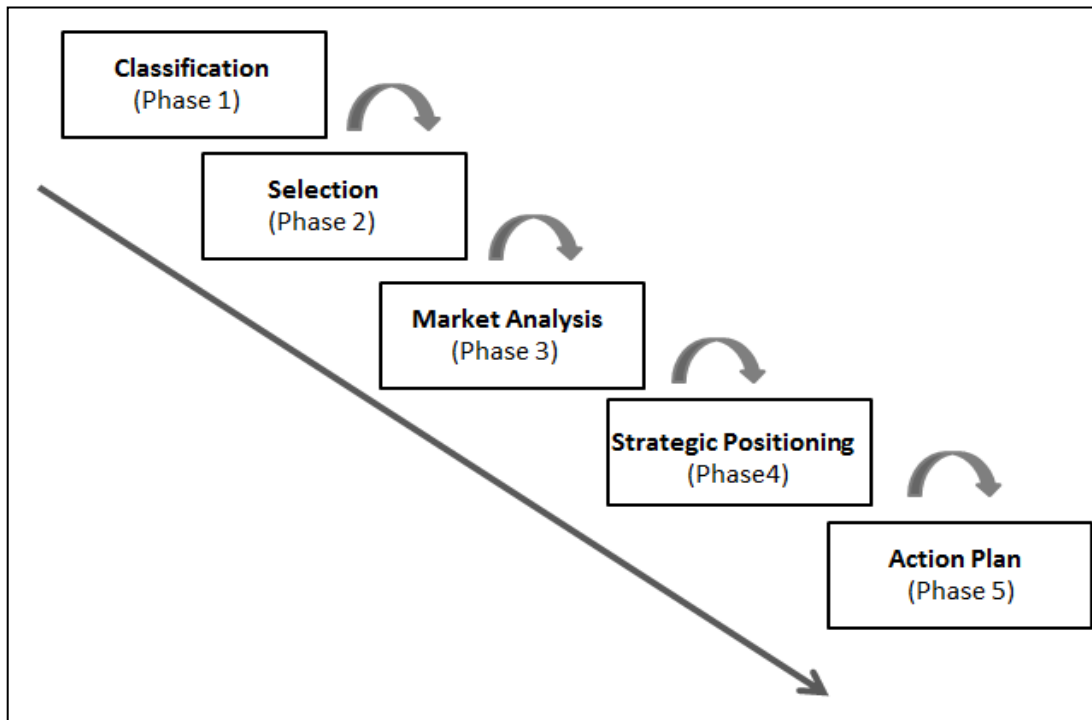


Figure 1. 1 Scheme for improving the supply management  
(adapted from Peter Kraljic) [1]

#### *Phase 1: Classification*

In this phase, the raw material will be classified by using Pareto Analysis based on the percentage of total expenditure cost (show in Appendix A). Those raw materials can be classified into three major classes which are class A (20% of raw material can generate the 80% of expenditure), class B (30% of raw material can generate 15% of expenditure) and class C (50% of raw material can generate 5% of expenditure) [2].

#### *Phase 2: Selection*

After raw materials have been classified, the selection of raw materials for improved their supply management and cost reduction is performed then. The selection focuses only on chemical raw material type. The chemical raw material in class A and top five chemical raw materials which have highest expenditure along with high supply risk from class B are selected to improve procurement cost and supply.

### *Phase 3: Market Analysis*

The selected raw materials from phase 2 are analyzed in terms of current market situation. The Five Force Model is used with five perspectives for considering.

- 1<sup>st</sup> Force: Competitive Rivalry within an Industry
- 2<sup>nd</sup> Force: Threat of new Entrants
- 3<sup>rd</sup> Force: Threat of Substitute Products
- 4<sup>th</sup> Force: Bargaining Power of Suppliers
- 5<sup>th</sup> Force: Bargaining Power of Customers

By using Five Force Analysis, the market risk score value can be known and plotted into strategic positioning in phase 4.

### *Phase 4: Strategic Positioning*

After knowing the risk supply position of each item, the strategic positioning is analyzed in order to sort out all of the selected items into categories. This category process can be divided into two parts. The first and second part will use Supply Positioning Model and Purchasing Portfolio Matrix respectively. By having the amount of expenditure from Pareto Analysis and supply risk score from Five Fore Model can locate raw material position in Supply Positioning Model. This model can classify raw materials into four different groups which are critical, bottleneck, leverage and routine. By using the analyzed information from Five Force Model, the power of purchaser and supplier can be compared. This can locate raw material in the Purchasing Portfolio Matrix. This model can classify the raw material position into three main groups which are Exploit, Balance and Diversify.

### *Phase 5: Action Plan*

After classified raw materials into three strategic thrusts with different supply position, the action plans for each raw material are created. With different classification, they will have different individual elements in purchasing strategy.

### 1.2.2 The important procurement improvement of raw material in a food seasoning production company

Because one of the factor that affected to the cost of goods sold is resulting from the cost of raw material. Not well operate in terms of purchasing strategy contract price; the company might struggle to hold the line on their overall cost of goods sold. In terms of production perspective, shortage even one of raw material can halt the whole production line. By having a good supply management along with good sourcing strategies, the company can eliminate the shortage of raw material creating on time delivery with competitive price as well.

### 1.3 Statement of Problem

There are several chemical raw materials that needed to be purchased and responsible for their movement by ABC (Thailand) Limited procurement team. With large amount of item lists, some of raw materials are not well plan and apply proper strategy for sourcing and performing the contract price. Purchasers might sometime perform contract by just using their habitude without well strategic planning even they have more bargaining power compared with vendors. This can create loss of bargaining power in the long term with high unit cost. Finally, the company will gain less profit because of high cost of goods sold. The selected chemical raw materials for improving procurement efficiency are following.

#### Sulfuric Acid

Problem           - Not maximize bargaining power  
                           - Creating high offer unit price with not conform to the global price trend

By observing the graph trend line between sulphur FOB (Free On Board) vancouver price and ABC purchasing price, the ABC purchasing price trend is not followed along the FOB (Free On Board) vancouver price trend. For example, when the global price trends to go down, the ABC purchasing price grows up or remains stable as shown in Figure 1.2. This indicates that the purchasing team are not well strategic plan for negotiation and not utilize the purchaisng power efficiently.

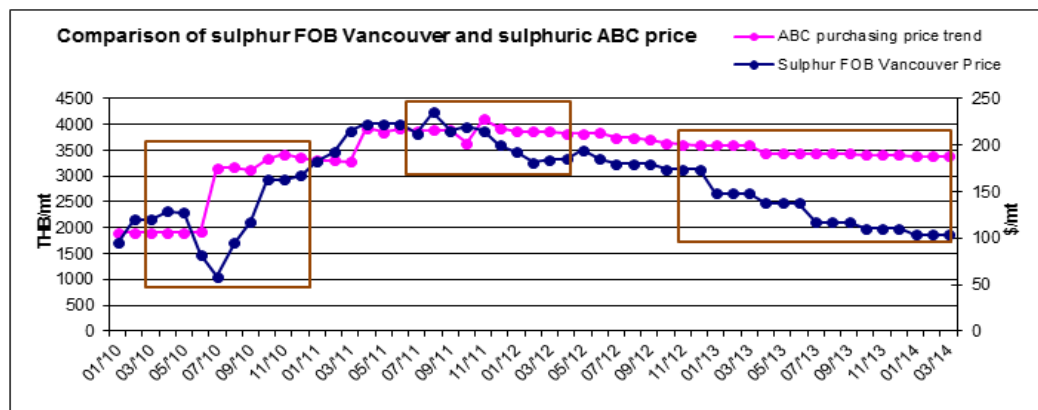


Figure 1. 2: FOB (Free On Board) Vancouver Price vs ABC purchasing price of Sulfuric Acid (Referencing price from FOB Vancouver Price [3] and ABC Purchasing Department)

The reason behind this issue is that there are too several suppliers with no competitive atmosphere. Every supplier will receive the same portion ratio of purchasing volume in every quarter as shown in the Table 1.1.

Table 1. 1: The portion of purchasing volume from current suppliers

Supplier Name	Purchasing Quantity Ratio
H Co., Ltd	30%
X Co., Ltd	20%
V Co., Ltd	20%
Y Co., Ltd	20%
Z Co., Ltd	10%
Total	100%

### Potassium Chloride

- Problem
- Monopoly supplier
  - Less bargaining power
  - High risk due to only one supply source

As the purchasing price and global price trend show in the Figure 1.3, the purchasing price trend is not followed along the global trend line in some of particular period. For example, when the global price trends to go down, the ABC purchasing price grows up or remains stable.

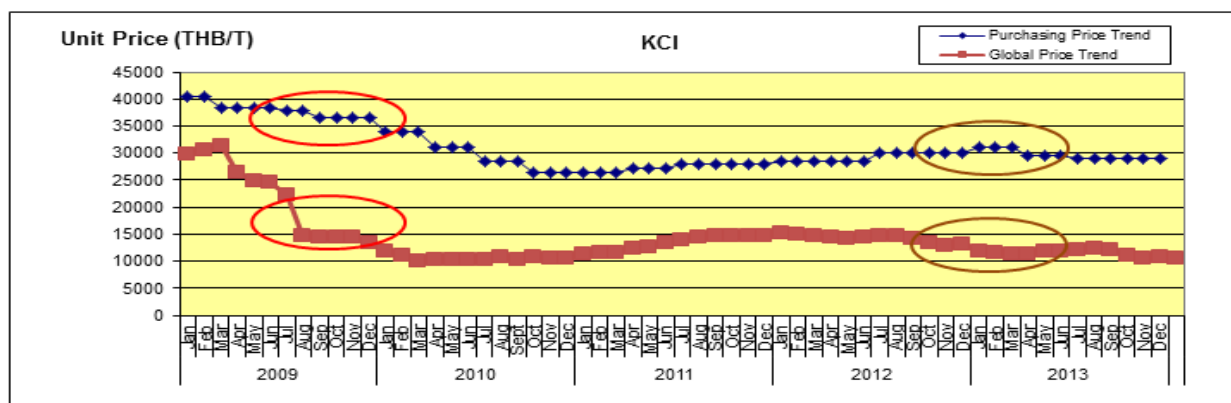


Figure 1. 3: Global Price Trend vs Purchasing Price Trend of Potassium Chloride  
(Referencing price from Fertecon Potash Report 2009-2014 [4]  
and ABC Purchasing Department)

The reason behind this issue is that there is only one trader supplying this raw material to ABC. Hence, the purchasing team might lose the bargaining power along with high risk due to no second source and monopoly supply.

#### Ammonium Chloride

- Problem
- Monopoly supplier
  - Less bargaining power
  - High risk due to only one supply source

As the graph in Figure 1.4 shows, the Ammonium chloride price almost conforms with Ammonia and Hydrochloric acid (two main raw material for producing Ammonium chloride) price trend. However, there is only one supplier supplied this product to ABC. Supplier offers the unit price as same as every month hence, the graph will show the stable offer unit price even the global price trends to decrease or even increase.

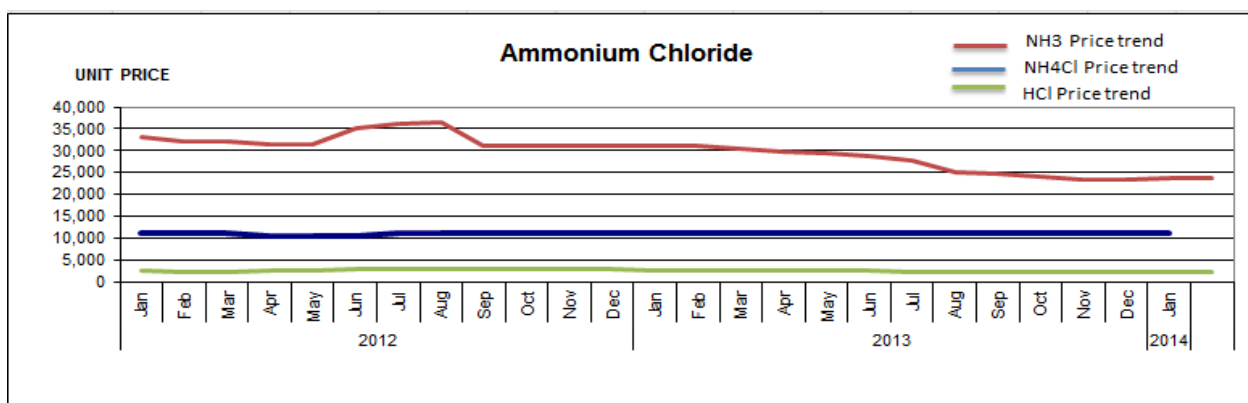


Figure 1. 4: Amonia, Hydrochloric acid and Ammonium chloride price trend  
(Referencing price from ABC purchasing department)

By having only one supplier, there is no competitive atmosphere along with no comparing offer price when performing the contract. This can create loss of bargaining power in the long term.

### Coal

- Problem
- Not creating competition atmosphere to supplier
  - High expenditure due to not well strategic plan for choosing product specification creating high consumption per day

Table 1. 2: The contract price, allocated volume and coal specification of each supplier

Supplier	Qty. (T/day)	Price offer			Calorific Value (Kcal) (ADB)	Sulphur (%)	ARB Moisture (%)	Ash (%)	Price Ratio	Delivery period	Purchasing plan	
		Oct.-Dec'13 offer	1st Offer	Final Offer Price							Contract Volume	Amount (THB)
U Co., Ltd	60	3,300	3,200	3,100	5,890	0.12%	23.21%	4.03%	0.725	Jan.-Mar.'14	5,400	16,740,000
O Co., Ltd	60	2,570	2,500	2,450	5,644	0.13%	33.14%	3.58%	0.687		5,400	13,230,000
P Co., Ltd	30	2,600	2,550	2,500	5,610	0.17%	31.81%	4.51%	0.702		2,700	6,750,000
Q Co., Ltd	30	2,600	2,500	2,450	5,600	0.60%	33.14%	3.45%	0.697		2,700	6,615,000
N Co., Ltd	60	2,500	2,550	2,450	5,558	0.38%	35.89%	5.00%	0.751		5,400	13,230,000
S Co., Ltd	60	2,450	2,450	2,450	5,677	0.80%	30.41%	3.73%	0.663		5,400	13,230,000
T Co., Ltd	30	2,600	2,600	2,550	5,570	0.30%	31.21%	3.94%	0.709		2,700	6,885,000
<b>Total</b>	<b>330</b>										<b>Total</b>	<b>76,680,000</b>
											<b>Avg. Price</b>	<b>2,581.82</b>

As the Table 1.2 shows, there are several suppliers receiving a few purchasing volume per day. For example, some supplier supply only one truck (30 T/truck) which is not maximized utilizing their capacity. This creates high offer unit price.

In terms of the product specification, coal specification can easily vary to the environment factors. Hence, calorific value, sulfur emission, moisture and ash are the factors that needed to concern when performing the contract as well. Some supplier offer high calorific value ( $\geq 5,800$  Kcal), some offer low-medium calorific value (5,500-5,800 Kcal). The high calorific value can lower the consumption per day but need to trade off with increasing in unit price. Hence, by creating the right portion between high and low heat calorific value along with negotiation for competitive price are needed to be performed in this raw material.

### Urea

- Problem
- Monopoly supplier
  - Not optimize using Urea as an alternative product of Ammonia

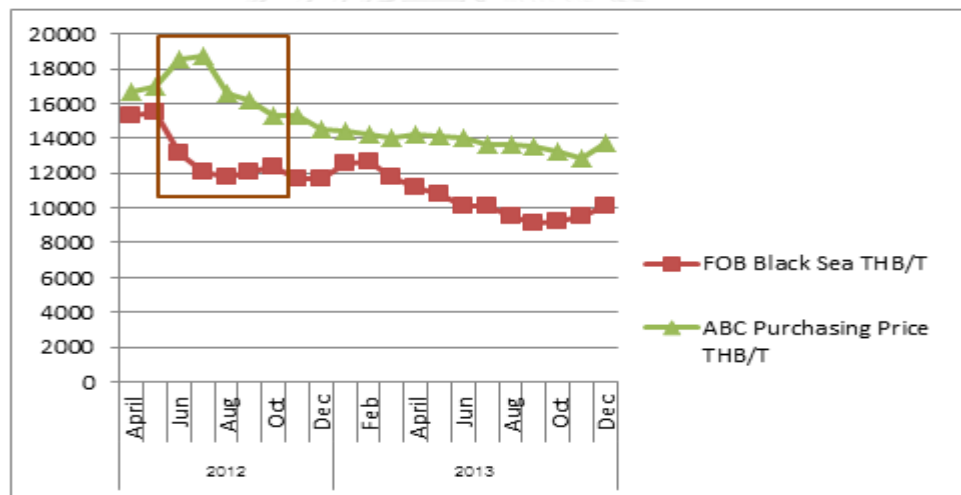


Figure 1. 5: Compare FOB Black Sea Price and ABC Purchasing Price of Urea  
(Referencing price from ABC Purchasing Department)

As the Figure 1.5 shows, urea market price is dramatically decreasing in June 2012. At that time, the ammonia is almost totally converted to urea due to high demand of fertilizer. However, even the global urea price is significant decreasing, ABC purchasing team still bought with high unit price. This is because ABC has to purchase large amount of urea quantity instead of ammonia in this urgent period with only one available urea supplier in a company approved vendor list.

Table 1. 3: The Consumption Ratio of Ammonia VS Urea

Urea Vs Ammonia Consumption				
Month	Urea (MT)	Ammonia (MT)	Urea %Ratio	Ammonia %Ratio
Apr-12	200.00	3700.00	10%	90%
May-12	200.00	3780.00	10%	90%
Jun-12	600.00	3550.22	25%	75%
Jul-12	600.00	3560.00	25%	75%
Aug-12	600.00	3506.00	25%	75%
Sep-12	200.00	3712.83	10%	90%
Oct-12	200.00	3790.25	10%	90%
Nov-12	200.00	3731.74	10%	90%
Dec-12	200.00	3754.22	10%	90%
Jan-13	200.00	3700.00	10%	90%
Feb'13 - Mar'14	-	-	-	-
	-	-	-	-
	-	-	-	-
	-	-	-	-
	-	-	-	-

As the Table 1.3 shows, by shortage of Ammonia in June 2012, ABC has to urgent purchase urea as an alternative for ammonia. The percentage ratio for using urea versus ammonia is 25% per 75%. However, after the situation subsides and to be normal in September 2012, purchaser still maintains to use urea: ammonia as 10:90 till March 2014 even urea price is more competitive. There is only 5-10% of urea portion. This might not create the significant profit.

#### Antifoam GD-113 and Succinic Acid

- Problem
- Long supply chain and several parties' cooperation creating high risk, long lead time and high unit price due to several premium costs added
  - Monopoly supplier creating loss bargaining power
  - The contract is performed as monthly basis. This initiates redundant work to the purchaser and can increase human error as well



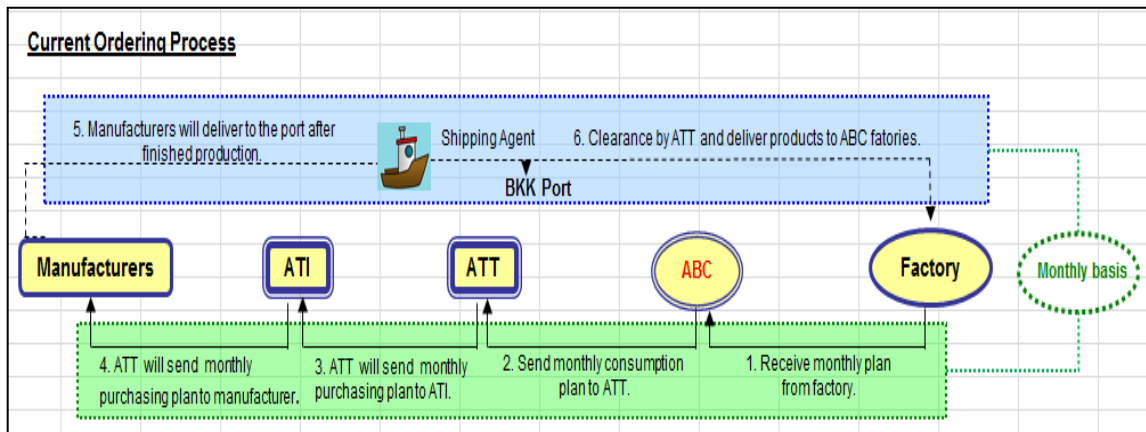


Figure 1. 6: The Current Ordering Process of Antifoam GD-113 and Succinic acid

As the Figure 1.6 shows, ABC purchasing team receives antifoam GD-113 and succinic acid monthly consumption plan from factory before using approximately 4 months. This consumption plan and purchasing order are forwarded forth and back along the chain. With several parties along the chain and monthly basis operation, this can create longer lead time, high premium cost added and create human errors as well.

### Ammonia

In order to produce ammonia, natural gas is used as main raw material. Ammonia can be converted to urea which is normally used as a main raw material for fertilizer (shows in figure 1.7).

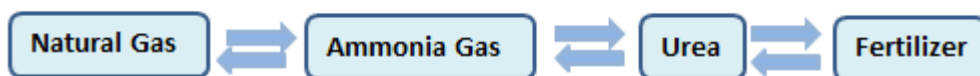


Figure 1. 7: The Ammonia Gas and Urea Production Process

Normally, ammonia supply chain is shipped from manufacture located in Indonesia (Main source for supply ammonia in Asia). By rising in the fertilizer demand in a particular period of time, more ammonia ratio is converted to urea in order to produce fertilizer using in their local country. Hence, there is not enough ammonia for export to other countries. By relying on only one source, our suppliers (A Co.,Ltd and B Co.,Ltd )

cannot search for new supply sources and not on time delivery. ABC (Thailand) Limited had to face with ammonia shortage situation (shows in Figure 1.8).

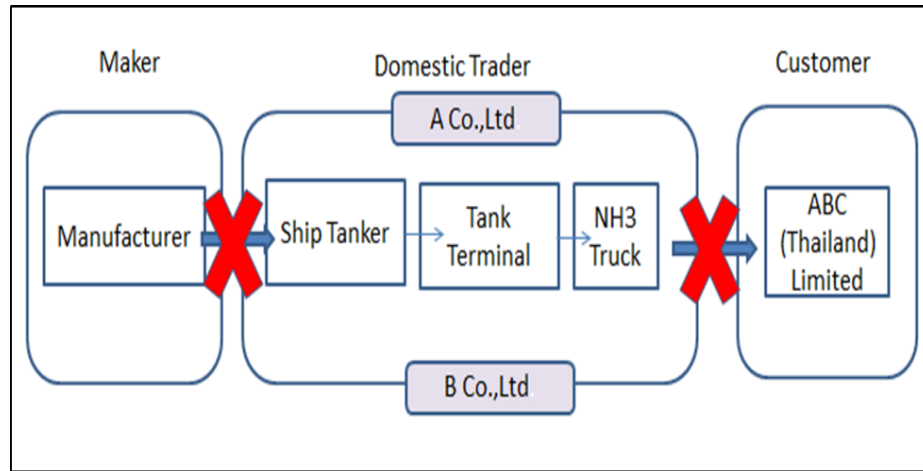


Figure 1. 8: Ammonia Supply chain

Normally, the total consumption ammonia per month is approximately 2,378 T. However, in crisis situation, supplier can supply this raw material only 1,276 T. or 46% decreasing from normal case as shown in Figure 1.9.

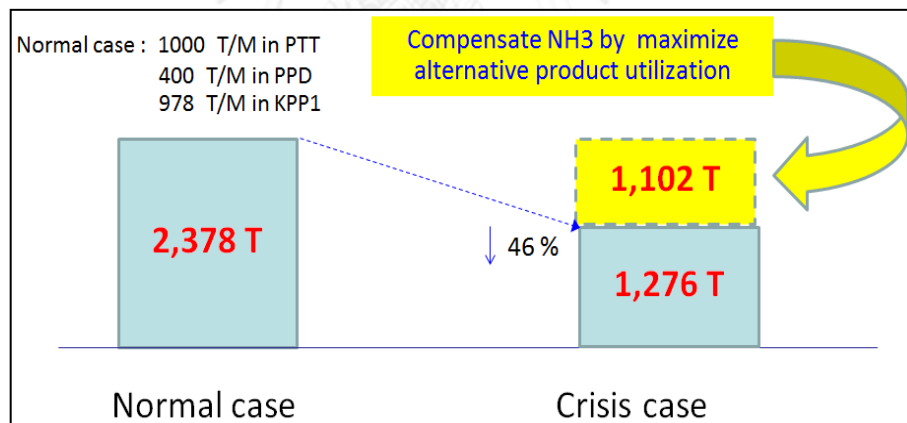


Figure 1. 9: The Ammonia Shortage Situation

### Caustic Soda and Hydrochloric acid (Chlor-Alkali)

Due to Japan earthquake (Tsunami), C Co.,Ltd in Japan had to shut two of its three caustic soda plants after they were damaged by the earthquake. By C's global policy, C in Thailand which is main domestic maker supplying Chlor-Alkali to ABC (Thailand) Limited (62% of ABC's total caustic soda consumption) had to transfer additional caustic Soda to C in Japan to supplement their local production. Hence, there is only a few portions which are approximately 38% supplied from other traders to ABC (Thailand)

Limited. This situation is not only affected to the caustic soda supply but also hydrochloric acid due to co-products.

As showed in the Figure 1.10 below, there are, normally, four suppliers supplied caustic soda and hydrochloric acid to ABC. By reducing in caustic soda and hydrochloric acid volume from C Co.,Ltd who is concerned as a major supplier in chlor-alkali business, this can create raw material shortage to ABC.

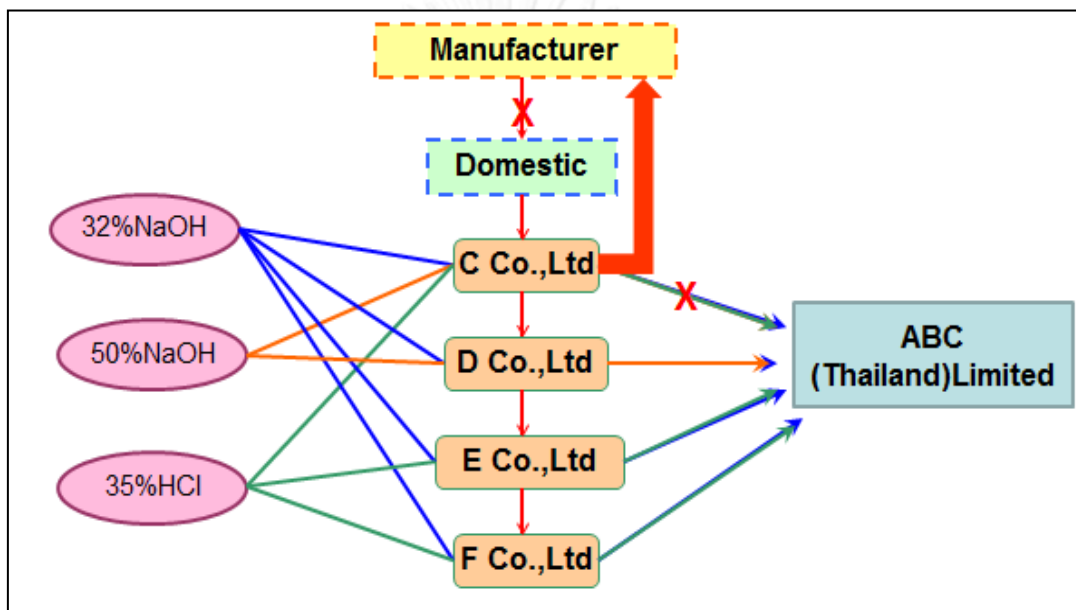


Figure 1. 10: The Caustic Soda Supply Chain

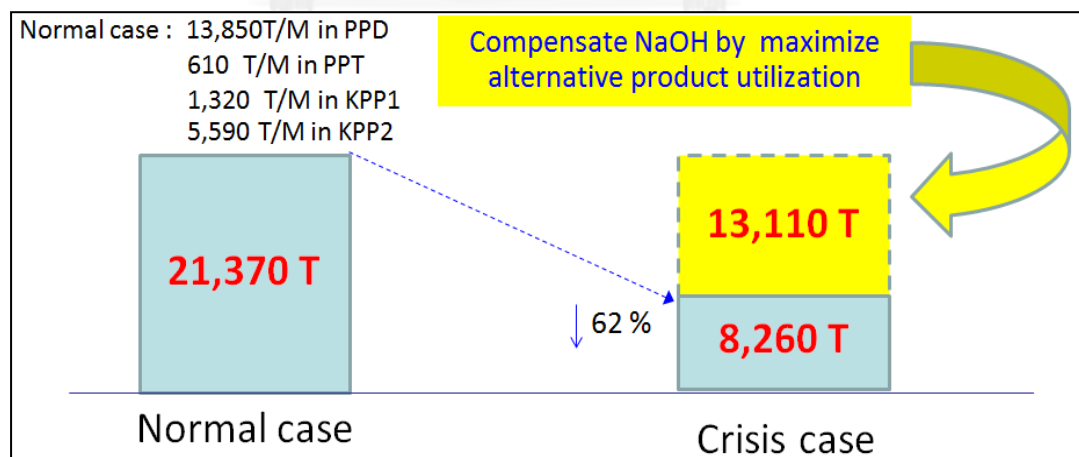


Figure 1. 11: The Caustic Soda Shortage Situation

As shown in the Figure 1.11, the consumption of caustic soda per month is 21,370 T. When the shortage situation occurred, the volume of supply is reduced to 8,260 T.

The conclusion of above problems can be stated as below.

#### In terms of raw material price

- No proper strategies for each raw material when performing the contract
- Loss bargaining power due to no competition atmosphere among the suppliers
- Long supply chain with more premium cost added, creating high unit offer price as a result

#### In terms of supply

- High risk due to no alternative products
- High risk due to no alternative sources and vendors
- Long supply chain creating more lead time and risks along the chain

### **1.4 Objective of Thesis**

The objective of this thesis is to improve the procurement of chemical raw material in a food seasoning production company in order to reduce cost for sourcing raw material and minimize risk in terms of supply.

### **1.5. Scope of Study**

The study will focus on minimize supply risk, make most of buying power and cost reduction for sourcing chemical raw material in class A and top five highest expenditure along with high supply risk from class B . The following topics will be included.

- 1). Classify the list of raw materials by using Pareto Analysis tool based on amount of annual expenditure into three classes (Appendix A)

#### Annual Expenditure Calculation

To calculate annual expenditure, it can be calculated by using contract unit cost multiply with contract volume as below equation. The contract unit cost is included raw material cost, transportation, exchange rate, premium cost, clearing charge, operation cost

and profit. However, this cost structure is depended on the nature of raw material such as domestic or import product.

Expenditure per contract = Contract Unit Cost X Contract Volume

Contract Unit cost structure = Raw material cost + Transportation cost + Exchange rate+ Premium Cost + Clearing charge+ Operation cost+ Profit

Amount of annual expenditure = The sum of total expenditure per contract in the particular year

### Word Definition

#### *Unit Cost:*

Unit cost refers to the contract price that supplier offers to buyer. There are several component costs are added in unit cost structure. Different raw material might have different unit cost structure. For example, the domestic raw material has no exchange rate, premium cost and clearing charge are added in the unit cost structure.

#### *Raw material Cost:*

Raw material cost is the cost of raw material itself. Mostly, raw material price is depended on demand and supply in a particular period.

#### *Transportation Cost:*

Transportation cost is the transaction cost of raw material. The transportation cost is depended on the delivery type agreement. ABC has two contract types which are delivery to factory and ex-factory

#### *Exchange rate:*

This value refers to the money exchange rate. It depends on appreciation and depreciation of Thai baht against the foreign rate.

*Premium Cost:*

Premium cost is the cost that each supplier added along the supply chain. The more number of suppliers or parties relevanted in the supply chain, the more premium costs are added along the chain.

*Clearing Charge:*

Clearing charge is the transaction fees. When the product arriving to the port, the shipping company has to pay for this cost.

*Operational Cost:*

Operational cost is the cost of business operating, producing or managing raw material such as warehousing cost and etc.

*Profit:*

Profit or margin is an added up price when supplier selling their product. Supplier is normally set up their profit as a fix percentage in their cost structure.

2). Only chemical raw material from class A and top five highest expenditure with high supply risk chemical raw material from class B are focused as shown in Table 1.4.

Table 1. 4: Selected Raw Materials from Class A and B

NO.	MATERIAL LIST	NO.	Amount	Cumulative	% total	Group
1	TAPIOCA STARCH	1	2,579,602,284.37	2,579,602,284.37	34.97	A
2	AMMONIA GAS 100% (NH <sub>3</sub> )	2	1,003,295,513.25	3,582,897,797.62	48.57	
3	RAW SUGAR	3	670,764,051.40	4,253,661,849.02	57.66	
4	INOSINE (Note: Will be Terminated)	4	335,203,822.40	4,588,865,671.42	62.21	
5	FUEL OIL "C"	5	302,268,615.43	4,891,134,286.85	66.31	
6	CAUSTIC SODA 32% (NaOH)	6	295,918,639.20	5,187,052,926.05	70.32	
7	SODIUM ACID PYROPHOSPHATE (Note: Will be Terminated)	7	284,003,180.60	5,471,056,106.65	74.17	
8	COAL	8	258,495,703.70	5,729,551,810.35	77.67	
9	HYDROCHLORIC ACID 35% (HCl)	9	219,808,978.40	5,949,360,788.75	80.65	
10	CAUSTIC SODA 50 % (NaOH)	10	185,142,824.00	6,134,503,612.75	83.16	
11	SULPHURIC ACID 98% (H <sub>2</sub> SO <sub>4</sub> 98%)	11	134,894,093.80	6,269,397,706.55	84.99	
12	TAPIOCA CHIP	12	128,728,354.17	6,398,126,060.72	86.74	
13	KEROSINE	13	121,343,464.60	6,519,469,525.32	88.38	
14	RICE HUSK	14	117,428,654.80	6,636,898,180.12	89.97	
15	CANE MOLASSES	15	105,966,157.80	6,742,864,337.92	91.41	
16	SOY BEAN MEAL	16	76,714,792.60	6,819,579,130.52	92.45	

17	UREA	17	75,801,334.00	6,895,380,464.52	93.48
18	POTASSIUM CHLORIDE	18	48,574,544.00	6,943,955,008.52	94.14
19	ANTIFORM GD-113K	19	44,082,857.50	6,988,037,866.02	94.73
20	SUCCINIC ACID	20	31,224,947.50	7,019,262,813.52	95.16
21	AMMONIUM CHLORIDE	21	26,408,532.34	7,045,671,345.86	95.51
22	AMIX- JAPAN	22	26,103,685.24	7,071,777,031.10	95.87
23	SODIUM TRIPOLYPHOSPHATE (STPP)	23	25,873,920.00	7,097,650,951.10	96.22
24	ACTIVATED CARBON S-5	24	25,005,000.00	7,122,655,951.10	96.56
25	SODA ASH (DENSE)	25	23,290,000.00	7,145,945,951.10	96.87
26	ANTIFOAM ANTIFOAM KAO FERMOL 1000	26	22,812,900.00	7,168,758,851.10	97.18
27	ENZYME DEXTROZYME GA	27	19,827,357.61	7,188,586,208.71	97.45
28	UF MODULE	28	19,800,000.00	7,208,386,208.71	97.72
29	ENZYME KLIESTASE E-5	29	18,088,419.00	7,226,474,627.71	97.97
30	ACTIVATED CARBON YL-303	30	17,097,500.00	7,243,572,127.71	98.20
31	FILTER AID CELATOM FW-20	31	16,179,062.85	7,259,751,190.56	98.42
32	ACTIVATED CARBON CALGON	32	12,245,987.50	7,271,997,178.06	98.58
33	PHOSPHORIC ACID (H3PO4 85%) FOOD GRADE	33	8,761,380.00	7,280,758,558.06	98.70
34	95% METHANOL	34	8,494,600.00	7,289,253,158.06	98.82
35	LPG	35	8,468,031.51	7,297,721,189.57	98.93
36	SUPER REFINED SUGAR(MSG)	36	7,537,640.00	7,305,258,829.57	99.03
37	PHOSPHORIC ACID (H3PO4 85%) FEED	37	7,378,510.00	7,312,637,339.57	99.13
38	DL METHIONINE	38	7,334,500.00	7,319,971,839.57	99.23
39	CALCIUM OXIDE (CaO)	39	7,071,797.00	7,327,043,636.57	99.33
40	BIOTIN (M GRADE)	40	6,539,643.00	7,333,583,279.57	99.42
41	ANTIFOAM COLORIN #102	41	5,585,000.00	7,339,168,279.57	99.49
42	AMIC C	42	4,923,100.00	7,344,091,379.57	99.56

Hence, there are ten selected raw materials for performing procurement improving in terms of price and supply. After apply the analyzing tools and models which are Five Force Analysis, Purchasing Portfolio Matrix (Figure 1.12) and Supply Positioning Model (Figure 1.13), the raw materials can be classified in to four different groups which are critical, bottleneck, leverage and routine.

		Power of Supplier		
		Low	Average	High
Power of Purchaser	High	Coal Sulfuric acid		
	Average		Caustic Soda Hydrochloric acid	Urea Ammonia Ammonium Chloride Potassium Chloride
	Low			Succinic GD-113

Figure 1. 12: Classify Raw Material into three groups by using Purchasing Portfolio Matrix

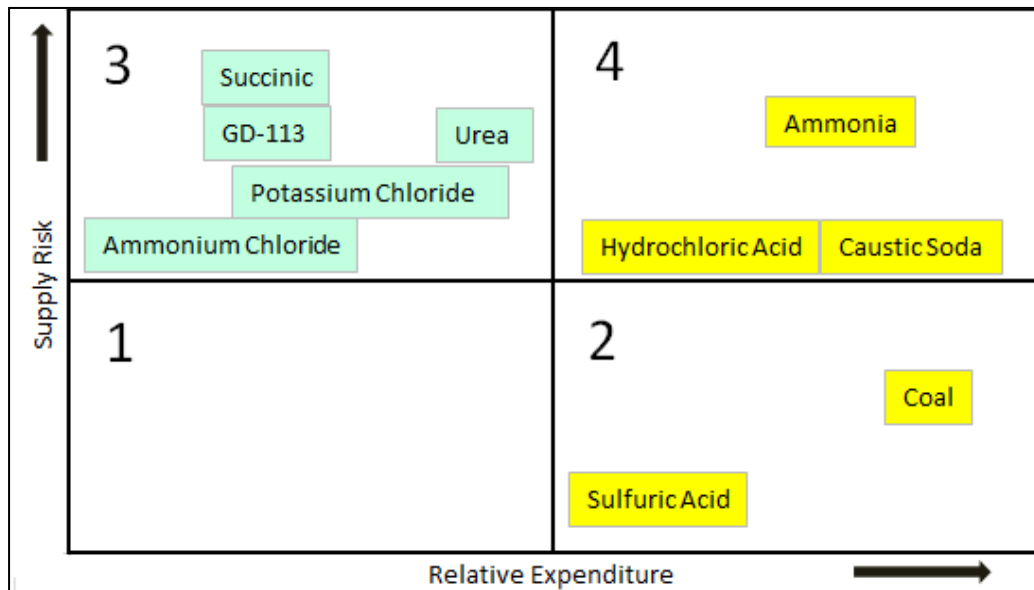


Figure 1. 13: Supply Positioning Model

(1. Routine position, 2. Leverage position, 3. Bottleneck position and 4. Strategic position)

### 1.6. Proposed Methodology

- 1). Classify the list of raw materials based on amount of annual expenditure into three classes which are class A, B and C ranking from highest expenditure to lowest
- 2). Select chemical raw material from class A and top five highest expenditure with high supply risk chemical raw material from class B in order to improve their supply along with cost reduction
- 3). Perform market analysis by using the Five Force model, the Competitive Rivalry within an Industry, Threat of new Entrants, Threat of Substitute Products, Bargaining Power of Suppliers and Bargaining Power of Customers are analyzed then, the level of the risk value is evaluated.
- 4). Plot the product to the strategic positioning, there are two models which are Supply Positioning Model and Purchasing Portfolio Matrix applied in this phase. The raw material risk value and company buying strength against the strengths of the supply market can be known respectively.
- 5). Set the action plan and strategy implementing to each selected raw material
- 6). Review result and create long term strategy



### 1.7. Expected Benefits

- 1). Can indicate the raw material position in terms of supply risk versus relative expenditure and relative bargaining power between supplier and buyer
- 2). Can create the action plan for improving supply management and cost reduction to each selected raw material
- 3). For the items that have an alternative, the breakeven point formula can be indicated and used in the real situation for deciding the contract
- 4). Can create competition atmosphere in order to make most of buying power with cost reduction as a target, by reducing the purchasing expenditures can therefore result in substantial improvements of the profit margin
- 5). For raw material with long supply chain, improve the supply route and find alternative source are needed to be achieve in order to minimize lead time and reduce risk as well

## CHAPTER II

### LITERATURE REVIEW

This chapter describes the related previous research and literature review. The review describes the important of purchasing and supply management. This session describes the important of purchasing department and function along with benefit for applying supply management to improve purchasing efficiency. Next, the four stages approach for improving purchasing efficiency is described. There are four steps which are classifying the list of raw material, performing the market analysis to each of raw material, locating the selected raw material to proper strategic position and creating the action plan at the end. The last session is conclusion which summary all of the literature review topics. The review topics are indicated below.

2.1 The important of purchasing and supply management

2.2 Measuring purchasing supply management and financial performance

2.2.1 Lever analysis

2.3 Four stages approach for improving purchasing efficiency

2.3.1 Phase 1: Classification

2.3.2 Phase 2: Market analysis

2.3.3 Phase 3: Strategic positioning

2.3.3.1 Supply positioning model

- Strategy for moving the matrix

2.3.3.2 Analyzing buyer and supplier power

- Purchasing Portfolio Matrix

2.1.4 Phase 4: Action plan

2.4 Conclusion

## 2.1 The important purchasing and supply management

Nowadays, purchasing is not concerned as a support department. It is considered as a strategic element of a company's structure. This due to the fact that there is high competition in term of the business operation, reduce cost along with increase revenue in order to gain high profit margin is the business target. Several manufacturing companies spend more than half of the sale turnover on purchased parts, raw material and services. As stated in Carl Fenson and Par Edin's research [5], the cost of goods sold is approximately 60 percent of the production value. Hence, the companies that able to enhance procurement understanding along with develop the buying process via supply management; they are not only reducing cost but also minimizing risk from raw material shortage as well.

## 2.2 Measuring purchasing supply management and financial performance

The scheme for measurement the purchasing & supply management and financial performance is stated in the Figure 2.1. As Evi Hartmann, Dieter Kerkfeld and Michael Henke's research stated [6], the performance of purchasing and supply management (PSM) outcome can be measured in two different perspectives. The first perspective is PSM performance outcomes. The second perspective is financial performance outcomes. In order to measure the PSM performance outcomes, there are five drivers as following.

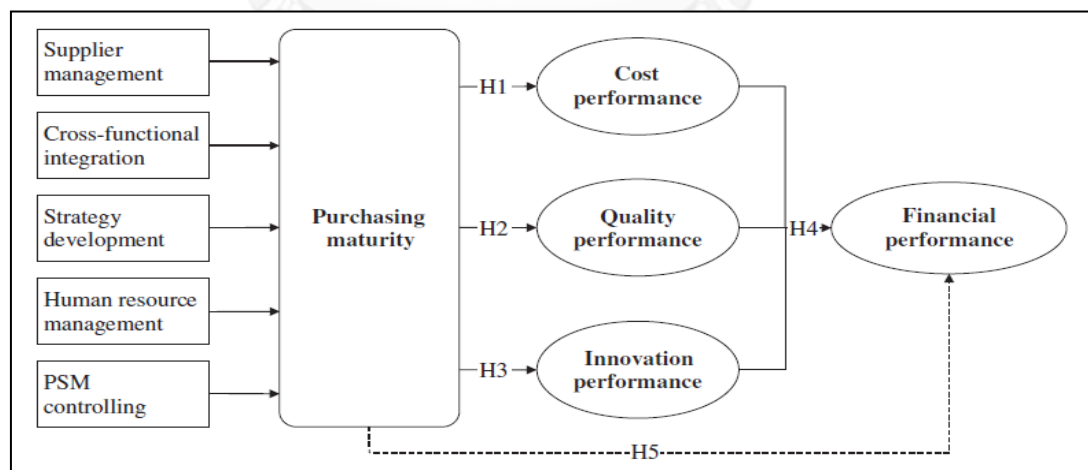


Figure 2. 1: Model of purchasing & supply management drivers and performance outcomes [6]

### 1). Supplier management

Supplier management is concerned as a core responsibility of PSM for dealing with the interface of supply base. The research states a shift for many categories away from the traditional emphasis on cost and quality toward increasing technological reliance on suppliers' capabilities to design processes and products. The growing of supply management on the supply base in order to create competitive advantages has increased the expectation of senior management about vendor performance [6]. Therefore, purchasing and supply management has a strong interest in managing the capabilities and performance of supply base [7].

### 2). Cross-functional integration

The cross-functional interaction and collaboration accentuates the PSM in terms of improvements with other functions such as product development, alternative product implementation and marketing. This indicates that the purchasing function is equally important to other strategic functions such as production, marketing or finance [8]. Before other functions consider inputs from PSM, they must accept it as being strategic and legitimate. Hence, by working as a cross-functional, it can indicate how well purchasing function is institutionally accepted and legitimized by other functions and senior management.

### 3). Strategy development

The purchasing and supply management strategy development has to support and consist to the firm's capabilities. This can be performed by three stages. First, PSM must have a formally written strategy. Second, PSM's strategy needs to be reviewed and adjusted regularly to match to the firm's strategy. Third, PSM's strategy requires to include a strategic category sourcing approach.

### 4). Human resource management

Purchasing professionalism is considered a significant antecedent to strategic purchasing [9]. Skill level has been found to be important in establishing an interface with technical functions especially when purchasing is integrated into new product

development project. As Carr and Smeltzer's research [10], they also stated that to fulfill the purchasing and supply improvement, human management is very significant point to concern. Develop and train over time along with appropriate allocated to tasks are the way to motivate PSM professionals to pursue the required development.

#### 5). Purchasing and supply management controlling

Performance measurement and control is not an easy exercise especially where purchasing and supply value chain are considered [11]. In order to perform PSM controlling, target setting and performance appraisals on the PSM team level have to create shared goals. This can encourage the responsibility toward the team and its individual members.

Purchasing can directly influence savings on materials and services by reducing the cost of purchased raw material over the time. Moreover, the contribution of purchasing to overall success exceeds cost reductions is supporting manufacturing performance [12] or innovation [13]. For the financial performance outcomes perspective, it is mainly focusing on cost reduction which concerned as a key of a financial. There are two main concepts emerged along this line. First, reductions in the costs of goods sold were attributed to PSM. Second, the utilization of PSM employees improved such as reduction in overhead costs. However, the second approach is attracted little to no interest from academia due to their over-simplicity.

To indicate the challenges at the output level, the cost, quality and innovation performances as stated as following are expected to illustrated direct operational benefits from improvements in PSM activity.

#### 1). Effect of PSM drivers on cost performance

As Carr and Pearson's research [14], cost savings are the primary target of PSM because it is influencing up to 80% of a firm's costs. The tackle of costs is from two ways. First, it can rationalize the demand for purchased goods and services on the business side. Second, it can lower the costs for goods and services on the supply side. On the business side, PSM can issue guidelines, substitute components and share resources. For

the supply side, PSM can create a supply base that offers the required goods and services at the lowest total cost which are purchasing price and logistic cost.

## 2). Effect of PSM drivers on quality performance

There are three factors affected to the quality performance which are optimizing the supply base, improving and developing the suppliers' capabilities and ensuring reliability of the supply chain to maintain the desired quality level. To implement a quality strategy, PSM needs to identify and select superior suppliers and monitor their performance [15]. There are defining, tracking and discussing performance measures of every supplier on a regular basis.

## 3). Effect of PSM drivers on innovation performance

Innovation can create cutting edge of product and service. It can differentiate themselves from competitors. The innovation can improve efficiency, quality, style and technology. PSM's access to its supply base opens the opportunity for several strategies along with significant innovations than companies could achieve alone from exploiting internal resources [16].

### 2.2.1 Lever Analysis

Lever analysis is a tool for measuring and identifying cost reduction. Identify the total cost of ownership (TCO) which is concerned as a purchasing tool aimed at understanding the true cost of purchasing especially service and goods from particular supplier [17] and perform in depth analysis of the relevant cost composition can lead to identify the proper cost reduction. The cost reduction can be performed by supplier consolidation such as leveraging volume and choosing best supplier or can be performed by innovation and continual improvement such as changing usage patterns and etc.[18]

Lever analysis has been applied by many consulting companies. This is a set of measurement of sourcing performance improvement in a commodity group. The traditional form of lever analysis considers six sourcing levers which are pooling, price evaluation, global sourcing, product optimization, process improvement and supply relationship [19]. However, there are 10 experts who had experience in over 100

commodity group saving projects, they revised lever workshop methodology in three firms, a seventh “commodity-spanned” lever was added [20] as shown in Figure 2.2.

However, all seven levers must be simultaneously considered in order to eliminate trade-offs. For example, the lever global sourcing may work against a strategy to intensify relationships in order to profit from local supply cluster [21].

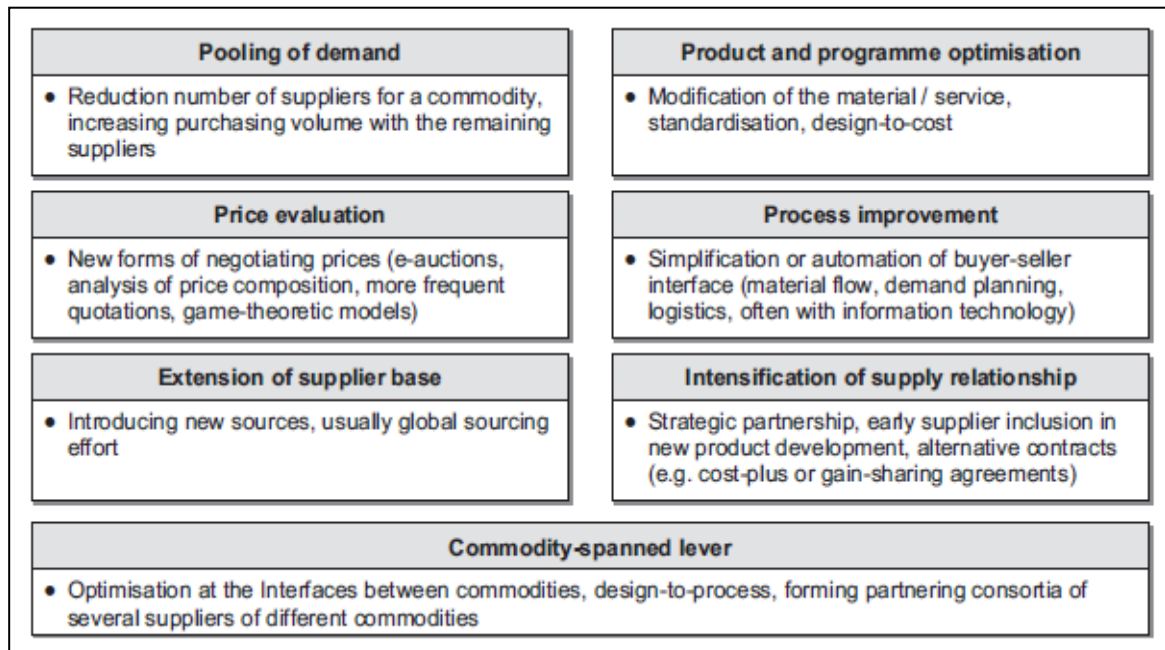


Figure 2. 2: The seven sourcing levers [20]

### 2.3 Four stages approach for improving purchasing efficiency

To minimize risk and make most of the potential of buying power, there are four stage approach indicated by Peter Kraljic [1] for achieving in this issue.

#### 2.3.1 Phase 1: Classification

First, the company has to classify its purchased materials or items. This can be classified by using volume of purchase basis, percentage of total purchase cost, expenditure cost or business growth. Using these criteria, the company can sort out all of the purchased items. Pareto analysis can be used as a helping tool in order to classify the list of the purchased raw material.

### 2.3.2 Phase 2: Market analysis

To perform the market analysis, Five Competitive Force can be used as a helping tool. As Michael E.Porter 's article [22], the five issues (show in Figure 2.3) for analyzing the market analysis are following.

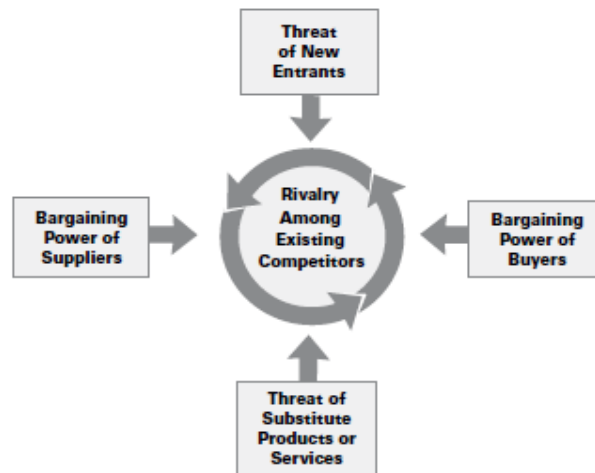


Figure 2. 3: The Five Forces that Shape Industry Competition [22]

#### 1). Threat of Entry

New entrants can bring new capacity along with desire to gain the current demand. This can increase the competition and pressure on prices, costs and the rate of investment in term of supply. Particularly to the new entrants who are diversifying from the markets can leverage the existing capabilities and cash flows to shake up competition. The threat of new entry depended on the entry barriers that available in the current market. If the entry barrier and current market competition are low, the threat of entry is high.

#### 2). Power of Suppliers

Suppliers that have a powerful power can charge higher prices, limit quality and service or shift cost to industry participants. If there is no alternative or substitute product available in the market, the supplier power will be enhance.



### 3). Power of Buyers

The customers who have power for negotiation can capture more value for price costing down; enhance product quality and more service from the supplier as well. The characteristic of powerful customer are indicated below.

- There are few purchasers with large amount of volumes relative to the size of the single vendor.
- If the buyers believe that the product is standard and can easily sourcing in the market, they tend to play one supplier against another in order to increase the purchasing power.
- If the switching cost for changing the product is low, the buyers will have more bargaining power and can change vendors whenever they require.

### 4). Threat of Substitute Product

The substitute product means the product that can perform the same or similar function as an industry's product. By having the substitute product, buyers tend to have more bargaining power in term of negotiation and compare the offer price between industry's product and substitute. The product that has a competitive position in term of price and supply will be chosen by buyer.

### 5). Rivalry among existing competitors

There are several rival forms among the existing competitors. There are advertising campaigns, service improvement, price discounting and new production introductions. With high rivalry of these factors can decrease the profitability of an industry. The factors that enhance the rivalry among existing competitors are following.

- There are several competitors existing in the current market. If the competitors are numerous or roughly equal in size and power, the company might find hard to survive in the business.
- The growth of industry can affect to the competition in the market. If the growth of industry is slow, this can precipitate the fight among the competitors in term of market share.

- If the exit barriers which are opposite to the entry barriers are high, these barriers can keep the companies in the market even they may gain low or negative returns. This brings about excess capacity remains in use in the supply market.

#### Consideration point for using Five Force Analysis

- Five Force Analysis can be used where there are at least three competitors in the market.
- The impact of the government should be concerned when performing the analysis.
- The dynamic or changing characteristics of the industry should be considered [23].

#### **2.3.3 Phase 3: Strategic positioning**

After performing classification and market analysis, the strategic positioning can be analyzed by using supply positioning model and purchasing portfolio matrix respectively.

##### 2.3.3.1 Supply Positioning Model (Kraljic's Approach)

To categorize the number of raw material, supply positioning model as shown in Figure 2.4 can be used. The model will indicate the allocation of resources across the organization as well as identifying appropriate procurement procedures in the Table 2.1. The materials can be classified into four groups as following.

- Critical or Strategic: High profit impact with high supply risk
- Bottleneck: Low profit impact with high supply risk
- Leverage: High profit impact with low supply risk
- Routine or noncritical: Low profit impact with low supply risk

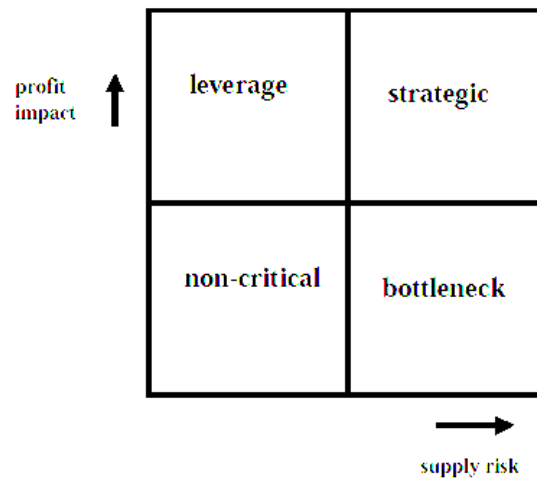


Figure 2. 4: Supply Positioning Model [24]

Table 2. 1: Main Tasks and Required Information of Supply Positioning Model [22]

Supply Position	Main Tasks	Required Information
<b>Strategic Items</b>	-Accurate demand forecasting	-Highly detailed market data
	-Detailed market research	-Long-term supply and demand trend
	-Development of long term supply relationships	-Good competitive intelligence
	-Risk analysis	-Industry cost curves
<b>Bottleneck Items</b>	-Control of Vendors	-Medium term supply and demand forecast
	-Security of inventories	-Very good market data
	-Back up plans	
<b>Leverage Items</b>	-Contract/spot purchasing mix	-Good market data
	-Vendor selection	-Short to medium term demand planning
	-Product substitution	-Accurate vendor data
	-Target pricing strategies and negotiations	-Price/transport rate forecast
	-Order volume optimization	
<b>Noncritical Items</b>	-Exploitation of full purchasing power	
	-Product standardization	-Good market overview
	-Order volume monitoring	-Short-term demand forecast
		-Economic order quantity inventory levels

As Marjolein C.J.Caniels and Cees J. Gelderman's research [25], the materials which are in the strategic quadrant in supply positioning model, both supplier and purchaser should have a good mutual understanding. Critical analysis in terms of the market, risk, optimization models, price forecasting including various other kinds of microeconomic analysis is needed. For the bottleneck quadrant, the purchaser should ensure a constant supply by keeping high stocks and specific market analysis is required.

For leverage quadrant, procurement department should let those suppliers prevail for the lowest offer price. E-procurement might be used for competitive bidding and short-term contract. Lastly, non-critical quadrant, the similar package of product with certain supplier is preferable. It is also possible to have only one supplier for several products.

Although there are other available models, supply positioning model or Kraljic's approach became the dominant approach to what the profession regards as operational professionalism [26]. As Lamming and Harrison's research stated [27], they also confirmed that supply positioning model remains the foundation of purchasing strategy for several organizations across different sectors.

#### Strategy for moving the matrix

In order to create strategy to each type of raw material in the supply positioning model, Marjolein C.J. Caniels and Cees J. Gelderman's research [25] states the strategy solution as following.

##### 1). Strategic Items

These items are concerned as value to the organization in term of large impact to the profit along with high supply risk. Strategic items are normally purchased from single source or one supplier causing a high supply risk to the company. The recommendation and scenario of supplier management in this position are following.

##### *Scenario 1: Maintain strategic partnership*

In order to balance the supply risk, company will aim to build the partnership relationship with supplier. The commitment and mutual trust that is associated with an intensified relationship is likely to reduce the supply risk to a minimum. With close relationship to supplier can improve the product quality, delivery, lead times and cost reduction. This situation can be characterized as one with balanced power between buyer and supplier hence, mutual dependence is expected to be high.

*Scenario 2: Accept a locked- in partnership*

This situation is concerned as supplier dominance while the buyer is in the unfavorable conditions. For example, the supplier might hold the patent to a certain product. Supplier and buyer in this condition are not much involved in the partnership as scenario 1 above.

*Scenario 3: Terminate a partnership*

When the supplier performance is unacceptable, the buyer should attempt to reduce the supplier dependence such as search for the alternative supplier or terminate in a partnership.

2). Bottleneck Items

These items have moderate influence on the firm financial result. The supplier trends to have dominant power. The recommend strategy for this product position is to reduce the negative effects of the unfavorable position such as find other suppliers and move towards the non-critical quadrant.

*Scenario 1: Accept dependence and reduce negative consequences*

This strategy is to ensure the supply even it needs to have an additional cost. For example, the company might keep the extra stocks of raw materials or develop consigned stock agreement with supplier.

*Scenario 2: Reduce dependence and risk, find other solutions*

This strategy aims to reduce the dependence of supplier. The company might broaden the specifications of the product or search for new supplier.

3). Leverage Items

These items are concerned as large share of the end product's cost price in combination with relative low supply risk. Obtain various suppliers can make buyer has several incentives and possibilities for negotiation. Only small percentages of cost savings usually involve large sums of money.

*Scenario 1: Exploit buying power*

Because suppliers and products are interchangeable, there are no needed for long term contract. Buyer might do the competitive bidding in order to dominance over the suppliers.

*Scenario 2: Develop a strategy partnership*

This scenario is concerned as a few practitioners. It is dealing about adopting the leverage to the strategic position. This cooperative strategy is only acceptable when the supplier is willing and able to competitive advantage of the buyer's firm.

4). Non-critical Items

The nature of the item in this position is having a small value per unit and many alternative suppliers can be found.

*Scenario 1: Pool purchasing requirements*

The main strategy is to enhance the purchasing power by bundling and standardization of purchasing requirements. This can reduce the cost of logistic and administrative complexity.

*Scenario 2: Individual ordering and efficient processing*

When the pool purchasing cannot apply, the purchaser might adopt some kind of individual ordering such as purchasing card application. This strategy attempts to reduce the indirect purchasing costs that are involved in administrative activities such as invoicing and ordering.

2.3.3.2 Analyzing buyer and supplier power

In order to determine the supplier versus buyer power, there are several supporting tools and models. In this thesis, the author describes the related tool which is purchasing portfolio matrix and relevant research which is buyer and supplier dependence.

### Purchasing Portfolio Matrix

This tool can identify areas of opportunity or vulnerability, assess supply risks and derive basic strategic thrusts for the purchasing product. The Purchasing Portfolio Matrix plots the power of purchasing against the power of supplier. This can be used for develop counterstrategy or reverse marketing as well. There are three basic categories shown in the Figure 2.5, each associated with a different strategic thrust as following.

- Exploit: Items where the company plays a dominant market role while suppliers' strength is rated medium or low.
- Diversify: Items where the company's role in the supply market is secondary while suppliers are strong.
- Balance : Items with neither major visible risks nor major benefits

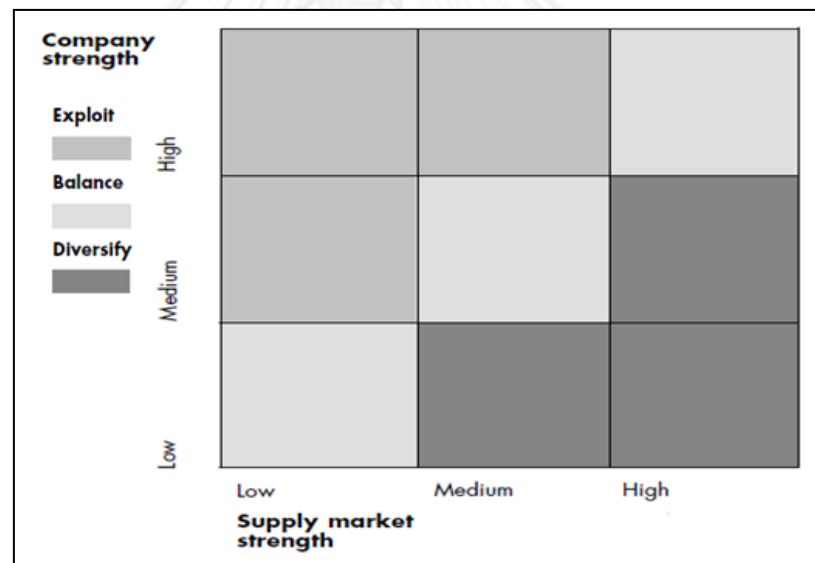


Figure 2. 5: Purchasing Portfolio Matrix [1]

As Kornelius and Van Stekelenborg research [28] stated, there is not enough for only focusing on the power balance between buyer and supplier. To exploit the buyer power can be a strategy that works in a short term especially in term of cost reduction but not permanent achieve in the long run. However, the main critique concerns the need of model in order to assist in the management of the company's entire portfolio of relationship.

### Relevant research

As referencing from the Marjolein C.J. Caniels and Cees J. Gelderman's research [25], the different in buyer and supplier perspective is analyzed in order to compare and analyze for the interdependency.

Table 2. 2: Buyer and supplier interdependency [25]

Construct Components	Buyer's dependence	Supplier's dependence
Logistic	Logistical indispensability	Financial magnitude
Technology	Need for supplier's technological expertise	Need for buyer's technological expertise
Availability of	Availability of alternative suppliers	Availability of alternative buyers
Switching costs	Switching costs buyer	Switching costs supplier

As the Table2.2 shows, the dependency of each construct components is different depending on the perspective side (buyer or supplier). For the logistic based dependence, the buyer focuses on the way of receiving goods. The logistic congruent to buyer's production system and correct delivery of goods are significantly concerned while the main consideration for supplier is the financial nature. For the technology issue, the need for the technological expertise is critical for both parties. The buyer requires for the advanced technology from the suppliers. Hence, supplier has to increase the critical specialized to the customers. For the alternative sources and products, buyer and supplier are depended on each other. When buyer invests specific dedicated equipment with specific supplier, this will result in high switching costs if the relationship is terminated.

#### 2.3.4 Phase 4: Action plan

After performing the product and supplier analysis, the company should create both short term and long term plan. To plan and apply the purchasing strategy to each type of raw material position is different depending on the nature of the product and supply. For instance, the priority purchasing strategy for the bottleneck items where the supplier's strength is more than the buyer, minimize the risk is highly concerned rather than cost reduction. Adding for the extra inventory cost should be performed due to supplier and source limitation. On the other hand, the priority for leverage item is cost reduction concern. Several suppliers available in the market can enhance the buyer



power to create competition atmosphere among the supplier in order to lowering the unit cost as much as possible.

## 2.4 Conclusion

Purchasing department is not concerned as a support department. It is concerned as a strategic department dealing with cost of company. To have a good result in company financial performance, it is significantly relied on how well purchasing and supply management operation in terms of supplier management, cost functional integration, strategy development, human resource management, purchasing and supply control. In order to improve the purchasing efficiency in terms of risk and cost reduction, the company can apply the four stages approach. Firstly, purchased raw material must be classified. It can be classified based on purchased volume, percentage of total purchase cost or business growth. Secondly, performing the market analysis by using Five Force Analysis as a helping tool, this can give the result in terms of the qualitative or/and quantitative. Thirdly, performing the strategic positioning, this can located the item positioning in order to apply the proper strategy. Normally, the supply positioning model and purchasing portfolio matrix can be used in this stage. By plotting risk score versus expenditure in supply positioning model, the product position can be known. For the purchasing portfolio analysis, power of buyer versus power of supplier can be plotted in order to know the relative power between buyer and supplier. Finally, the action plan can be created to each selected raw material by using the analyzed information from the previous phases.

Hence, by proper analyzing the product position along with observe from the current problem situation, the worker can create the right strategy to the right item. This can improve the purchasing efficiency in terms of risk management and cost reduction both short term and in the long run.

## CHAPTER III

### PRELIMINARY STUDY

This chapter describes about the raw material analysis. Five force analysis is a main tool for analyzing the current situation of each raw material especially for the company risk impact. In order to be more concrete in terms of risk analysis, quantitative measurement is defined as a risk value number. These risk values along with other analyzed information can be one of the significant data for locating raw material position in the supply positioning model and purchasing portfolio model respectively.

#### **3.1 Purposes**

The preliminary study was created and conducted in order to satisfy the following purposes:

- 1). To analyze the market current situation by using five force analysis model in order to know the risk score value
- 2). To classify raw material position by using supply positioning model along with purchasing portfolio matrix in order to apply the proper strategy to each raw material

#### **3.2 Objectives**

The major objectives of the preliminary study are following.

- 1). To rank raw material expenditure into three different classes by using Pareto analysis and select the class that needs to focus
- 2). To analyze the current market situation in five different aspects which are competitive rivalry within an industry, threat of new entrances, threat of substitute material, bargaining power of supplier and bargaining power of buyer in order to know the risk score value as a result
- 3). To classify the raw material position in term of supply risk versus relative expenditure into four different groups which are strategic, bottleneck, leverage and non-critical in order to apply the proper strategy
- 4). To compare the power of buyer and supplier in each raw material in order to create proper strategy

### 3.3 Scope of the preliminary study

The scope of the preliminary will focus on the chemical raw material in class A and top five highest expenditure chemical raw materials from class B which also have high risk in terms of monopoly supplier, long supply chain with high expenditure.

#### 3.3.1 Procedure

The procedure for classify and locate raw material position can be separated into 4 steps as following.

##### 1.) Apply Pareto Analysis

Using Pareto Analysis based on amount of annual expenditure in order to rank the raw material expenditure from highest to lowest. Those raw materials can be separated into three classes which are class A (20% of raw material can generate the 80% of expenditure), class B (30% of raw material can generate 15% of expenditure) and class C (50% of raw material can generate 5% of expenditure) as shown in Appendix A.

Due to our scope of research, only chemical raw materials are focused. The highest to lowest expenditure of chemical raw material in class A and top five highest expenditure raw materials from class B which also have high risk in terms of monopoly supplier, long supply chain with high expenditure. The list of selected improving raw materials is following (shows in Table 3.1).

Table 3. 1: Selected Raw Materials from Class A and B

NO.	MATERIAL LIST	NO.	Amount	Cumulative	% total	Group
1	TAPIOCA STARCH	1	2,579,602,284.37	2,579,602,284.37	34.97	A
2	AMMONIA GAS 100% (NH <sub>3</sub> )	2	1,003,295,513.25	3,582,897,797.62	48.57	
3	RAW SUGAR	3	670,764,051.40	4,253,661,849.02	57.66	
4	INOSINE (Note: Will be Terminated)	4	335,203,822.40	4,588,865,671.42	62.21	
5	FUEL OIL "C"	5	302,268,615.43	4,891,134,286.85	66.31	
6	CAUSTIC SODA 32% (NaOH)	6	295,918,639.20	5,187,052,926.05	70.32	
7	SODIUM ACID PYROPHOSPHATE (Note: Will be Terminated)	7	284,003,180.60	5,471,056,106.65	74.17	
8	COAL	8	258,495,703.70	5,729,551,810.35	77.67	
9	HYDROCHLORIC ACID 35% (HCl)	9	219,808,978.40	5,949,360,788.75	80.65	
10	CAUSTIC SODA 50 % (NaOH)	10	185,142,824.00	6,134,503,612.75	83.16	
11	SULPHURIC ACID 98% (H <sub>2</sub> SO <sub>4</sub> 98%)	11	134,894,093.80	6,269,397,706.55	84.99	
12	TAPIOCA CHIP	12	128,728,354.17	6,398,126,060.72	86.74	
13	KEROSINE	13	121,343,464.60	6,519,469,525.32	88.38	
14	RICE HUSK	14	117,428,654.80	6,636,898,180.12	89.97	
15	CANE MOLASSES	15	105,966,157.80	6,742,864,337.92	91.41	
16	SOY BEAN MEAL	16	76,714,792.60	6,819,579,130.52	92.45	

17	UREA	17	75,801,334.00	6,895,380,464.52	93.48
18	POTASSIUM CHLORIDE	18	48,574,544.00	6,943,955,008.52	94.14
19	ANTIFORM GD-113K	19	44,082,857.50	6,988,037,866.02	94.73
20	SUCCINIC ACID	20	31,224,947.50	7,019,262,813.52	95.16
21	AMMONIUM CHLORIDE	21	26,408,532.34	7,045,671,345.86	95.51
22	AMIX- JAPAN	22	26,105,685.24	7,071,777,031.10	95.87
23	SODIUM TRIPOLYPHOSPHATE (STPP)	23	25,873,920.00	7,097,650,951.10	96.22
24	ACTIVATED CARBON S-5	24	25,005,000.00	7,122,655,951.10	96.56
25	SODA ASH (DENSE)	25	23,290,000.00	7,145,945,951.10	96.87
26	ANTIFOAM ANTIFOAM KAO FERMOL 1000	26	22,812,900.00	7,168,758,851.10	97.18
27	ENZYME DEXTROZYME GA	27	19,827,357.61	7,188,586,208.71	97.45
28	UF MODULE	28	19,800,000.00	7,208,386,208.71	97.72
29	ENZYME KLIESTASE E-5	29	18,088,419.00	7,226,474,627.71	97.97
30	ACTIVATED CARBON YL-303	30	17,097,500.00	7,243,572,127.71	98.20
31	FILTER AID CELATOM FW-20	31	16,179,062.85	7,259,751,190.56	98.42
32	ACTIVATED CARBON CALGON	32	12,245,987.50	7,271,997,178.06	98.58
33	PHOSPHORIC ACID (H3PO4 85%) FOOD GRADE	33	8,761,380.00	7,280,758,558.06	98.70
34	95% METHANOL	34	8,494,600.00	7,289,253,158.06	98.82
35	LPG	35	8,468,031.51	7,297,721,189.57	98.93
36	SUPER REFINED SUGAR(MSG)	36	7,537,640.00	7,305,258,829.57	99.03
37	PHOSPHORIC ACID (H3PO4 85%) FEED	37	7,378,510.00	7,312,637,339.57	99.13
38	DL METHIONINE	38	7,334,500.00	7,319,971,839.57	99.23
39	CALCIUM OXIDE (CaO)	39	7,071,797.00	7,327,043,636.57	99.33
40	BIOTIN (M GRADE)	40	6,539,643.00	7,333,583,279.57	99.42
41	ANTIFOAM COLORIN #102	41	5,585,000.00	7,339,168,279.57	99.49
42	AMIC C	42	4,923,100.00	7,344,091,379.57	99.56

B

#### Selected raw material from Class A

- Ammonia
- Caustic Soda 32% and 50%
- Coal
- Hydrochloric acid
- Sulfuric acid

#### Selected raw material from Class B

- Urea
- Potassium Chloride
- Antifoam GD-113
- Succinic acid
- Ammonium Chloride

## 2). Apply Five Force Analysis

Each selected raw material has to perform the current market analysis. The author applies Five Force Analysis as a helping tool in order to analyze in five different views which are competitive rivalry within an industry, threat of new entrances, threat of substitute material, bargaining power of supplier and bargaining power of buyer in order to know the risk score value as a result. As John F. Rice' publication [25], performing brainstorming session is a potential way to scoring the risk in each force. Hence, the author uses this method to score the risk value in each force. Purchasing manager, division manager, senior supervisor and in charge purchaser have a meeting session and conclude for the average risk score value in each selected raw material as shown in the Appendix B.

### 2.1) Ammonia (NH<sub>3</sub>)

#### Background

- The main raw material for producing ammonia is natural gas while the product of ammonia is urea using in the fertilizer industry.
- This raw material is used in every ABC production plans which are PPD, PPT, KPP and AYT. Its function is to provide nitrogen supplied to the ferment bacteria in fermentation production phase.
- There are two current suppliers which are A Co.,Ltd and B Co.,Ltd supplied ammonia to ABC.
- In PPD and KPP production plant, the tank owner is A Co., Ltd. Hence, these two plants can receive ammonia only from A Co.,Ltd. However, in PTT and AYT production, ABC is the tank owner. Hence, these two production plants can receive ammonia from both suppliers.
- It is concerned as a highest expenditure of chemical raw material in class A.
- The risk score values from Five Force Analysis are shown in the Table 3.2 to Table 3.6.

Table 3. 2: Competitive Rivalry within an Industry (Force 1)

Force 1: Competitive Rivalry within an Industry							
Consideration Point	Current Situation	Impact Factor	Purchasing Manager	Division Manager	Senior Supervisor	In charge Purchaser	Average risk Score
Number of supplier	- 6-10 Ammonia's traders in Thailand with total import volume approximately 600,000 MT/year	External	2	2	2	2	2.00
	- Only two suppliers with same sources supplying this raw material	Internal	4	3	3	4	3.50
Growth rate of Ammonia Business	- Growth rate of Ammonia business is around 4.86% YoY	External	3	3	3	3	3.00
ABC Ammonia facility tank	- In some production plant, the Ammonia facility tank is invested by specific supplier. Hence, it is limited in term of supply due to the contract.	Internal	4	4	4	4	4.00
Total Average Risk Score							3.13

Table 3. 3: Threat of New Entrances (Force 2)

Force 2: Threat of New Entrances							
Consideration Point	Current Situation	Impact Factor	Purchasing Manager	Division Manager	Senior Supervisor	In charge Purchaser	Average risk Score
Capital requirements	- Require high standard of storage tank system and transportation safety devices	External	4	4	4	4	4.00
Special skills	- Require a specific safety and operation training	External	4	4	4	4	4.00
Market defensive from current ABC supplier	- It is quite high competition in order to enter to supply Ammonia to ABC due to the tank owner.	Internal	4	4	4	4	4.00
Cash flow	- The cash flow in each shipment is very high with vary transportation sizes between 560 to 1,496 MT per shipment.	External	4	4	4	4	4.00
Total Average Risk Score							4.00

Table 3. 4: Threat of Substitute Material (Force 3)

Force 3: Threat of Substitute Material							
Consideration Point	Current Situation	Impact Factor	Purchasing Manager	Division Manager	Senior Supervisor	In charge Purchaser	Average risk Score
Alternative material	- Urea can be used as an alternative product of Ammonia because it is also contained the nitrogen component and concerned as a commercial product.	External	4	3	4	4	3.75
Switching Cost	- There is low switching cost in PPD and AYT production plant while high switching cost in PTT and KPP production plant because there are no dissolving tanks in these two factories.	Internal	4	4	3	3	3.50
Pricing of alternative material	- Because urea is concerned as a commercial product so, price can be predictable and competitive than Ammonia in some period.	External	4	4	4	4	4.00
Total Average Risk Score							3.75

Table 3. 5: Bargaining Power of Supplier (Force 4)

Force 4: Bargaining power of supplier							
Consideration Point	Current Situation	Impact Factor	Purchasing Manager	Division Manager	Senior Supervisor	In charge Purchaser	Average risk Score
Supplying source	- The main raw material for producing ammonia is natural gas with several supply sources.	External	2	2.5	2	2	2.13
Availability of natural gas	- There is high availability for supply Natural gas especially in Middle East	External	2	2	2	2.5	2.13
Supplier supply chain	- Due to large and global standard company, supplier can well manage their supply chain. However, quantity of Ammonia supply is depended on urea demand in some of period (fertilizer season).	External	3	3	3.5	3	3.13
Total Average Risk Score							2.46

Table 3. 6: Bargaining Power of Buyer (Force 5)

Force 5: Bargaining power of buyer							
Consideration Point	Current Situation	Impact Factor	Purchasing Manager	Division Manager	Senior Supervisor	In charge Purchaser	Average risk Score
Switching cost	- There is high switching cost for switching supplier because high cost of installation a new tank and special operation, storage and transportation.	Internal	4	4	3.5	4	3.88
Supply limitation	- It is limited in term of tank facility in PPD and KPP production plan. Hence, only Unique gas supplier can supply for these two plants.	Internal	4	4	4	4.5	4.13
Potential Supplier	- There are less potential suppliers supplied Ammonia to ABC.	Internal	3	3.5	2.5	3	3.00
Total Average Risk Score							3.67

2.2) Caustic Soda 32% (32%NaOH) and Caustic Soda 50% (50%NaOH)

2.3) Hydrochloric acid 35% (35%HCl)

#### Background

- Because Caustic Soda 32% (32%NaOH), Caustic Soda 50% (50%NaOH) and Hydrochloric acid 35% (35%HCl) have same market and supply situation. Hence, they can be simultaneous analyzed.
- Caustic Soda 32% is in rank 2 of class A chemical raw material. This costs 295,918,639.20 THB per annual. Caustic Soda 50% is in rank 5 of class A chemical raw material with cost 185,142,824.00 per annual.
- Hydrochloric acid also uses in every ABC production plants. It is in rank 4 of chemical raw material. This costs 219,808,978.40 THB per annual.

- The risk score values from Five Force Analysis are shown in the Table 3.7 to Table 3.11.

Table 3. 7: Competitor Rivalry within an Industry (Force 1)

Force 1: Competitive Rivalry within an Industry							
Consideration Point	Current Situation	Impact Factor	Purchasing Manager	Division Manager	Senior Supervisor	In charge Purchaser	Average risk Score
Number of supplier	- There are limited in local manufacturers, only 6 plants in Thailand.	External	4.5	4.5	4.5	4.5	4.50
	- There are 4 suppliers supplied this raw material to ABC.	Internal	3.5	3.5	3.5	3.5	3.50
Business growth rate	- With high customer demand of chlor-alkali, the growth rate of this business is high. However, caustic soda and hydrochloric acid production is relied on each other due to co-product. For example, with high demand of caustic soda and low demand of hydrochloric acid, to increase production rate of caustic soda is limited by hydrochloric acid.	External	4	4	4	4	4.00
Total average risk score							4.00

Table 3. 8: Threat of New Entrants (Force 2)

Force 2: Threat of New Entrants							
Consideration Point	Current Situation	Impact Factor	Purchasing Manager	Division Manager	Senior Supervisor	In charge Purchaser	Average risk Score
Specific Skill	- Chlor-alkali industry not requires specific technology (only electrolysis of Sodium Chloride)	External	3	3	3.5	3	3.13
Investment Capital	- High capital is needed for installation of new electrolyze membrane and the construction of new plant.	External	4	4	4	3.5	3.88
Total average risk score							3.50

Table 3. 9: Threat of Substitute Product (Force 3)

Force 3: Threat of Substitute Product							
Consideration Point	Current Situation	Impact Factor	Purchasing Manager	Division Manager	Senior Supervisor	In charge Purchaser	Average risk Score
Available of substitute product	- The substitute product for Caustic soda is Sodium carbonate. The substitute product for Hydrochloric acid is sulfuric acid.	External	2	3	3	2	2.50
ABC switching cost	- Some plant of ABC can promptly use an alternative product due to available of facility (PPD). However, there are some plant that not promptly use an alternative as well.	Internal	4	4	4	4	4.00
Total average risk score							3.25



Table 3. 10: Bargaining Power of Supplier (Force 4)

Force 4: Bargaining Power of Supplier							
Consideration Point	Current Situation	Impact Factor	Purchasing Manager	Division Manager	Senior Supervisor	In charge Purchaser	Average risk Score
Bargaining power to their supplier	- The bargaining power to their supplier is quite high due to large volume negotiation.	External	2	2.5	2	2	2.13
Supply chain	- Supplier can well manage their supply chain. Moreover, trader also has a strong relationship among their suppliers.	External	2	2.5	2	2	2.13
Total average risk score							2.13

Table 3. 11: Bargaining Power of Customer (Force 5)

Force 5: Bargaining Power of Customer							
Consideration Point	Current Situation	Impact Factor	Purchasing Manager	Division Manager	Senior Supervisor	In charge Purchaser	Average risk Score
ABC bargaining power	- With huge consumption volume along with many suppliers in the market, ABC bargaining power is quite high.	Internal	2	2	3	2	2.25
Supplier perception to ABC	- ABC is in the develop or core position in supplier perception.	Internal	2	2	2	2	2.00
Total average risk score							2.13

#### 2.4) Coal

##### Background

- Coal is used as steam energy for co-generator in PTT factory.
- There are 7 current approved suppliers.
- It is in rank 3 of chemical raw material with 258,495,703.70 THB per annual.
- The cost of this raw material comes from two parts. The first is the cost of coal itself. The second part is ash treatment cost.
- The nature of coal is not concerned as a chemical raw material. However, it is also responsible by chemical purchasing team so, coal is also classified as a chemical raw material in this thesis
- The risk score values from Five Force Analysis are shown in the Table 3.11 to Table 3.15.

Table 3. 12: Competitive Rivalry within an Industry (Force 1)

Force 1: Competitive Rivalry within an Industry							
Consideration Point	Current Situation	Impact Factor	Purchasing Manager	Division Manager	Senior Supervisor	In charge Purchaser	Average risk Score
Number of supplier	- There are several coal suppliers in Thailand.	External	2	2	2	2	2.00
	- ABC also has many approved suppliers (7 vendors).	Internal	2	2	2.5	2	2.13
Thailand coal market	- Coal business is continuously growth because of its competitive price when compare to Fuel oil.	External	2	1.5	2	2	1.88
Policy and control	- With environmental concern, coal business might be prohibited to construct stockpile in vicinity to the community area.	External	4	4	4	4	4.00
Total average risk score							2.50

Table 3. 13: Threat of New Entrances (Force 2)

Force 2: Threat of New Entrances							
Consideration Point	Current Situation	Impact Factor	Purchasing Manager	Division Manager	Senior Supervisor	In charge Purchaser	Average risk Score
Capital Investment	- High investment in term of transportation, stockpile, crusher and sieving machine including environmental pollution concern	External	3	3.5	3	3	3.13
Cash flow	- Due to huge volume of each shipment (10,000-100,000T), high cash flow will be involved which is around 24 million THB per shipment.	External	3	3	2.5	3	2.88
Market defensive	-There are several coal businesses in Thailand hence, it might be difficult for new entranes to make brand and famous in this business field.	External	3	3	3	2.5	2.88
Market defensive of ABC current supplier	- ABC highly concerns about coal quality and there are also several approved suppliers in hand. Hence, it might be difficult to enter to ABC.	Internal	3	2	3	3.5	2.88
Total average risk score							2.94

Table 3. 14: Threat of Substitute Product (Force 3)

Force 3: Threat of Substitute Product							
Consideration Point	Current Situation	Impact Factor	Purchasing Manager	Division Manager	Senior Supervisor	In charge Purchaser	Average risk Score
Available of substitute product	- Fuel oil can be an alternative material for coal.	External	2	2	3	2.5	2.38
Switching cost	- It takes high switching cost due to different boiler specification between coal and fuel oil. However, fuel oil is high price when compare with coal price.	External	3	3	2.5	3	2.88
Total average risk score							2.63

Table 3. 15: Bargaining Power of Supplier (Force 4)

Force 4: Bargaining Power of Supplier							
Consideration Point	Current Situation	Impact Factor	Purchasing Manager	Division Manager	Senior Supervisor	In charge Purchaser	Average risk Score
Supply source	- There are more than 100 coal sources in the global. However, the major supply source in Asia is from Indonesia.	External	2	2	2	2	2.00
Supplier supply chain	- Traders have a good relationship with supplier. Normally, they perform contract with supplier as a long term contract.	External	2	2.5	2	2	2.13
Cost of switching sources and suppliers	- Because there are plenty of available sources and suppliers, the switching cost is low.	External	2	2	1.5	2	1.88
Total average risk score							2.00

Table 3. 16: Bargaining Power of Customer (Force 5)

Force 5: Bargaining Power of Customer							
Consideration Point	Current Situation	Impact Factor	Purchasing Manager	Division Manager	Senior Supervisor	In charge Purchaser	Average risk Score
ABC bargaining power	- ABC uses high volume of coal per day (330 MT/day) but requires specific size which is 5-10 mm. with highly quality concern. Hence, the bargaining power is moderate.	Internal	3	3	2.5	2	2.63
ABC switching cost	- The switching cost for changing supplier is low.	Internal	2	3	2.5	2.5	2.50
Total average risk score							2.56

## 2.5) Sulfuric acid 98% (98% H<sub>2</sub>SO<sub>4</sub>)

### Background

- Sulfuric acid is used in every ABC production plant (PPD,PTT,KPP and AYT).
- It is used for adjust pH in order to crystallized glutamic.
- There are five approved current vendors supplied this raw material to ABC.
- The annual expenditure is 134,894,093.80 THB with rank number 6 of chemical raw material in class A.
- The risk score values from Five Force Analysis are shown in the Table 3.17 to Table 3.21.

Table 3. 17: Competitive Rivalry within an Industry (Force1)

Force 1: Competitive Rivalry within an Industry							
Consideration Point	Current Situation	Impact Factor	Purchasing Manager	Division Manager	Senior Supervisor	In charge Purchaser	Average risk Score
Number of supplier	- There are several import traders and local makers supplied this material.	External	2	2	2	2	2.00
	- ABC has five approved vendors supplied this raw material.	Internal	2	2.5	2	2	2.13
Growth rate in this business	- The growth rate in this business is quite high.	External	2	2	1.5	2	1.88
Total average risk score							2.00

Table 3. 18: Threat of New Entrances (Force 2)

Force 2: Threat of New Entrances							
Consideration Point	Current Situation	Impact Factor	Purchasing Manager	Division Manager	Senior Supervisor	In charge Purchaser	Average risk Score
Capital Investment	- This business can be separated into two investment types. First is sulfuric local maker which requires huge capital investment (Plant operation and maintenance, warehouse and transportation). Second is import trader. This type will require less capital investment (just warehouse and transportation).	External	2	2.5	2	2	2.13
Specific Skill	- Medium of specific skill	External	2	1.5	2	2	1.88
Total average risk score							2.00

Table 3. 19: Threat of Substitute Product (Force 3)

Force 3: Threat of Substitute Product							
Consideration Point	Current Situation	Impact Factor	Purchasing Manager	Division Manager	Senior Supervisor	In charge Purchaser	Average risk Score
Available substitute product	- Hydrochloric acid can be an alternative material to Sulfuric acid. This is because they have same functionality giving proton in order to adjust the pH. However, user ,normally, prefers to use sulfuric acid. Because hydrochloric acid can encourage tank corrosive more than sulfuric acid. This will cause large amount of maintenance cost.	External	3	3	3	2.5	2.88
Switching Cost	- Switching cost for using alternative material (hydrochloric acid) is very high. It needs to construct a new pipe line with high resistance to the corrosiveness.	External	3	3	3.5	3	3.13
Total average risk score							3.00

Table 3. 20: Bargaining Power of Supplier (Force 4)

Force 4: Bargaining Power of Supplier							
Consideration Point	Current Situation	Impact Factor	Purchasing Manager	Division Manager	Senior Supervisor	In charge Purchaser	Average risk Score
Bargaining Power to supplier	- Traders have bargaining power in order to negotiate with their supplier due to large volume per contract.	External	2	2	2	2	2.00
Source of Raw material	- There are several available sources of raw material (sulfur) especially in Korea.	External	2	2.5	2	2	2.13
Supplier supply chain	- Supplier can well manage their supply route with on time delivery to trader.	External	2	2	1.5	2	1.88
Total average risk score							2.00

Table 3. 21: Bargaining Power of Customer (Force 5)

Force 5: Bargaining Power of Customer							
Consideration Point	Current Situation	Impact Factor	Purchasing Manager	Division Manager	Senior Supervisor	In charge Purchaser	Average risk Score
Number of buyer in the market	- There are several buyers in the market.	External	4	4	4	4	4.00
ABC bargaining power	- Because ABC has many approved suppliers in hand with high consumption demand. This can encourage the bargaining power in order to negotiate with supplier.	Internal	2	2.5	2	2	2.13
Supplier perception to ABC	- ABC is in between develop and core customer position to the suppliers.	Internal	2	2	1.5	2	1.88
Total average risk score							2.67

## 2.6) Urea 46% (46% CO(NH<sub>2</sub>)<sub>2</sub>)

### Background

- Urea can be use as an alternative of Ammonia. This is because there is also available of nitrogen containment approximately 44-46%. However, ABC uses urea with a few ratio when compare with ammonia even urea is more competitive price in some period.
- Its fuction is to provide nitrogen soure supplied to ferment bacteria in fermentation production phase.
- There is only one supplier supplied urea to ABC.
- It is concern as highest expenditure of chemical raw material in class B. The urea expenditure per annual is 75,801,334 THB.
- The risk score values from Five Force Analysis are shown in the Table 3.22 to Table 3.26.

Table 3. 22: Competitive Rivalry within an Industry (Force 1)

Force 1: Competitive Rivalry within an Industry							
Consideration Point	Current Situation	Impact Factor	Purchasing Manager	Division Manager	Senior Supervisor	In charge Purchaser	Average risk Score
Number of supplier	- There are several suppliers with many supply sources such as Indonesia, Malaysia and Middle East imported Urea to Thailand.	External	2	2	2	2	2.00
	- There is only supplier supplied this raw material to ABC.	Internal	5	4.5	5	5	4.88
Import Volume	- Urea import volume quite stable. It is approximately 2 million MT imported Urea per annual.	External	2	2	2.5	2	2.13
Total Average Risk Score							3.00

Table 3. 23: Threat of New Entrances (Force 2)

Force 2: Threat of New Entrances							
Consideration Point	Current Situation	Impact Factor	Purchasing Manager	Division Manager	Senior Supervisor	In charge Purchaser	Average risk Score
Capital Requirement	- It is concerned as a medium investment. Trader has to invest in term of warehouse, transportation and port management.	External	3	3	3	3.5	3.13
Special skill	- Urea is concerned as a commercial product, not hazardous with identical specification in the market. Hence, there is no need for the special operation when compared to Ammonia.	External	3	3.5	3	3	3.13
Cash flow	- Because there is huge volume per shipment (vary between 6,000 -15,000 MT per shipment), it is high cash flow per each shipment which is at least around 70 million THB .	External	4	4	3.5	4	3.88
Market Defensive of ABC current supplier	-There is monopoly supplier supplied Urea to ABC.	Internal	5	5	4.5	5	4.88
Total Average Risk Score							3.75

Table 3. 24: Threat of Substitute Material (Force 3)

Force 3: Threat of Substitute Material							
Consideration Point	Current Situation	Impact Factor	Purchasing Manager	Division Manager	Senior Supervisor	In charge Purchaser	Average risk Score
Available alternative material	- Ammonia can be used as an alternative material.	External	2	2	2	2	2.00
Pricing of alternative material	- The price of urea is competitive than alternative (Ammonia) because it is concerned as a commercial product with able to perform price prediction.	External	2	2	2.5	2	2.13
ABC switching cost	- It is low switching cost between urea and Ammonia. This is because there are available Ammonia tank facilities in every plant.	Internal	3	3.5	2	3	2.88
Total Average Risk Score							2.33

Table 3. 25: Bargaining Power of Supplier (Force 4)

Force 4: Bargaining power of supplier							
Consideration Point	Current Situation	Impact Factor	Purchasing Manager	Division Manager	Senior Supervisor	In charge Purchaser	Average risk Score
Bargaining power to the supply source	- Supplier has less volume to negotiate with their supplier. With unattractive volume, the bargaining power is low.	External	4	4	3.5	4	3.88
Availability of urea's raw material	- There is plenty of natural gas (main raw material for producing urea) especially in Middle East.	External	2	2.5	2	2	2.13
Supplier supply chain	- Supplier well manage their supply chain. There is approximately 1-1.5 delivery lead time from maker sources to trader.	External	2	2	2	2	2.00
Total Average Risk Score							2.67

Table 3. 26: Bargaining Power of Buyer (Force 5)

Force 5: Bargaining power of buyer							
Consideration Point	Current Situation	Impact Factor	Purchasing Manager	Division Manager	Senior Supervisor	In charge Purchaser	Average risk Score
ABC purchasing Volume	- The current purchasing volume is not attractive to the trader.	Internal	4	4	3.5	4	3.88
ABC bargaining power	- The bargaining power is not quite high due to low consumption.	Internal	4	4	4	4	4.00
* Note: In the future, if ABC can implement urea as an alternative product in other production plant (other than PPD), the consumption of urea will be higher and attractive to the traders.							
Total Average Risk Score							3.94

## 2.7) Potassium chloride (KCl)

### Background

- Potassium chloride is used in every ABC plant.
- There is monopoly supply from one supplier with single source.
- It is in rank 2 of class B chemical raw material. It costs 48,574,544.00 THB per annual.
- The risk score values from Five Force Analysis are shown in the Table 3.27 to Table 3.31.

Table 3. 27: Competitive Rivalry within an Industry (Force 1)

Force 1: Competitive Rivalry within an Industry							
Consideration Point	Current Situation	Impact Factor	Purchasing Manager	Division Manager	Senior Supervisor	In charge Purchaser	Average risk Score
Number of supplier	- In term of the global market, there are plenty of suppliers and sources such as Germany, Jordan, Belarus, Israel and North America.	External	2	2	2	2	2.00
	- ABC has only one current approved supplier.	Internal	4	4	3.5	4	3.88
Business growth rate	- The price and growth factor for this business depends on the fertilizer demand. However, there is a stable demand in industry field.	External	2	2.5	2	2	2.13
Total average risk score							2.67

Table 3. 28: Threat of New Entrants (Force 2)

Force 2: Threat of New Entrants							
Consideration Point	Current Situation	Impact Factor	Purchasing Manager	Division Manager	Senior Supervisor	In charge Purchaser	Average risk Score
Special skill	- Normally, in Thailand, this business is concerned as a trading business. Hence, there are no needed for special skill. It is easily for entering to this business.	External	2	2	2.5	2	2.13
Capital investment	- It requires moderate capital investment such as warehouse and port management.	External	3	2.5	3	3	2.88
Total average risk score							2.50

Table 3. 29: Threat of Substitute Product (Force 3)

Force 3: Threat of Substitute Product							
Consideration Point	Current Situation	Impact Factor	Purchasing Manager	Division Manager	Senior Supervisor	In charge Purchaser	Average risk Score
ABC substitute product	- There is no substitute product because Potassium chloride is fit to the ABC ferment bacteria in all production plans. It is concerned as a specific raw material for pre-seed of glutamic acid process.	Internal	5	5	5	5	5
Total average risk score							5.00

Table 3. 30: Bargaining Power of Supplier (Force 4)

Force 4: Bargaining Power of Supplier							
Consideration Point	Current Situation	Impact Factor	Purchasing Manager	Division Manager	Senior Supervisor	In charge Purchaser	Average risk Score
Bargaining power to their supplier	- Trader buys product as an industrial grade which has less volume when compared to the fertilizer grade. Hence, the bargaining power is low.	External	4	3.5	4	4	3.88
Supply chain	- The supplier can well-managed their supply to trader.	External	2	2.5	2	2	2.13
Total average risk score							3.00



Table 3. 31: Bargaining Power of Customer (Force 5)

Force 5: Bargaining Power of Customer							
Consideration Point	Current Situation	Impact Factor	Purchasing Manager	Division Manager	Senior Supervisor	In charge Purchaser	Average risk Score
ABC bargaining power	- Nowadays, there are many buyers in this business especially in fertilizer business. ABC uses this product as an industrial grade hence, ABC has less bargaining power when compared to those buyers.	Internal	4	4	4	4	4.00
Total average risk score							4.00

2.8) Antifoam GD-113

2.9) Succinic acid

### Background

- Because both Antifoam GD-113 and Succinic acid have the same supply and market situation. Hence, they can be simultaneously analyzed.
- Both antifoam GD-113 and succinic acid are monopoly supply from one supplier with single source
- Both antifoam GD-113 and succinic acid is in class B chemical raw material with expenditure 44,082,857.50 THB/annual and 31,224,947.50 THB/annual.
- The risk score values from Five Force Analysis are shown in the Table 3.32 to Table 3.36.

Table 3. 32: Competitive Rivalry within an Industry (Force 1)

Force 1: Competitive Rivalry within an Industry							
Consideration Point	Current Situation	Impact Factor	Purchasing Manager	Division Manager	Senior Supervisor	In charge Purchaser	Average risk Score
Number of supplier	- There are moderate traders in Thailand.	External	3	3	3	3	3.00
	- Monopoly supplier supplies this raw material to ABC.	External	4	4.5	4	4	4.13
Business growth rate	- This two raw materials are used in specific process with a few portions. Hence, the business growth for this raw material is depended on the niche customer.	External	4	4	3.5	4	3.88
Total average risk score							3.67

Table 3. 33: Threat of New Entrants (Force 2)

Force 2: Threat of New Entrants							
Consideration Point	Current Situation	Impact Factor	Purchasing Manager	Division Manager	Senior Supervisor	In charge Purchaser	Average risk Score
Special Skill	- Normally, in Thailand, this business is concerned as a trading business. Hence, there is not required for special skill. It is easily for entering to this business.	External	2	1.5	2	2	1.88
Capital investment	- It requires moderate capital investment such as warehouse and port management.	External	2	2	2.5	2	2.13
Total average risk score							2.00

Table 3. 34: Threat of Substitute Product (Force 3)

Force 3: Threat of Substitute Product							
Consideration Point	Current Situation	Impact Factor	Purchasing Manager	Division Manager	Senior Supervisor	In charge Purchaser	Average risk Score
ABC substitute product	- There are no substitute products for these two raw materials.	Internal	5	5	5	5	5.00
Total average risk score							5.00

Table 3. 35: Bargaining Power of Supplier (Force 4)

Force 4: Bargaining Power of Supplier							
Consideration Point	Current Situation	Impact Factor	Purchasing Manager	Division Manager	Senior Supervisor	In charge Purchaser	Average risk Score
Bargaining power to their supplier	- Trader has to collect the volume from buyer in order to negotiate with their supplier. Hence, trader bargaining power depends on the customer order volume.	External	4	3.5	4	4	3.88
Supply chain	- The supplier can well manage their supply with on time delivery.	External	2	2	2.5	2	2.13
Total average risk score							3.00

Table 3. 36: Bargaining Power of Customer (Force 5)

Force 5: Bargaining Power of Customer							
Consideration Point	Current Situation	Impact Factor	Purchasing Manager	Division Manager	Senior Supervisor	In charge Purchaser	Average risk Score
ABC bargaining power	- There is a monopoly supplier hence the buyer bargaining power is low.	Internal	4	4	4	4	4.00
Total average risk score							4.00

2.10) Ammonium Chloride (NH<sub>4</sub>Cl)Background

- There is a monopoly supply along with single source.
- It is classified as class B chemical raw material with expenditure 26,408,532.34 THB/annual.
- The risk score values from Five Force Analysis are shown in the Table 3.37 to Table 3.41.

Table 3. 37: Competitive Rivalry within an Industry (Force 1)

Force 1: Competitive Rivalry within an Industry							
Consideration Point	Current Situation	Impact Factor	Purchasing Manager	Division Manager	Senior Supervisor	In charge Purchaser	Average risk Score
Number of supplier	- In term of the global market, there are plenty of suppliers and sources such as Germany and China.	External	2	2	2.5	3	2.38
	- ABC has only one current approved supplier.	Internal	4	3.5	3.5	3.5	3.63
Business growth rate	- This product is common chemical and use in several businesses.	External	2	2	2	2	2.00
Total average risk score							2.67

Table 3. 38: Threat of New Entrants (Force 2)

Force 2: Threat of New Entrants							
Consideration Point	Current Situation	Impact Factor	Purchasing Manager	Division Manager	Senior Supervisor	In charge Purchaser	Average risk Score
Special skill	- Normally, in Thailand, this business is concerned as a trading business. Hence, there are no needed for special skill. It is easily for entering to this business.	External	2	2	2	2	2
Capital investment	- It requires moderate capital investment such as warehouse and port management.	External	3	3	3	3	3
Total average risk score							2.50

Table 3. 39: Threat of Substitute Product (Force 3)

Force 3: Threat of Substitute Product							
Consideration Point	Current Situation	Impact Factor	Purchasing Manager	Division Manager	Senior Supervisor	In charge Purchaser	Average risk Score
ABC substitute product	- ABC is ,now, having ammonium sulfate as an alternative product of ammonium chloride but can be used only some ABC factories.	Internal	4	4	4	4	4.00
Total average risk score							4.00

Table 3. 40: Bargaining Power of Supplier (Force 4)

Force 4: Bargaining Power of Supplier							
Consideration Point	Current Situation	Impact Factor	Purchasing Manager	Division Manager	Senior Supervisor	In charge Purchaser	Average risk Score
Bargaining power to their supplier	- Trader imports this product from only one source which is china. Hence, trader has less bargaining power with high risk in case product shortage.	External	4	4	3.5	4	3.875
Supply chain	- The supplier can well-managed their supply to trader.	External	2	2.5	2	2	2.125
Total average risk score							3.00

Table 3. 41: Bargaining Power of Customer (Force 5)

Force 5: Bargaining Power of Customer							
Consideration Point	Current Situation	Impact Factor	Purchasing Manager	Division Manager	Senior Supervisor	In charge Purchaser	Average risk Score
ABC bargaining power	- There is a monopoly supplier hence the buyer bargaining power is low.	Internal	4	4	4	4	4
Total average risk score							4.00

In summary, there are 10\* chemical raw materials are selected to analyze and perform purchasing improvement. Some of raw material such as 35%, 50% caustic soda and 35% hydrochloric acid, antifoam GD-113 and succinic acid have the same supply nature and market situation hence, they can simultaneously analyse and result in the same average risk score value. In this report, the raw material that has average risk score < 3 is concerned as low risk. For the raw material that has average risk score  $\geq 3$  is concerned as high risk. As the table 3.42 shows, there are 8 raw materials concerned as high risk and only 2 raw materials concerned as low risk. (\*32% caustic soda and 50% caustic soda are classified as one raw material due to same chemical composition. There is only different in concentration.)

Table 3. 42: The summary table of average risk score value in each selected chemical raw material from class A and class B

Name of Raw material	Average Risk Score Value
<b>Class A</b>	
1. Ammonia	3.40
2. 35% and 50% Caustic Soda	3.00
3. 35% Hydrochloric acid	3.00
4. coal	2.53
5. 98% Sulfuric acid	2.33
<b>Class B</b>	
6. 46% Urea	3.14
7. Potassium Chloride	3.43
8. Anitifoam GD-113	3.53
9. Succinic acid	3.53
10. Ammonium Chloride	3.23

### 3). Apply Purchasing Portfolio Matrix

In order to know the power of purchaser compared with the power of supplier, the purchasing portfolio matrix is applied. The analysed information in the five force analysis is used for locating the items' position. There are 3 classified areas in the purchasing portfolio matrix. The first area is exploit. In this area, the power of purchaser trends to be more than power of supplier. The raw materials that are classified in this position are coal and sulfuric acid. The second classified area is balance. In this area, the power of purchaser and power of supplier trend to be equivalent to each other. There are caustic soda and hydrochloric acid located in this area. Lastly, diversify area, the power of supplier trends to be higher than power of purchaser. The raw materials in this position are ammonia, urea, ammonium chloride, potassium chloride, succinic and antifoamGD-113 as shows in Figure 3.1.

Knowing the purchasing power between power of purchaser and supplier can help the purchaser to create the right strategy for performing the contract with supplier. For example, the raw materials which are in the exploit area should maximize the purchaser power as much as possible and create high competition among the suppliers to lowering the unit cost. On the other hand, the raw materials which are located in the diversify area should compromise and make a good relationship with supplier, long term contract is

preferable. However, after applying new strategy, the raw material position can be changed.

		Power of Supplier		
		Low	Average	High
Power of Purchaser	High	Coal Sulfuric acid		
	Average		Caustic Soda Hydrochloric acid	Urea Ammonia Ammonium Chloride Potassium Chloride
	Low			Succinic GD-113

Figure 3. 1: Classify Raw Material into three groups by using Purchasing Portfolio Matrix

#### 4). Apply Supply Positioning Model

After using five force analysis, the risk score value of each raw material can be known. The risk score from five force analysis along with annual expenditure from pareto analysis can plot raw material position in a supply positioning model. Class B or class C raw materials with risk score  $\leq 3$  are located in routine position. However, in this research, there are no raw materials classified as routine. Class B or class C raw materials with risk score  $> 3$  are located in the bottleneck position. There are urea, succinic acid, antifoam-GD-113, potassium chloride and ammonium chloride located in this position. Class A raw materials with risk score  $\leq 3$  are located in leverage position. There are coal and 98% sulfuric acid located in this position. Lastly, class A raw materials with risk score value  $> 3$  are classified in the critical position. There are ammonia, 32%, 50% caustic soda and 35% hydrochloric acid in this position as shown in Figure 3.2.

Knowing the raw material position in the supply positioning model, purchaser can create the proper strategy to each raw material. For example, the material with high risk such as bottleneck and critical position, the purchaser can lower the risk by increasing bargaining power, find alternative raw material and etc. This is not only reduce the risk but

also reduce the unit cost as well. After applying the strategy, the raw material position can be changed.

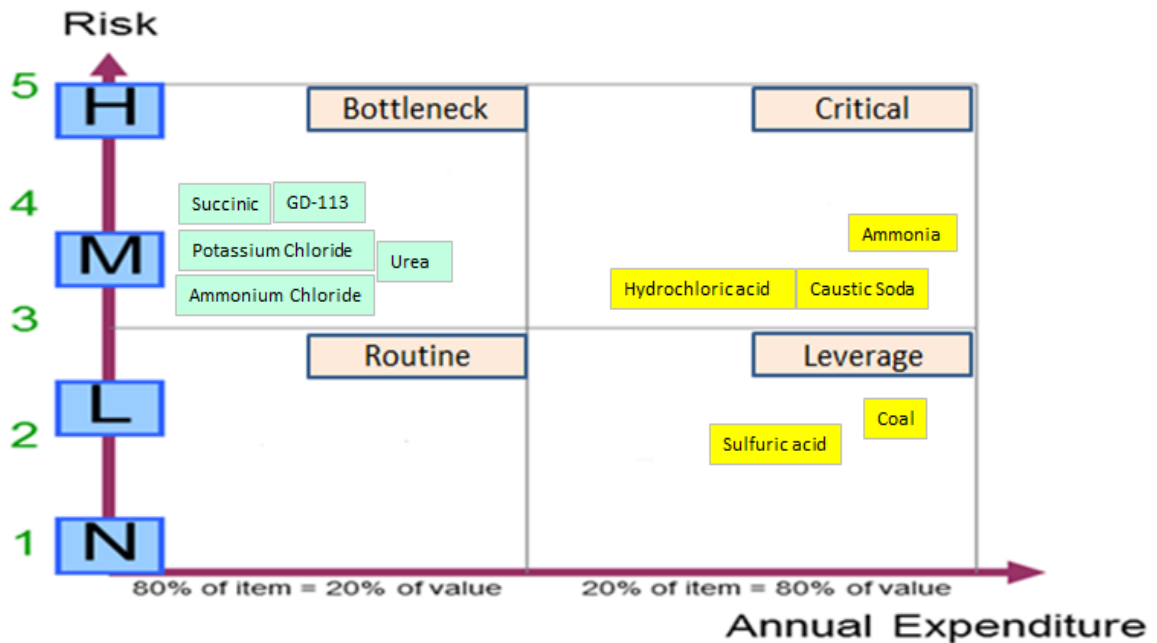


Figure 3. 2: The position of each raw material located in the supply positioning model

### 3.4 Conclusion

Preliminary study is conducted in order to know scope and select the raw materials that needed to be improved. Firstly, using the Pareto analysis in order to rank raw material from the highest to lowest annual expenditure, the list of raw materials can be classified into three classes which are class A, B and C. Then, scoping the improved raw material, chemical raw material from class A along with top five expenditure of chemical raw material from class B that also have high risk in terms of monopoly supplier, long supply chain with high expenditure are selected to improve. Secondly, using Five Force Analysis as a helping tool to analyze the current market and supply situation. There are five different aspects that needed to be considered. In order to be more concrete, the author attempts to measure as a quantitative way by assigned risk score value in each analyzed issue and calculated for average value. Thirdly, Purchasing Portfolio Matrix is applied by using the analyzed information from Five Force Analysis. This matrix informs about the relative power between buyer and supplier of each selected raw material. Lastly, the risk scores from Five Force Analysis along with annual expenditure from Pareto

analysis can locate raw material in Supply Positioning model in order to know the raw material classification. Those selected raw material can be located and separated into 4 different groups which are critical, bottleneck, leverage and non-critical. Ammonia, 35%, 50% caustic soda, 35% hydrochloric acid are located in critical position which concerned as high expenditure along with high risk items. Urea, antifoam GD-113, succinic acid and ammonium chloride are located in bottleneck position which concerned as low to medium expenditure with high risk. Coal and 98% sulfuric acid are located in leverage position which concerned as high expenditure with low risk. However, there are no selected raw materials that are classified as routine. After knowing the position in terms of risk, expenditure along with buyer and supplier relative power, the proper strategies can be created to each of selected raw material in the next chapter.



## CHAPTER IV

### BUSINESS STRATEGIES DEVELOPMENT

After analyzing the raw material position in supply positioning model along with purchasing portfolio matrix, the major strategies are created to improve the purchasing scheme to each raw material. The major improvement strategies are relied on the position that each raw material is located.

This chapter consists of operational plan and strategies for improving the raw material purchasing scheme. First, the root causes of price and supply risk are analyzed. Next, the improvement plans for strategic, leverage and bottleneck raw material are created. Finally, the operational team is set in order to cooperate and perform this improvement project. The included topics are followings.

#### 4.1 Root Cause Analysis

4.1.1 Not conforming between purchasing contract price and market price

4.1.2 Supply risk creating raw material shortage

#### 4.2 Improving Planning

4.2.1 Strategic raw material

4.2.2 Leverage raw material

4.2.3 Bottleneck raw material

#### 4.3 Operational Team in Improvement Planning

#### 4.4 Conclusion

### 4.1 Root Cause Analysis

The main root cause for inefficiency in terms of the purchasing and supply management can be classified into two main causes. The first cause is not conforming price for the purchasing contract price or high purchasing price when compared with market price. The second cause is supply risk that can create shortage of raw material. Those two causes are analyzed by using a fishbone diagram as shown in Figure 4.1 and Figure 4.2.

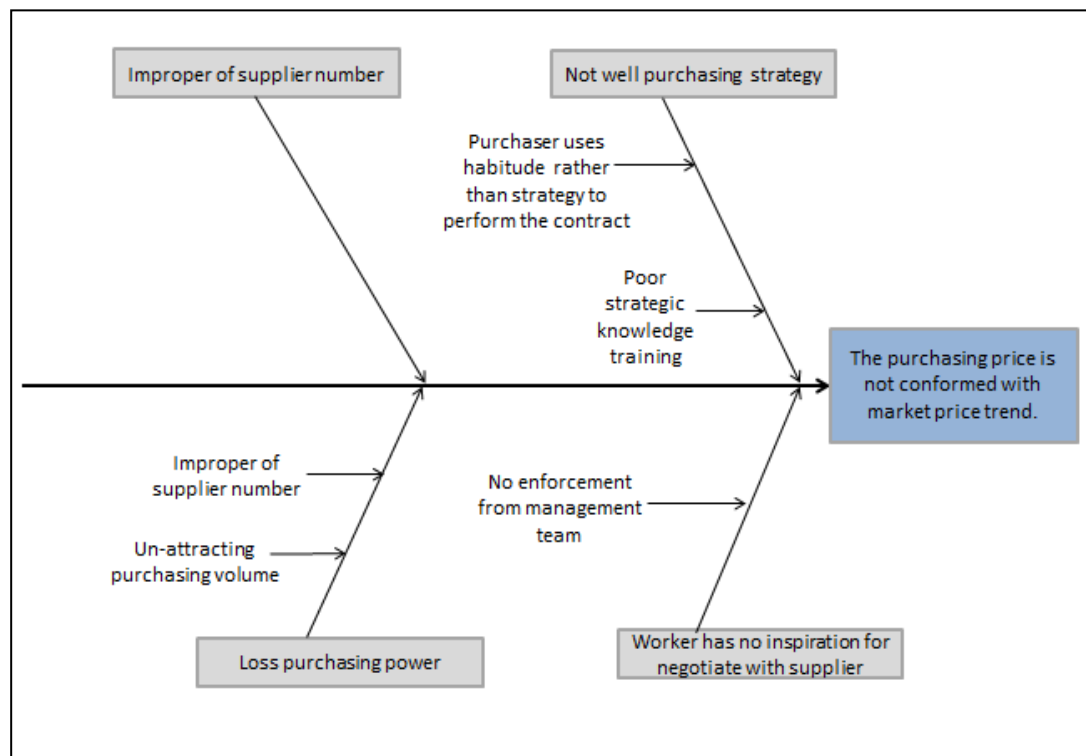


Figure 4. 1: Fishbone Diagram for not conforming between purchasing price and market price trend

#### 4.1.1 Not conforming between purchasing contract price and market price

##### 1) Improper of supplier number

Too much supplier or too less supplier can affect to the bargaining power. Some raw material that concerned as leverage items may need high competition in order to bidding for the offer price. Finally, only 2-3 suppliers with lowest price may choose for that contract. On the other hand, the item that concerned as bottleneck may have a few suppliers available in the market hence searching for the second source in order to reduce risk is important more than price concern.

##### 2) Not well purchasing strategy

When performing the contract, purchaser uses their habitude rather than purchasing strategic along with no proper training about purchasing strategy. Hence, the contract might be higher than the market price.

### 3) Loss purchasing power

Too much supplier per each contract can reduce the purchasing power because the purchasing volume needs to be more separated and allocated to each supplier. With less volume, it may not attract to the supplier.

### 4) Worker has no inspiration for negotiating with supplier

With no enforcement from the management team along with no clear target, this may bring about the worker has no inspiration for negotiation with supplier and creation the project.

#### 4.1.2 Supply risk creating raw material shortage

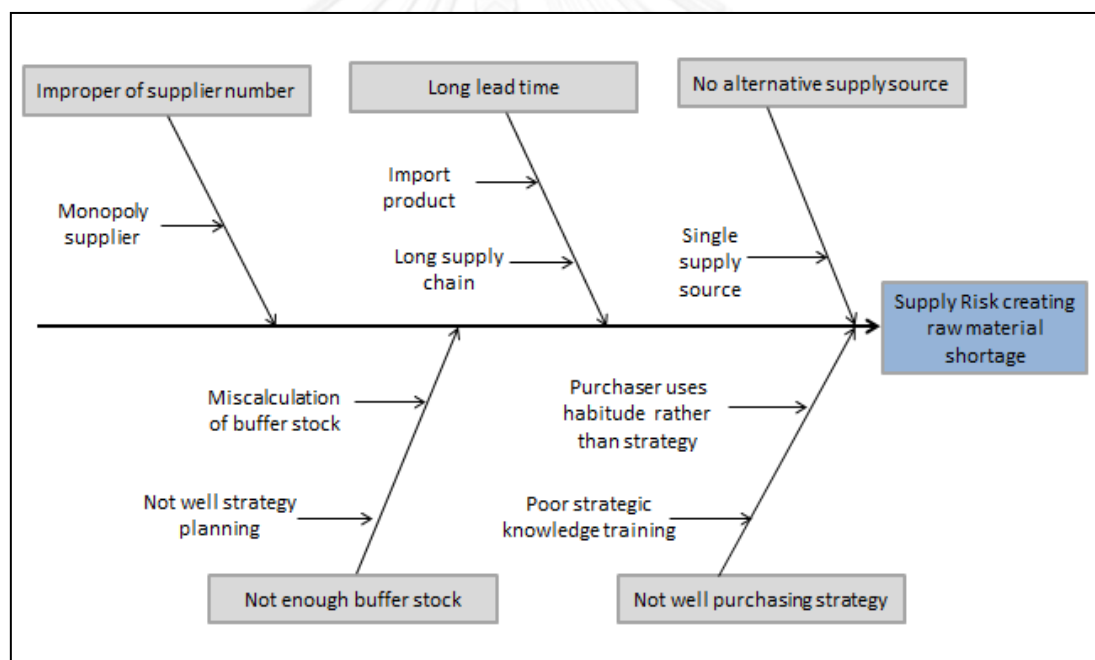


Figure 4. 2: Fishbone Diagram for supply risk creating raw material shortage

#### 1) Improper of supplier number

Having only one supplier, it may increase risk for the raw material shortage. If the supplier suffers from the financial problem, production problem or any other accidents, the buyer company will suffer from raw material shortage because of no back up supplier.

## 2) Long lead time

Having long supply chain especially for the import raw material, this can create high risk to the company such as not on time delivery and raw material contamination.

## 3) No alternative supply source

Having only one supply source, the company may take high risk in case there are wrong product specification, plant shut down and etc.

## 4) Not enough buffer stock

Not well strategic planning along with miscalculation for the buffer stock, this can create raw material shortage in case underestimate buffer stock. On the other hand, overestimate in buffer stock can increase the warehouse cost and expiry of raw material.

## 5) Not well purchasing strategy

By not having a good training for the purchasing knowledge, the purchasers may not concern for the supply risk aspect. He/she might only concern for the contract price. This can halt the production process because of no input raw material creating loss of business opportunity.

## 4.2 Improvement Planning

### 4.2.1 Strategic raw material

- Ammonia
- 35%,50%Caustic Soda
- 35% Hydrochloric acid

Priority target: Reduce Supply Risk and contract price

Scenario 1: Moving down the supply risk position from strategic position to leverage position

OR Scenario 2: Same position with improved purchasing plan and strategy

Major applied strategies:

- Develop long term supply relationships
- Find alternative product
- Create competition atmosphere to lower the unit price

*Develop long term supply relationships*

For Ammonia, there are a few potential numbers of suppliers available in the market. Hence, perform long term contract with potential supplier is performed in order to lower the company's risk.

*Find alternative product*

In order to minimize the supply risk, alternative product should be searched and abled to use in the production line. This is not only reducing the risk but also creating competitive to the company when the price of major product is rising. The alternative product of Ammonia, Caustic Soda and Hydrochloric acid are Urea, Soda Ash and Sulfuric acid respectively.

*Create competition atmosphere to lower the unit price*

Mostly, the alternative products (urea and sulfuric acid) are concerned as commercial product and standard specification. Hence, there are several traders with high supply volume available in the market. Hence, bidding for the price or E-auction can apply. Supplier with lowest offer price is chosen to perform the contract. This can create competition atmosphere and lower the unit price.

#### **4.2.2 Leverage raw material**

- Coal
- 98% Sulfuric acid

Priority Target: Reduce average price

Scenario 1: Moving the relative expenditure from leverage position to noncritical position

OR Scenario 2: Same position with improved purchasing plan and strategy

Major applied strategies:

- Vendor Selection
- Target pricing strategies and negotiations
- Order volume optimization
- Exploration of full purchasing power

#### *Vendor selection*

Performing vendor selection or apply vendor optimization strategy in order to optimize the number of supplier in each contract, this can increase the buyer bargaining power. However, buyer has to concern about the truck capacity, flexibility to service in an urgent order along with buffer stock as well.

#### *Target pricing strategies and negotiations*

Coal and sulfuric acid are commodity products with identity of specification. Hence, choosing supplier with the lowest price is main target strategy for leverage product. Supplier who can offer the most competitive price will receive high volume portion. This can create the competition atmosphere among the suppliers.

#### *Order volume optimization*

The volume allocation to each supplier will depend upon the offer price. Supplier who offers the lowest price will receive high volume in that contract and vice versa to who offer for the higher price. In order to optimize the volume allocation, buyer has to concern about the capacity of truck. With maximize the volume to fulfill each truck can minimize the transportation cost. For example, the coal truck size is 30 MT per truck. For sulfuric acid uses trailer with 24 MT per truck. The buyer should allocate the volume to each supplier by divisibly to truck capacity.

### *Exploration of full purchasing power*

By apply vendor optimization strategy; buyer will have more power to negotiate for the unit price. The buyer might limit the number of time to offer the unit price from each supplier such as three times per vendor. Those who offer non-competitive price might be eliminated to that contract. This can fully create the competitive atmosphere among the suppliers.

However, E-auction might not suitable for applied to these two items because of supplier and product nature. For coal, the product specification is highly concerned such as moisture, heat value and etc. Hence, the supplier that offers the lowest price does not ensure for the best product quality. SGS analysis certification from independent verification service company is required in order to inspect for the product quality as well. For sulfuric acid, the business sizes are different among the supplier. Some vendors have plenty of service trucks. Some have limited truck sizes and numbers. The one who offers the lowest price might not have enough capacity to supply. Therefore, verbal bidding and negotiation are more suitable than E-auction.

#### **4.2.3 Bottleneck raw material**

- 46% Urea
- Potassium Chloride
- Antifoam GD-113
- Succinic acid
- Ammonium Chloride

Priority target: Reduce supply risk

Scenario 1: Moving down the supply risk position from bottom-neck position to noncritical position

OR Scenario 2: Same position with improved purchasing plan and strategy

Major Applied Strategies:

- Find more vendors
- Security of inventories
- Perform long term contract

*Find more vendors*

Normally, the bottleneck items have monopoly supplier, or single source supply. Hence, it is risk in terms of supply in case there is no product available or suppliers might terminate their business. Currently, all of the raw materials that are located in this position have only one supply supplier. Hence, find alternative sources and vendors are needed.

*Security of inventories*

Some raw material is imported with longer lead time when compared to the domestic purchase. The buffer stock should be set and available in case there is no supply raw material. The direct imported raw materials are Antifoam GD-113 and Succinic acid.

*Perform long term contract*

Long term contract is preferable especially for the import product. By perform the yearly contract instead of monthly, the overseas manufacturer can well plan their production schedule along with well manage their raw material and reduce supply risk.

### **4.3 Operational Team in Improvement Planning**

In order to achieve the improvement project, relevant department especially production department and purchasing department are needed for simultaneously cooperative developing the procurement improvement project. The major meeting schedule is described in the Table 4.1 below.



Table 4. 1: Detail of Meeting Session

Session	Month	Participant	Details
<b>One:</b> Apply alternative raw material discussion session	Jan-14	1. Project team member	-Purchasing team discusses with production department for the possibility applying the alternative raw material.
		2. Project leader	
		3. Head of production department	
		4. Head of purchasing department	
<b>Research and CP Test Period (February-March 2014)</b>			
<b>Two:</b> Summary for the testing result and current market situation	Mar-14	1. Project team member	-Production department concludes for the testing result - Purchasing team shares the current market situation.
		2. Project leader	
		3. Head of production department	
		4. Head of purchasing department	
<b>Three:</b> Discussion for implement the vendor optimization strategy along with alternative vendors and sources	Mar-14	1. Project team member	- Purchasing team is internally meeting and discussing for applied new strategies in next contract in order to increase the bargaining power.
		2. Project leader	
		3. Head of purchasing department	

#### 4.4 Conclusion

This chapter describes the improvement plans and strategies to each raw material. There are two major problems which are relevant to price and supply risk. Firstly, Fishbone Diagram is applied in order to analyze the root cause of not conforming between purchasing contract price and market price, and supply risk creating raw material shortage. Secondly, the strategies are created to each raw material based on supply position in the supply positioning model. The main strategy for the bottleneck is to lower the supply risk. The strategy for the leverage is to lower the unit price while the strategies for the critical raw materials are not only lower supply risk but also lower the unit price. Thirdly, cooperative with production team is very significant. The cooperated discussing between purchasing and production department can analyze the possibility for applying alternative raw materials using in the production line.

## CHAPTER V

### IMPROVEMENT AND IMPLEMENTATION

This chapter describes about the improvement plans and results after applying to each selected raw material. The improvement procedures and applied strategies can be classified into three categories which are strategic raw material, leverage raw material and bottleneck raw material based on supply position as following.

#### 5.1 Strategic raw material

5.1.1 Ammonia

5.1.2 32%, 50% Caustic Soda

5.1.3 35% Hydrochloric acid

#### 5.2 Leverage raw material

5.2.1 Coal

5.2.2 98% Sulfuric acid

#### 5.3 Bottleneck raw material

5.3.1 Urea

5.3.2 Potassium Chloride

5.3.3 Antifoam GD-113

5.3.4 Succinic acid

5.3.5 Ammonium chloride

#### 5.4 Conclusion

#### 5.1 Strategic raw material

5.1.1 Ammonia

#### Applied strategies

- Find alternative raw material

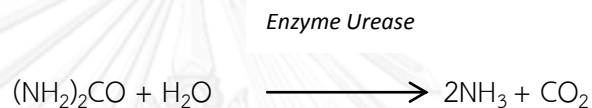
- Find breakeven point formula between main raw material and alternative
- Create competition atmosphere in order to lowering the unit price

### Procedure

1). Cooperate with production department in order to find an alternative raw material which gives the nitrogen source as same as Ammonia

#### 1.1 Find alternative raw material

As below chemical reaction shows, enzyme urease which is already available in the fermentation process can change urea to be ammonia providing nitrogen source as same as using ammonia



#### 1.2 Advantage and disadvantage point analysis

##### *In terms of production*

Because both ammonia and urea can provide nitrogen to the process hence, they can be an alternative to each other. However, ammonia is liquid which can promptly use in the process while urea is solid chemical. It is required to dissolve in the dissolve tank before using in the process. However, it takes only a few dissolvent time so, it is not significant affected to the production time.

##### *In terms of sourcing and purchasing*

The nature of the market price of these two alternative products is different. For example, ammonia market price of this month comes from the average price of every single day from previous month. Hence, to offer the urea price, supplier has to wait until the end of the month. For urea, the price is depended on the fertilizer usage and crop seasoning. When it is not in the crop season, the price is low. Hence, trader can make their stock at this low price.

2). Find breakeven point formula in order to know the equivalent price between main raw material and alternative

2.1 Break Even Point Formula Calculation of Ammonia (NH<sub>3</sub>) and Urea (CH<sub>4</sub>N<sub>2</sub>O)

Mole of nitrogen (N) calculation

$$100\% \text{ of NH}_3 = \frac{14}{17} * 1 = 0.82 \text{ (NH}_3 \text{ molecular weight is 17 g.)}$$

$$100\% \text{ of Urea} = \frac{28}{60} * 1 = 0.46 \text{ (Urea molecular weight is 60 g.)}$$

Assume: The price of NH<sub>3</sub> = X Baht/Kg

$$\text{If mole of nitrogen NH}_3: \quad 0.82 = X \text{ Baht}$$

$$\text{Hence mole of nitrogen in CH}_4\text{N}_2\text{O:} \quad 0.47 = \frac{X}{0.82} * 0.46$$

After substitution, the equivalent price between NH<sub>3</sub> and CH<sub>4</sub>N<sub>2</sub>O is following.

$$\text{The urea price} = \text{Ammonia price} * 0.56$$

3). Find urea suppliers in order to bid among each other and compare with ammonia price

4). Performing the contract by allocating the larger portion to competitive price raw material

4.1 Calculating the equivalent price

By referencing from the offer price of ammonia (April 2014) = 23,650 THB/MT

$$\text{The equivalent of urea price} = 23,650 * 0.56 = 13,244 \text{ THB/MT}$$

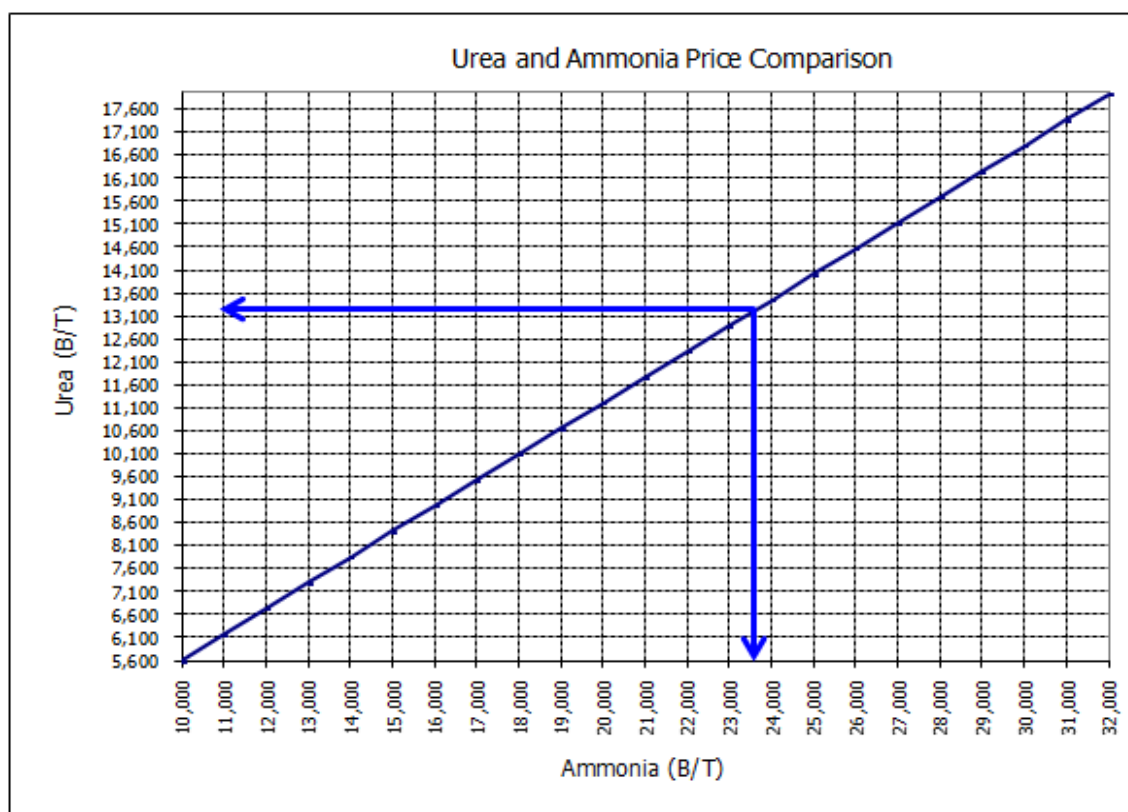


Figure 5. 1: Urea and Ammonia Price Comparison (equivalent price)

By using breakeven point formula or graphing as Figure 5.1 to calculate the equivalent price, urea is more competitive. The equivalent urea price is 13,244 THB/MT while there is only 12,300 -12,500 THB/MT of urea offer price. Hence allocate more portion to urea is more competitive.

#### 4.2 Performing the contract

Table 5. 1: Ammonia Contract comparing the price and volume between March and April 2014

Supplier name	Ammonia Contract for March 2014			Ammonia Contract for April 2014		
	Mar-14	Contract Volume (MT)	Total cost	Apr-14	Contract Volume (MT)	Total cost
A co.,Ltd	23,600	1,750	41,300,000	23,650	1,150	27,197,500.00
B co.,Ltd	23,600	1,750	41,300,000	23,650	1,150	27,197,500.00
Total		3,500	82,600,000	Total	2,300	54,395,000.00
Average price			23,600	Average price	23,650	

In latest contract, the ammonia price is slightly increasing from previous contract because the purchased ammonia volume is decreasing approximately 34% (from 3,500 to

2,300 MT/month) as stated in the Table 5.1. By substituting ammonia price which is 23,650 THB/MT and multiply by 0.56 in breakeven point formula, the equivalent urea price is 13,244 THB/MT while the actual market price is 12,400 THB/MT. Hence, urea price is more competitive. Then, searching urea suppliers in order to bid for the offer price is performed. At first, there are five vendors come to bid for the quarter 2/2014 price however, only three lowest price vendor are selected as shows in the Table 5.2.

Table 5. 2: Urea Contract price and volume allocation  
for quarter1/2014 and quarter 2/2014

Supplier name	Quarter 1/2014 (Jan.-Mar.)		Urea Contract: Quarter 2/2014 (Apr.-Jun.)				
	Final Price	Contract Volume (MT)	First offer (THB/MT)	Second offer (THB/MT)	Final price (THB/MT)	Contract Volume (MT)	Total Cost
G Co.,Ltd	14,000	600	13,400	12,900	-	-	-
H Co.,Ltd	-	-	12,300	12,300	12,300	4,000	49,200,000
B Co.,Ltd	-	-	12,500	12,500	12,500	2,000	25,000,000
I Co.,Ltd	-	-	13,200	-	-	-	-
J Co.,Ltd	-	-	13,000	12,500	12,500	2,000	25,000,000
Average price	14,000	600	Total Volume =8,000 MT/quarter (2,667 MT/month)				99,200,000
			Average Price			12,400	

To do the urea contract, it is slightly different from the ammonia contract. Ammonia contract is performed as monthly due to the fluctuation and unpredictable of market price. On the other hand, urea price trend has a seasonal trend depending on the crop season so the price is predictable. In this period (at the end of March 2014), the urea price is concerned as low and trend to increase in approaching month (quarter2-3/2014). Hence, quarterly contract is chosen rather than monthly. This can fix the contract price avoided the increasing in market price. The average price of urea in quarter2/2014 is significantly decreasing (11%) due to more bidding suppliers. This can create higher competition atmosphere.

Table 5. 3: Urea versus Ammonia Consumption from  
April 2012 – March 2013

Urea Vs Ammonia Consumption				
Month	Urea (MT)	Ammonia (MT)	Urea %Ratio	Ammonia %Ratio
Apr-12	200.00	3700.00	10%	90%
May-12	200.00	3780.00	10%	90%
Jun-12	600.00	3550.22	25%	75%
Jul-12	600.00	3560.00	25%	75%
Aug-12	600.00	3506.00	25%	75%
Sep-12	200.00	3712.83	10%	90%
Oct-12	200.00	3790.25	10%	90%
Nov-12	200.00	3731.74	10%	90%
Dec-12	200.00	3754.22	10%	90%
Jan-13	200.00	3700.00	10%	90%
Feb'13 - Mar'14	-	-	-	-
	-	-	-	-
	-	-	-	-
	-	-	-	-
Apr-14	2667.00	2300.00	70%	30%

As Table 5.3 shows, in the previous day, the using ratio between urea and ammonia is 10:90. Until June 2012, in that month, there is an ammonia shortage situation due to high demand of fertilizer. Ammonia is totally converted to urea by chemical process in order to supply in the fertilizer business field. Hence, ABC has to urgent purchase urea and perform production test whether the process can use urea as an alternative or not. Finally, it is acceptable to use urea hence, the ratio between urea and ammonia in June 2012 is 25:75. However, after the situation subsides and to be normal in September 2012, purchaser still maintains to use urea: ammonia as 10:90 till March 2014 even urea price is more competitive. There is only 5-10% of urea portion. This might not create the significant profit. Hence, in April 2014, purchasing team cooperates with production department perform cost reduction project, the utilization of urea is increased up to 70% due to its competitive price rather than ammonia. There is only 30% of ammonia consumption.

## Result and Discussion

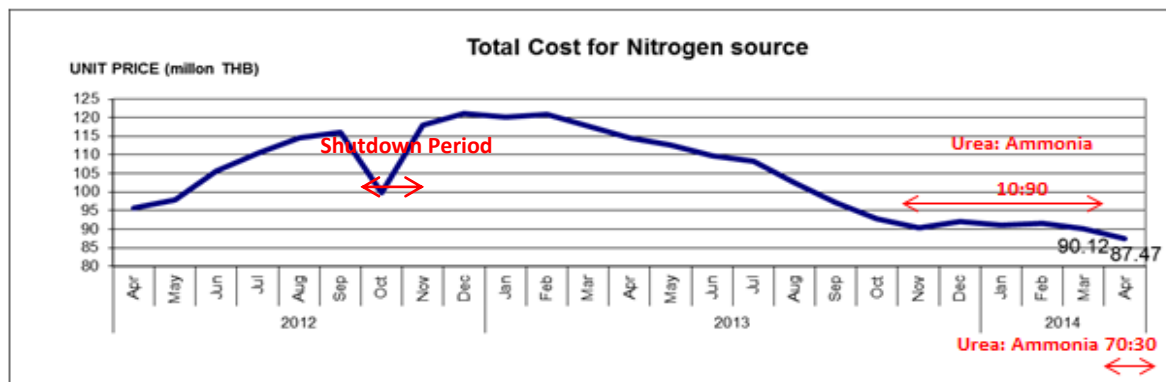


Figure 5. 2: The total cost of Nitrogen Cost from April 2012- April 2014

As the Figure 5.2 shows, after implement urea ratio up to 70% due to its competitive price in this period, the total purchasing cost is reduced from 90.12 to 87.47 million THB with cost merit approximately 2.65 million THB.

In the future contract, the percent ratio might be changed depending upon urea and ammonia market price. By using breakeven point formula, it can be a helping tool to decide the allocation ratio. However, 100% utilization of one raw material might not be suitable even the price is more competitive. This is because maintaining relationship with supplier is also important that has to concern when performing the contract as well.

### 5.1.2 32% and 50% Caustic Soda

#### Applied strategies

- Find alternative raw material
- Find breakeven point formula between main raw material and alternative
- Create competition atmosphere in order to lowering the unit price

#### Procedures

- 1). Cooperate with production department in order to find an alternative raw material giving the sodium source as same as caustic soda does



### 1.1 Find alternative raw material

Sodium carbonate or soda ash ( $\text{Na}_2\text{CO}_3$ ) can be used as alternative of sodium hydroxide or caustic soda ( $\text{NaOH}$ ). As the following chemical reaction indicated, when caustic soda and soda ash dissolve in water, they can give sodium ion as a product. However, caustic soda can generate only one sodium ion while soda ash can give two sodium ions.



### 1.2 Advantage and disadvantage point analysis

#### *In terms of production*

Soda ash can be used as an alternative of caustic soda because it can generate sodium ion as same as caustic soda does. However, soda ash is normally sold in a solid form while caustic soda is sold in liquid form. Hence, soda ash needs to be dissolved before using in the process.

#### *In terms of sourcing and purchasing*

As shows in the Figure 5.3 and Figure 5.4, the market price of caustic soda is fluctuated while the market price of soda ash is stable. Hence, using soda ash can be more predictable in terms of the market price and budget as well.

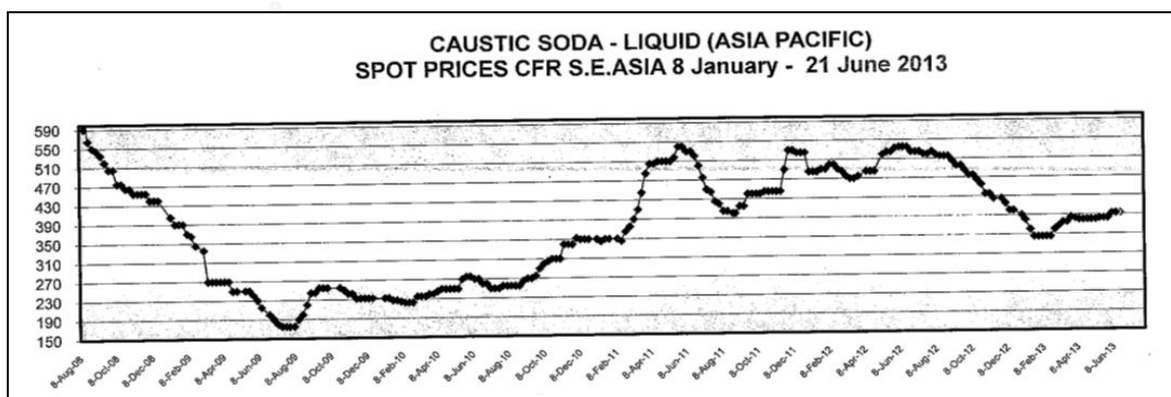


Figure 5. 3: The spot prices of caustic Soda (CER S.E. ASIA) from 8 January – 21 June 2013[29]

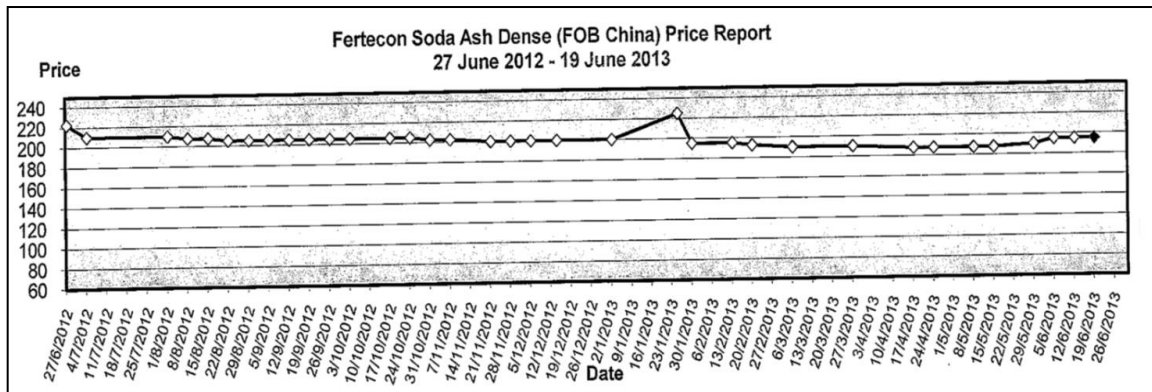


Figure 5. 4: The sort prices of soda ash (FOB China) from 27 June 2012 – 19 June 2013 [30]

2). Find breakeven point formula in order to know the equivalent price between main raw material and alternative

2.1 Break Even Point Formula Calculation of Caustic Soda (NaOH) and Soda Ash ( $\text{Na}_2\text{CO}_3$ )

Mole of sodium (Na) calculation

$$32\% \text{ NaOH} = \frac{23}{40} * 0.32 = 0.18 \text{ (NaOH molecular weight is 40 g.)}$$

$$50\% \text{ NaOH} = \frac{23}{40} * 0.50 = 0.29$$

$$100\% \text{ NaOH} = \frac{23}{40} * 1 = 0.57$$

$$100\% \text{ Na}_2\text{CO}_3 = \frac{46}{106} * 1 = 0.43 \text{ (Na}_2\text{CO}_3 \text{ molecular weight is 106 g.)}$$

Assume: The price of 32% NaOH = X Baht/Kg

If mole of Sodium in 32%NaOH:  $0.18 = X \text{ Baht}$

\*Hence mole of Sodium in 100%NaOH:  $0.57 = \frac{X}{0.184} * 0.57$  ----- (1)

\*\*Hence mole of Sodium in 100%  $\text{Na}_2\text{CO}_3$ : (1) \*  $\frac{0.43}{0.57}$

After substitution, the equivalent price between  $\text{Na}_2\text{CO}_3$  and NaOH is following.

$$\text{Na}_2\text{CO}_3 \text{ price} = 32\% \text{ NaOH price} * 2.34$$

$$\text{Na}_2\text{CO}_3 \text{ price} = 50\% \text{ NaOH price} * 1.48$$

3). Find soda ash suppliers in order to bid among each other and compare the offer price with caustic soda

4). Performing the contract by allocating the larger portion to competitive price raw material

#### 4.1 Calculating the equivalent price

By referencing from the offer price of 32% caustic soda (April 2014) = 4,300 THB/MT

The equivalent of soda ash price =  $4,300 * 2.34 = 10,148$  THB/MT

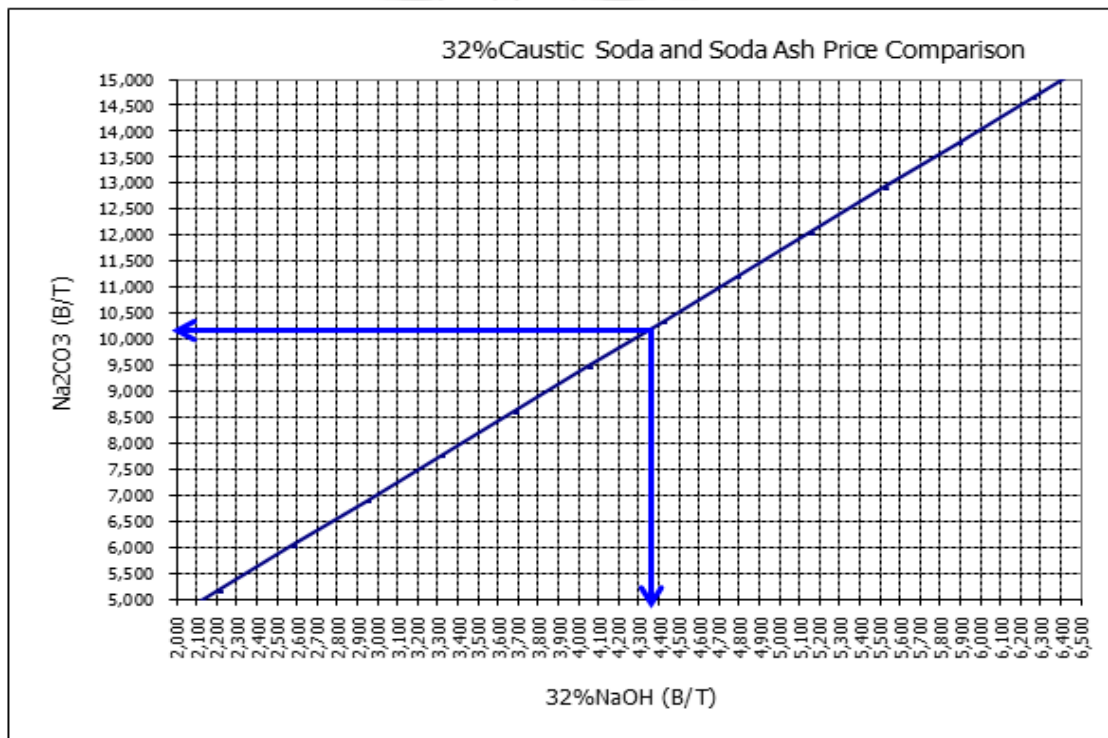


Figure 5. 5: 32% Caustic soda and Soda Ash Price Comparison  
(equivalent price)

By using breakeven point formula or graphing as Figure 5.5 to calculate the equivalent price, soda ash is more competitive. Soda ash equivalent price is 10,148 THB/MT while there is only 8,288 THB/MT of soda ash offer price. Hence, allocate more portion to soda ash is more competitive.

#### 4.2 Performing the contract

Because the soda ash price is more competitive, finding more suppliers in order to bid for the price is performed. There are five vendors bidding for the offer price however, only three suppliers with the lowest price are selected. As the Table 5.4 shows, the average price in March 2014 is high when compared with quarter 2/2014 contract price. This is because the order in March is concerned as a trial lot with less volume so the unit price is high. On the other hand, the average price in quarter 2/2014 is dramatically decreasing from 8,600 to 8,288 THB/MT or 3.62% due to more vendors, volume attraction along with high competition atmosphere.

Table 5. 4: Soda ash contract for March 2014 and Quarter 2/2014

Supplier name	March 2014 (Trial order)		Soda Ash Dense Contract: Quarter 2/2014 (April-June)				
	Final offer (THB/MT)	Contract Volume (MT)	First offer (THB/MT)	Second offer (THB/MT)	Final price (THB/MT)	Contract Volume (MT)	Total Cost
H Co.,Ltd	-	-	8,250	8,200	8,200	2,550	20,910,000
K Co.,Ltd	8,650 (Trial order)	720	8,600	-	-	-	-
L Co.,Ltd	-	-	8,500	-	-	-	-
M Co.,Ltd	-	-	8,350	-	8,350	1,275	10,646,250
N Co.,Ltd	-	-	8,400	-	8,400	1,275	10,710,000
Average price	8,600	720	Total Contract Volume = 5,100 MT/quarter (1,700 MT/month)				42,266,250
			Average price				8,288

Table 5. 5: The 32% Caustic Soda contract price comparison between Quarter 1/2014 and Quarter 2/2014

Supplier name	Quarter 1/2014 (January - March)					Quarter 2/2014 (April - June)					
	32% NaOH	Contract Volume (MT)	50% NaOH	Contract Volume (MT)	Total Cost	32% NaOH	Contract Volume (MT)	50% NaOH	Contract Volume (MT)	Total Cost	
C Co.,Ltd	4300	2200	-	-	9,460,000	4300	380	-	-	1,634,000	
D Co.,Ltd	4300	2200	-	-	9,460,000	4300	380	-	-	1,634,000	
E Co.,Ltd	4300	2200	-	-	9,460,000	4300	380	-	-	1,634,000	
Total Contract Volume = 6,600 MT/quarter (2,200MT/Month)			-	-	28,380,000	Total Contract Volume = 1,140 MT/quarter (380 MT/month)			-	-	4,902,000
Average price					4,300	Average price					4,300.00

By using the breakeven point formula, caustic soda has less competitive price when compared with soda ash. Hence, the volume allocation in quarter 2/2014 is significantly less than quarter 1/2014. Fortunately, by negotiation and in advance inform about alternative raw material project to suppliers, they still maintain the contract price even less caustic soda volume allocation (Table 5.5). However, in this period, there is no

requirement for using 50% caustic soda from production department. Once, the production department requires using 50% caustic soda, the breakeven point formula for comparing the equivalent price with soda ash is also available.

### Result and Discussion

Table 5. 6: Comparing Soda Ash and Caustic Soda Utilization Ratio and Total Purchasing Cost in each Month

Soda Ash Vs Caustic Soda Consumption					Convert Na <sub>2</sub> CO <sub>3</sub> to NaOH (Equivalent Consumption Noah : Na <sub>2</sub> CO <sub>3</sub> 1 : 0.75)	Total Volume of Caustic Soda	Total Cost (Using NaOH = 4,300 THB/MT as a reference price)
Month	Soda Ash (MT)	Caustic Soda (MT)	Soda Ash %Ratio	Caustic Soda %Ratio			
Nov-13	0	4,200.73	0%	100%	-	4,200.73	18,063,139
Dec-13	0	4,760.45	0%	100%	-	4,760.45	20,469,935
Jan-14	0	4,334.57	0%	100%	-	4,334.57	18,638,651
Feb-14	0	4,059.95	0%	100%	-	4,059.95	17,457,785
Mar-14	721.44	2,193.06	40%	60%	962	3,154.98	13,566,414
Apr-14	1,700.00	380.00	90%	10%	2,267	2,646.66	11,380,638

As Table 5.6 shows, by using 100% portion of caustic soda, the total cost is approximately 17—20 million THB. Implementing soda ash as an alternative raw material for reducing risk supply and more competitive price with the ratio 40% in March 2014, the total cost (using same unit price for calculation) is decreasing to 13 million THB. Moreover, by increasing the soda ash portion to 90%, the total cost is decreasing to 11 million. Hence, using 90% portion of soda ash in April 2014, the total cost is dramatically decreasing approximately 6 million baht or 35% decreasing comparing with using 100% portion of caustic soda in February 2014.

#### 5.1.3 35% Hydrochloric Acid

##### Applied Strategies

- Find alternative raw material
- Find breakeven point formula between main raw material and alternative
- Create competition atmosphere in order to lowering the unit price

##### Procedures

1). Cooperate with production department in order to find an alternative raw material giving the proton (H<sup>+</sup>) as same as hydrochloric acid does

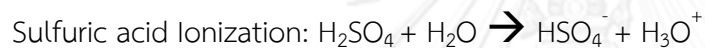
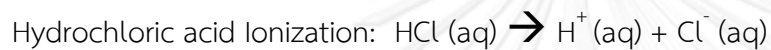
### 1.1 Find alternative raw material

- Find alternative raw material
- Find breakeven point formula between main raw material and alternative
- Create competition atmosphere in order to lowering the unit price

### 1.2 Advantage and disadvantage point analysis

#### *In terms of production*

Sulfuric acid can be used as an alternative for hydrochloric acid. It can generate proton ( $H^+$ ) as same as hydrochloric acid does. The chemical reactions are following.



However, hydrochloric acid which is monoprotic tends to have more corrosiveness rather than sulfuric acid which is diprotic. Using hydrochloric acid can be more corrosive to the pipe line as well as storage tank creating high maintenance cost. Hence, using sulfuric acid as an alternative or substitute raw material can solve this problem.

#### *In terms of sourcing and purchasing*

The chlor-alkali production is showed in the Figure 5.6. The supply volume of hydrochloric acid in the market is relied on the caustic soda demand. For example, if there is high demand of hydrochloric acid with low demand of caustic soda situation, the chlor-alkali's manufacture cannot increase hydrochloric acid production due to limitation of caustic soda demand. This situation can affect to the hydrochloric market price which is unpredictable. On the other hand, sulfuric acid uses sulfur as an only one major raw material. There is no co-product selling in the market hence, the market price can be more predictable when compared with hydrochloric acid.

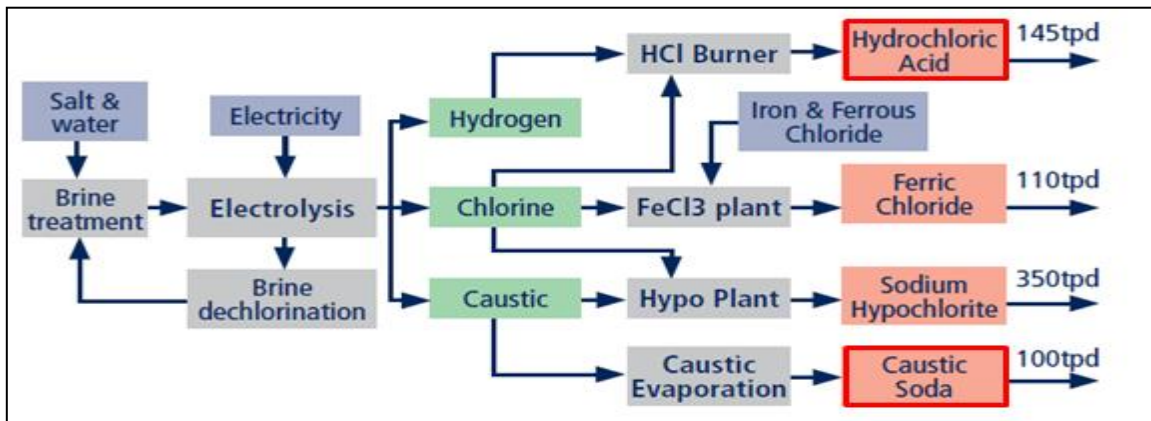


Figure 5. 6: ChlorAlkali Production Chart [31]

2). Find breakeven point formula in order to know the equivalent price between main raw material and alternative

2.1 Break Even Point Formula Calculation of Hydrochloric acid (HCl) and Sulfuric acid (H<sub>2</sub>SO<sub>4</sub>)

Mole of hydrogen (H) calculation

$$35\% \text{ HCl} = \frac{1}{36.5} * 0.35 = 0.01$$

$$98\% \text{ HCl} = \frac{1}{36.5} * 0.98 = 0.027 \text{ (Hydrochloric molecular weight is 36.5 g.)}$$

$$98\% \text{ H}_2\text{SO}_4 = \frac{2}{98} * 0.98 = 0.02 \text{ (Sulfuric acid molecular weight is 98 g.)}$$

Assume:

HCl 35% price = X Baht

If mole hydrogen in 35% HCl:

$$0.01 = X \text{ Baht}$$

\*Hence mole of hydrogen in 98 %HCl:

$$0.02 = \frac{0.027 * X}{0.01} \text{ ----- } \textcircled{1}$$

\*\*Hence mole of hydrogen in 98% H<sub>2</sub>SO<sub>4</sub>:

$$\textcircled{1} * \frac{0.02}{0.027}$$

After substitution, the equivalent price between 98%H<sub>2</sub>SO<sub>4</sub> and 35%HCl is following.

$$\boxed{98\% \text{H}_2\text{SO}_4 \text{ price} = 35\% \text{HCl price} * 2}$$



### 3). Calculating the equivalent price

By referencing from the offer price of 35% hydrochloric acid (April 2014) = 2,374 THB/MT

The equivalent of 98% sulfuric acid price =  $2,374 * 2 = 4,748$  THB/MT

By using breakeven point formula to calculate the equivalent price, 98% sulfuric acid is more competitive in this period. 98% sulfuric acid equivalent price is 4,748 THB/MT while there is only 3099.66 THB/MT of sulfuric acid offer price.

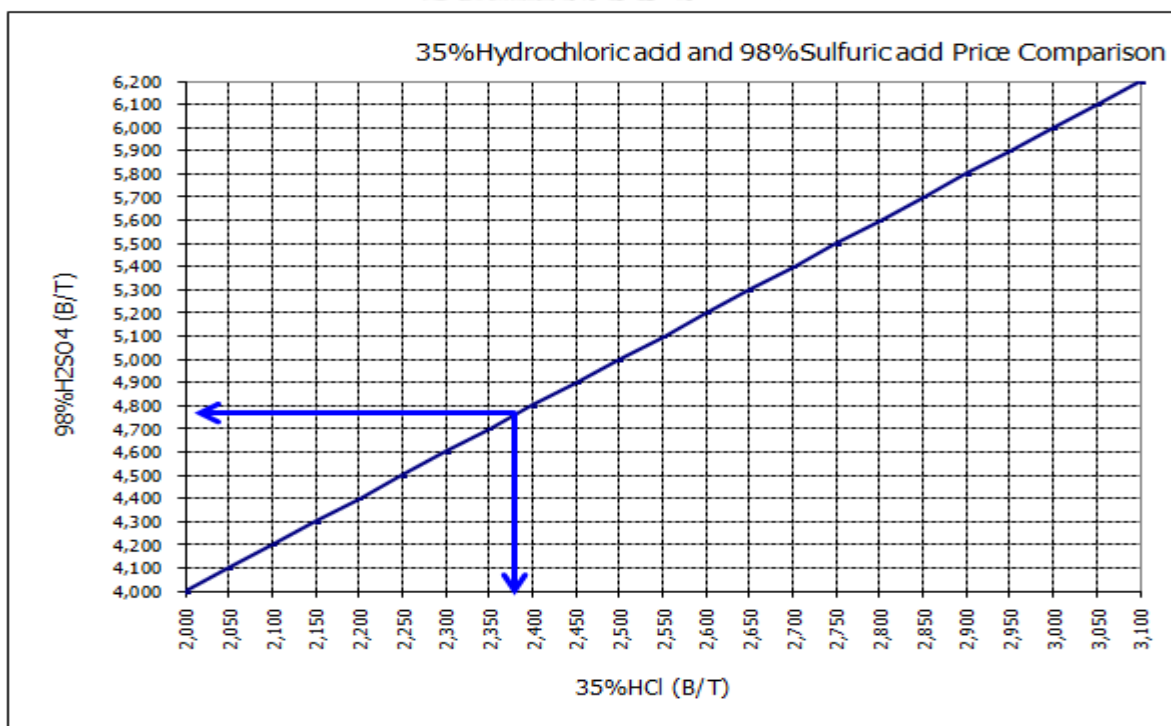


Figure 5. 7: 35% Hydrochloric acid and 98% Sulfuric acid Price Comparison  
(equivalent price)

However, hydrochloric acid has a pending contract from January 2014 till June 2014. Hence, it cannot apply alternative raw material which is sulfuric acid to use in the production line even sulfuric acid has more competitive price.



## 5.2 Leverage raw material

### 5.2.1 Coal

#### Background

Normally, there are 6 vendors supplying coal to ABC Company with the coal consumption approximately 330 MT/day. As the Table 5.7 shows, the average price is approximately 2,549.09 THB/T.

Table 5. 7: Coal contract price, coal quality and price ratio for quarter 2/2014 (October-December 2014)

Supplier	Qty. (T/day)	Price offer		Calorific Value (Kcal) (ADB)	Sulphur (%)	ARB Moisture (%)	Ash (%)	Delivery period	Purchasing plan	
		Jul.- Sep.'13 offer	Final Offer Price						Contract Volume	Amount (THB)
O Co.,Ltd	60	2,570	2,570	5,720	0.13%	33.38%	3.58%	Oct- Dec.'13	5,400	13,878,000
P Co., Ltd	30	2,600	2,600	5,519	0.17%	31.81%	4.51%		2,700	7,020,000
Q Co., Ltd	60	2,600	2,600	5,600	0.60%	35.04%	3.45%		5,400	14,040,000
R Co., Ltd	60	2,500	2,500	5,744	0.38%	35.69%	5.00%		5,400	13,500,000
S Co., Ltd	60	2,450	2,450	5,580	0.80%	30.41%	3.73%		5,400	13,230,000
T Co., Ltd	60	2,600	2,600	5,720	0.30%	31.21%	3.94%		5,400	14,040,000
<b>Total</b>	<b>330</b>								<b>Total</b>	<b>75,708,000</b>
									<b>Avg. Price</b>	<b>2,549.09</b>

#### Applied strategies

- Perform vendor optimization strategy in order to increase bargaining power, create competition among vendors and cost reduction as a target
- Choosing the optimum ratio between high heat and normal heat in order to decrease the using quantity
- Negotiation with supplier that has ash treatment license in order to offer free change of ash elimination service tradeoff with more order volume
- Using price ratio formula as a decision tool in order to weigh not only for the offer price but also quality when performing the contract

## Procedures

- 1). Finding the vendor that has ash treatment license
- 2). Finding the vendor that has high heat of coal in order to mix this portion with normal heat
- 3). Cooperation with production in order to find the optimum portion between high heat and normal heat ratio
- 4). Negotiation with supplier in order to service free ash treatment tradeoff with more contract volume allocation
- 5). Performing the Q2/2014 contract by applying vendor optimization strategy and using price ratio as a reference.

### 5.1 Price Ratio Formula

Because heat of coal is significantly factor to concern, with different in heat value can affect to the coal consumption volume. To concern both of the price and coal quality, price ratio formula is created in order to use as a tool for choosing the vendors when performing the contract. The lower value of price ratio indicates the better price and coal quality.

$$\text{Price Ratio Formula} = \frac{\text{Price}}{\text{Heat} * (1 - \% \text{Sulfer} - \% \text{Moisture} - \% \text{Ash})}$$

## Result and Discussion

The Table 5.8 shows the ratio of normal heat and high heat along with coal consumption and total cost from December 2013 to April 2014. The result and discussion in each month is described below.

Table 5. 8: The information of coal consumption and total cost from December 2013 to April 2014 (High heat of coal= Calorific value > 5,800 Kcal, Normal heat of coal = Calorific value 5,500-5,800 Kcal)

Period	Coal Specification	Avg. Price (THB/Month)	Total Actual Consumption (MT/Month)	Total Cost of Coal (THB/Month)	Ash Amount (MT/Month)	Ash Treat Fee (THB/Month)	Responsibility of Ash Treatment	Total Cost (THB/Month)
Dec.2013	Normal Heat : High Heat (100:0)	2,549	9,979	25,436,471	520	260,000	ABC	25,696,471
Jan.2014	Normal Heat : High Heat (80:20)	2,581	9,827	25,363,487	484	242,000	ABC	25,605,487
Feb.2014	Normal Heat : High Heat (80:20)	2,581	9,800	25,293,800	479	239,500	ABC	25,533,300
Mar.2014	Normal Heat : High Heat (30:70)	2,720	8,444	22,967,680	436	218,000	ABC	23,185,680
Note: The Avg. unit price in March is significantly increased because there is a trial order of high heat of coal.								
Apr.2014	Normal Heat: High Heat (30:70)	2,540 (Apr.-Jun.'14)	8,430	21,412,200	430	215,000	Supplier (U Co.,Ltd.)	21,412,200
Note: The total cost is dramatically decreased because of decreasing in coal consumption and no cost of ash treatment.								
Comparing Before and After implementing the project (December'13 VS April'14)		(9)	(1,549)	(4,024,271)	(90)	(45,000)	Free ash treatment	(4,284,271)
		0.20%	-18%	-19%	-21%	-21%		-20%

As Table 5.8 shows, in January, the company chooses U Co.,Ltd. to supply high heat of coal as an additional contract due to its competitive price, good coal quality and available of ash treatment license. Then, trial high heat (20%) mixing with normal heat (80%), the average unit price in January'14 (2,581 THB) is increasing from December'13 (2,549 THB) approximately 1.12% resulting from higher unit price of additional high heat contract. However, the volume consumption and ash amount is decreasing approximately 1.52% and 6.92% respectively. The total expenditure is also decreasing as well.

In February, the production still uses the same ratio as January dose in order to confirm the operation result. Hence, the unit price, coal consumption along with ash amount is quite the same.

In March which is the last trial month, the production performing research and production test. They surely confirm that the optimum point for mixing normal and high heat is 30:70. With this ratio, it can generate the maximum stream using in the production

line. The unit price (2,720 THB) is increasing from February (2,581 THB) around 5.38%. However, the coal consumption and ash amount is significantly decreasing around 14% and 8.98% respectively.

After trial period with production confirmation, the purchasing department performs the quarter 2 /2014's contract. In this contract, the price ratio that concerned for the offer price and coal quality has also calculated. The lower value of price ratio indicated the proper offer price and good quality of coal when compared with other vendors. Purchasing team is not only optimizing high heat and low heat consumption ratio but also applying vendor optimization strategy referencing from the price ratio information in this contract as well. There are 4 out of 7 vendors selecting in this contract as shown in the Table 5.9. With huge portion (70%) of high heat supplying from U Co.,Ltd, negotiation for lower unit price and free ash treatment service can be negotiated and achieved.

Table 5. 9: Coal contract price, coal quality and price ratio  
for quarter 2/2014 (April-June 2014)

Supplier	Qty. (T/day)	Price offer			Calorific Value (Kcal (ADB)	Sulphur (%)	ARB Moisture (%)	Ash (%)	Price Ratio	Delivery period	Purchasing plan	
		Jan.- Mar'13 offer	1st Offer	Final Offer Price							Contract Volume	Amount (THB)
U Co., Ltd	180	3,100	3,200	2,750	5,900	0.12%	23.21%	2.60%	0.629	Apr.- Jun'14	16,200	44,550,000
O Co., Ltd	30	2,450	2,350	2,250	5,624	0.13%	33.14%	3.58%	0.634		2,700	6,075,000
P Co., Ltd	-	2,500	2,400	2,300	5,610	0.17%	33.88%	4.51%	0.667		-	-
Q Co., Ltd	30	2,450	2,360	2,250	5,750	0.60%	33.14%	3.45%	0.623		2,700	6,075,000
R Co., Ltd	-	2,450	2,350	2,250	5,749	0.38%	35.89%	5.00%	0.666		-	-
S Co., Ltd	60	2,450	2,270	2,200	5,600	0.60%	30.01%	3.88%	0.600		5,400	11,880,000
T Co.,Ltd	-	2,550	2,350	2,300	5,700	0.30%	31.21%	5.01%	0.636		-	-
Total	300									Total	68,580,000	
										Avg. Price	2,540.00	

By comparing before and after implement the project (December'13 and April'14), the average unit price is slightly decreasing (0.3%) because of high mixing portion of high heat with higher unit price. However, the total cost is dramatically decreasing around 4,284,271 THB or 20%. This is resulting from a significant decreasing in consumption per month around 18% and no cost of ash elimination.

## 5.2.2 Sulfuric acid

### Apply strategies

- Perform vendor optimization strategy in order to increase bargaining power, create competition among vendors and cost reduction as a target

### Procedures

1. Inform the supplier for applying vendor optimization strategy in order to give them awareness for offering the best price
2. Biding for the offer price for quarter 2/2014 (April-July 2014)
3. Selecting supplier with the best offering price and performing volume allocation

### Result and Discussion

Table 5. 10: Compare Sulfuric acid offer price and volume allocation in quarter 1/2014 and quarter 2/2014

Supplier Name	Factory Supply	Quarter 1/2014 (Jan.-Mar. '14)		Quarter 2/2014 (Apr.-Jul. '14)		% Price Different
		Unit Price	Quantity (MT)	Unit Price	Quantity	
H Co.,Ltd	PPD,PTT,AYT	3,200	4,237 (41%)	2,680	4,605 (43%)	-19%
	KPP	3,700		3,180		-16%
V Co.,Ltd	PPD,PTT,AYT	3,300	2,377 (23%)	2,900	3,105 (29%)	-14%
	KPP	3,800		3,400		-12%
X Co.,Ltd	PPD,PTT,AYT	3,300	2,584 (25%)	2,800	2,784 (26%)	-18%
	KPP	3,800		3,300		-15%
Y Co.,Ltd	PPD,PTT,AYT	3,400	723 (7%)	3,000		-13%
	KPP	3,900		3,500		-11%
Z Co., Ltd	KPP	3,700	207 (2%)	3,300	297 (2%)	-12%
Average Price and Total Volume		Avg. Price 3,413.36	Total Volume 10,336	Avg. Price 3,099.6	Total Volume 10,710	% Avg.Price Different -3.49%
Total Cost		35,280,488.96		33,196,716.00		-6%

As the Table 5.10 shows, the offered price for Quarter 2/2014 is dramatically decreasing. It is more than 10 % decreasing in offer price in every supplier. However, the supplier who offers the highest price is not selected to perform the contract. Y Co.,Ltd offers the highest unit price while H Co., Ltd offers the lowest one. Hence, Y Co.,Ltd is not

selected for supply sulfuric acid in this contract. However, Y Co., Ltd still has chance for bidding in the next quarter.

For selecting supplier, they receive more volume portion when comparing with previous quarter. The supplier with the lowest offer unit price will receive the highest volume portion and in descending order.

### 5.3 Bottleneck raw material

#### 5.3.1 Urea

##### Apply strategies

- Perform vendor optimization strategy in order to increase bargaining power, create competition among vendors and cost reduction as a target
- Apply breakeven point formula between urea and ammonia (stated in session 5.1.1) in order to consider for the competitive raw material in term of price

##### Procedure

1). Calculate the breakeven point formula in order to compare the price competitive raw material between urea and ammonia.

As the session 5.1.1 stated above, urea price is more competitive. Hence, allocate more volume to urea is more competitive to the company. In this quarter, the volume portion between urea and ammonia is 90:10 as stated in the Table 5.11.

2). Search for the urea supplier in order to increase the bargaining power and lower the offer unit price

## Result and Discussion

Table 5. 11: Urea contract price and volume allocation  
for quarter1/2014 and quarter 2/2014

Supplier name	Quarter 1/2014 (Jan.-Mar.)		Urea Contract: Quarter 2/2014 (Apr.-Jun.)				Total Cost
	Final Price	Contract Volume (MT)	First offer (THB/MT)	Second offer (THB/MT)	Final price (THB/MT)	Contract Volume (MT)	
G Co.,Ltd	14,000	600	13,400	12,900	-	-	-
H Co.,Ltd	-	-	12,300	12,300	12,300	4,000	49,200,000
B Co.,Ltd	-	-	12,500	12,500	12,500	2,000	25,000,000
I Co.,Ltd	-	-	13,200	-	-	-	-
J Co.,Ltd	-	-	13,000	12,500	12,500	2,000	25,000,000
Average price	14,000	600	Total Volume =8,000 MT/quarter (2,667 MT/month)				99,200,000
			Average Price			12,400	

As the Table 5.11 shows, there is only one supplier supplies urea in quarter 1/ 2014 due to a few orders quantity when compare with ammonia. However, after apply new strategy such as breakeven point formula along with vendor optimization strategy in quarter 2/2014; urea is concerned as more competitive price. Hence, more volume portion is allocated to urea. There is 90:10 of urea and ammonia volume allocation respectively. With high order volume of urea, bidding among suppliers is performed in order to create competition atmosphere and lower the unit price. There are 3 out of 5 suppliers selected to supply urea in quarter 2 /2014. The one who offers the lowest offer price will receive the highest volume allocation. The average unit price is decreasing from 14,000 THB/MT to 12,400 THB/MT or 14.2% decreasing.

### 5.3.2 Potassium Chloride

#### Apply strategies

- Improve alternative supplier in order to increase the bargaining power, reduce the unit price and supply risk

#### Procedure

- 1). Search for the alternative vendor with the same product specification
- 2). Bidding for the offer price and performing the quarter 2/2014 (April-June 2014)'s contract

## Result and Discussion

Table 5. 12: Compare Potassium chloride offer unit price  
between quarter 1/2014 and quarter 2/2014

Supplier Name	Quarter 1/2014 (January-March 2014)			Quarter 2/2014 (April-June 2014)			% Total cost decreasing
	Unit price	Contract Volume (MT)	Total Cost	Unit Price	Contract Volume (MT)	Total Cost	
AA Co.,Ltd	25,000.00	180 (100%)	4,500,000.00	23,000.00	110 (60%)	2,530,000.00	7.20%
B Co.,Ltd				23,500.00	70 (40%)	1,645,000.00	
Average Unit Price	25,000.00		4,500,000.00	23,200.00		4,175,000.00	

As Table 5.12 shows, by approving alternative supplier, it can increase competition atmosphere. The alternative vendor, B Co.,Ltd attempts to offer lower unit price when compared with previous supplier. The offering unit price is 23,500 THB/MT. However, the previous supplier, AA Co.,Ltd requires high volume allocation. Hence, AA Co.,Ltd offers 23,000 THB/MT. Finally, AA Co.,Ltd gains 60% of volume allocation while B Co.,Ltd gains 40% of volume allocation. The percent of average unit price is decreasing approximately 7.20% when compared with previous quarter.

### 5.3.3 Antifoam GD-113 and 5.3.4 Succinic acid

Both Antifoam GD-113 and Succinic acid are having the same nature supply. Hence, they can apply the same strategy in order to improve the purchasing efficiency.

#### Apply strategies

- Shorten supply chain in order to reduce premium cost, shorter lead time and reduce risk
- Search alternative vendor with different source in order to increase bargaining power and lower the supply risk
- Apply yearly contract instead of monthly contract in order to lower the supply risk, reduce redundant work and reduce unit cost as well

#### Procedure

- 1). Inform the relevant parties about this project especially ATT (domestic trader) for not continuing the contract



- 2). Inform factory to forecast and send the yearly consumption plan to purchasing department
- 3). Search for the additional vender with different supply source but same product specification as well as current vendor
- 4). Apply yearly contract instead of monthly contract

### Result and Discussion

#### *Supply Chain Improvement*

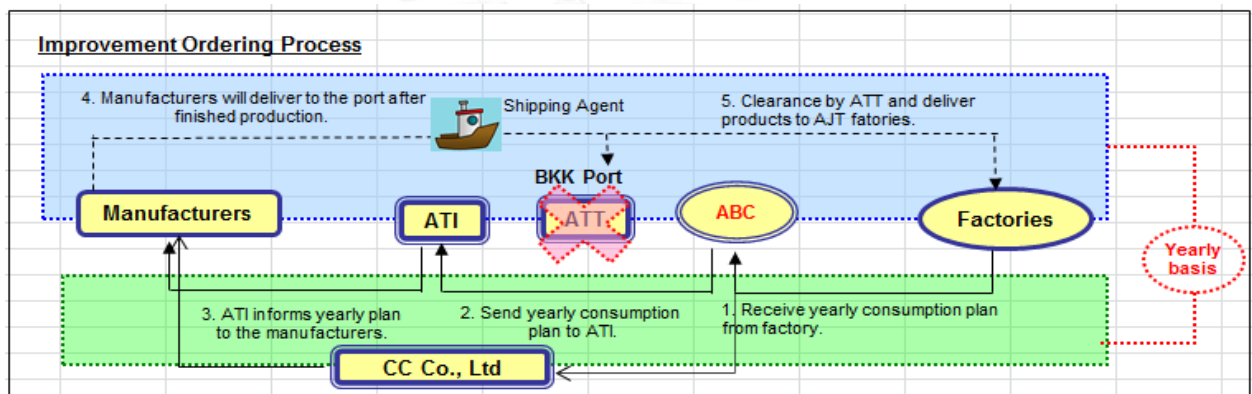


Figure 5.8: The improvement of ordering process by shorten the supply chain

As the Figure 5.8 shows, in order to shorten the supply chain, ATT is not chosen for continuing the contract. ABC purchasing team directly contracts with ATI which is concerned as overseas trader. The yearly consumption plan along with yearly purchasing order document is sent to the ATI and forwarded to manufacturer. Hence, manufacturer can advance perform the production planning. Moreover, purchaser also approves local alternative trader with different supply source which is CC Co.,Ltd. This can reduce lead time and supply risk in case there is shortage raw material situation from one supplier.

### Unit Cost Improvement

Table 5. 13: Compare the total average price of Antifoam GD-113 and Succinic acid between March 2014's contract and April-December 2014's contract

Name of Supplier	Antifoam GD-113 and Succinic acid Contract: Mar. 2014 (Monthly Contract)						
	Antifoam GD-113	Contract Volume (MT)	Antifoam GD-113 Total Cost (THB)	Succinic acid	Contract Volume (MT)	Succinic acid Total Cost (THB)	Total Cost/month (THB)
BB Co.,Inc. (Overseas Trader)	175.00	6,000 (100%)	1,050,000	109.50	1800 (100%)	197,100.00	1,247,100.00
Name of Supplier	Antifoam GD-113 and Succinic acid Contract : Apr.- Dec. 2014 (Yearly Contract)						
	Antifoam GD-113	Contract Volume (MT)	Antifoam GD-113 Total Cost	Succinic acid	Contract Volume (MT)	Succinic acid Total Cost	Total Cost (THB)
BB Co.,Inc. (Overseas Trader)	165.00	4,500 (25%)*	742,500	98.00	1,350 (25%)*	132,300.00	874,800.00
CC Co., Ltd. (Domestic Trader)	158.00	13,500 (75%)*	2,133,000	95.50	4,050 (75%)*	386,775.00	2,519,775.00
<b>Total Average Price</b>	<b>161.5</b>	<b>18,000</b>	<b>2,865,500 THB/year (Total Cost per month = 958,500)</b>	<b>96.75</b>	<b>5,400</b>	<b>519,075 THB/year (Total Cost per month = 173,025)</b>	<b>3,394,575.00 THB/year (Total cost per month = 1,131,525.00 THB )</b>
*Antifoam GD-113 and Succinia acid have 3 orders per year.							

As shown in the Table 5.13, by approving the alternative vendor and perform yearly contract instead of monthly, purchaser has more bargaining power to negotiate the unit price and reduce the redundant works. The average unit price of antifoam GD-113 is decreasing 7.71% while there is 11.60% decreasing in succinic acid average unit price.

#### 5.3.5 Ammonium chloride

##### Apply strategy

- Improve alternative supplier in order to increase the bargaining power, reduce the unit price and supply risk

##### Procedure

- 1). Search for the alternative vendor with the same product specification
- 2). Bidding for the offer price and performing the quarter 2/2014 (April-June 2014)'s contract

## Result and Discussion

Table 5. 14: Compare Ammonium chloride offer unit price between quarter 1/2014 and quarter 2/2014

Supplier Name	Quarter 1/2014 (January-March 2014)			Quarter 2/2014 (April-June 2014)			% Total cost decreasing
	Unit price	Contract Volume (MT)	Total Cost	Unit Price	Contract Volume (MT)	Total Cost	
AA Co., Ltd	11,000.00	30 (100%)	330,000.00	9,500.00	15 (50%)	142,500.00	
H Co., Ltd				9,500.00	15 (50%)	142,500.00	
Average Unit Price	11,000.00		330,000.00	9,500.00		285,000.00	

As shown in the Table 5.14, by approving alternative supplier which is H Co.,Ltd, it is increasing in competition atmosphere. Both two supplier offer for the same unit price hence, the percent volume allocation is the equivalent which is 50%. The average unit cost is decreasing from the previous contract approximately 13.63%.

### 5.4 Conclusion

The conclusion results are summarized and shown in the Tables 5.15 and 5.16. Those summarized tables conclude the applied strategies along with improvement points. The priority concern for strategic raw material is to reduce the supply risk and average unit cost. The priority concern for the leverage raw material is to lowering the unit price and total cost. For the bottleneck raw material, the priority concern is to reduce the supply risk. With different group in supply positioning model, the different strategies are chosen to apply. The details are shown in the tables below.

Table 5. 15: The summary results and improvement points of strategic and leverage raw material

Supply Positioning	Name of Raw Material	Priority Concern	Strategy	Before Apply Improvement Strategy	After Apply Improvement Strategy	Improvement Point
Strategic	Ammonia		-Create competition atmosphere in order to lowering the unit price	- No alternative raw material and sometime suffer from raw material	- Can use Urea as alternative raw material	- Reduce supply risk
				- Total Cost per month = 90.12 million THB (Using Urea:Ammonia= 10:90)	- Total cost per month = 87.47 million THB (Using Urea:Ammonia= 70:30)	- Cost merit per month = 2.65 million THB
	Caustic Soda	Reduce supply risk and Unit Price	- Find alternative raw material and source	- No alternative raw material and sometime suffer from raw material shortage	- Can use Soda ash as alternative raw material	- Reduce supply risk
Leverage	Coal		- Vendor optimization - Apply price ratio formula - Optimize high heat and low heat of coal utilization - Negotiation with supplier for free charge of ash elimination service	- Total cost per month approximately = 18 million THB	- Total cost per month approximately = 11 million THB	- Cost merit per month approximately = 7 million THB
				- No alternative raw material	- Can use Sulfuric acid as alternative raw material	- Reduce supply risk
	Sulfuric acid	Reduce unit price	- Find breakeven point formula between main raw material and alternative	The alternative raw material cannot be applied and performed the contract in this quarter even it has more competitive price because Hydrochloric acid still has pending contract from January till June 2014. However, the production department had already accepted for using sulfuric acid as an alternative raw material in the production		
				- Un-attraction volume due to too several supply vendors - Total cost per month = 25.69 million THB	- More attracting volume because of applying vendor optimization - Total cost per month = 21.41 million THB	- Purchaser has more bargaining power to negotiate with vendors. - Cost merit per month = 4.28 million THB
			- Vendor optimization	- Un-attraction volume due to too several supply vendors - Total cost per quarter = 35 million THB (11.66 million THB per month )	- More attracting volume because of applying vendor optimization - Total cost per quarter = 33 million THB (11 million THB per month)	- Purchaser has more bargaining power to negotiate with vendors. - Cost Merit per month = 660,000 THB

Table 5. 16: The summary results and improvement points of bottleneck raw material

Supply Positioning	Name of Raw Material	Priority Concern	Strategy	Before Apply Improvement Strategy	After Apply Improvement Strategy	Improvement Point
Bottle neck	Urea			<ul style="list-style-type: none"> <li>- High risk due to only one supply source and single vendor</li> <li>- Total cost per month = 90.12 million THB (Using Urea:Ammonia= 10:90)</li> </ul>	<ul style="list-style-type: none"> <li>- More vendors along with different sources bidding for the offer price</li> <li>- Total cost per month = 87.47 million THB (Using Urea:Ammonia= 70:30)</li> </ul>	<ul style="list-style-type: none"> <li>- Purchaser has more bargaining power to negotiate with vendors.</li> <li>- Cost merit per month = 2.65 million THB</li> </ul>
	Potassium Chloride			<ul style="list-style-type: none"> <li>- High risk due to only one supply source and single vendor</li> <li>- Total cost per quarter = 4.5 million THB (1.5 million THB per month)</li> </ul>	<ul style="list-style-type: none"> <li>- More vendors along with different sources bidding for the offer price</li> <li>- Total cost per quarter = 4.17 million THB ( 1.39 million THB per month)</li> </ul>	<ul style="list-style-type: none"> <li>- Purchaser has more bargaining power to negotiate with vendors.</li> <li>- Cost merit per month = 110,000 million THB</li> </ul>
	Antifoam GD-113	Reduce supply risk	<ul style="list-style-type: none"> <li>- Break monopoly</li> <li>- Approve alternative suppliers and supply sources</li> </ul>	<ul style="list-style-type: none"> <li>- Long supply chain resulting in high premium cost added along the chain</li> <li>- High risk due to only one supply source and single vendor</li> <li>- Total cost per month = 1,050,000 THB</li> </ul>	<ul style="list-style-type: none"> <li>- Eliminate the most unrelated party to shorten the chain</li> <li>- More vendors along with different sources bidding for the offer price</li> <li>- Total cost per month = 958,500 THB</li> </ul>	<ul style="list-style-type: none"> <li>- Reduce supply risk and cost of product</li> <li>- Purchaser has more bargaining power to negotiate with vendors.</li> <li>- Cost merit per month = 91,500 THB</li> </ul>
	Succinic acid			<ul style="list-style-type: none"> <li>- Long supply chain resulting in high premium cost added along the chain</li> <li>- High risk due to only one supply source and single vendor</li> <li>- Total cost per month = 197,100 THB</li> </ul>	<ul style="list-style-type: none"> <li>- Eliminate the most unrelated party to shorten the chain</li> <li>- More vendors along with different sources bidding for the offer price</li> <li>- Total cost per month = 173,025 THB</li> </ul>	<ul style="list-style-type: none"> <li>- Reduce supply risk and cost of product</li> <li>- Purchaser has more bargaining power to negotiate with vendors.</li> <li>- Cost merit per month = 24,075 THB</li> </ul>
	Ammonium Chloride			<ul style="list-style-type: none"> <li>- High risk due to only one supply source and single vendor</li> <li>- Total cost per quarter = 330,000 THB/MT (110,000 THB per month)</li> </ul>	<ul style="list-style-type: none"> <li>- More vendors along with different sources bidding for the offer price</li> <li>- Total cost per quarter = 285,000 THB/MT (95,000 THB per month)</li> </ul>	<ul style="list-style-type: none"> <li>- Purchaser has more bargaining power to negotiate with vendors.</li> <li>- Cost Merit per month = 15,000 THB</li> </ul>

## CHAPTER VI

### CONCLUSION AND SUGGESTIONS

This chapter concludes for the improvement plan and strategies applied to each raw material position (critical, bottleneck, and leverage). The result improvement in terms of the cost reduction and supply risk are also indicated. Finally, both short to medium term plan and long term plan are also suggested in the end of the session. The covered topics are following.

#### 6.1 Improvement plan and strategy conclusion

#### 6.2 Result conclusion

##### 6.2.1 Cost reduction

##### 6.2.2 Reduce supply risk

#### 6.3 Future plans and suggestions

##### 6.3.1 Short to medium term plan

##### 6.3.2 Long term plan

#### 6.4 Conclusion

#### **6.1 Improvement plan and strategy conclusion**

By using the supply positioning model to classify the group of raw material; it can be classified raw materials into 4 groups which are strategic, bottleneck, leverage and routine. The strategic raw materials are ammonia, caustic soda, and hydrochloric acid. The main strategy is to reduce supply risk along with unit price due to high expenditure per annual (Class A raw material). To reduce supply risk, the alternative products have been approved and the breakeven point formulas have defined in order to find the equivalent price and compare for the offer price when performing the contract. This is not only reducing supply risk but also reducing unit price and total cost in case the alternative raw material has more competitive market price. For the leverage raw materials, there are coal and sulfuric acid. The major target to achieve is cost reduction. To achieve this target, create more on competition

atmosphere among suppliers to increase purchasing power is applied. For bottleneck raw materials, there are urea, potassium chloride, antifoam GD-113, succinic acid and ammonium chloride. The major target is to reduce supply risk. By searching for alternative suppliers along with alternative sources is a major applied strategy. However, there are no selected raw materials that are located in the routine position.

## 6.2 Result conclusion

After performing the purchasing improvement project, the achieved improvement points can be classified into two issues which are cost reduction and reduce supply risk. These improvement points are achieved the thesis objectives and covered the expected benefits that stated in the chapter I. The improvement results are following.

### 6.2.1 Cost reduction

As the Table 6.1 shows, before applying the purchasing improvement project, the total expenditure of selected raw materials (10 selected raw materials) is 238,667,100 THB/month. After apply the improvement strategy, the total cost is reducing to 220,966,525.00 THB/month. Hence, the cost reduction per month is 17,700,575.00 THB/month or 7.42% reduction.

Table 6. 1: The summary table of cost reduction after implementing the purchasing improvement project

Before Apply Improvement Strategy		After Apply Improvement Strategy		Cost Reduction per month	% Reduction per month
<b>Total Cost</b>	238,667,100.00 THB/month	<b>Total Cost</b>	220,966,525.00 THB/month	17,700,575.00 THB	7.42%
<b>Risk</b>	- 3 Items in Critical Position	<b>Risk</b>	- No items located in Critical Position (Move to leverage position)	X	
	- 5 Items in Bottleneck Position		- No items located in Bottleneck Position (Move to Routine and leverage position)		



### 6.2.2 Reduce supply risk

As the Table 6.1 and Figure 6.1 show, before applying the purchasing improvement project, there are 3 raw materials located in critical position which are concerned as high expenditure along with high risk and 5 raw materials located in bottleneck position which are concerned as low expenditure but high risk. After implementing the improvement strategy, there are no items located in critical and bottleneck position. The strategic raw materials are moved to leverage position and bottleneck raw materials are moved to routine position and leverage position.

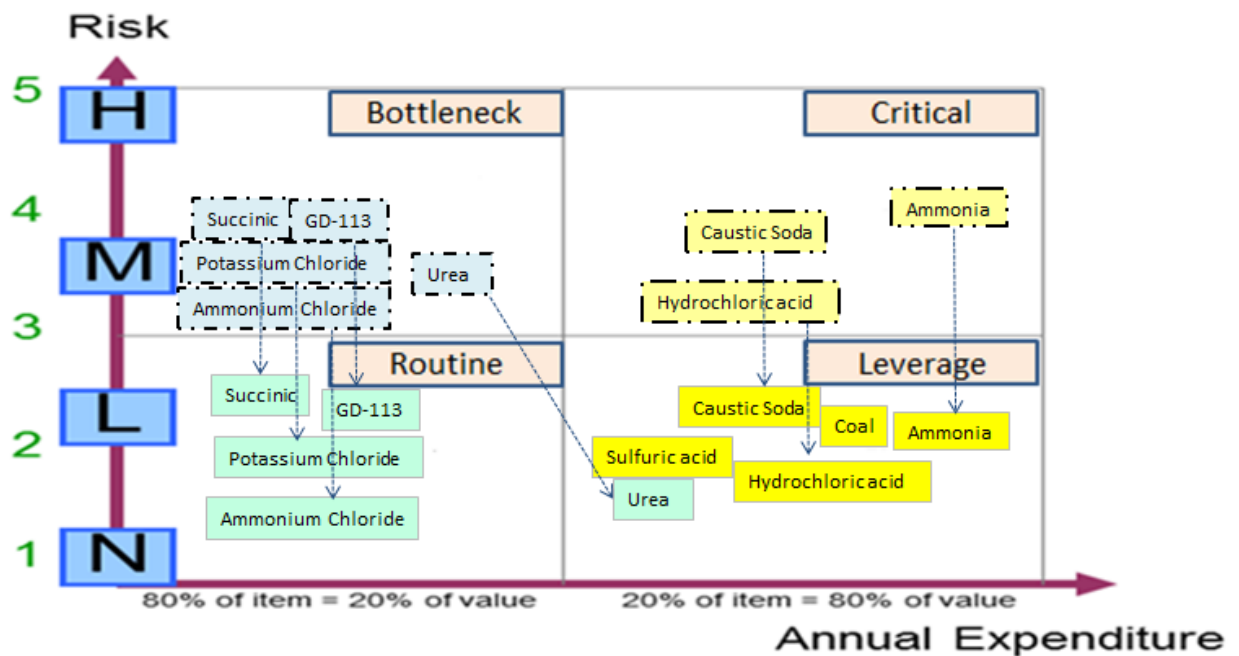


Figure 6. 1: The supply positioning movement of improved raw material

### 6.3 Future plans and suggestions

The future plans can be separate into two types which are short to medium term and long term as following.

#### 6.3.1 Short to medium term plan

As stated above, hydrochloric acid which is concerned as a strategic raw material also has an alternative product (sulfuric acid). However, hydrochloric acid has a pending contract from January to June 2014. Therefore, sulfuric acid cannot



apply for using in the production line even there is more competitive price in this period (quarter 2/2014).

For the short term plan, after hydrochloric acid contract is terminated, the breakeven point formula is applied for calculating the equivalent price of these two products. The more competitive raw material is chosen to perform the contract.

### **6.3.2 Long term plan**

In the future, control and monitor the applied strategy along with market situation are required. However, the applied strategies are needed to adapt and match to the particular situation.

### **6.4 Conclusion**

Purchasing department is concerned as a strategic department dealing with the cost of company. In order to have a good financial performance along with low supply risk, the improvement of purchasing strategies are applied. Firstly, applying the Pareto Analysis in order to classify the list of raw materials based on annual expenditure in to three classes, class A chemical raw materials and top five with high supply risk from class B chemical raw materials are focused and selected for applying procurement improvement in terms of cost reduction and reduce supply risk. Due to the limitation of study scope, only chemical raw materials are concerned. The selected raw materials are ammonia, caustic soda, hydrochloric acid, coal, sulfuric acid, urea, antifoam GD-113, succinic acid and ammonium chloride. Secondly, applying Five Force Analysis tool to each selected chemical raw material, the average risk scores from brain storming session are indicated. The raw materials with average risk score equal or more than 3 are concerned as high supply risk. While, the raw materials with average risk score less than 3 are concerned as low supply risk. Thirdly, the average risk score information from Five Force Analysis and annual expenditure information from Pareto Analysis can plot each raw material positions in Supply Positioning Model. Those raw materials can be classified into four classes which are critical, bottleneck, leverage and routine. Critical raw materials are ammonia, caustic soda and hydrochloric acid. Bottleneck raw materials are antifoam GD-113, succinic acid and ammonium chloride. Leverage raw materials are coal and

sulfuric acid. However, there are no raw materials classified as routine. Fourthly, Purchasing Portfolio Matrix is applied. The supplier power against the buyer power is compared. Hence, the purchasing power of each raw material can be indicated. Finally, the proper strategies are applied to each raw material based on their supply position. The main strategies for critical raw materials are reducing supply risk and average unit price. The main strategies for bottleneck raw materials are reducing supply risk while the main strategies for leverage raw materials are reducing average unit price. Although the cost of reduction and reduce supply risk are considered as significant points, maintaining the supplier relationship is also an important issue to concern when performing the contract as well. After applying this improvement procurement project, the total expenditure is reducing from 238,667,100 THB/month to 220,966,525.00 THB/month. Hence, the cost reduction per month is 17,700,575.00 THB/month or 7.42% reduction. For the supply risk, before applying the purchasing improvement project, there are 3 raw materials located in critical position which are concerned as high expenditure along with high risk and 5 raw materials located in bottleneck position which are concerned as low expenditure but high risk. After implementing the improvement strategy, there are no items located in critical and bottleneck position. The strategic raw materials are moved to leverage position and bottleneck raw materials are moved to routine position and leverage position. Hence, it can be concluded that the project objectives are achieved.

## REFERENCES

1. Kraljic, P., *Purchasing must become supply management*. Harvard business review, 1983. **61**(5): p. 109-117.
2. Management, C.G.o.M., *ABC Classification/ Analysis of Inventory* in <http://www.materialsmanagement.info/inventory/abc-inventory-analysis.htm>. 2014.
3. Company, N.I.G., *Sulfur Price* in <http://sulfur.nigc.ir/en/sulfurtrade/sulfurmarket/sulfurprice>. 2012
4. Limited, F., *Potash Report 2009-2014*
5. Edin, C.F.a.P., *How purchasing practitioners use the Kraljic matrix*. 2008.
6. Hartmann, E., D. Kerkfeld, and M. Henke, *Top and bottom line relevance of purchasing and supply management*. Journal of Purchasing and Supply Management, 2012. **18**(1): p. 22-34.
7. Hahn, C.K., C.A. Watts, and K.Y. Kim, *The supplier development program: a conceptual model*. Journal of Purchasing and Materials Management, 1990. **26**(2): p. 2-7.
8. Carter, J.R. and R. Narasimhan, *Is purchasing really strategic?* Journal of Supply Chain Management, 1996. **32**(1): p. 20-28.
9. Ogden, J.A., C.L. Rossetti, and T.E. Hendrick, *An exploratory cross-country comparison of strategic purchasing*. Journal of purchasing and supply management, 2007. **13**(1): p. 2-16.
10. Carr, A.S. and L.R. Smeltzer, *An empirical study of the relationships among purchasing skills and strategic purchasing, financial performance, and supplier responsiveness*. Journal of Supply Chain Management, 2000. **36**(2): p. 40-54.
11. Weele, A.J., *Purchasing & supply chain management: analysis, strategy, planning and practice*. 2005: Thomson learning London.
12. Narasimhan, R. and A. Das, *The impact of purchasing integration and practices on manufacturing performance*. Journal of Operations Management, 2001. **19**(5): p. 593-609.
13. Schiele, H., *How to distinguish innovative suppliers? Identifying innovative suppliers as new task for purchasing*. Industrial Marketing Management, 2006. **35**(8): p. 925-935.
14. Carr, A.S. and J.N. Pearson, *The impact of purchasing and supplier involvement on strategic purchasing and its impact on firm's performance*. International Journal of Operations & Production Management, 2002. **22**(9): p. 1032-1053.
15. Kenneth Lyons, B.F., *Purchasing and Supply Chain Management* 2006

16. Ramsay, J. and S. Croom, *The impact of evolutionary and developmental metaphors on Purchasing and Supply Management: A critique*. Journal of Purchasing and Supply Management, 2008. **14**(3): p. 192-204.
17. Ellram, L.M., *Total cost of ownership: an analysis approach for purchasing*. International Journal of Physical Distribution & Logistics Management, 1995. **25**(8): p. 4-23.
18. Service, U.S.P., *Identify Cost Reduction Levers* in [http://about.usps.com/manuals/spp123108/html/pp\\_ps1\\_008.html](http://about.usps.com/manuals/spp123108/html/pp_ps1_008.html). 2014.
19. Schiele, H., P. Horn, and B. Vos, *Estimating cost-saving potential from international sourcing and other sourcing levers: Relative importance and trade-offs*. International Journal of Physical Distribution & Logistics Management, 2011. **41**(3): p. 315-336.
20. Schiele, H., *Supply-management maturity, cost savings and purchasing absorptive capacity: Testing the procurement-performance link*. Journal of purchasing and supply management, 2007. **13**(4): p. 274-293.
21. Claus Stainle, H.S., Kai Mietzner *Merging a Firm-Cintred and a Regional Policy Perspective for the Assessment of Regional Clusters: Concepte and Application of a Dual Approach to a Medical Technology Cluster* Vol. 15. 2007.
22. Porter, M.E., *The five competitive forces that shape strategy*. Harvard business review, 2008. **86**(1): p. 25-40.
23. Accountant, C.C.G.M., *Porter's Five Forces of Competitive Position Analysis* in <http://www.cgma.org/Resources/Tools/essential-tools/Pages/porters-five-forces.aspx>. 2011.
24. Gelderman, C.J. and A.J. Van Weele, *Handling measurement issues and strategic directions in Kraljic's purchasing portfolio model*. Journal of purchasing and supply management, 2003. **9**(5): p. 207-216.
25. Caniëls, M.C. and C.J. Gelderman, *Power and interdependence in buyer supplier relationships: A purchasing portfolio approach*. Industrial Marketing Management, 2007. **36**(2): p. 219-229.
26. Cox, A., *Business Success: A Way of Thinking about Strategy, Critical Supply Chain Assets and Operational Best Practice* 1997. 327.
27. Lamming, R.C., Harrison,D., *Smaller Customers and Larger Suppliers: The Potencialfor Strategic Purchasing Approach* 2001, Jonkoping, Sweden
28. Kornelius, L., Van Stekelenborg *A Diversified Approach towards Purchasing and Supply Production Management Methods* 1994.
29. ICIS, *Caustic Soda-Liquid (Asia Pacific)*, S.P.C.S.E. ASIA, Editor. 2013.
30. Fertecon, *Soda Ash Dense (FOB China) Price Report* 2013.

31. Limited, O., *Chlor Alkali Production Chart*, in <http://www.orica.com/locations/asia-pacific/australia/botany/operations/Operations#.U2MruPmSxqU>. 2014.





APPENDIX

จุฬาลงกรณ์มหาวิทยาลัย  
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## Appendix A - Pareto Analysis of raw material using in every plant

NO.	MATERIAL LIST	NO.	Amount	Cumulative	% total	Group
1	TAPIOCA STARCH	1	2,579,602,284.37	2,579,602,284.37	34.97	A
2	AMMONIA GAS 100% (NH3)	2	1,003,295,513.25	3,582,897,797.62	48.57	
3	RAW SUGAR	3	670,764,051.40	4,253,661,849.02	57.66	
4	INOSINE (Note: Will be terminated)	4	335,203,822.40	4,588,865,671.42	62.21	
5	SUGAR CANE	5	302,268,615.43	4,891,134,286.85	66.31	
6	CAUSTIC SODA 32% (NaOH)	6	295,918,639.20	5,187,052,926.05	70.32	
7	SODIUM ACID PYROPHOSPHATE (Note: Will be terminated)	7	284,003,180.60	5,471,056,106.65	74.17	
8	COAL	8	258,495,703.70	5,729,551,810.35	77.67	
9	HYDROCHLORIC ACID 35% (HCl)	9	219,808,978.40	5,949,360,788.75	80.65	
10	CAUSTIC SODA 50 % (NaOH)	10	185,142,824.00	6,134,503,612.75	83.16	
11	SULPHURIC ACID 98% (H2SO4 98%)	11	134,894,093.80	6,269,397,706.55	84.99	
12	TAPIOCA CHIP	12	128,728,354.17	6,398,126,060.72	86.74	
13	FRESH MILK	13	121,343,464.60	6,519,469,525.32	88.38	
14	RICE HUSK	14	117,428,654.80	6,636,898,180.12	89.97	
15	CANE MOLASSES	15	105,966,157.80	6,742,864,337.92	91.41	
16	SOY BEAN	16	76,714,792.60	6,819,579,130.52	92.45	
17	UREA	17	75,801,334.00	6,895,380,464.52	93.48	B
18	POTASSIUM CHLORIDE	18	48,574,544.00	6,943,955,008.52	94.14	
19	ANTIFORM GD-113K	19	44,082,857.50	6,988,037,866.02	94.73	
20	SUCCINIC ACID	20	31,224,947.50	7,019,262,813.52	95.16	
21	AMMONIUM CHLORIDE	21	26,408,532.34	7,045,671,345.86	95.51	
22	AMIX- JAPAN	22	26,105,685.24	7,071,777,031.10	95.87	
23	SODIUM TRIPOLYPHOSPHATE (STPP)	23	25,873,920.00	7,097,650,951.10	96.22	
24	ACTIVATED CARBON S-5	24	25,005,000.00	7,122,655,951.10	96.56	
25	SODA ASH (DENSE)	25	23,290,000.00	7,145,945,951.10	96.87	
26	ANTIFOAM ANTIFOAM KAO FERMOL 1000	26	22,812,900.00	7,168,758,851.10	97.18	
27	ENZYME DEXTROZYME GA	27	19,827,357.61	7,188,586,208.71	97.45	
28	UF MODULE	28	19,800,000.00	7,208,386,208.71	97.72	
29	ENZYME KLIESTASE E-5	29	18,088,419.00	7,226,474,627.71	97.97	
30	ACTIVATED CARBON YL-303	30	17,097,500.00	7,243,572,127.71	98.20	
31	FILTER AID CELATOM FW-20	31	16,179,062.85	7,259,751,190.56	98.42	
32	ACTIVATED CARBON CALGON	32	12,245,987.50	7,271,997,178.06	98.58	
33	PHOSPHORIC ACID (H3PO4 85%) FOOD GRADE	33	8,761,380.00	7,280,758,558.06	98.70	
34	95% METHANOL	34	8,494,600.00	7,289,253,158.06	98.82	
35	LPG	35	8,468,031.51	7,297,721,189.57	98.93	
36	SUPER REFINED SUGAR(MSG)	36	7,537,640.00	7,305,258,829.57	99.03	
37	PHOSPHORIC ACID (H3PO4 85%) FEED	37	7,378,510.00	7,312,637,339.57	99.13	
38	DL METHIONINE	38	7,334,500.00	7,319,971,839.57	99.23	
39	CALCIUM OXIDE (CaO)	39	7,071,797.00	7,327,043,636.57	99.33	
40	BIOTIN (M GRADE)	40	6,539,643.00	7,333,583,279.57	99.42	
41	ANTIFOAM COLORIN #102	41	5,585,000.00	7,339,168,279.57	99.49	
42	AMICC	42	4,923,100.00	7,344,091,379.57	99.56	

43	L-RO MEMBRANE	43	4,221,000.00	7,348,312,379.57	99.62
44	CELITE 545RVZ	44	3,022,500.00	7,351,334,879.57	99.66
45	RO MEMBRANE	45	2,607,800.00	7,353,942,679.57	99.69
46	MANGANESE SULPHATE (MnSO4) Food	46	2,023,500.00	7,355,966,179.57	99.72
47	SODIUM HYPO CHLORIDE 10% (NaClO)	47	1,968,112.00	7,357,934,291.57	99.75
48	NITROGEN GAS	48	1,959,713.62	7,359,894,005.19	99.77
49	CELITE 535RVZ	49	1,942,500.00	7,361,836,505.19	99.80
50	YEAST EXTRACT BIO SPRINGER	50	1,832,750.00	7,363,669,255.19	99.83
51	MONO POTASSIUM PHOSPHATE (KH2PO4)	51	1,802,000.00	7,365,471,255.19	99.85
52	BIOTIN TG GRADE	52	1,511,922.50	7,366,983,177.69	99.87
53	THIAMINE HYDROCHORIDE HCL (VB1)	53	1,350,000.00	7,368,333,177.69	99.89
54	DEXTRIN MIXTURE (PX-31)	54	1,332,300.00	7,369,665,477.69	99.91
55	ACTIVATED CARBON CGC-200U	55	1,230,000.00	7,370,895,477.69	99.92
56	MAGNESIUM SULFATE	56	1,020,000.00	7,371,915,477.69	99.94
57	AMINOBENZOIC ACID (PABA)	57	1,012,000.00	7,372,927,477.69	99.95
58	ANTIFOAM ADEKANOL LG 109	58	621,000.00	7,373,548,477.69	99.96
59	ZIRCONIA BEADS	59	611,101.00	7,374,159,578.69	99.97
60	CITRIC ACID	60	410,000.00	7,374,569,578.69	99.97
61	FILTER AID CELATOM FW-60	61	379,104.00	7,374,948,682.69	99.98
62	ARONVIS - S	62	369,798.63	7,375,318,481.32	99.98
63	I-GMF MODULE	63	348,000.00	7,375,666,481.32	99.99
64	MANGANESE SULPHATE (MnSO4) Tech	64	188,000.00	7,375,854,481.32	99.99
65	SODIUM PYRUVATE	65	114,254.38	7,375,968,735.70	99.99
66	COPPER SULPHATE	66	85,500.00	7,376,054,235.70	99.99
67	FERROUS SULPHATE (FeSO4) Food	67	57,375.00	7,376,111,610.70	99.99
68	FERROUS SULPHATE (FeSO4) Feed	68	57,375.00	7,376,168,985.70	100.00
69	VITAMIN C	69	53,000.00	7,376,221,985.70	100.00
70	VITAMIN B12	70	48,000.00	7,376,269,985.70	100.00
71	ZINC SULPHATE	71	39,600.00	7,376,309,585.70	100.00
72	AMMONIUM SULPHATE 21%	72	20,400.00	7,376,329,985.70	100.00
73	TERMAMYL SC	73	20,090.00	7,376,350,075.70	100.00
74	SODIUM HEXAMETA PHOSPHATE (SHMP)	74	19,789.90	7,376,369,865.60	100.00
75	MF MODULE	75	19,764.00	7,376,389,629.60	100.00
76	VITAMIN B3	76	18,609.97	7,376,408,239.57	100.00
77	FLA VOURZYME 1000 L	77	18,400.00	7,376,426,639.57	100.00
78	RESIN REGENERATING SALT 97.5%	78	15,000.00	7,376,441,639.57	100.00
79	WET STARCH	79	14,520.00	7,376,456,159.57	100.00
80	MAMENO	80	13,833.90	7,376,469,993.47	100.00
81	FERRIC CHLORIDE 40% (FeCl3)	81	12,000.00	7,376,481,993.47	100.00
82	ACTIVATED CARBON (Kuraray) COAL KLY)	82	11,000.00	7,376,492,993.47	100.00
83	RIBONUCLEIC ACID (RNA)	83	9,000.00	7,376,501,993.47	100.00
84	NICOTINAMIDE	84	8,754.90	7,376,510,748.37	100.00

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## Appendix B – Five Force Analysis &amp; Risk score value of each raw material

## Minute of Raw Material Meeting

PROJECT TITLE: Purchasing Improvement MEETING DATE: 27 Feb. 2014 LOCATION: Meeting room 2

## ATTENDANT NAME:

- Mrs. Kesya Chaichansheep – Purchasing Manager
- Mrs. Patrachol Cheewasakulyong- Purchasing Division
- Ms. Sutthata Ngleartlasamee – Senior Supervisor
- Ms. Thapatch Punarnunnon- In charge purchaser

## MEETING ISSUE:


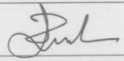
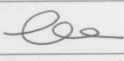

Five Force Analysis is chosen as a helping tool to analysis the risk in the current market situation in term of competitive rivalry within an industry, threat of new entrances, threat of substitute material, bargaining power of supplier and bargaining power of buyer of each product. However, in order to be more quantitative, performing the risk score as a number is applied. The risk scores are running from 1-5 with 0.5 incremental.

For scoring method, each person gives score to each force. Average those score in each force is performed then. Finally, the total average risk score of each selected raw material is came out. The raw materials that have total average risk score less than 3 are concerned as low risk. The raw materials that have total average risk score equal or more than 3 are concerned as high risk.

## ATTACH DOCUMENT:

## The scoring of each selected raw material

- Ammonia
- Caustic Soda and Hydrochloric acid (Chlor-alkaline)
- Coal
- Sulfuric acid
- Urea
- Potassium Chloride
- Antifoam GD-113 and Succinic acid
- Ammonium Chloride

			
Purchasing Manager	Division Manager	Senior Supervisor	In charge purchaser

Name of Raw Material: Ammonia (NH <sub>3</sub> )						
Five Force Analysis	Current Situation	Risk Score				Average risk score in each force
		Purchasing Manager	Division Manager	Senior supervisor	In charge purchaser	
Force 1: Competitive Rivalry within an Industry	- Number of supplier : 6-10 supplier in Thailand.	2	2	2	2	2.00
	- Only two suppliers with some sources supplying this raw material.	4	3	3	4	3.50
	- Growth rate of this business ≈ 4.86% YoY	3	3	3	3	3.00
	- It is limited in term of supply due to facility tank contract in some production plant.	4	4	4	4	4.00
Total Average Risk Score for force 1						3.13
Force 2: Threat of New Entrants	- Require high standard of storage tank system and transportation safety devices.	4	4	4	4	4.00
	- Require a specific safety and operation training.	4	4	4	4	4.00
	- It is quite high competition in order to enter to supply Ammonia to ABC due to tank owner.	4	4	4	4	4.00
	- The cash flow in each shipment is very high with very transportation sizes	4	4	4	4	4.00
Total Average Risk Score for force 2						4.00
Force 3: Threat of Substitute product	- Urea can be used as an alternative product of ammonia.	4	3	4	4	3.75
	- Low switching cost in PPD and AVT production plant while high switching cost in PTR and KPP plant	4	4	3	3	3.50
	- Urea is more concerned as a commercial product so, the price can be more predictable.	4	4	4	4	4.00
Total Average Risk Score for force 3						3.75
Force 4: Bargaining Power of Supplier	- The main raw material for producing ammonia is natural gas with several supply sources.	2	2.5	2	2	2.13
	- There is high availability for supply natural gas especially in Middle East.	2	2	2	2.5	2.13
	- Due to large and global standard company, supplier can well manage their supply chain.	3	3	3.5	3	3.13
Total Average Risk Score for force 4						2.46
Force 5: Bargaining Power of Customer	- High switching cost for switching supplier because high cost of installation a new tank and special operation	4	4	3.5	4	3.88
	- It is limited in term of tank facility in PPD and KPP production plant due to contract.	4	4	4	4.5	4.13
	- There are less potential suppliers supplied NH <sub>3</sub> to ABC.	3	3.5	2.5	3	3.00
Total Average Risk Score for force 5						3.67
Total Average Risk Score for this selected raw material						3.40

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Name of Raw Material: 32%, 50% Caustic Soda and 35% Hydrochloric acid.						
Five Force Analysis	Current Situation	Risk Score				Average risk score in each force
		Purchasing Manager	Division Manager	Senior supervisor	In charge purchaser	
Force 1: Competitive Rivalry within an Industry	- There are limited in local manufacturers, only 6 plants in Thailand.	4.5	4.5	4.5	4.5	4.50
	- There are 4 suppliers supplied this raw material to ABC.	3.5	3.5	3.5	3.5	3.50
	- High demand of chlor-alkali, the growth rate of business is high. However, NaOH & HCl production is relied on each other due to co-product.	4	4	4	4	4.00
Total Average Risk Score for force 1						4.00
Force 2: Threat of New-Entrants Substitute product	- The substitute product for caustic soda is $\text{Na}_2\text{CO}_3$ . The substitute product HCl is $\text{H}_2\text{SO}_4$ .	2	3	3	2	2.50
	- Some plant of ABC can promptly use an alternative product due to available of facility but some plant cannot use an alternative product.	4	4	4	4	4.00
Total Average Risk Score for force 2						3.25
Force 3: Threat of Substitute-product Bargaining power of supplier	- The bargaining power to their supplier is quite high due to large volume negotiation.	2	2.5	2	2	2.13
	- Supplier can well manage their supply chain. Trader also has a strong relationship among suppliers.	2	2.5	2	2	2.13
Total Average Risk Score for force 3						2.13
Force 4: Bargaining Power of Supplier Threat of New Entrants	- Chlor-alkali industry not requires specific technology (only electrolysis of NaCl)	3	3	3.5	3	3.13
	- High capital is needed for installation of new electrolyse membrane and construction of new plant	4	4	4	3.5	3.88
Total Average Risk Score for force 4						3.50
Force 5: Bargaining Power of Customer	- With huge consumption volume along with many suppliers in the market, ABC bargaining power is high.	2	2	3	2	2.25
	- ABC is in the develop or core position in supplier perception.	2	2	2	2	2.00
Total Average Risk Score for force 5						2.13
Total Average Risk Score for this selected raw material						3.00

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Name of Raw Material: Coal						
Five Force Analysis	Current Situation	Risk Score				Average risk score in each force
		Purchasing Manager	Division Manager	Senior supervisor	In charge purchaser	
Force 1: Competitive Rivalry within an Industry	- there are several coal suppliers in Thailand.	2	2	2	2	2.00
	- ABC also has many approved suppliers. (7 vendors).	2	2	2.5	2	2.13
	- Coal business is continuously growth because of its competitive price when compare to fuel oil.	2	1.5	2	2	1.88
	- with environmental concern, coal business might be prohibited to construct stockpile in community area.	4	4	4	4	4.00
Total Average Risk Score for force 1						2.50
Force 2: Threat of New Entrants	- High investment in term of transportation, stockpile crusher and sieving machine and environmental pollution concern.	3	3.5	3	3	3.13
	- Huge volume of each shipment, high cash flow will be involved.	3	3	2.5	3	2.88
	- There are several coal business in Thailand so it might be difficult for new entrants to make brand and enter to this business.	3	3	3	2.5	2.88
	- ABC highly concerns about coal quality	3	2	3	3.5	2.88
Total Average Risk Score for force 2						2.94
Force 3: Threat of Substitute product	- Fuel oil can be an alternative material for coal.	2	2	3	2.5	2.58
	- It takes high switching cost due to different boiler specification between coal and fuel oil.	3	3	2.5	3	2.88
Total Average Risk Score for force 3						2.63
Force 4: Bargaining Power of Supplier	- There are more than 100 coal sources in the global. The major supply source in Asia is from Indonesia.	2	2	2	2	2.00
	- Traders have a good relationship with supplier. Normally, they perform contract with supplier as long term.	2	2.5	2	2	2.13
	- There are plenty of available sources and suppliers, the switching cost is low.	2	2	1.5	2	1.88
Total Average Risk Score for force 4						2.00
Force 5: Bargaining Power of Customer	- ABC uses high volume of coal per day (330 MT/day) but requires specific size with highly quality concern.	3	3	2.5	2	2.63
	- The switching cost for changing supplier is low.	2	3	2.5	2.5	2.50
Total Average Risk Score for force 5						
Total Average Risk Score for this selected raw material						2.53

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Name of Raw Material: Sulfuric Acid ( $H_2SO_4$ )						
Five Force Analysis	Current Situation	Risk Score				Average risk score in each force
		Purchasing Manager	Division Manager	Senior supervisor	In charge purchaser	
Force 1: Competitive Rivalry within an Industry	- There are several import traders and local makers supplied this material.	2	2	2	2	2.00
	- ABC has five approved vendors supplied this raw material.	2	2.5	2	2	2.13
	- The growth rate in this business is quite high.	2	2	1.5	2	1.88
Total Average Risk Score for force 1						2.00
Force 2: Threat of New Entrants	- There are two business types which are sulfuric acid local maker and import trader.	2	2.5	2	2	2.13
	- Medium of specific skill is required.	2	1.5	2	2	1.88
Total Average Risk Score for force 2						2.00
Force 3: Threat of Substitute product	- HCl can be an alternative material to sulfuric acid.	3	3	3	2.5	2.88
	- Switching cost for using alternative material is very high. It needs to construct a new pipe line.	3	3	3.5	3	3.13
Total Average Risk Score for force 3						3.00
Force 4: Bargaining Power of Supplier	- Traders have bargaining power in order to negotiate with their supplier due to large volume per contract.	2	2	2	2	2.00
	- There are several available sources of raw material for producing sulfuric acid especially in Korea.	2	2.5	2	2	2.13
	- Supplier can well manage their supply route with on time delivery to trader.	2	2	1.5	2	1.88
Total Average Risk Score for force 4						2.00
Force 5: Bargaining Power of Customer	- There are several buyers in the market.	4	4	4	4	4.00
	- Because ABC has many approved suppliers in hand with high consumption demand hence bargaining power is high.	2	2.5	2	2	2.13
	- ABC is in between develop and core customer to supplier.	2	2	1.5	2	1.88
Total Average Risk Score for force 5						2.67
Total Average Risk Score for this selected raw material						2.33

*J. L. J. J.*  
J. L. J. J.

Name of Raw Material: Urea		Risk Score				Average risk score in each force
Five Force Analysis	Current Situation	Purchasing Manager	Division Manager	Senior supervisor	In charge purchaser	
Force 1: Competitive Rivalry within an Industry	- There are several suppliers with many supply sources such as Indonesia, Malaysia and middle east	2	2	2	2	2.00
	- There is only supplier supplied this raw material to ABC	5	4.5	5	5	4.88
	- Urea import volume quite stable.	2	2	2.5	2	2.13
Total Average Risk Score for force 1						3.00
Force 2: Threat of New Entrants	- It is concerned as a medium investment. Trader has to invest in term of warehouse, transportation.	3	3	3	3.5	3.13
	- Urea is concerned as a commercial product, not hazardous with identical specification in the market.	3	3.5	3	3	3.13
	- Because there is huge volume per shipment, it is high cash flow per each shipment.	4	4	4	4	3.88
	- There is monopoly supplier supplied urea to ABC.	5	5	4.5	5	4.88
Total Average Risk Score for force 2						3.75
Force 3: Threat of Substitute product	- Ammonia can be used as an alternative material.	2	2	2	2	2.00
	- The price of urea is competitive than Ammonia because it is concerned as a commercial product.	2	2	2.5	2	2.13
	- It is low switching cost between urea and Ammonia.	3	3.5	2	3	2.88
Total Average Risk Score for force 3						2.33
Force 4: Bargaining Power of Supplier	- Supplier has less volume to negotiate with their supplier. With unattractive volume, the bargaining power is low.	4	4	3.5	4	3.88
	- There is plenty of natural gas especially in Middle East.	2	2.5	2	2	2.13
	- Supplier will manage their supply chain. There is 1-1.5 delivery lead time from maker sources to trader.	2	2	2	2	2.00
Total Average Risk Score for force 4						2.67
Force 5: Bargaining Power of Customer	- The current purchasing volume is not attractive to the trader.	4	4	3.5	4	3.88
	- The bargaining power is not quite high due to low consumption.	4	4	4	4	4.00
Total Average Risk Score for force 5						3.94
Total Average Risk Score for this selected raw material						

*J.L.*  
*J.M.S.*



Name of Raw Material: Potassium chloride (KCl)						
Five Force Analysis	Current Situation	Risk Score				Average risk score in each force
		Purchasing Manager	Division Manager	Senior supervisor	In charge purchaser	
Force 1: Competitive Rivalry within an Industry	- In term of the global market, there are plenty of suppliers and sources.	2	2	2	2	2.00
	- ABC has only one current approved supplier.	4	4	3.5	4	3.88
	- The price and growth factor for this business depends on the fertilizer demand in industry field.	2	2.5	2	2	2.13
Total Average Risk Score for force 1						2.67
Force 2: Threat of New Entrants	- Normally, this business in thailand is concerned as a trading business. There are no need for special skill.	2	2	2.5	2	2.13
	- It requires moderate capital investment such as warehouse and part management.	3	2.5	3	3	2.88
Total Average Risk Score for force 2						2.50
Force 3: Threat of Substitute product	There is no substitute product because kcl is fit to the ABC ferment bacteria in all production plants	5	5	5	5	5.00
Total Average Risk Score for force 3						5.00
Force 4: Bargaining Power of Supplier	- trader buys product as on industrial grade which has less volume when compared to fertilizer grade.	4	3.5	4	4	3.88
	- The supplier can well-managed their supply to trader.	2	2.5	2	2	2.13
Total Average Risk Score for force 4						3.00
Force 5: Bargaining Power of Customer	- ABC uses kcl as a production grade not a fertilizer grade so, the bargaining power is low.	4	4	4	4	4.00
Total Average Risk Score for force 5						4.00
Total Average Risk Score for this selected raw material						3.43

JL.  
Jm

Name of Raw Material: <u>Anti foam GD-113 and Succinic acid.</u>						
Five Force Analysis	Current Situation	Risk Score				Average risk score in each force
		Purchasing Manager	Division Manager	Senior supervisor	In charge purchaser	
Force 1: Competitive Rivalry within an Industry	- There are moderate traders in Thailand.	3	3	3	3	3.00
	- Monopoly supplier supplies this raw material to ABC.	4	4.5	4	4	4.13
	- These two raw materials are used in specific process with specific process and few portions. So, the business growth is depended on niche customer.	4	4	3.5	4	3.88
Total Average Risk Score for force 1						3.67
Force 2: Threat of New Entrants	- Normally, this business is concerned as a trading business. Hence, there is not required for special skill.	2	1.5	2	2	1.88
	- It requires moderate capital investment such as warehouse and port management.	2	2	2.5	2	2.13
Total Average Risk Score for force 2						2.00
Force 3: Threat of Substitute product	- There are no substitute products for these two raw materials.	5	5	5	5	5.00
Total Average Risk Score for force 3						6.00
Force 4: Bargaining Power of Supplier	- Trader has to collect the volume from buyer in order to negotiate with supplier. This depends on the customer order volume.	4	3.5	4	4	3.88
	- The supplier can well manage their supply with on time delivery.	2	2	2.5	2	2.13
Total Average Risk Score for force 4						3.00
Force 5: Bargaining Power of Customer	- There is a monopoly supplier hence, the buyer bargaining power is low.	4	4	4	4	4.00
Total Average Risk Score for force 5						4.00
Total Average Risk Score for this selected raw material						3.53

*J.P.*  
*3/11/2023*



Name of Raw Material: Ammonium Chloride (NH <sub>4</sub> Cl)						
Five Force Analysis	Current Situation	Risk Score				Average risk score in each force
		Purchasing Manager	Division Manager	Senior supervisor	In charge purchaser	
Force 1: Competitive Rivalry within an Industry	- In term of global market, there are plenty of suppliers and sources such as Germany and China	2	2	2.5	3	2.58
	- ABC has only one current approved supplier.	4	3.5	3.5	3.5	3.13
	- This product is concerned as common chemical and used in several business.	2	2	2	2	2.00
Total Average Risk Score for force 1						2.67
Force 2: Threat of New Entrants	- Normally, in Thailand, this business is concerned as a trading business. Hence, there are no need for special skill.	2	2	2	2	2
	- It requires moderate capital investment such as warehouse and port management.	3	3	3	3	3
Total Average Risk Score for force 2						2.50
Force 3: Threat of Substitute product	- ABC is now, having ammonium sulfate as an alternative product of NH <sub>4</sub> Cl but it can be used only some plants.	4	4	4	4	4.00
Total Average Risk Score for force 3						4.00
Force 4: Bargaining Power of Supplier	- Trader imports this product from only one source. So trader has high risk in case product shortage.	4	4	3.5	4	3.87
	- The supplier can well-managed their supply to trader.	2	3.5	2	2	2.12
Total Average Risk Score for force 4						3.00
Force 5: Bargaining Power of Customer	- There is a monopoly supplier hence the buyer bargaining power is low.	4	4	4	4	4.00
Total Average Risk Score for force 5						4.00
Total Average Risk Score for this selected raw material						3.23

*J.L. Suresh*

## VITA

Miss Thapatch Punarnunnon was born on 14th November 1989, Bangkok, Thailand. She was graduated Chemical Engineering from Sirindhorn International Institute of Technology-SIIT, Thammasat University in 2012. She continued her Master degree at Regional Center for Manufacturing System Engineering, Chulalongkorn University and University of Warwick in the major of Engineering Business Management.

About the career, Thapatch had been working as a purchasing engineer in a seasoning food company. She had to responsibility for sourcing and purchasing energy along with chemical raw materials. She was one of the purchasing audit team who worked with production and quality assurance department auditing and evaluating supplier factories.