

**DECISION SUPPORT SYSTEM FOR RUBBER VALUE  
CREATION IN THAILAND**



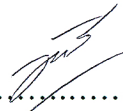
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**A THESIS SUBMITTED IN PARTIAL FULFILLMENT  
OF THE REQUIREMENTS FOR  
THE DEGREE OF MASTER SCIENCE  
(TECHNOLOGY OF INFORMATION SYSTEM MANAGEMENT)  
FACULTY OF GRADUATE STUDIES  
2011**

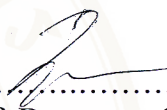
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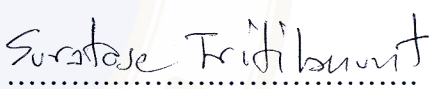
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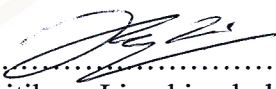
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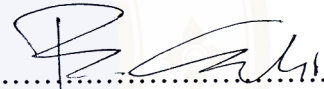
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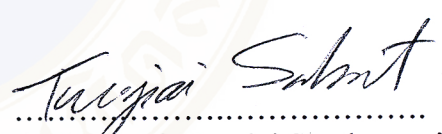
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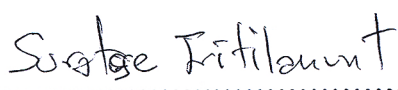
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Chaiyaporn Hirunviwatkul

**DECISION SUPPORT SYSTEM FOR RUBBER VALUE CREATION IN THAILAND**

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**ABSTRACT**

Thailand is the number one rubber exporter in the world. Almost 90 percent of the natural rubbers are exported while the rest are consumed in the country. Some of these are supplied to manufacturers and processed to end products. Rubber products produced in Thailand create almost 40 percent of the total exporting value. In the author's previous research, it was found that different end products produced in Thailand create different portions of exporting value. Furthermore, this also affected the types of natural rubber upstream.

Hence we have proposed a decision support system for the value creation alternatives. The application enables us to understand the linkage of value creation in the rubber supply chain. It also demonstrates the value and volume of each product type affecting volume needed from downstream to upstream natural rubbers. The forecast volume can also be input to predict future impact. Users can analyze the direction for rubber value creation as well as the strategy enabling the integrated supply chain.

**KEY WORDS: DECISION SUPPORT SYSTEM / THAILAND RUBBER EXPORTS / LOGISTICS / VALUE CREATION / SUPPLY CHAIN**

108 pages

การพัฒนาาระบบสนับสนุนการตัดสินใจเพื่อสร้างมูลค่าเพิ่มของยางพารา

DECISION SUPPORT SYSTEM FOR RUBBER VALUE CREATION IN THAILAND

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#### บทคัดย่อ

ยางพาราเป็นหนึ่งในผลิตภัณฑ์เกษตรกรรมที่มีความสำคัญต่อประเทศไทย ซึ่งเราเป็นผู้ส่งออกอันดับหนึ่งของโลก โดยกว่า 90 เปอร์เซ็นต์ ของยางแปรรูปที่ผลิตขึ้นทั้งหมดถูกนำไปใช้ในด้านการส่งออก ส่วน 10 เปอร์เซ็นต์ที่เหลือถูกนำมาใช้บริโภคภายในประเทศ โดยจะถูกส่งต่อไปให้โรงงานแปรรูปผลิตเป็นผลิตภัณฑ์ยางขั้นสุดท้ายซึ่งผลิตภัณฑ์ที่ผลิตภายในประเทศนี้คิดเป็นมูลค่ากว่า 40 เปอร์เซ็นต์ จากมูลค่าการส่งออกทั้งหมด ซึ่งในงานวิจัยที่ผ่านมาได้แสดงความแตกต่างของผลิตภัณฑ์ยางแต่ละชนิดที่ถูกผลิตภายในประเทศมีความสามารถในการสร้างมูลค่าไม่เท่ากัน

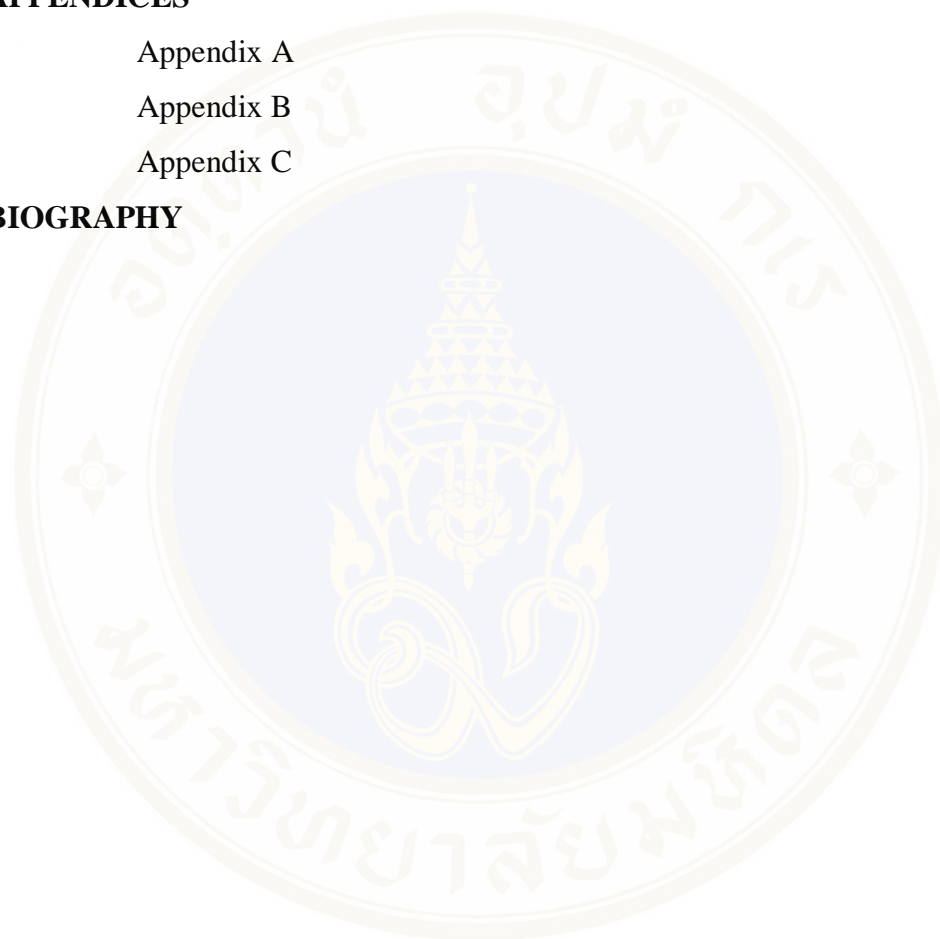
ดังนั้นงานวิจัยนี้จึงขอเสนอแนวคิดระบบสนับสนุนการตัดสินใจเพื่อหาทางเลือกในการสร้างมูลค่าเพิ่มให้กับยางพาราแนวคิดของ Application นี้จะทำให้เราสามารถเข้าใจถึงการเชื่อมโยงสายโซ่คุณค่าที่อยู่ ภายในห่วงโซ่อุปทานของยางพาราได้ดี โดยแสดงให้เห็นถึงความสัมพันธ์ของปริมาณและมูลค่าของผลิตภัณฑ์ยางแต่ละประเภทที่มีผลต่อความต้องการยางแปรรูปจากกลางน้ำไปจนถึงต้นน้ำ ผลการพยากรณ์ความต้องการใช้ยางแปรรูปสามารถนำเข้าไปคาดการณ์ผลกระทบที่จะเกิดขึ้นในอนาคต ผู้ใช้สามารถนำเป็นเครื่องมือในการวิเคราะห์ทิศทางการสร้างมูลค่า เพื่อนำไปใช้สนับสนุนการตัดสินใจในการผลักดันนโยบายของการเพิ่มมูลค่าที่จะใช้ในระบบห่วงโซ่อุปทานยางพาราไทย

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## **CHAPTER I**

### **INTRODUCTION**

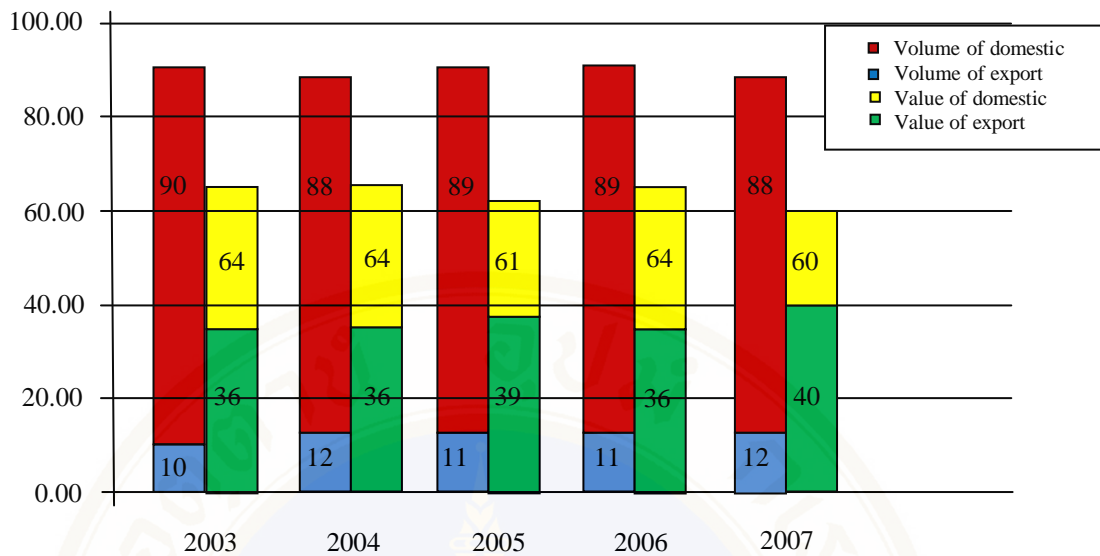
This chapter introduces background and problem statement, objectives, scopes of work and expected result from this research.

#### **1.1 Background**

Thailand is the number one natural rubber (NR) exporter in the world since the country climate is suitable for its growth. It is also important to the economy and way of life. Its demand has continuously increased in the world market.

Currently, almost 90 percent of the natural rubbers are exported while the rest of them are consumed in the country. Some of these are supplied to manufacturers and processed to end products. The majority of exporting value are from natural rubbers i.e. rubber latex, rubber smoked, cup lump, rubber concentrated latex, etc. The rest are from end products, i.e. tires, gloves, rubber band, hose, conveyer belts, scientific instruments, etc. The top five importers for Thailand's natural rubber, in terms of exporting value during 2003 to 2007 were: China, Japan, Malaysia, the United States, and South Korea. (Kritchanchai, D., & Chanpuypetch, W., 2009).

The traditional problem of Thailand's rubber is that the most of natural rubbers are exported while a little of them are processed to end products (Kritchanchai, D. & Somboonwiwat, T. 2009). Considering from statistical Thailand's rubber, the end products create better value than the natural rubber exports. Those are shown in Figure 1.1



**Figure 1.1** Thailand's rubber volume and value during 2003-2007 (Kritchanchai, D. & Somboonwiwat, T., 2009)

From figure 1.1, it shows that approximately 10 percent of all the natural rubber processed to end products that created almost 40 percent of the total exporting value. So, it can be considered that domestic has more interested for value creation. Although it is known that rubber products create better value, this exporting amount is still relatively low. We found that one of the critical enabling factors is that rubber product champion must be identified. (Kritchanchai, D. & Somboonwiwat, T., 2009)

Thus, in this paper, we attempt to develop a decision support system (DSS) to support decision-makers to direct rubber value creation alternatives in Thailand's rubber industry. The application also enables us to understand the linkage of value creation in rubber supply chain.

## 1.2 Objectives

The purpose of this thesis is divided as following:

1.2.1 To direct the value creation alternatives of Thailand rubber in the period 2010-2012 by using scenario analysis.

1.2.2 To design and develop a decision support system prototype which analyze a process alternative of value creation for Thailand rubber.

### 1.3 Scope of works

1.3.1 The scope of Thailand rubber was studied the value creation in the period 2010-2012.

1.3.1.1 We only investigate the rubber product at downstream factory that includes: tires, gloves, rubber band, elastic, belt, and hose.

1.3.1.2 The strategy of Rubber Development Plan was used for value creation. They was planned to increase usage of natural rubber in the country at 17 percentage of production, and expect the export value approximately 600,000 million baht. We examined the natural rubber usage alternatives which have ability to accomplish the goal.

1.3.1.3 The experiment focuses to the natural rubbers usage that was designed three strategies by scenario analysis. Scenario describes the detail of each strategy following as:

*The first scenario* describes the rubbers added by the average addition for each industry.

*The second scenario* involve the rubber added to each industry as portion to the volume of initial conditions

*The third scenario* added rubbers to each industry as value of initial conditions

1.3.2 The DSS development was scoped of works as following.

1.3.2.1 The impact of linkage of Thailand rubber process from upstream to downstream. That including: production, exportation, domestic consumption: tires, gloves, rubber band, elastic, belt, and hose.

1.3.2.2 The system can simulate value and volume of each product for the experiments.

1.3.2.3 The results of experiments can be shown scenario cases that were compared with base case in reports.

## 1.4 Results

The outcomes of this research are:

1.4.1 A prototype of decision support system which helps analyzes the value creation alternatives for Thailand's rubber.

1.4.2 The direction for rubber value creation as well as the strategy enabling the integrated supply chain during 2010-2012.



## CHAPTER II

### LITERATURE REVIEW

This research involves Thailand rubber supply chain, Decision making process and model, Decision support system, and Scenario analysis. This chapter is classified as following:

#### 2.1 Thailand's Rubber Supply Chain (Kritchanchai, D., & Chanpuypetch, W. 2009)

Rubber is one of the most important agricultural to the processing industry in Thailand. The country is the largest natural rubber (NR) exporter in the world since 1991

**Table 2.1** The volume Thailand's rubber exported by countries during 2003 to 2007 (Rubber Research Institute of Thailand., 2008)

Unit: tons

<b>Countries/Year</b>	2003	2004	2005	2006	2007
China	650,898	619,800	573,385	747,168	827,369
Japan	542,837	525,654	540,485	492,740	405,599
Malaysia	365,486	383,695	403,506	442,664	413,049
USA	278,693	249,196	237,858	210,784	213,080
South Korea	165,832	171,668	185,308	173,477	151,824
Europe Group	294,239	291,670	281,090	261,882	262,182
Other	275,465	395,413	410,766	442,958	430,659
<b>Total</b>	<b>2,573,450</b>	<b>2,637,096</b>	<b>2,632,398</b>	<b>2,771,673</b>	<b>2,703,762</b>

Table 2.1 shows the volume Thailand's natural rubber exported by countries in 2003 to 2007, almost 2.6 million tons of natural rubber exported to foreign

countries. The top five recipients of Thailand's natural rubber were China, Japan, Malaysia, United States, and South Korea. The exporting value is divided by type of products.

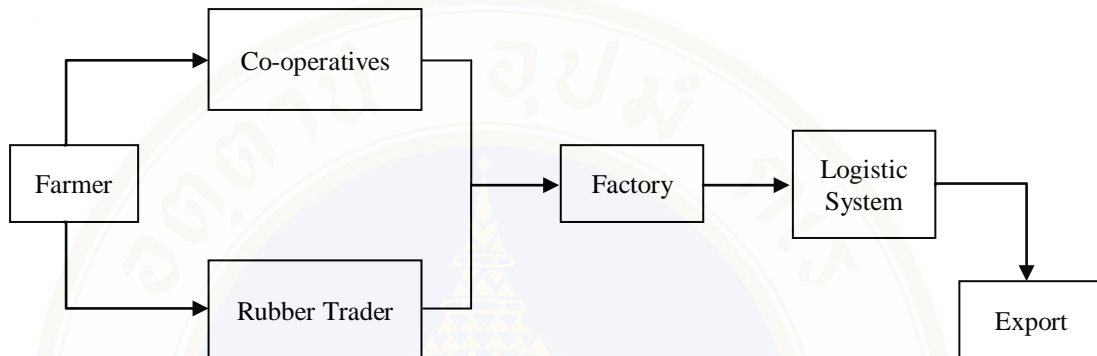
**Table 2.2** The exporting value of Thailand's rubber by type and growth rate (Information Industrial Economics Center, the office of Industrial Economics, Ministry of Industrial, Thailand, 2008)

Type	Exporting value (million US\$)				Growth rate (%)		
	2004	2005	2006	2007	2005	2006	2007
<b><u>Natural rubbers</u></b>							
Rubber smoked sheet	1,325.43	1,317.99	1,912.73	1,931.21	-0.56	45.1	0.97
Rubber block	1,325.31	1,565.00	2,175.53	185.81	18.10	39.00	-91.46
Rubber concentrated latex	713.74	757.23	1,314.79	1,199.26	6.09	60.40	-1.28
Others	64.44	69.76	93.54	2,091.98	8.26	34.10	2,136.45
<b>Total</b>	<b>3,248.92</b>	<b>3,709.98</b>	<b>5,396.59</b>	<b>5,408.26</b>	<b>8.2</b>	<b>45.5</b>	<b>0.22</b>
<b><u>Rubber Products</u></b>							
Tires	679.75	900.44	1,196.06	1,588.66	32.50	32.80	32.82
Gloves	489.45	515.66	558.83	593.83	5.35	8.37	6.26
Rubber band	45.86	47.80	64.99	52.02	4.23	36.00	-19.96
Hose	73.03	86.47	105.92	130.32	18.40	22.50	23.04
Conveyer belts	23.72	31.33	45.52	71.94	32.10	45.30	58.04
Scientific instruments	151.13	189.20	211.07	210.91	25.20	11.60	-0.08
Others	361.18	432.58	692.58	748.19	19.80	60.20	7.97
Vulcanized rubber	120.46	147.74	206.69	210.70	22.70	39.90	1.94
<b>Total</b>	<b>1,944.58</b>	<b>2,315.22</b>	<b>3,082.01</b>	<b>3,606.56</b>	<b>20.90</b>	<b>31.10</b>	<b>17.02</b>

Table 2.2 shows the exporting value of Thailand's rubber by type of products. The value rubber exporting results from natural rubber, i.e. rubber smoked sheet, rubber block, rubber concentrated latex, and others. The other is the end products, i.e. tires, gloves, rubber band, hose, conveyer belts, scientific instruments, and others.

### 2.1.1 Structure of Thailand's Rubber Supply Chain (Kritchanchai, D., & Somboonwiwat, T. 2009)

Thailand's rubber supply chain consists 4 sections as follow: farmer, co-operatives and rubber trader, factory and logistics system: domestic and export.

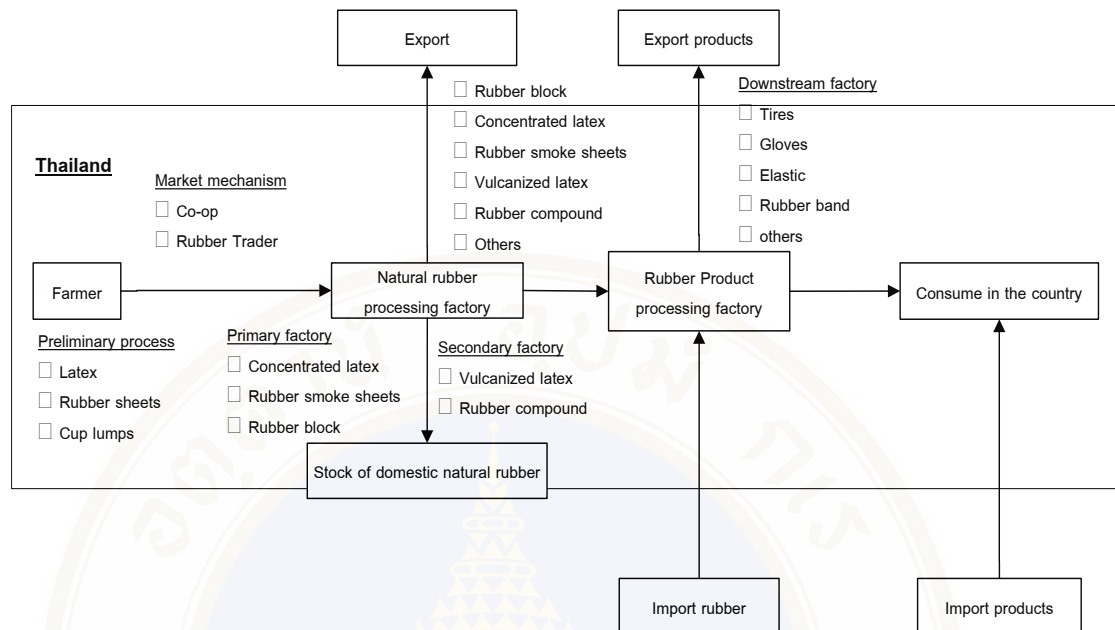


**Figure 2.1** Structure of Thailand's rubber supply chain (Kritchanchai, D., & Somboonwiwat, T. 2009)

From figure 2.1, farmer produces rubber latex, rubber cup lumps and rubber sheets. They are gathered and bidden at the rubber market by cooperative department, and rubber trader. Then, they are sent to factory for process to primary rubber products, i.e. rubber smoke sheets, rubber block, rubber concentrated latex. Finally, almost of natural rubbers are exported to foreign while the rest of them are processed to end products in the country.

### 2.1.2 Value Chain Structure of Thailand's Rubber (Kritchanchai, D., & Somboonwiwat, T. 2009)

A value chain is a flow of activities when the products pass through each activity of chain in order and at each activity their gains some value (Wikipedia, 2009). A value chain structure of Thailand's rubber is shown in figure 2.2



**Figure 2.2** Structure of Thailand's rubber value chain (Kritchanchai, D., & Somboonwiwat, T. 2009)

From value chain structure, farmer produces rubber latex, rubber cup lumps and rubber sheets. They are sent to rubber market are; co-op or rubber trader. Then, they are sent to primary and secondary factory for primary rubber products, i.e. rubber smoke sheets, rubber block, rubber concentrated latex, vulcanized latex, rubber compound. Some of these are sent to downstream factory for end products, i.e. tires, gloves, rubber band, elastic, etc. The rest of them are exported. This paper focus on activities related to rubber production to produce rubber products

**2.1.3 The Rubber Development Plan** (Rubber Research Institute of Thailand, 2010)

The strategic plan had already performed for develop a second editions. First issue presents the complete development that enforced in the period 1999-2003, second issue described about structure of natural rubber and rubber products for improvement which performed in the period 2006-2008. Moreover, the latest issue just had build for strategic plan during 2009-2013. Main idea of its was described an operational, marketing support for competition potential, increased productivity for rubber products, and reduced the exports of raw to foreign countries. After the

operating plan, expected results would be accepted in 2013 that were described as following.

- 1) Productivity of rubber would be increased at least 10 percent per area unit (amount of productivity would be increased from 3.09 million ton into 3.40 million ton)
- 2) Domestic consumption would be increased from 12 percent into 17 percent
- 3) Industrial entrepreneur would be increased potential to compete with foreign. They can add the exporting value of natural rubber approximately 230,000 million baht.
- 4) Farmer would be accepted stability from income distribution at least 15,000 baht per rai.
- 5) Farmer would accept a nice social welfare.

Amount of there was used as operational guidance, and expected the value creation of rubber will reach 600,000 million baht in 2013.

#### **2.1.4 Forecasting Situation of Value Chain during 2008 to 2012**

(Kritchanchai, D., & Somboonwiwat, T. 2009)

Kritchanchai and Somboonwiwat forecasted the situation of value chain by trend analysis methodology. The pattern of growth in the past (2003-2007) forecasted the future situation (2008-2012).

**Table 2.3** Thailand's rubber value chain during 2008 to 2012 (Kritchanchai and Somboonwiwat, 2009)

		2008	2009	2010	2011	2012	Total
<b>Volume (Ton)</b>	<b>Production</b>	3,162,775	3,201,014	3,235,127	3,265,950	3,294,085	<b>16,158,951</b>
	<b>Domestic consumption</b>	376,726	392,700	408,674	424,648	440,622	<b>2,043,370</b>
	<b>Exportation</b>	2,786,049	2,808,314	2,826,453	2,841,302	2,853,463	<b>14,115,581</b>
	<b>Stock</b>	236,180	239,035	241,583	243,884	245,985	<b>1,206,667</b>
<b>Value (Million Baht)</b>	<b>Production</b>	383,785	428,981	474,969	522,246	570,226	<b>2,380,207</b>
	<b>Domestic consumption</b>	148,363	168,088	188,932	210,839	233,803	<b>950,025</b>
	<b>Exportation</b>	235,421	260,892	286,037	311,407	336,423	<b>1,430,180</b>
	<b>Stock</b>	19,956	22,196	24,452	26,724	29,010	<b>122,337</b>

Table 2.3 shows the expected volume and value production of Thailand's rubber. It can be seen that volume and value will continuously increase from 3.1 to 3.2 million tons for the period 2008 to 2012. Kritchanchai and Somboonwiwat selected a product champion which is expected a potential during 2008-2012: tries, gloves, rubber band, elastic, belt, hose and others. Moreover, they also forecast rubber industries.

**Table 2.4** The end products export value during 2003 to 2007 and its forecast during 2008 to 2012 (Kritchanchai, D., & Somboonwivat, T. 2009)

Year	Tires			Gloves			Rubber band			Elastic		
	Input (Tons)	Value (Million Baht)	Ratio/Ton	Input (Tons)	Value (Million Baht)	Ratio/Ton	Input (Tons)	Value (Million Baht)	Ratio/Ton	Input (Tons)	Value (Million Baht)	Ratio/Ton
2003	124,356	18,376	147,771	55,321	17,837	322,422	27,466	2,924	106,461	26,098	1,469	56,277
2004	130,085	25,722	197,733	56,790	23,916	421,130	40,213	4,096	101,864	27,120	1,841	67,872
2005	139,790	34,575	247,335	57,658	26,078	452,289	43,752	4,630	105,813	25,412	1,921	75,608
2006	137,153	43,583	317,769	52,312	27,288	521,636	68,179	6,866	100,705	16,382	2,468	150,659
2007	170,893	53,718	314,337	54,808	25,274	461,137	72,193	6,406	88,736	17,232	1,855	107,650
<b>Total</b>	<b>813,467</b>	<b>193,311</b>	<b>237,638</b>	<b>276,889</b>	<b>120,393</b>	<b>438,975</b>	<b>251,803</b>	<b>24,922</b>	<b>97,001</b>	<b>112,244</b>	<b>9,554</b>	<b>77,740</b>
2008	172,886	63,157	365,313	61,299	33,660	549,104	86,178	8,603	103,041	15,072	2,161	143,382
2009	185,774	75,040	403,933	63,001	36,975	586,898	98,215	9,871	102,997	12,724	2,039	160,268
2010	199,623	88,344	442,553	64,542	40,319	624,692	110,252	11,154	102,962	10,375	1,838	177,154
2011	214,504	103,214	481,173	65,952	43,692	662,485	122,289	12,453	102,935	8,027	1,558	194,039
2012	230,495	119,810	519,793	67,254	47,096	700,279	134,326	13,769	102,912	5,679	1,198	210,925
<b>Total</b>	<b>1,003,282</b>	<b>449,565</b>	<b>448,094</b>	<b>322,048</b>	<b>201,743</b>	<b>626,435</b>	<b>551,260</b>	<b>55,850</b>	<b>102,962</b>	<b>51,877</b>	<b>8,794</b>	<b>169,510</b>

**Table 2.4** The end products export value during 2003 to 2007 and its forecast during 2008 to 2012 Con. (Kritchanchai, D., & Somboonwiwat, T. 2009)

Year	Belt			Hose			Others			Total		
	Input (Tons)	Value (Million Baht)	Ratio/Ton	Input (Tons)	Value (Million Baht)	Ratio/Ton	Input (Tons)	Value (Million Baht)	Ratio/Ton	Input (Tons)	Value (Million Baht)	Ratio/Ton
2003	2,415	636	263,350	803	2,356	2,933,611	62,240	20,951	336,615	298,699	64,548	216,098
2004	2,481	1,000	403,245	828	3,385	4,087,645	61,132	18,668	305,368	318,649	78,628	246,754
2005	3,386	1,256	370,978	763	3,496	4,582,464	63,888	22,394	350,524	334,649	94,351	281,939
2006	1,318	1,057	802,102	950	4,060	4,273,358	44,591	32,255	723,358	320,885	117,577	366,415
2007	1,370	2,345	1,711,577	964	4,698	4,873,268	56,199	31,898	567,596	373,659	126,194	337,725
<b>Total</b>	<b>13,780</b>	<b>6,858</b>	<b>497,704</b>	<b>5,072</b>	<b>19,644</b>	<b>3,873,105</b>	<b>288,050</b>	<b>126,166</b>	<b>2,283,461</b>	<b>1,924,896</b>	<b>535,695</b>	<b>278,298</b>
2008	1,301	2,002	1,539,187	986	5,548	5,626,452	39,004	32,101	823,019	376,726	148,364	393,824
2009	1,124	2,024	1,800,294	1,032	6,338	6,143,045	30,830	35,200	1,141,750	392,700	168,092	428,043
2010	972	2,004	2,061,400	1,080	7,189	6,659,637	21,830	38,099	1,745,249	408,674	188,914	462,261
2011	840	1,952	2,322,507	1,130	8,106	7,176,229	11,906	40,631	3,412,721	424,648	210,829	496,480
2012	727	1,877	2,583,614	1,182	9,092	7,692,821	959	42,627	44,449,837	440,622	233,837	530,698
<b>Total</b>	<b>4,964</b>	<b>9,859</b>	<b>1,986,056</b>	<b>5,409</b>	<b>36,274</b>	<b>6,706,398</b>	<b>104,530</b>	<b>188,658</b>	<b>51,572,576</b>	<b>2,043,370</b>	<b>950,037</b>	<b>464,936</b>

Table 2.3 and Table 2.4 show the future condition Thailand’s rubber value chain. We notice that while the production rate is continually increasing and creates better value, there is a need to direct product type at downstream process. Thus a decision support system can come into play.

## 2.2 Decision Making Process and Model (Turban, E., 1998)

Decision making is a process of alternative selection to achieve the objective. Currently, decision making is the operational problem of all enterprise. The solution of these maybe consists of one or more possibilities which should consider the variables related. So, we must be to decisions appropriate alternatives.

### 2.2.1 Decision making process

Decision making process deals three major phases: intelligence, design and choice. A four and a five phases were added later. A conceptual of decision making process is shown in figure 2.3. There is a continuous flow or activities from intelligence to design to choice, but any phase may be a return to previous phase (feedback).

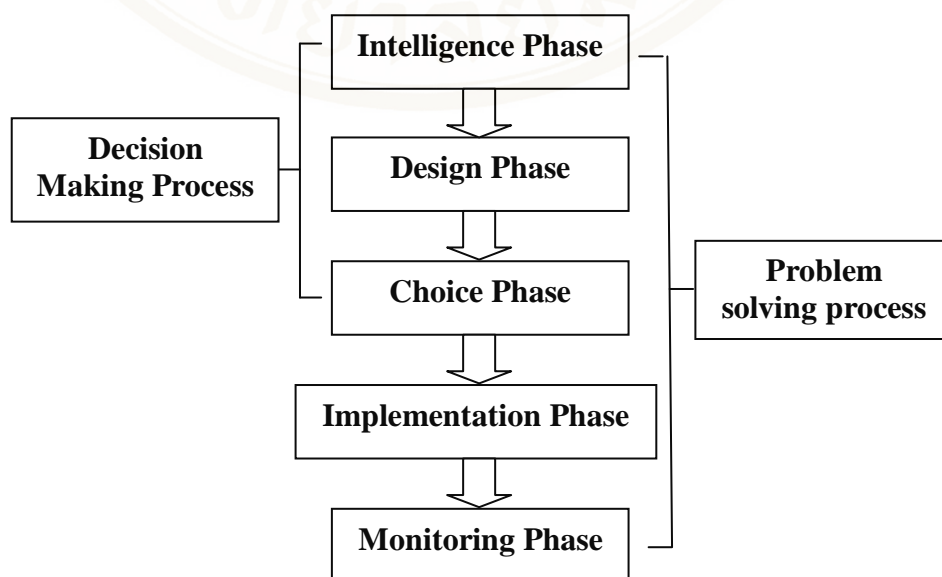


Figure 2.3 Decision making process and problem solving (Turban, E., 1998)

### **1) Intelligence phase**

An intelligence phase is studying the environment, either intermittently or continuously. It includes several activities aimed at identifying problem and scope of work.

### **2) Design phase**

A design phase involves analyzing and developing possible alternatives of action. This includes activities i.e. testing solution, evaluating solution for feasibility. Then, a model of the problem situation is constructed.

Modeling deals the conceptualization of the problem and its abstraction to quantitative and/or qualitative form. For mathematical model, the variables are identified and formulas describing their relationships are established. Simplifications are made, whenever necessary, through a set of assumption. For example, a relationship two variables may be assumed to be linear, even though in reality there may be slight nonlinear effect (such as in the model of a pendulum). A proper balance between the level of model simplification and the representation and faster solution, but is less representative of the real problem.

#### **2.1) Variables for quantitative model**

**2.1.1) Result variables** involve effective of system. There are the indicative achievements how well. The mean value of the variable depends on the values of other variables which are called dependent variables.

**2.1.2) Decision variables** describe the practice alternatives. Value of variables is indicated by decision-maker. For example, a bond is the decision variables in the investment or decision variables of scheduling are human resource, time and schedule.

**2.1.3) Uncontrollable variables** which influence a result variables, and decision-maker cannot control. They can be constant or varies parameter. For example, interest rate, tax rate or facility rate. These are factors that cannot control.

**2.1.4) Intermediate result variables** as a result of the practice, i.e. a salary of employee are a decision variable which determines the satisfaction of employee. It can be measure productivity.

### **3) Choice phase**

The boundary between the design and the choice phase is often unclear because certain activities may be performed both during the design and the choice phase and because one may return frequently from the choice activities to the design. For example, one may generate new alternatives while performing and evaluation of the existing ones the choice phase includes: search, evaluation and recommending and appropriate solution to the model. A solution to a model is a specific set of values for the decision variable in a select alternative.

### **4) Implementation phase**

This phase is somewhat complicated because implementation is a long involved process whose boundaries are vague. In a characteristic, it may be defined as putting a recommend solution to work.

### **5) Monitoring phase**

After implementation, decision-maker will be evaluated a solution to work. If that are failed that will be diagnosed for improvement.

## **2.3 Decision Support System**

### **2.3.1 Overview** (Power, D.J., 2003)

A decision support system (DSS) invented in 1965 by the two pioneers named Peter Keen and Charles Stabell who claim the concept of DSS evolved from two main area of research: the theoretical studies of organizational decision making and the technical work on interactive computer system. During 1970 to 1980s, Executive Information Systems (EIS), Group Decision Support Systems (GDSS), and Organizational Decision Support Systems (ODSS) evolved from the single user and model-oriented DSS. Data warehousing and On-Line Analytical Processing (OLAP) began expanding the framework of DSS around 1990. Finally, new evolution of DSS was an Intelligence Agent (IA) claimed from autonomous programs which used for operator assistance or data mining.

### 2.3.2 Definition (Power, D.J., 2003; Turban, E., 1998)

The definition of DSS differs is extremely broad and its definitions vary depending on the author's point of view. (Marek, D., & Roger, 2002) F, It can take many different forms and can be used in many different ways. (Alter, 1980)

Little argued the definition of DSS as “model-based set of procedures for processing data and judgments to assist a manager in his decision making” To be the successful, such a system must be simple, robust, easy to control, adaptive, complete on important issues and easy to communicate with. The system is served as an extension of the user's problem-solving capabilities. (Little, J. D. C., 1970)

Then 1971, Gorry and Scott Morton argued that Management Information Systems primarily focused on structured decisions and suggested that the supporting information systems for semi-structured and unstructured decisions should be termed “Decision Support Systems”. DSS are as “interactive computer-based system, which help decision makers utilize data and model to solve problems”. (Power, D.J., 2003)

At the same time, Gerrity argued as “an effective blend of human intelligence, information technology and software that interact closely to solve complex problems”. (Gerrity, T. P. 1971)

Alter defined DSS by contrasting them with traditional Electronic Data Processing system on five dimensions, are shown in Table 2.5. (Alter, S.L.,1970)

**Table 2.5** DSS versus EDP

Dimension	DSS	EDP
Use	Active	Passive
User	Line and staff management	Clerical
Goal	Effectiveness	Mechanical efficiency
Time horizon	Flexibility	Consistency

Moore and Chang argued that the concept of structuredness, so much a part of early DSS definitions (that is, that DSS can handle semi-structure and un-

structure situations), is not meaningful in general; a problem can be described as structured or unstructured only with respect to a particular decision-maker. Thus, they define DSS as extendible system capable of supporting ad-hoc data analysis and decision modeling, oriented toward future planning, and used at irregular, unplanned intervals. (Moore J. H., & Chang, M.G., 1980)

Bonczek define a DSS as a computer-based system consisting of three interacting components: a language system (a mechanism to provide communication between the user and other components of the DSS), a knowledge system (the repository of problem domain knowledge embodied in DSS, either as data or procedures) and a problem-processing system (the link between the other two components, containing one or more of the general problem-manipulation capabilities required for decision making). The concepts provided by the definition are important for understanding the structures of DSS and ES and the relationship between the two technologies. (Bonczek, R.H., 1980)

Keen applied the term DSS "to situations where a final system can be developed only through an adaptive process of learning and evolution". (Keen, P. G. W., 1980).

Finally, Watkins and McKinney define DSS as an interactive computer program that uses analytical methods and models to help decision-makers formulate alternatives for large unstructured problems, and then select appropriate solution for implementation. It supports decision-making activities for managerial organization. (Watkins, D., & McKinney, D., 1995)

The definitions of DSS are defined from the authors. These can be summarized following as.

- 1) DSS is computer based information system which consists six parts; hardware, software, database, network, procedure and people.
- 2) The general of DSS supports the structure and semi-structure solution. But, the un-structure problems are solved with particular DSS.
- 3) DSS utilizes data into model.
- 4) DSS focuses on data analysis and statistics to model.

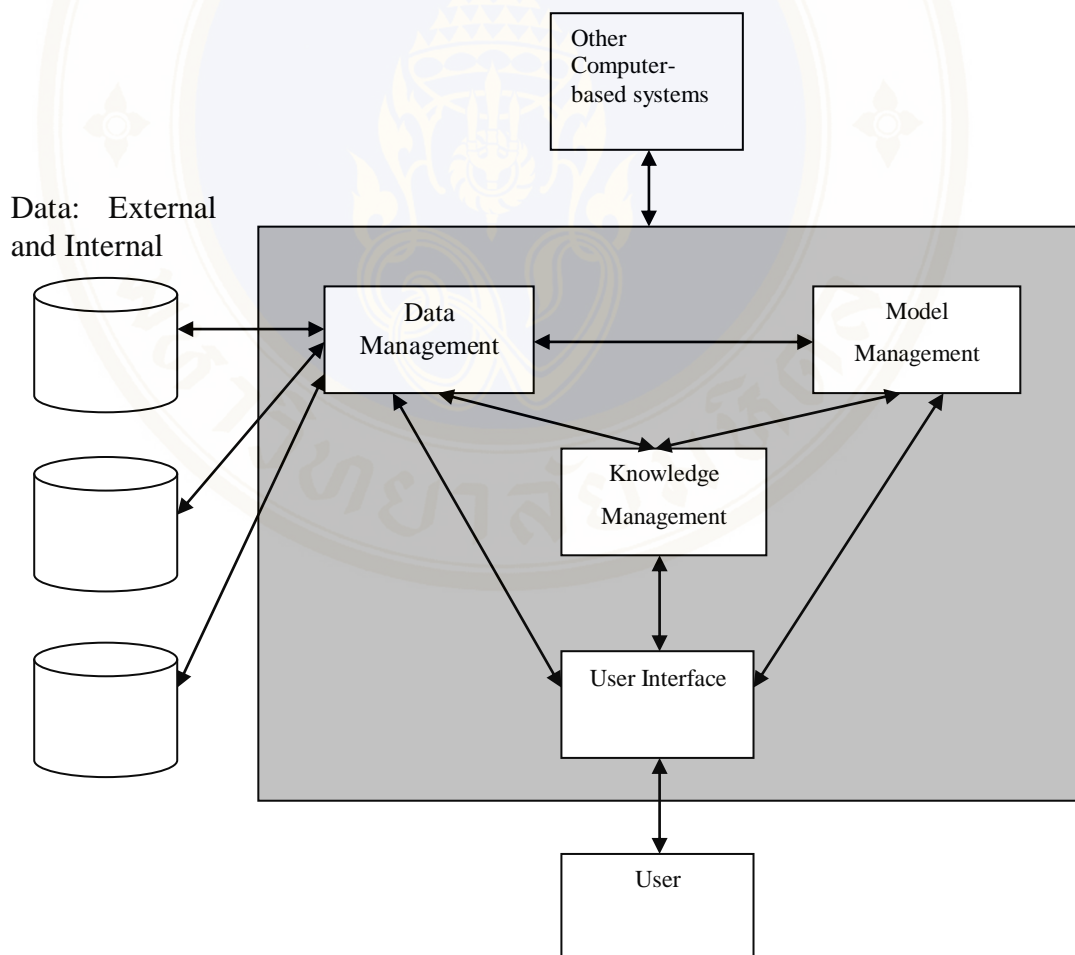
5) DSS provides information to senior executives and analysts for decision making.

**2.3.3 Components of Decision Model (Turban, E., 1998)**

The point of view of decision making a model and its variables represent the following three components: a measure of preferences over decision objectives, available decision options, and a measure of uncertainty over variables influencing the decision and the outcomes

**2.3.4 Fundamental component of DSS**

DSS composes three fundamental components as following:



**Figure 2.4** Schematic fundamental components of a DSS (Turban, E., 1998)

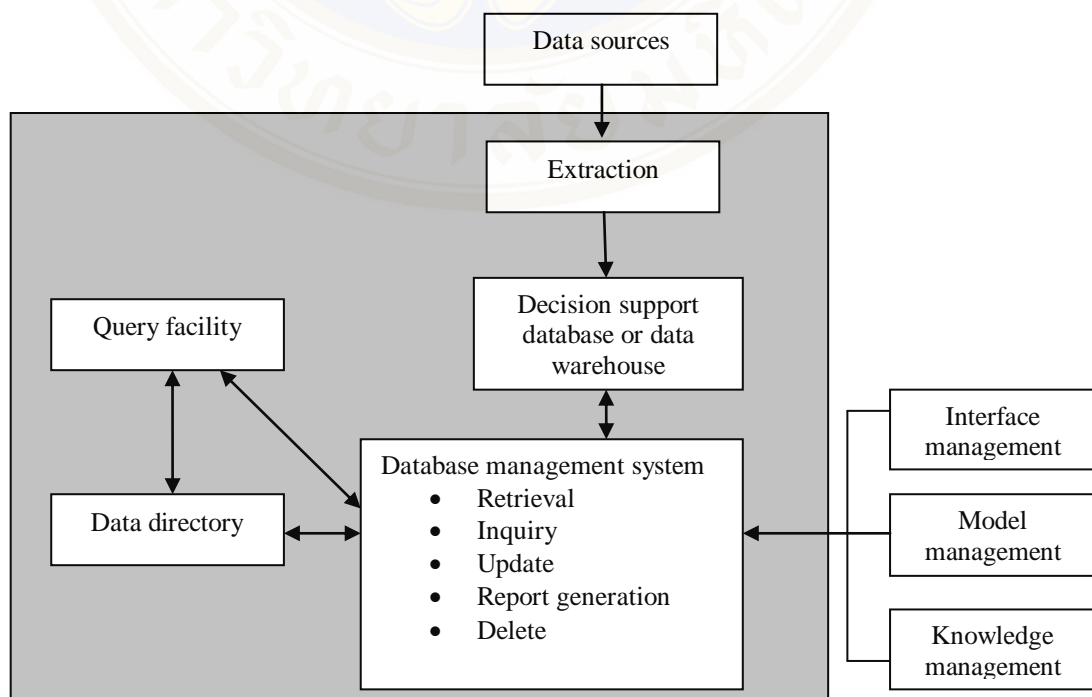
A schematic fundamental component of a DSS is shown in figure 2.5. It provides a basic understanding of the general structure of DSS. The detail is described look each component following as.

**2.3.4.1 Database management subsystem (DBMS):** a DBMS serves as a data store for the DSS. It stores large quantities of data that are relevant to class of problems for which the DSS has been designed and provides logical data structures with which the user interact. A data is levels

**1.1) Data** means groups of information that represent the qualitative or quantitative attributes of variable which have not been transcribe i.e. image, sound, number or word.

**1.2) Information** means data “processed data” that are analyzed for implementation.

**1.3) Knowledge** means the appropriate collections of information, such that its intent is to be useful. Knowledge is a deterministic process. When someone memorizes information, then they have amassed knowledge. This knowledge has useful meaning to them, but it does not provide for, in and of itself, an integration such as would infer further knowledge



**Figure 2.5** The structure of the data base management system (Turban, E., 1998)

Database management system consists 4 parts which are shown in figure 2.5

*Database* is an integrated collection of logically related records according to model. Database is a record capability to information system. User extracts a data in the systems that not occur duplication of data

*Data management system* is created, assessed and updated by DBMS software. Most of DSS are built with a standard commercial DBMS that provide capabilities as follows:

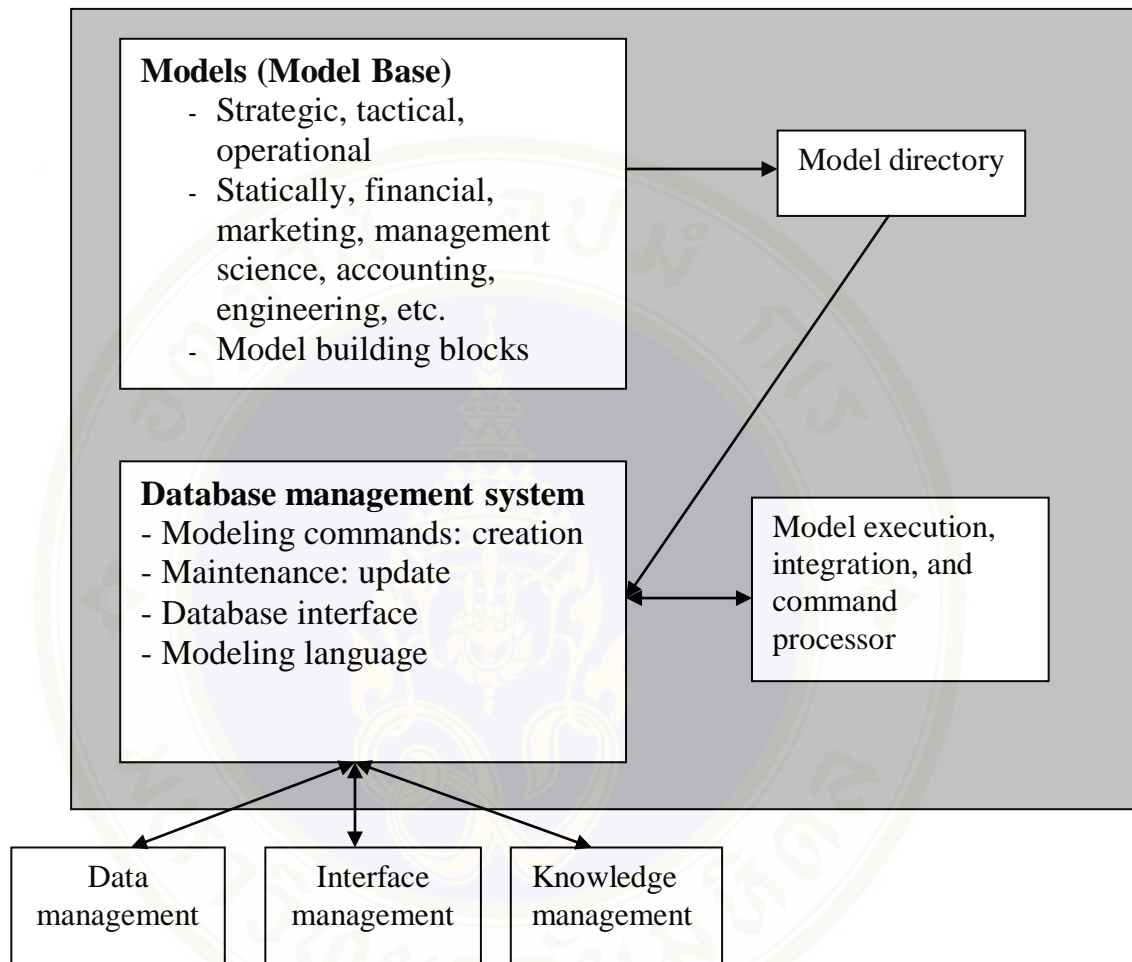
- Extracts data in a DSS database
- Edit (adds, deletes, updates, changes) and data records
- Interrelates data from different sources
- Retrieve data from database for query and prints report.
- Provides comprehensive data security
- User can experiment with alternative solution base on their own judgment
- Performs complex data manipulation tasks based on queries
- Tracks data use within the DSS
- Manages data through data dictionary which are used the defining of data

*Data directory* is a list of all the data in the database. It describes the data definitions, data types and, its main function is to answer question about the availability of data item, data source, and data extract meaning. The directory, like any other catalog, supports the addition of new entries, deletion of entries, and retrieval of information on specific objects.

*Query facilities* are often to data access. It accepts requests from data form DSS components, determines how these requests can be filled, formulates the detailed requests, and returns the results to the issuer of the request.

**2.3.4.2 Model-base management subsystem (MBMS):** It is software package which is used for financial, statistical or quantitative models. The role of MBMS is analogous to that of a DBMS. Its primary function is providing independence between specific models that are used in a DSS from the applications that use them. The purpose of an MBMS is to transform data from the DBMS into

information that is useful in decision making. MBMS consists into five parts as follow.



**Figure 2.6** Structure of the model management system (Turban, E., 1998)

1.) **Model Base** involves routine and special statistical; financial, forecasting, management science and quantitative models that provide the analysis capabilities in a DSS. The models in the model base can be separated into four major categories.

1.1) **Strategic models** are used for support top management’s strategic planning responsibilities. Potential application include developing corporate, the objective, merges planning, factory location selection, environmental impact and non-routine capital budgeting

**1.2) Tactical models** are used for middle management to assist in allocating and controlling the organization resources. Examples of tactical models include labor requirement planning, sales promotion planning, plant layout determination and routine capital budgeting. These models are usually applicable only to an organizational subsystem such as the accounting department. Their time horizon varies from one month to less than two years. Some external data are needed, but greatest requirements are for internal data.

**1.3) Operational models** are used to support the daily working activities of organization. Typical decisions are approving personal loans by a bank, production scheduling, inventory control, maintenance planning and scheduling and quality control. Operational models support mainly first-line managers' decision-making with a daily to monthly time horizon. These models normally use internal data.

**1.4) Model building blocks** are used to support the model performance. These include a random number generator routine, curve line fitting routine, present value computational routine, or regression analysis. Such building blocks can be used in several ways. They can be used as components in larger models. For example, a present value is one of parts in a make or buy model.

**2.) Model base management system (MBMS)** involves model creation by subroutine of MBMS software and other building blocks, generation of new routine and report, model updating and changing and model data manipulation. The MBMS is capable of interrelating model with the appropriate linkages through a database.

**3.) Modeling language** is used with semi-structured or unstructured problem. This can be done with high-level languages. Some of these are COBOL, spreadsheet, the fourth generation language (4G) or special languages such as IFPS/Plus.

**4.) Model directory** is similar to that of a database directory. It is a list of all model and software in MBMS that describe the definition of model, and its main function is to answer questions about the availability of models.

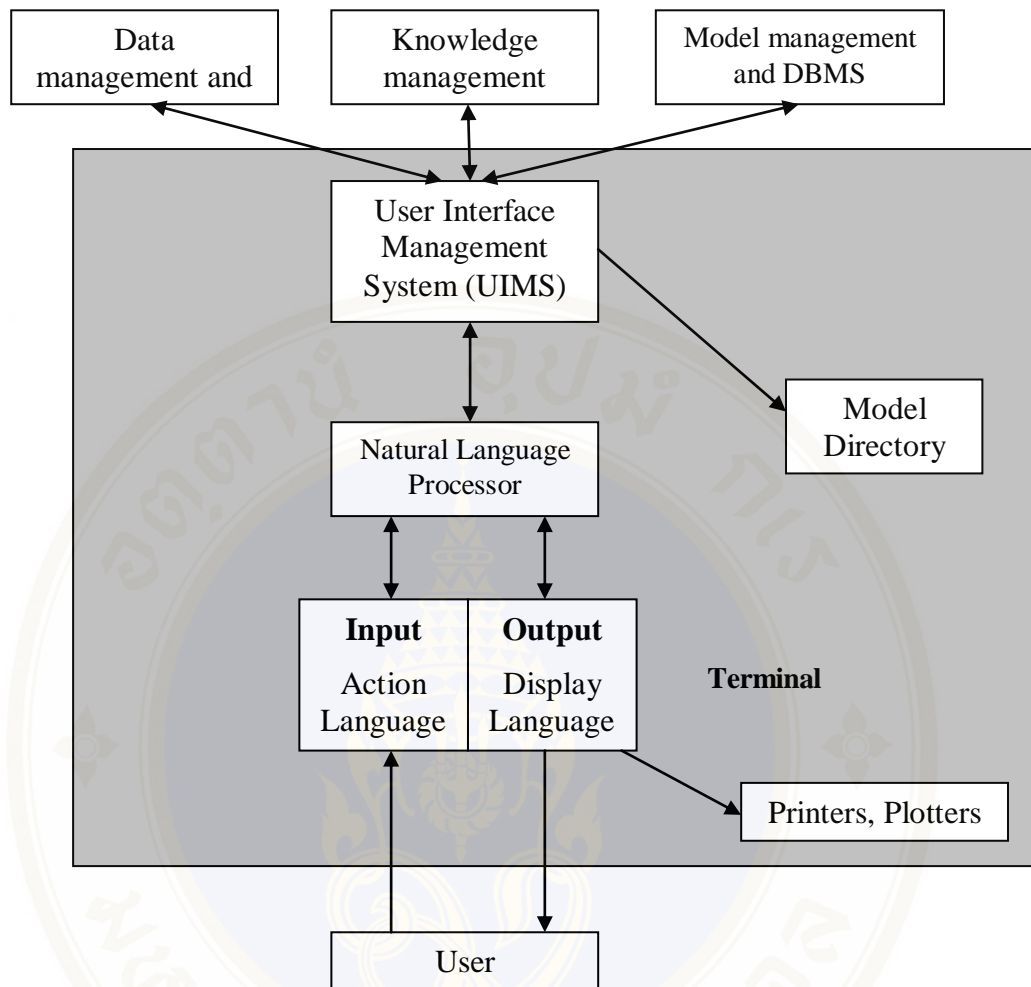
**5.) Model execution, integration, and command** are described activities as following: model execution is a process of controlling the actual running of the model; model integration is a work combination of models; a model command processor is used to accept and interpret modeling instructions from the command prompt and to route them to the MBMS, the model execution or the integration function.

**2.3.4.3 Knowledge management subsystem:** the problems of decision making are the semi-structured and the un-structured that are so complex. They require the expert system to solving problem within regular DSS capabilities. Therefore, the more advanced DSS are equipped with a component called knowledge management. Such a component can provide the required expertise for solving some aspects of the problem and providing knowledge that can enhance the operation of other DSS component.

*Knowledge base* supports the steps of decision process unaddressed by mathematics; intelligent decision modeling systems that help user build, apply, and manage libraries of models; and decision analytic expert systems that integrate theoretically rigorous methods of uncertainty into the expert system knowledge bases.

**2.3.4.4 User interface subsystem** is a combination of hardware, software and people that enables the user to interact with a DSS. The function of the user interface subsystem is to assign user input internal representations of the application and internal representations of the application to output that is comprehensible to the user. The user interface subsystem is managed by software called the User Interface Management System (UIMS).

*User interface management system (UIMS)* presents data with a variety of formats and output devices in design phase. Furthermore, it provides a specialized language for the user enables to manage input data and output data in the framework or the processing format. So, UIMS includes all aspects of communication between a user and functions of the system interaction.



**Figure 2.7** Schematic view of the user interface subsystem (Turban, E., 1998)

From figure 2.7, the user interacts with the computer via an action language processed via UIMS. In advanced systems, The user interface component includes a natural language processor or may use standard objects (such as pull-down menus and button) through a Graphical user interface (GUI). The UIMS enables the user to interact with the model management, data management, and knowledge management subsystem.

## 2.3 Scenario Analysis

Scenario analysis or scenario planning is one of a strategic planning methods that as a process of analyzing a possibility future by considering alternative possible outcomes. The characteristics of scenarios are five common as follows.

**2.4.1 Multiple Views:** Scenarios always involve more than one view of the future. That is their explicit objective. A single view is a forecast.

**2.4.2 Qualitative Change:** Scenarios are most appropriate when dealing with complex, highly uncertain situations in which qualitative, non-qualitative forces are at work.

**2.4.3 Objective:** Scenarios describe what could happen, not what we want to happen. Objectivity requires that scenarios be internally consistent and feasible. If scenarios are viewed as impossible or not feasible, they are rejected. The challenge is to broaden thinking without becoming unbelievable.

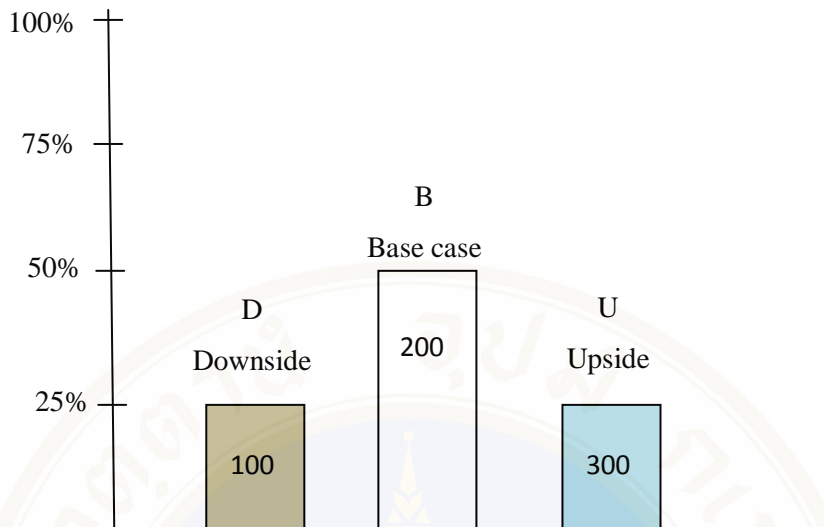
**2.4.4 Open-Ended:** Scenarios are stories. They do not provide precise details. Challenging and engaging scenarios allow the reader to add details which help bring the scenarios alive.

**2.4.5 Focused and Relevant:** Scenarios must be relevant to the situation at hand. They must focus on the driving forces and the critical uncertainties relevant to strategic decisions under consideration.

The most typical method is to perform multi-factor analysis (models containing multiple variables) in the following ways.

- 1) Creating a fixed number of scenarios
- 2) Determining the high-low spread
- 3) Creating intermediate scenarios
- 4) Random factor analysis
- 5) Others

The simplest method to forecast potential outcomes of an investment or venture is to produce an upside and downside case for each outcome and then to speculate the probability that it will occur. Figure 2.9 uses a three scenario method evaluating a base case (B) (mean value), upside case (U) and a downside case (D)



**Figure 2.8** Example three scenarios

For example a simple two factor analysis:

Value  $V = \text{Variable A} + \text{Variable B}$ , where each variable value is not constrained.

By assigning two extreme upside and downside value for A and B, we would then get our three scenario values. By assigning the probability of occurrence, let us assume:

50% for Value (B) = 200

25% for Value (U) = 300

25% for Value (D) = 100

When assigning probabilities the sum of the probabilities assigned must equal 100%. By graphing these values and their probabilities we can infer a rather crude probability distribution (the distribution of all calculated values and the probability of those values occurring). By forming the upside and downside cases we begin to get an understanding of other possible return outcomes, but there are many other potential outcomes within the set bounded by the extreme upside and downside already estimated.

According characteristics in above, Scenario analysis can be applied in many ways.

In 1994, related research studied in applying the goal decomposition and scenario analysis model in the context of Business Process Reengineering (BPR). Scenario analysis was used for the refinement of goals as a type of discovery or inquiry process throughout which the analyst repeatedly asks questions of certain types. For example, to refine an achievement goal the analyst asks what constituent conditions must be attained for the target condition to become true. By resolving these questions it becomes possible to refine, operationalize and reorganize the goals. The goal refinement strategy depends most of all on asking 'what if' questions and using scenarios to explain the rationale for goals. Explanatory scenarios that justify descriptive goals are easier to obtain but are fragmentary. We conclude that both types of scenario and goal analysis are necessary for effective BPR. (Anton, W. McCracken., & Potts, 1994)

In 2006, textile industry had studied about an order fulfillment process for waiting time investigation which occurred in enterprises. It presented the analysis and improvement for a waiting time to shorten by reengineering business process. the method can be demonstrated that the restructuring process can reduce the average order fulfillment cycle time when compared to normal conditions.(Laongam, S., & Vasusri, T., 2006).

In 2007, Ozbayrak applied to develop Make to Order (MTO) model was built using a system dynamics approach. The modeling frame work is also used to study the performance of the system under the initial conditions considered and compare it with that obtained by running the system under eight different scenarios concerning commonly addressed real-life operational conditions. The study concludes with the analysis of the obtained results and the conclusion drawn from contrasting the system's performance under each investigated scenario to that of the benchmark model. (Ozbayrak M., Papadopoulou, T., & Akgun, M., 2007)

And the latest, the operation of the manufacturing supply chain was used to the simulation and scenario analysis for evaluating performance under different operational conditions. The results obtained the difference between the scenarios that the supplier fails to fulfill the demand fully. Improvements made on the direction of creating information enriched supply chain resulted in significant reductions in the inventory levels of each echelon, which in turn enabled further reductions in the lead

time thus making the overall supply chain more agile. (Subhash, W., Felix, T., & Madhawanand, M., 2008)

According to the above literatures, we notice Thailand rubber that still has no direction. Thus, this research aims to continuously improve Thailand rubber for value creation. What-if technique was used for resolving directions. It was improved behavior of rubber usage to achieving the goal by re-engineering method. Also, the details of each method were explained using Scenario analysis. These scenarios will be compared to initial conditions and normal conditions (Base case) for obtained different operations. Finally, this research attempts to apply all the relevant principles to develop an application which to analyze and comprehend alternatives behavior for value creation. It is considered as an essential tool to supports decision-maker for directing value creation in rubber supply chain.

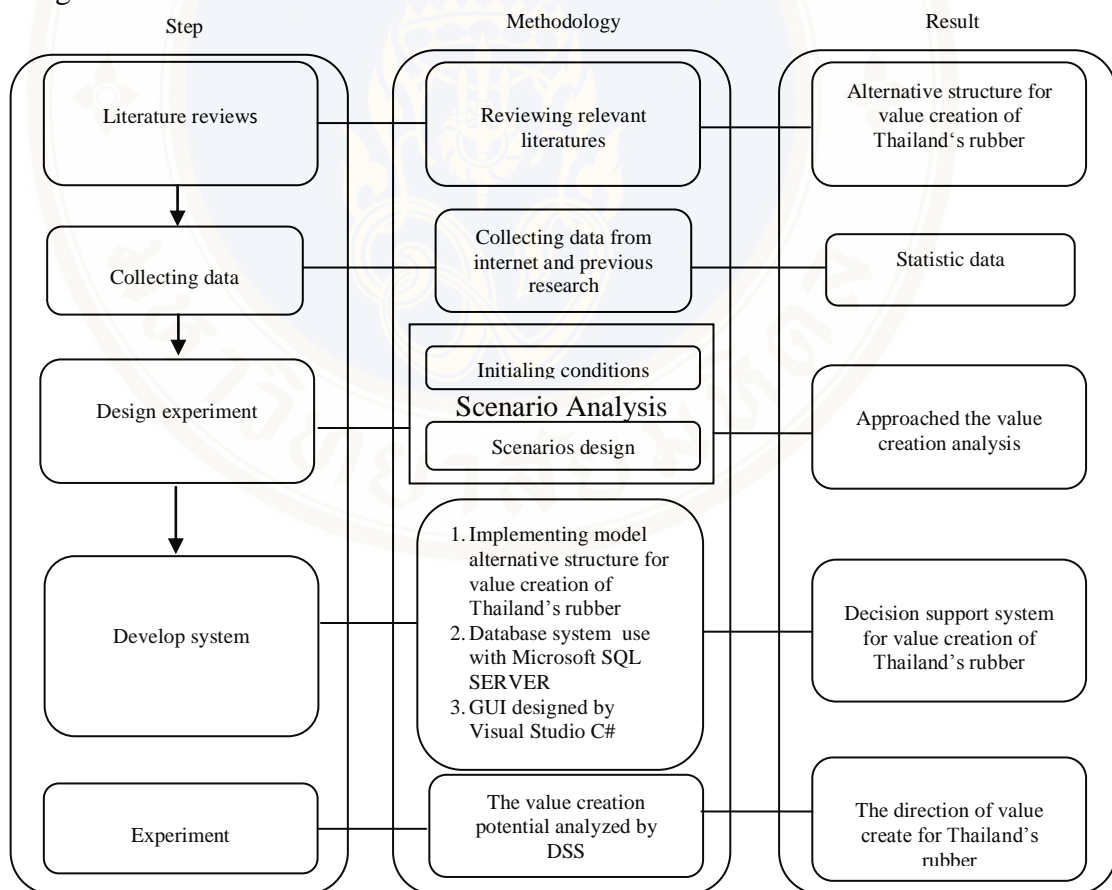
## CHAPTER III

### RESEARCH METHODOLOGY

This chapter describes the research methodology for developing a decision support system and directing the value creation of Thailand’s rubber in this study.

#### 3.1 Steps of Research Methodology

In the research, steps of methodology consisted of the processes as shown in Figure 3.1



**Figure 3.1** Conceptual framework of research methodology

Figure 3.1 was shown a Conceptual framework of research methodology which steps are as following.

**3.1.1 Literature reviews**

This study has presented way of a value creation for rubber in Thailand. The structure of Thailand rubber value chain was reviewed by literatures and fieldwork. It described every available alternatives of rubber process into rubber products that can be divided into two decision levels: First, farmer and natural rubber processing factory. They process for primary rubber products that all of these are called natural rubber, i.e. rubber smoke sheets, rubber block, rubber concentrated latex, vulcanized latex, and rubber compound. Natural rubbers can be used for two alternatives on the first decision level (exportation or domestic consumption). Second, domestic consumptions, natural rubbers are sent to downstream factory for end products. They can be processed to many product on the second decision level i.e. tires, gloves, rubber band, elastic, belt, hose, and others (Tassakorn, 2009). They called products champion that were expected the potential value creation. The all of value get return outcomes amount as total exporting value.

**Table 3.1** Decision level of rubber model

Primary production	Level1 alternative	Level2 alternative	Outcome
Volume in year (100%)	Exportation		Total exporting value
	Domestic consumption	Tires	
		Gloves	
		Rubber band	
		Elastic	
		Belt	
		Hose	
		Others	

Table 3.1 shows two decision levels of rubber value creation in this study. The first one is to choose either export or domestic consumption. If the first level identifies domestic consumption, to select among tires, gloves, rubber band, elastic, belt, hose or others. All of the alternatives are calculated to total exporting value.

### **3.1.2 Collecting data**

The facts and forecasting data were collected from secondary source such as; internet source and the previous research source. They will be implemented on DSS.

### **3.1.3 Design experiment**

As reviews in the sections above, it can be seen that Thailand has no strategic direction and don't know how to drive rubber industry. Latest, Thailand rubber development strategy was planned to increase usage of natural rubber in the country at 17 percentage of production. It expected the total of export value approximately 600,000 million baht. That was targeted to be succeeding in 2013. So, researcher wants test possibility to goal by scenario analysis methodology which used to analyzing for comparing performance under different operational conditions. This research will do experiment during 2010-2012 The experiment is design initial conditions, and scenarios that are as following.

**3.1.3.1 Initial scenarios:** is the operation performance under the normal conditions (As-Is). That will be use as a base case for comparing other scenarios in the experiment.

**Table 3.2** Initial operating conditions

	Type	2010	2011	2012
<b>Production</b>	<b>Volume (Ton)</b>	3,235,127	3,265,950	3,294,085
	<b>Percentage</b>	100	100	100
	<b>Value (Million)</b>	476,830	525,439	573,038
<b>Export</b>	<b>Volume (Ton)</b>	2,842,383	2,869,464	2,894,183
	<b>Percentage</b>	87.86	87.86	87.86
	<b>Value (Million)</b>	287,649	314,493	341,224
<b>Domestic consumption</b>	<b>Volume (Ton)</b>	392,744	396,486	399,902
	<b>Percentage</b>	12.14	12.14	12.14
	<b>Value (Million)</b>	189,181	210,946	231,813
<b>Tires</b>	<b>Volume (Ton)</b>	199,607	206,735	214,774
	<b>Percentage</b>	6.17	6.33	6.52
	<b>Value (Million)</b>	88,346	99,481	111,640
<b>Gloves</b>	<b>Volume (Ton)</b>	64,056	66,299	68,846
	<b>Percentage</b>	1.98	2.03	2.09
	<b>Value (Million)</b>	42,437	46,429	50,816
<b>Rubber band</b>	<b>Volume (Ton)</b>	84,437	87,528	90,917
	<b>Percentage</b>	2.61	2.68	2.76
	<b>Value (Million)</b>	6,654	6,573	6,492
<b>Elastic</b>	<b>Volume (Ton)</b>	20,058	20,902	21,741
	<b>Percentage</b>	0.62	0.64	0.66
	<b>Value (Million)</b>	3,554	4,055	4,585
<b>Belt</b>	<b>Volume (Ton)</b>	1,618	1,633	1,647
	<b>Percentage</b>	0.05	0.05	0.05
	<b>Value (Million)</b>	3,334	3,793	4,255
<b>Hose</b>	<b>Volume (Ton)</b>	971	1,306	1,318
	<b>Percentage</b>	0.03	0.04	0.04
	<b>Value (Million)</b>	6,463	9,375	10,136
<b>Others</b>	<b>Volume (Ton)</b>	21,999	12,084	988
	<b>Percentage</b>	0.68	0.37	0.03
	<b>Value (Million)</b>	38,392	41,240	43,890

The operation's performance under the normal conditions is shown in table 3.2. That is the current proportion of rubber usage in the country. The initial condition shows that the period 2010-2012 has the same portion in 2007 (not include others), about 88 percent of the natural rubbers are exported while the rest of them are processed to end products. The results gathered from this initial condition will be used as a base case for comparing scenarios in the experiments.

**3.1.3.2 Scenarios design:** As Rubber Development Plan, it has planned to increase natural rubbers in domestic consumption. This plan has many strategies for natural rubbers which were added under different environments of each

industry. So, the experiments not only test possibility to the goal but also demonstrate the impacts from strategies which were designed for the natural rubber sharing by scenarios. The results of scenario have been able to see the advantages and disadvantages that occur on the industry. They help to know the direction of the rubber industry development. The details of each scenario are shown in table 3.3.

**Table 3.3** Scenario design

Year	Type	Base case	Add	S1	S2	S3
2010	Domestic consumption	12.14	4.86	17	17	17
	<b>Products</b>					
	Tires	6.17	Vary	6.98	8.79	8.94
	Gloves	1.98	Vary	2.79	2.82	3.28
	Rubber band	2.61	Vary	3.42	3.71	2.94
	Elastic	0.62	Vary	1.43	0.88	0.72
	Belt	0.05	Vary	0.86	0.07	0.17
	Hose	0.03	Vary	0.84	0.05	0.27
	Others	0.68	Not vary	0.68	0.68	0.68
2011	Domestic consumption	12.14	4.86	17	17	17
	<b>Products</b>					
	Tires	6.33	Vary	7.14	8.95	9.1
	Gloves	2.03	Vary	2.84	2.87	3.33
	Rubber band	2.68	Vary	3.49	3.78	3.01
	Elastic	0.64	Vary	1.45	0.9	0.74
	Belt	0.05	Vary	0.86	0.07	0.17
	Hose	0.04	Vary	0.85	0.06	0.28
	Others	0.37	Not vary	0.37	0.37	0.37
2012	Domestic consumption	12.14	4.86	17	17	17
	<b>Products</b>					
	Tires	6.52	Vary	7.33	9.14	9.29
	Gloves	2.09	Vary	2.90	2.93	3.39
	Rubber band	2.76	Vary	3.57	3.86	3.09
	Elastic	0.66	Vary	1.47	0.92	0.76
	Belt	0.05	Vary	0.86	0.07	0.17
	Hose	0.04	Vary	0.85	0.06	0.28
	Others	0.03	Not vary	0.03	0.03	0.03

From table 3.3, three scenarios were built to reflect on different priority for the rubber dispensations that would be replied the Rubber Development Plan to as follows:

- 1) Can strategy to create value better initial conditions?
- 2) Can strategy for value succeed the goal (600,000 million baht)?
- 3) When strategy to succeed the goal?

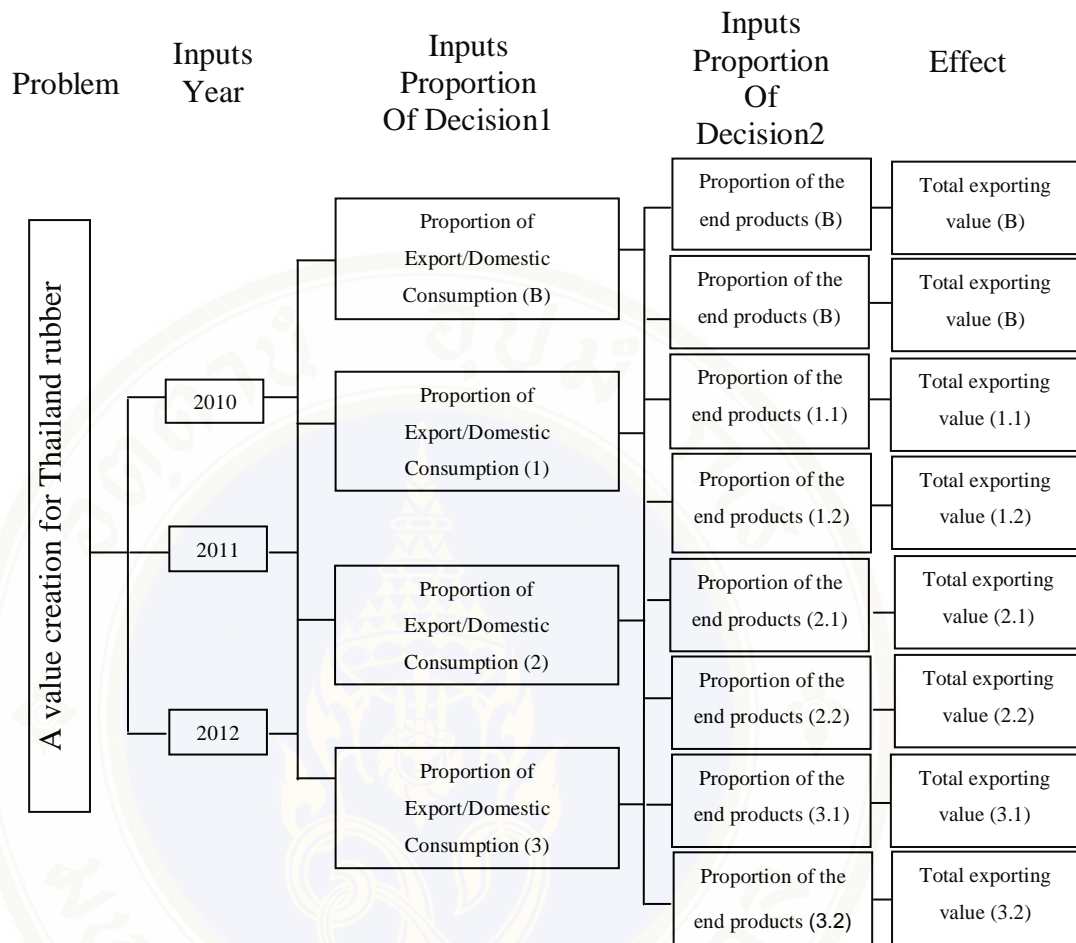
First scenario divided of the usage added to equal of each industry, second scenario increases/decreases by the proportional amount of each industry, and third scenario increases/decreases by the share value of each industry. The results obtained from each scenario will show the total export value compared to the initial conditions. This can indicate different value in different proportions of products produced. The growth rate of each proportion will also be displayed. Finally, the results can be discussed each scenario that has affect how each industry on a different environments and perspective.

#### **3.1.4 Develop system**

In this section presents the step to build a decision support system that helps analyze the value creation alternatives for Thailand rubber. There are five steps to follows:

**3.1.4.1 System analysis phase:** From experimental design and decision level model, these were considered to defining system framework, approach algorithm of system, and display results. These are to description as follows:

**1.) System framework:** the system must be provides a formal structure in which decisions and events was linked since upstream to downstream. It demonstrates the value and volume of each product type affecting volume needed from midstream semi-finished and upstream. The forecast demand can also be input to predict the future impact scenario. that was shown in figure 3.2



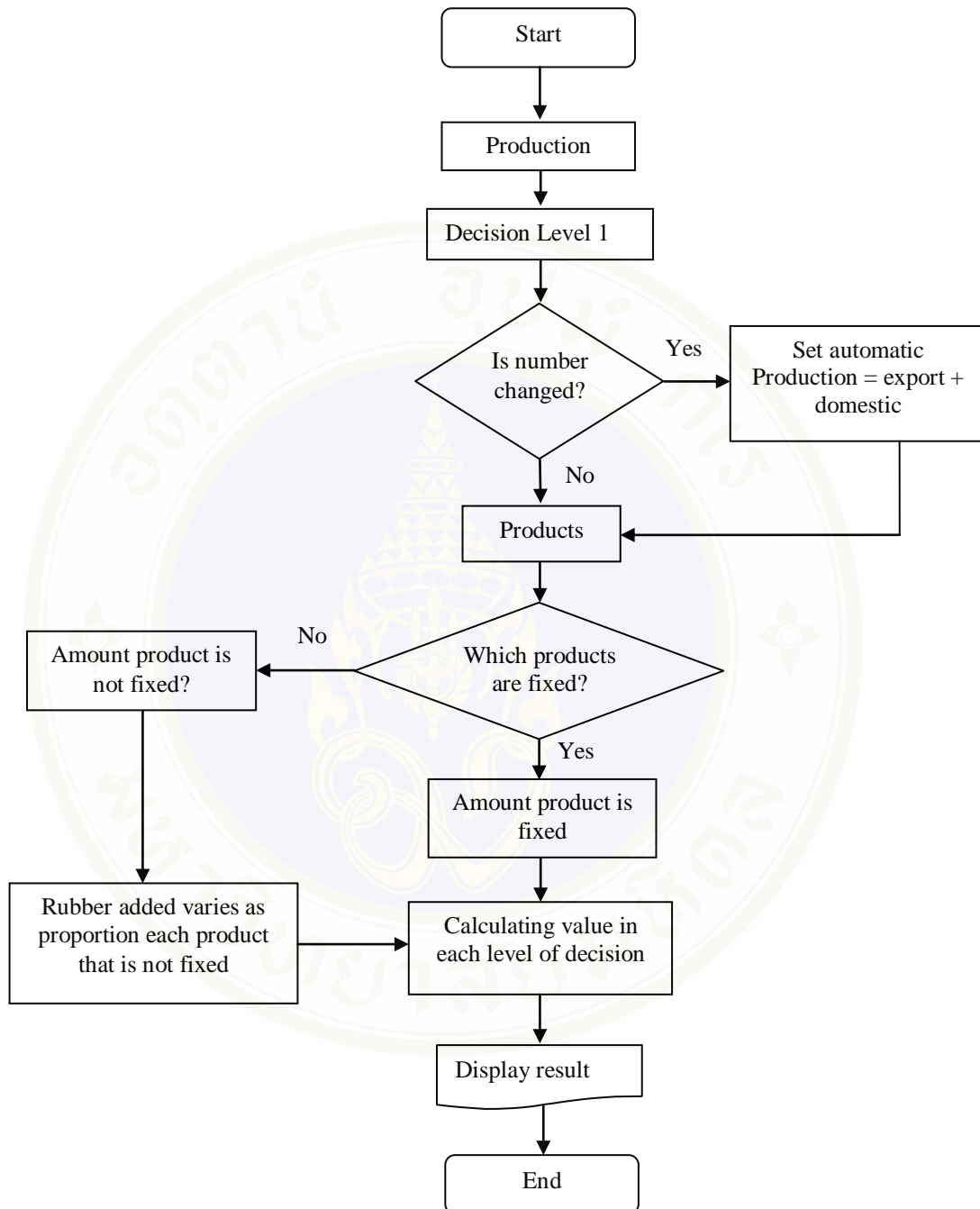
Remark: (B) = Base case is compared with any scenario case.

(Number) = Number of scenario case

**Figure 3.2** System framework

Considering that the proportion volume of natural rubber is one of the most decisive parameters affecting the operating of value. From figure 3.2, user can vary information input in the decision part to study changes and effects within the value chain by interpreting total exportation value. Moreover, scenario can be setup into base case of year that will be also compared with other scenarios.

**2.) Approach algorithm:** this research presents the algorithm for calculating the impact when user varies a parameter. The detail includes as follows.

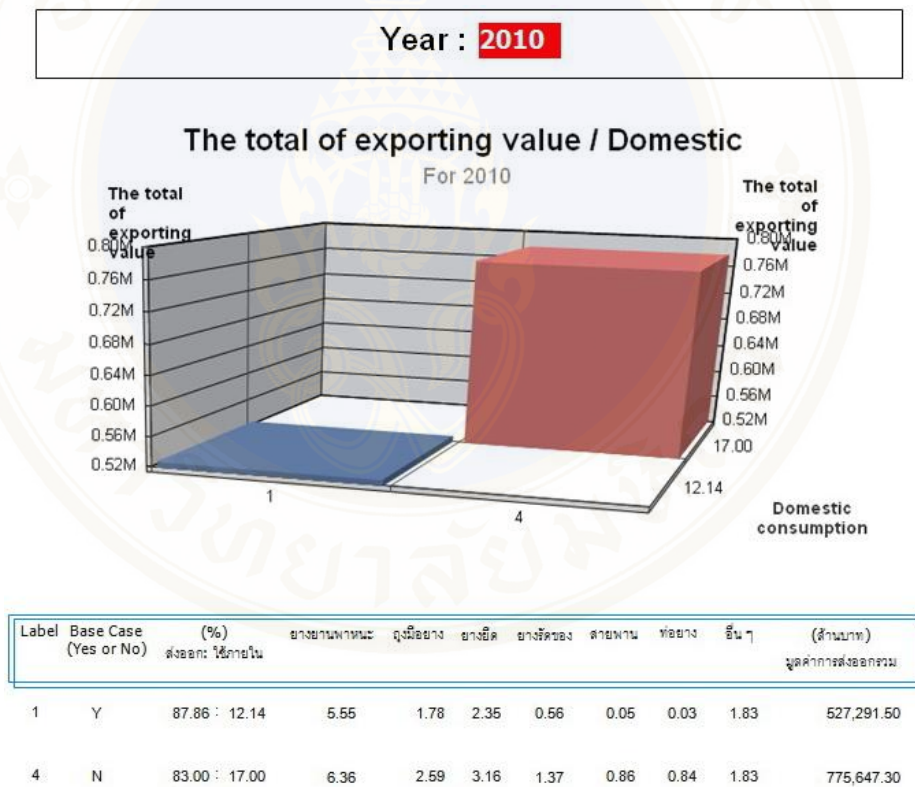


**Figure 3.3** The algorithm of the system

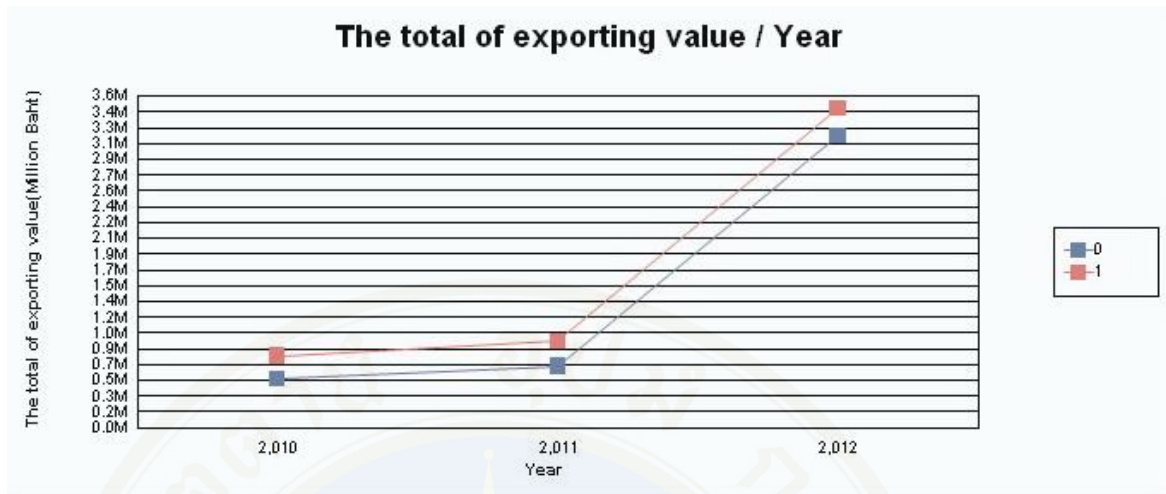
From figure 3.3, the system starts when user retrieved the prediction of rubber from database. Production had different quantity as each year which they are used as a base limitation for the first decision level. The system checks the rubber usage in the first decision level which composes an export and a domestic

consumption. If those numbers be varied, then the system automatically set as amount value of those numbers as production. After that, the product state be checked if which products are not fixed value by user, then each product be added or dropped rubber volume as proportion of themselves. Finally, all activity will be calculated value for looking result.

**3.) Display results:** the system can display graph by report that displayed two results. Total exportation value compared the different value with base case of each year, and the total exportation value in each year to analyze sensitivity of each scenario.



**Figure 3.4** Display result 1: the different value in different proportion



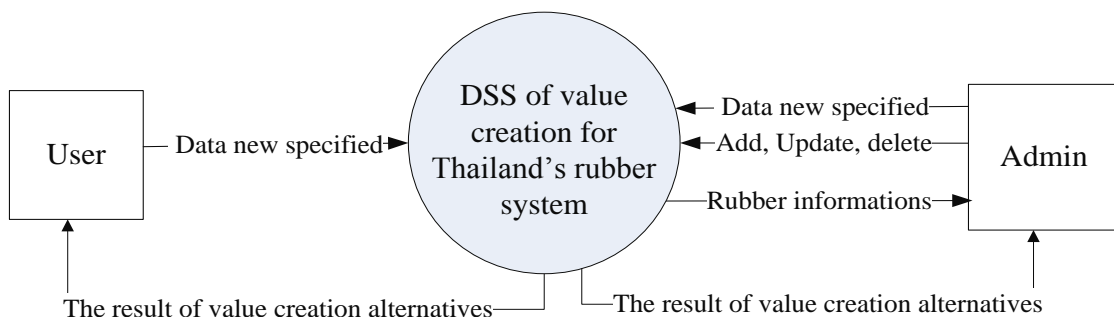
**Figure 3.5** Display result 2: Sensitivity of each scenario

The outcomes are used to implement it as Ministry of Industry Thailand, who is responsible for drafting policy and strategy of industry. They will help defining value creation direction for rubber in Thailand.

**3.1.4.2 Design phase:** describes the structure of decision support system and database system. These were designed according to the system operational. This phase can be divided into two parts.

- 1) Structure of DSS** was designed by Data Flow Diagram (DFD) that can show an overview of DSS.

**Context Diagram**



**Figure 3.6** Context diagram

As figure 3.6, context diagram shows the interaction between the system and external agents which act as user and administrator. They can access to the system for analyzing the value creation alternatives. Moreover, rubber information can be added, updated, and deleted by administrator. The context diagram was exploded to produce a Data Flow Diagram Lv1 that shows the detail of system was divided into six sub-processes to follows.

1.1) Check authority is one of the processes that are responsible monitoring the login as admin or user online.

1.2) Managing data is a process that is responsible for the administrator to manage data (Add, update, and delete) in database system.

1.3) Retrieve data is a process that connects to database for data query when user requires rubber data.

1.4) Vary data is a process of calculating impacts which occurred by changing variables. Every variable in the process can be set by user for building scenarios that can be recorded 2 types: They were initial scenario and trial scenarios.

1.5) Analyze data served the recorded data were processed which will be display two results. These displays as the different value in the proportions of products produced and the growth value of each proportion.

1.6) Result is a process that displays processing results that are considered in order to support decision-maker.

Data Flow Diagram Lv1

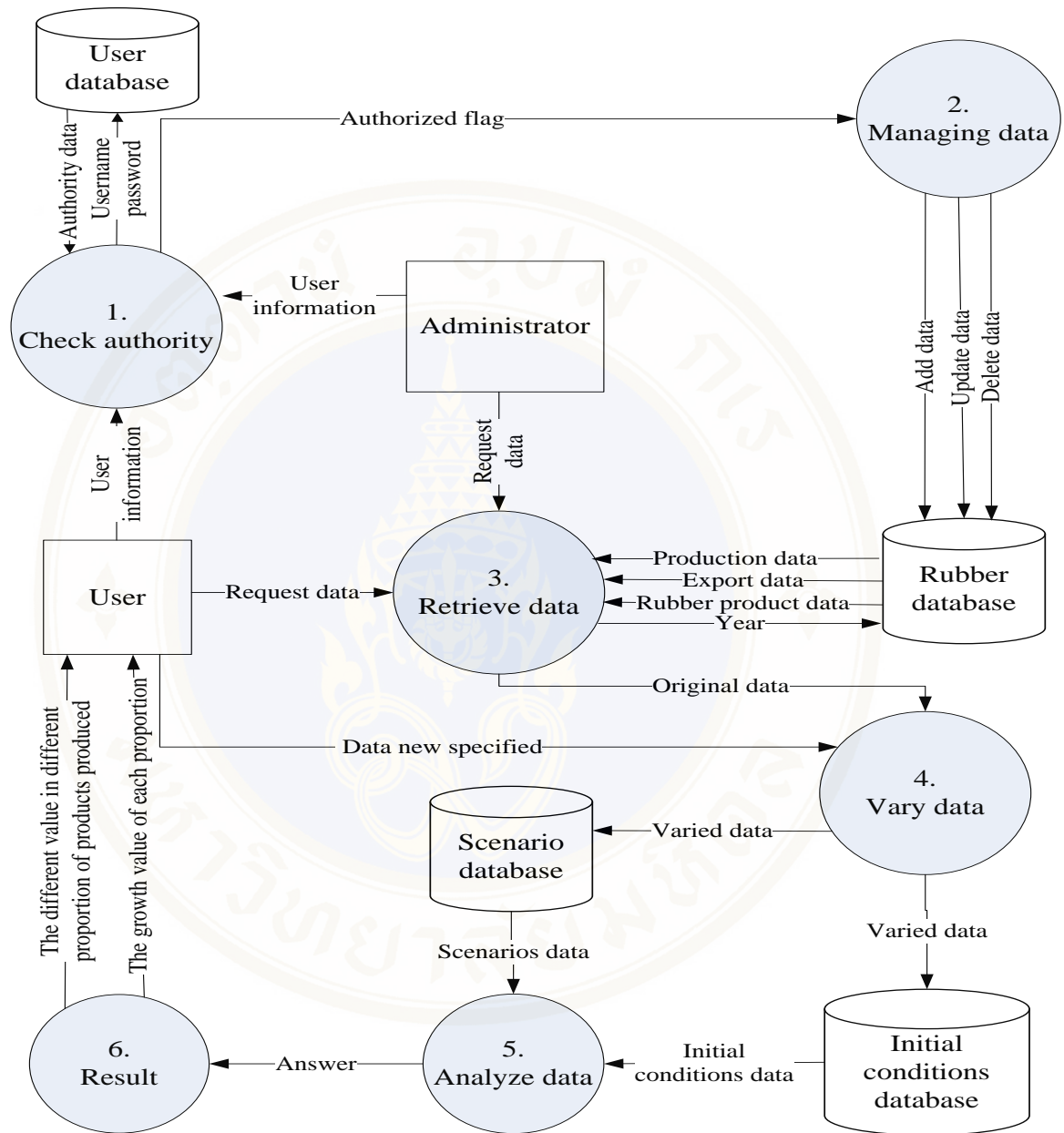
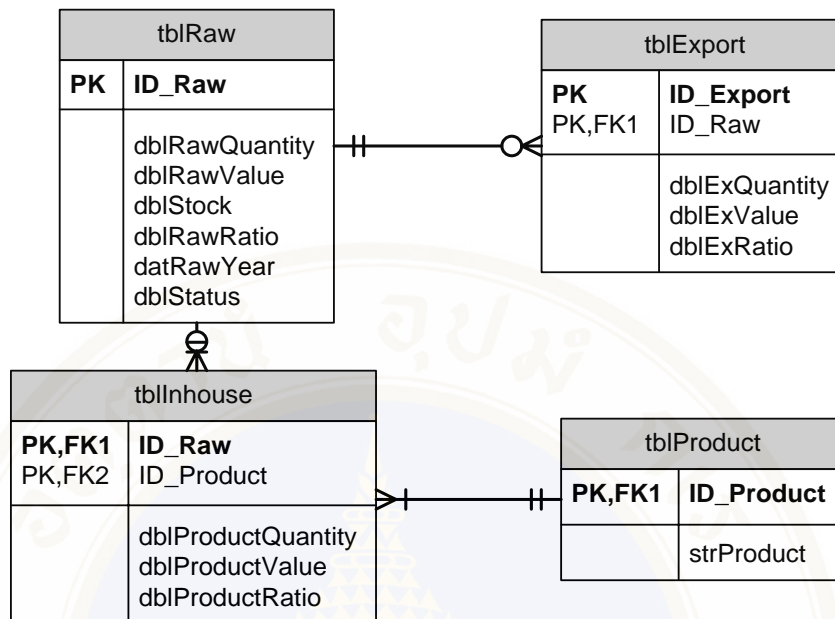


Figure 3.7 Data Flow Diagram Lv1

2.) **Database system** was designed by entity Relationship model. The linkage of activities was defined between entities. That was considered under normalization rule. Finally, the key are defined attribute



**Figure 3.8** ER-diagram of DSS

**2.1) Data dictionary:** It describes the definition of field name, data type, width, key, and data format. These shows detail as follows.

**Table 3.4** tblRaw

Field Name	Description	Type	Width	Key	Null	Example
ID_Raw	ID of production	Varchar	5	PK	Not Null	00001
dblRawQuantity	Volume of production	Real	30			999,999.00
dblRawValue	Value of production	Real	30			999,999.00
dblStock	Stock	Real	20			999,999.00
dblRawRatio	Ratio (Baht/ton)	Real	15			999.00
datRawYear	Year	Date/Time	5		Not Null	2009
dblStatus	Status	Varchar	2			Y or N

**Table 3.5** tblExport

Field Name	Description	Type	Width	Key	Null	Example
ID_Export	ID of export	Varchar	5	PK	Not Null	10001
ID_Raw	ID of production	Varchar	5	PK,FK1	Not Null	00001
dblExQuantity	Volume of export	Real	30			999,999.00
dblExValue	Value of export	Real	30			999,999.00
dblExRatio	Ratio (Baht/ton)	Real	15			999.00

**Table 3.6** tblInhouse

Field Name	Description	Type	Width	Key	Null	Example
ID_Raw	ID of production	Varchar	5	PK,FK1	Not Null	00001
ID_Product	ID of product	Varchar	5	PK,FK2	Not Null	20001
dblPQuantity	Volume of export	Real	30			999,999.00
dblPValue	Value of export	Real	30			999,999.00
dblPRatio	Ratio (Baht/ton)	Real	15			999.00

**Table 3.7** tblProduct

Field Name	Description	Type	Width	Key	Null	Example
ID_Product	ID of product	Varchar	5	PK,FK1	Not Null	20001
strProduct	Name of product	Varchar	30			Tires, gloves

**3.1.4.3 Construct phase:** software development composes material as following: Microsoft SQL server used to found database system within stand alone computing architecture. The system and user interface must be connected to database system by Visual Studio C#.

**3.1.4.4 Testing phase:** In this phase, each module is examined by debugging

### **3.1.4 Experiment**

The application was used to analyze alternative of value creation for Thailand rubber. It was developed on Microsoft Windows XP operating system. This section has steps as following.

3.1.4.1 First step, scenarios were simulated by the application. They divide type into base case (initial conditions) and scenario case. The volumes of these cases were inputted to the application. After that, the total exporting value of scenario cases would be compared with base case by Crystal report.

3.1.4.2 Secondary step, the results would be concluded value creation potential in each case, and they would be replied the Rubber Development Plan which argue to increase natural rubbers in domestic consumption. The strategies of each scenario can be shown possibility to accomplish of this plan.

3.1.4.3 Third step, strategies of each scenario would be discussed to appropriate for environmental industry that includes market sharing, market growth, manufacturing force, and world demand. These can be considered advantage, and disadvantage of their scenario, and also can be seen the ready growth for each industry.

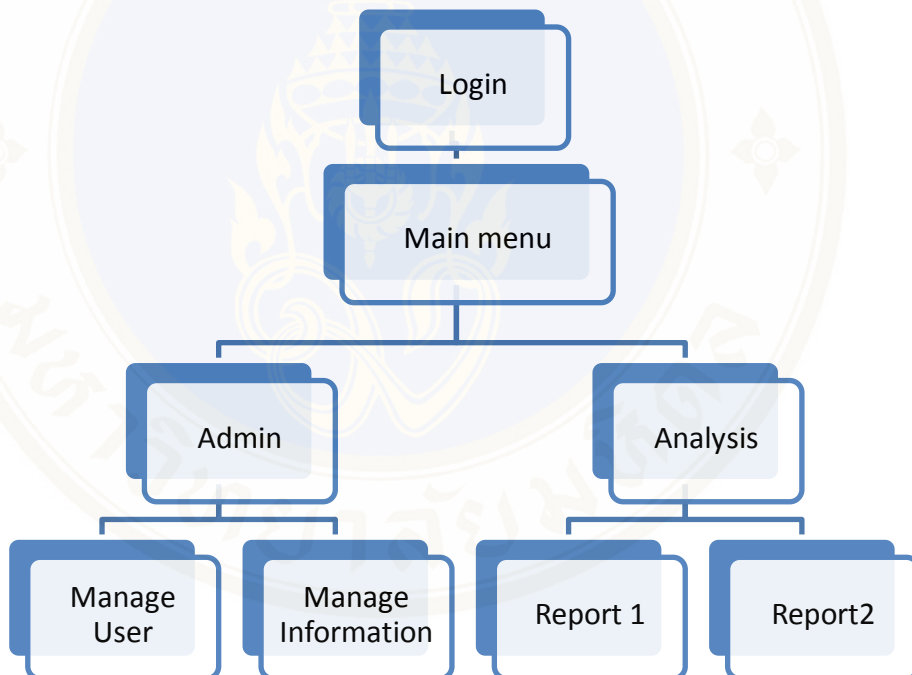
These steps will be analyzing the direction for Thailand rubber value creation as well as the strategy enabling the integrated supply chain.

## CHAPTER IV

### RESULTS

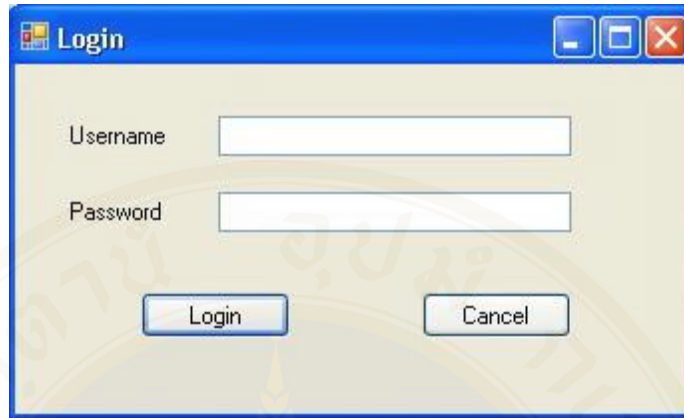
#### 4.1 System Development

The decision support was operated on Microsoft Windows XP. User can connect to system via Graphic User Interface (GUI) within form interaction which had operational structure as follows.



**Figure 4.1** Operational structure of system

## 1) Login



**Figure 4.2** Login form

This is a first form of structure user must be input your “Username” and “Password” for authentication yourself which has two authority. First, it was called “User” which can use the system only “Analysis section”. And second, it was called “Admin” the system grants special user can add, edit, and delete any information about user account and rubber data.

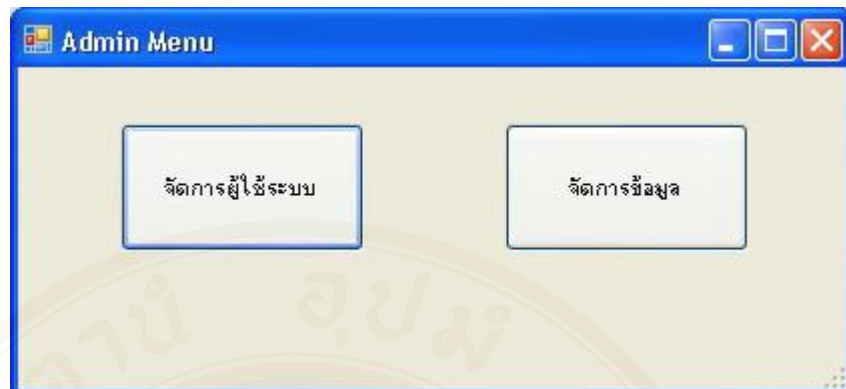
## 2) Main menu



**Figure 4.3** Main menu form

After login, this page has been available between analysis section and admin menu section.

### 3) Admin menu



**Figure 4.4** Admin menu form

Admin menu serves as back office that grants to managing information about user account and rubber data that for administrator only.

### 4) Manage user

A screenshot of a software window titled "Manage user". The window has a blue title bar with standard Windows window controls. The main area is light beige and contains a table on the left and a form on the right. The table has columns for "รหัส" (ID), "ชื่อ" (Name), "นามสกุล" (Last Name), and "ประเภท" (Authority). The first row shows "5", "admin", "bbb", and "A". Below the table is a scrollable area. The form on the right has fields for "รหัสพนักงาน" (Employee ID), "ชื่อ" (Name), "นามสกุล" (Last Name), "ประเภท" (Authority), "ชื่อเข้าใช้ระบบ" (System Username), "รหัสผ่าน 1" (Password 1), and "รหัสผ่าน 2" (Password 2). There are "Save", "Clear", and "Delete" buttons at the bottom of the form. A faint watermark of Mahidol University is visible in the background.

**Figure 4.5** Manage user form

Administrator can manage user account in Manage user form that composes id, name, last name, authority, user name, and password of user.

### 5) Manage information

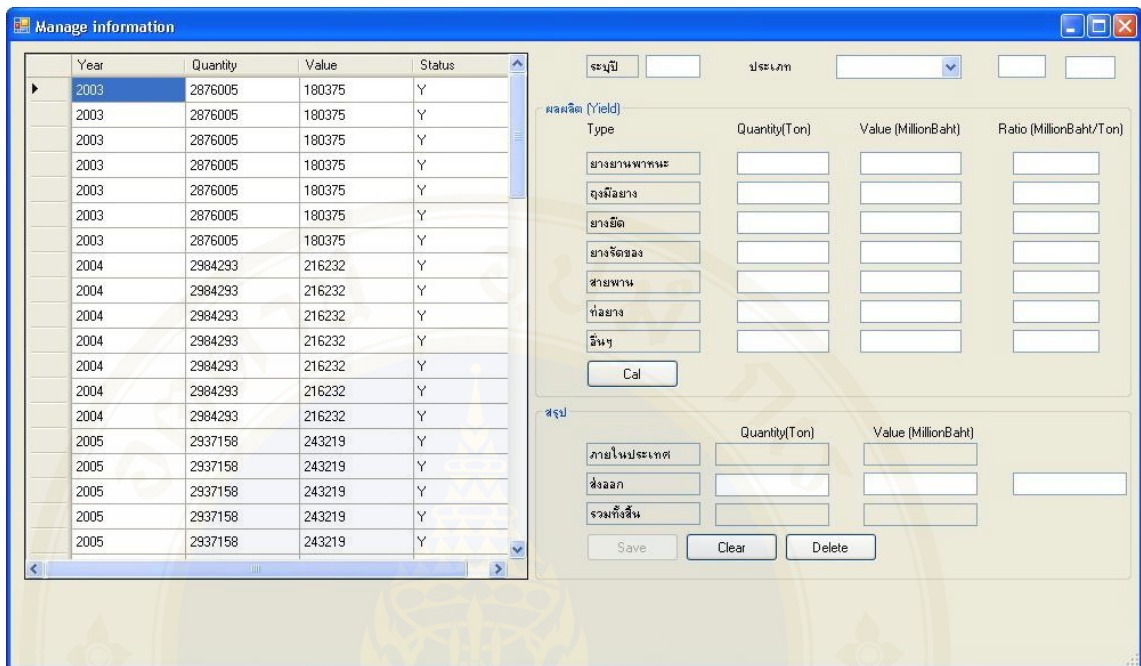


Figure 4.6 Manage information form

In addition user account, administrator also grants to add, edit and delete Thailand rubber which demonstrated the value and volume of each activity for the rubber usage. They can be managed in Manage information form.

### 6) Analysis

**Figure 4.7** Analysis form

This form serves accession for all users can try to find ways of value creation for Thailand, and looking for the impacts which may be occur when user demonstrate the new value and volume to some activity.

Example, the system starts program and retrieves rubber data when user chooses a year in combo box which this demonstrated year in 2010. Then, tester want change the usage proportion in this year as the past (2007) user would be select combo box of portion. There proportions will be used in 2010. It was displayed in figure 4.8.

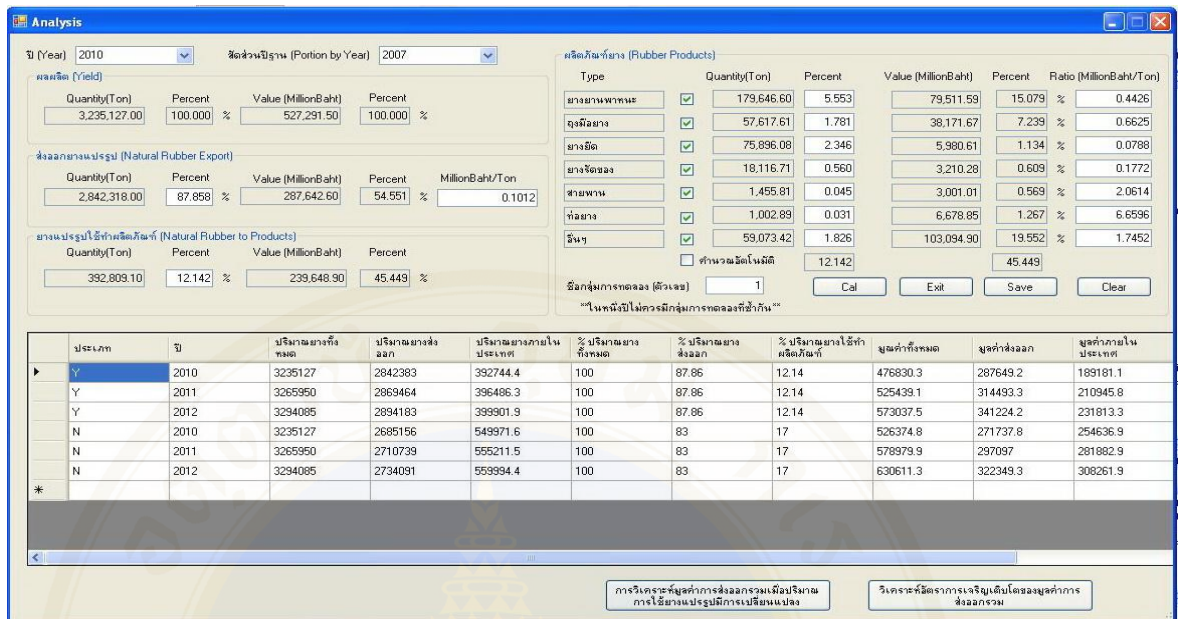


Figure 4.8 The first example in analysis form

Moreover, tester wants to vary rubber volume in domestic consumption that was added 17 percentages, and tires, and gloves were fixed value. Those were show as follows.

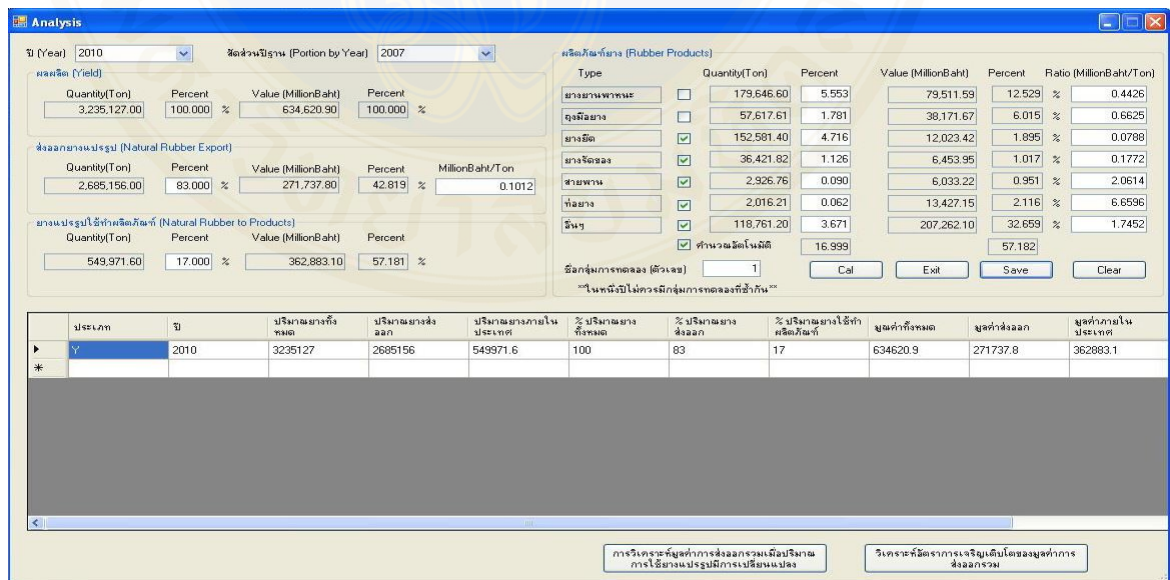


Figure 4.9 The second example in analysis form

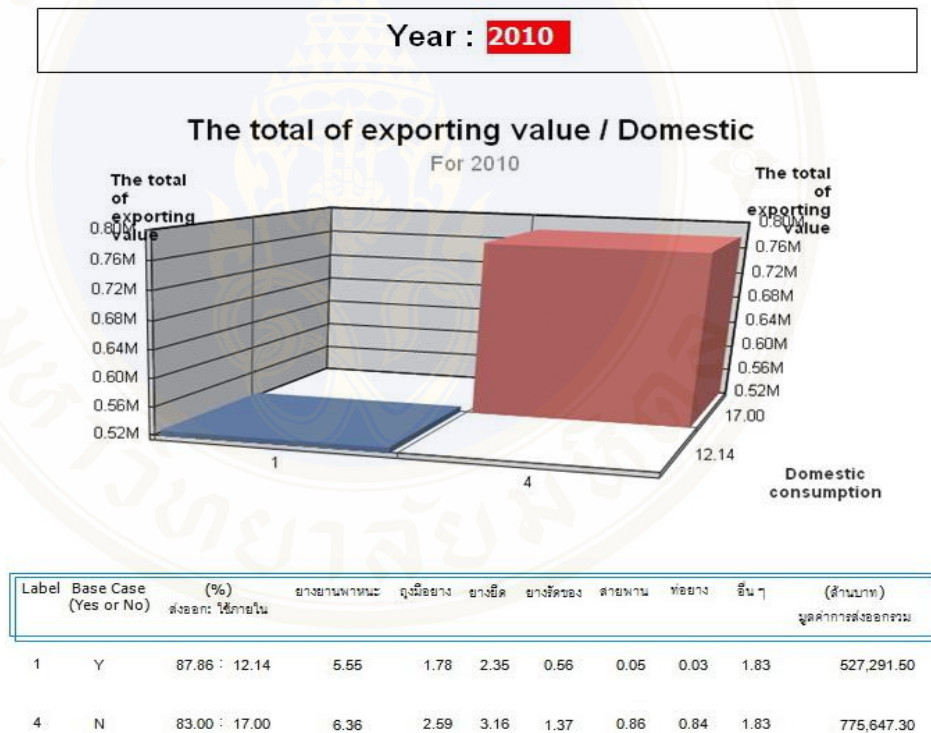
The system set automatically in export section that was changed into 83 percent for total as domestic consumption as a hundred percent. And, rubber added was increased in domestic consumption that would be added in products

which no have be checked in box. From figure 4.9, the system can share rubber added to rubber band, elastic, belt, hose, and others as proportions of them. That has little error about 0.001 percentages which also was the nearest value 17 percentages.

### 7) Report

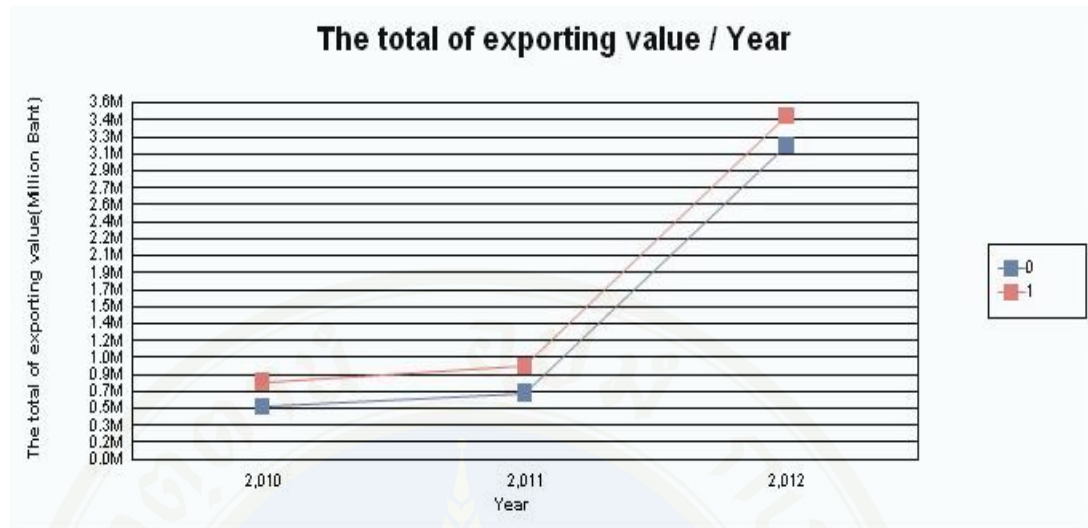
This phase will be appeared after the experiments complete. The system can displays two type of report as follows.

7.1) **Report 1** it displays the result with bar chart that compares value between a base case and scenario cases in each years. That was displayed in figure



**Figure 4.10** Form of report 1

7.2) **Report 2** it displays the result with line graph that compares growth rate between a base case and scenario cases in each years. That was displayed in figure



**Figure 4.11** Form of report 2

Finally, this decision support system can be used experiments as scenario design. It is a tool for analyzing to direct value creation of Thailand rubber which was describes in the next section.

## 4.2 Value Creation of Thailand’s rubber

Value creation for rubber in Thailand was discussed so long time. From the author’s previous research, demonstrated Thailand was a number one natural rubber manufacturer and exporter in the world that were a competitive advantage in global markets, but most rubber was exported to create high value for foreign. There was caused Thailand should added the rubber to downstream industry for value creation. But, what are industries to added, and how much to added? Hence, this research developed a decision support system for analytical tool the value creations alternatives.

### 4.2.1 Experimentation

From experiment design, there was bring some strategic of the Rubber Development Plan (2009-2013) as the topic to seeking a value creations, that was almost 17 percentages of rubber production will add to domestic consumption for

rubber products, which expected all exporting value to 600,000 million baht in 2013. Three scenarios presented the usage strategy for natural rubber manipulation which will be added to all industry. These experiments proposed to evaluate each scenario that could be succeed the goal or not, and when was succeed the goal.

#### 4.2.1.1 Scenario 1

From normal conditions (Base case), the first scenario was simulated the rubber increased in domestic consumption to 17 percentages, and the rubber added was used by the average increase for each industry.

**Table 4.1** The rubber added was used by the average increase for each industry.

Year	Type	Base case	Scenario2	Add
2010	Domestic consumption	12.14	17	4.86
	<b><u>Rubber industry</u></b>			
	Tires	6.17	6.98	0.81
	Gloves	1.98	2.79	0.81
	Rubber band	2.61	3.42	0.81
	Elastic	0.62	1.43	0.81
	Belt	0.05	0.86	0.81
	Hose	0.03	0.84	0.81
Others	0.68	0.68	0	
2011	Domestic consumption	12.14	17	4.86
	<b><u>Rubber industry</u></b>			
	Tires	6.33	7.14	0.81
	Gloves	2.03	2.84	0.81
	Rubber band	2.68	3.49	0.81
	Elastic	0.64	1.45	0.81
	Belt	0.05	0.86	0.81
	Hose	0.04	0.85	0.81
Others	0.37	0.37	0	
2012	Domestic consumption	12.14	17	4.86

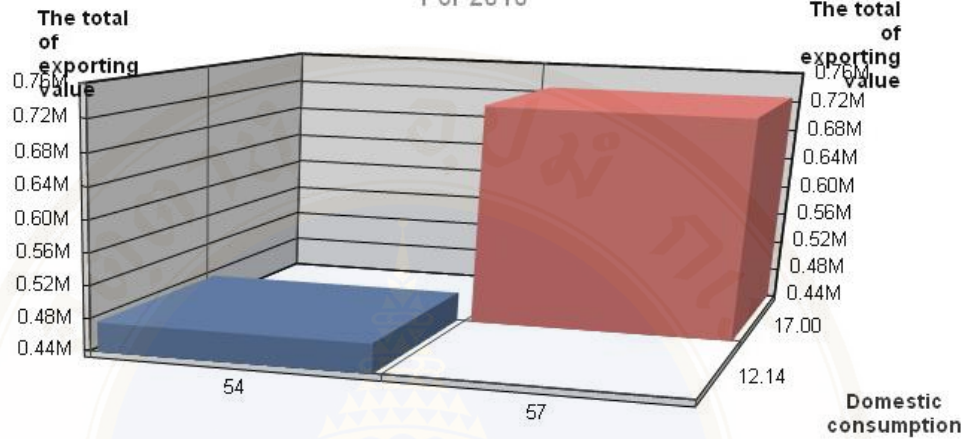
Year	Type	Base case	Scenario2	Add
	<b><u>Rubber industry</u></b>			
	Tires	6.52	7.33	0.81
	Gloves	2.09	2.90	0.81
	Rubber band	2.76	3.57	0.81
	Elastic	0.66	1.47	0.81
	Belt	0.05	0.86	0.81
	Hose	0.04	0.85	0.81
	Others	0.03	0.03	0

Table 4.1 shows domestic consumption added the rubber approximately 4.86 percentages from base case 17 percentages. And, the rubber added was used by the average increase about 0.81 percentages for each industry.

**Year : 2010**

**The total of exporting value / Domestic**

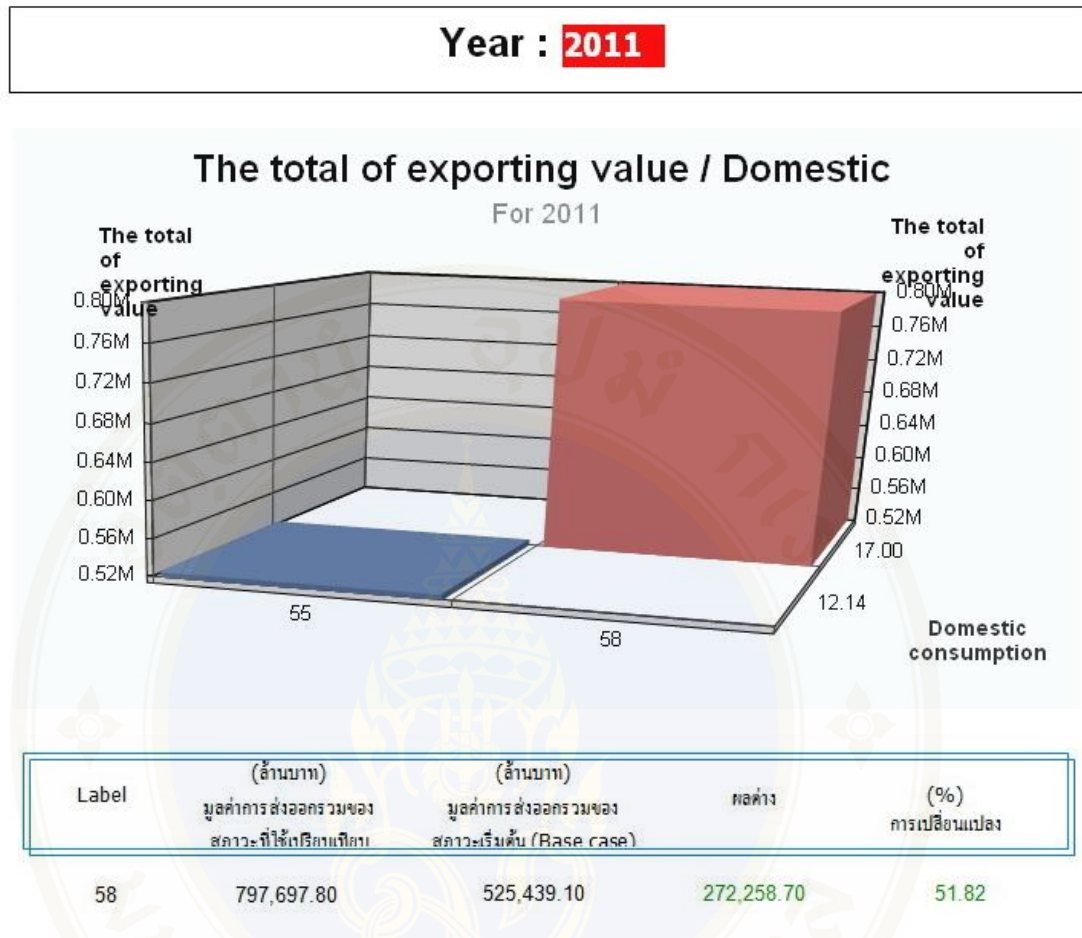
For 2010



Label	(ล้านบาท) มูลค่าการส่งออกรวมของ สวาะที่ใช้เทรียกาเทียกา	(ล้านบาท) มูลค่าการส่งออกรวมของ สวาะระดับ (Basic level)	ผลต่าง	(%) การเปลี่ยนแปลง
57	725,115.60	476,830.30	248,285.30	52.07

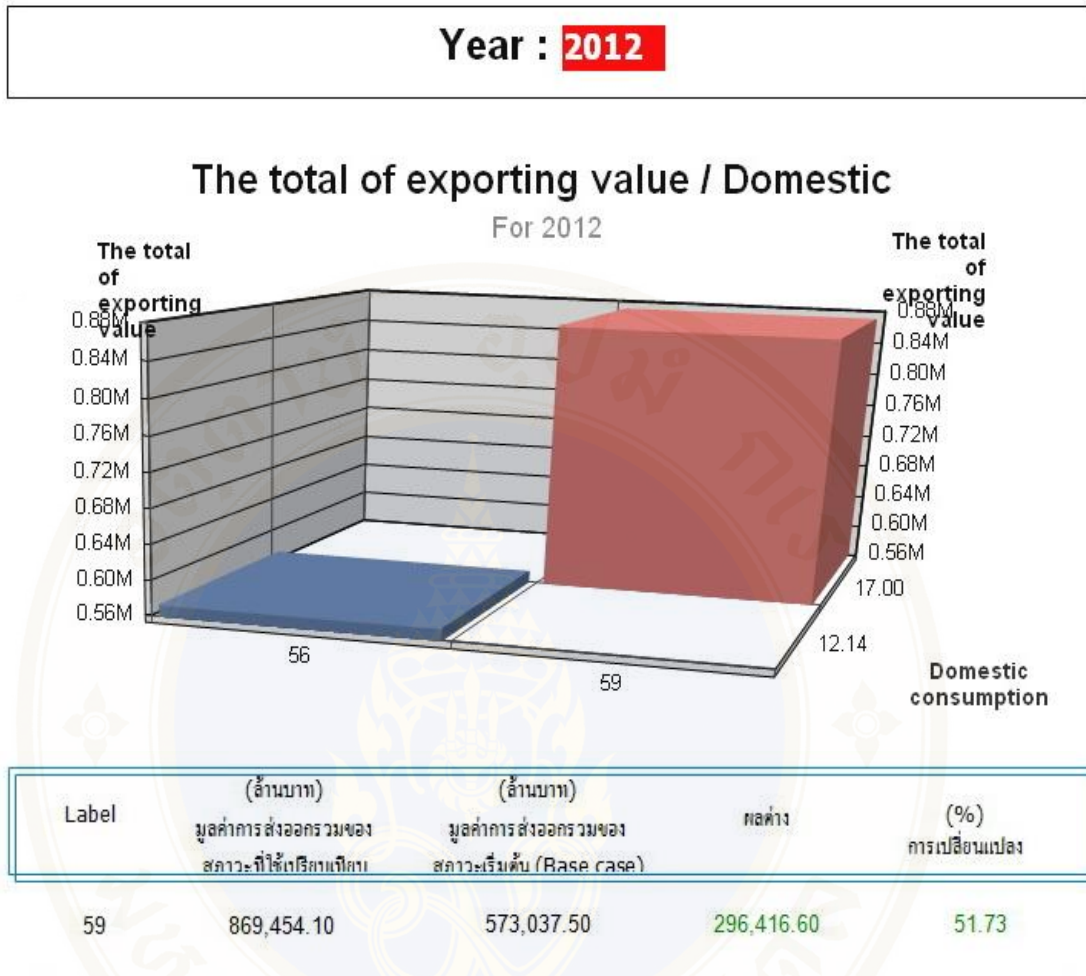
**Figure 4.12** The result of scenario1 in 2010

From the first scenario result, this technique can help the rubber industry to increase the total exporting value to 725,114.60. The different value is increased approximately 52.07 percentages. It is thought to increase value to 248,285.30 million baht in 2010.



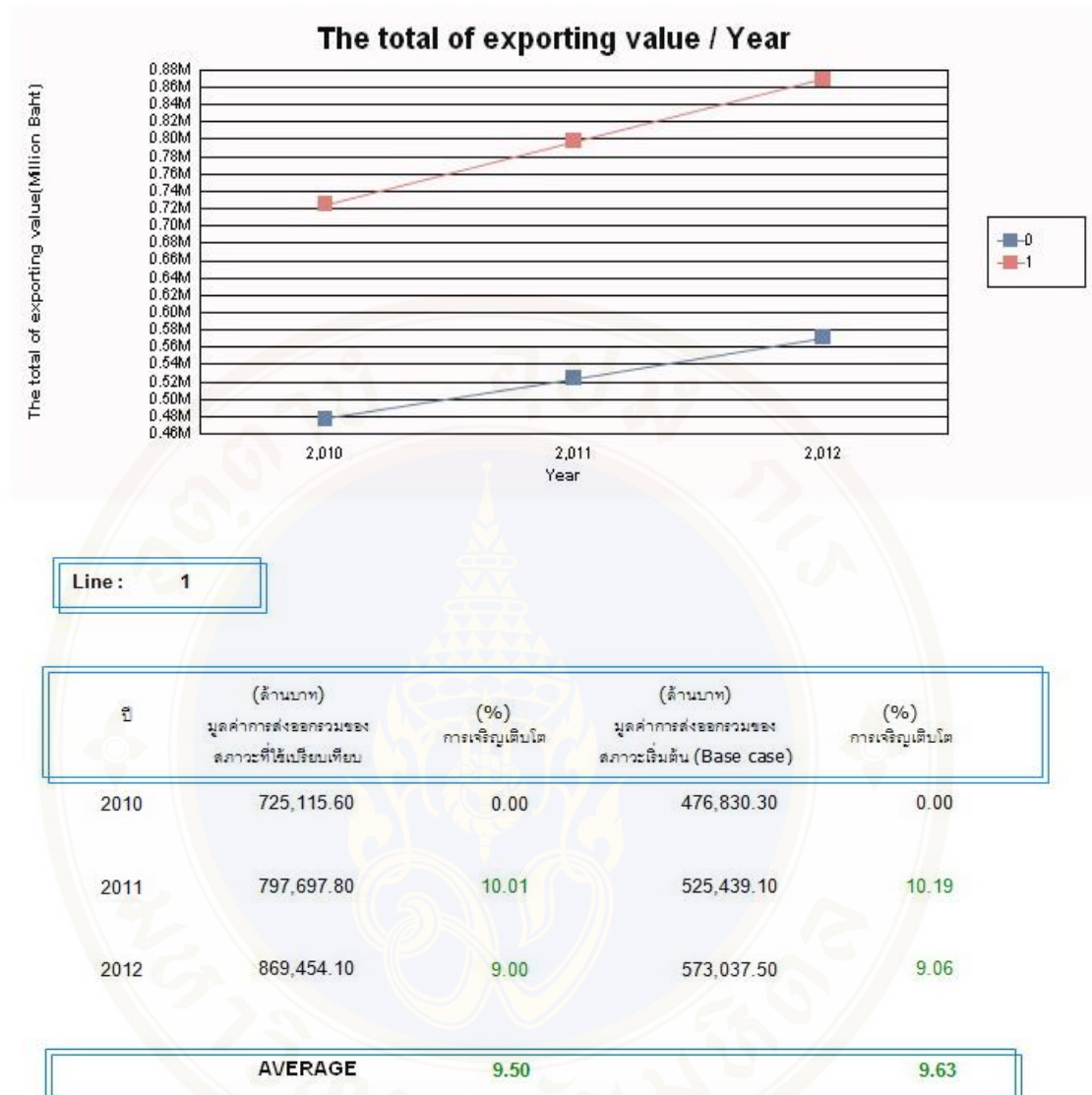
**Figure 4.13** The result of scenario1 in 2011

Then, the forecasting conditions also make the total exporting value to 797697.80 million baht. The different value also is increased approximately 51.82 percentages which is the best changing value. It is thought to increase value to 272,258.70 million baht in 2011.



**Figure 4.14** The result of scenario 1 in 2012

Finally, the last year has the most value to 869,454.10 million baht. The different value is approximately changed 51.73 percentages. It is thought to income to 296,416.60 million baht.



**Figure 4.15** Comparison between growth rate of base case and scenario1 in the period 2010-2012

From figure 4.15, Line 1 representing the first scenario has impacted to the total exporting value of rubber is increasing continuously. There has average of growth rate changes approximately 9.50 percentages. While, base case has changed the exporting value approximately 9.63 percentages.

#### 4.2.1.2 Scenario 2

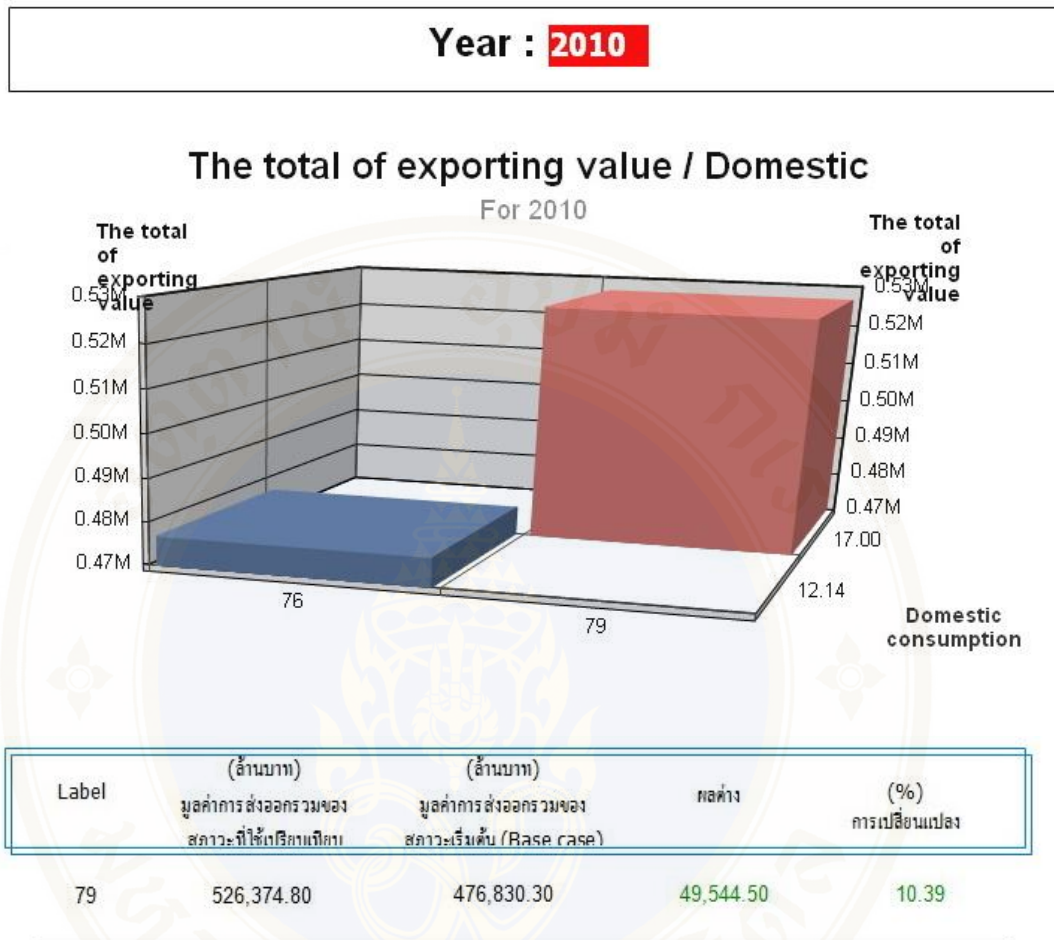
The second scenario simulated rubber of domestic consumption was added into 17 percentages from normal conditions (base case). Natural rubbers were added as the proportional usage of each industry in 2007. The details are concludes as shown below.

**Table 4.2** The rubber added was used to product champion industries as proportional to the volume used in 2007

Year	Type	Base case	Scenario2	Add
2010	Domestic consumption	12.14	17	4.86
	<b><u>Rubber industry</u></b>			
	Tires	6.17	8.79	2.62
	Gloves	1.98	2.82	0.84
	Rubber band	2.61	3.71	1.10
	Elastic	0.62	0.88	0.26
	Belt	0.05	0.07	0.02
	Hose	0.03	0.05	0.02
	Others	0.68	0.68	0
2011	Domestic consumption	12.14	17	4.86
	<b><u>Rubber industry</u></b>			
	Tires	6.33	8.95	2.62
	Gloves	2.03	2.87	0.84
	Rubber band	2.68	3.78	1.10
	Elastic	0.64	0.90	0.26
	Belt	0.05	0.07	0.02
	Hose	0.04	0.06	0.02
	Others	0.37	0.37	0
2012	Domestic consumption	12.14	17	4.86
	<b><u>Rubber industry</u></b>			
	Tires	6.52	9.14	2.62

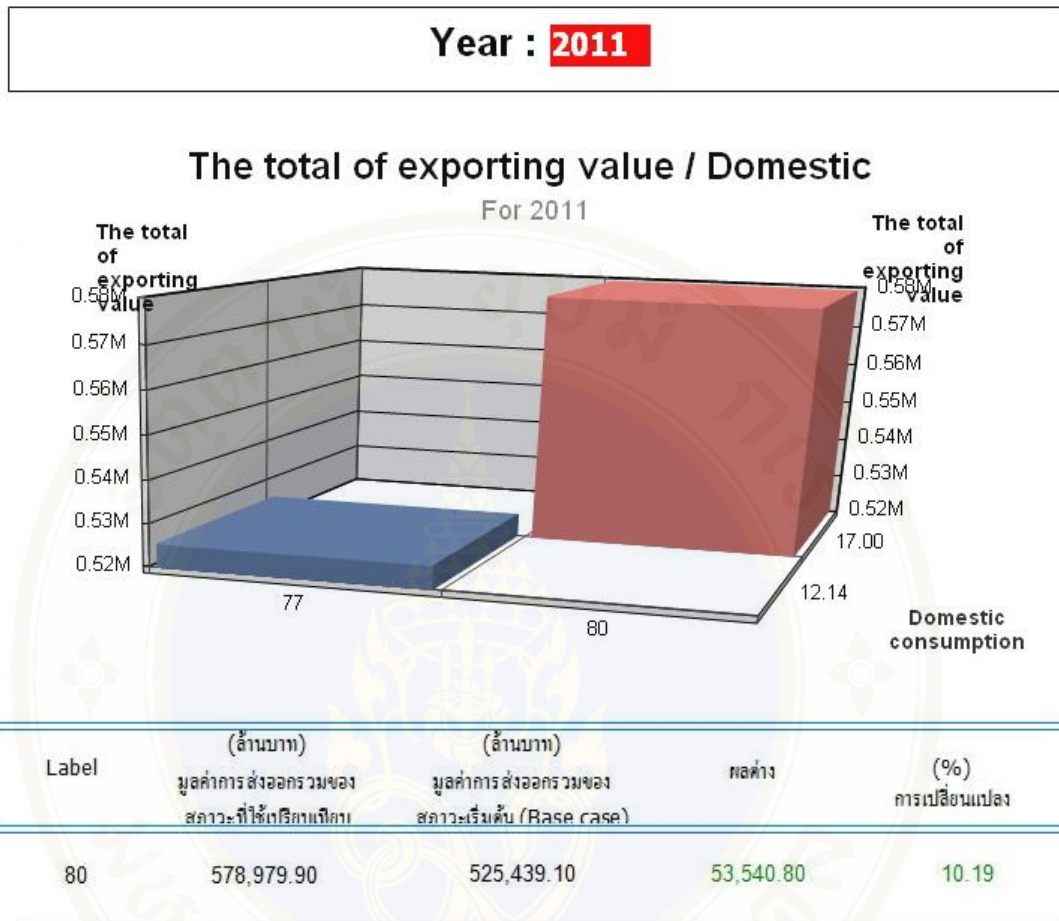
Year	Type	Base case	Scenario2	Add
	Gloves	2.09	2.93	0.84
	Rubber band	2.76	3.86	1.10
	Elastic	0.66	0.92	0.26
	Belt	0.05	0.07	0.02
	Hose	0.04	0.06	0.02
	Others	0.03	0.03	0

From table 4.2, Almost 4.86 percentages of rubber production are used to increase for downstream industries which compose tires, gloves, rubber band, elastic, belt, and hose industry. The natural rubbers are shared approximately 2.62 percentages for tires industry, 0.84 percentages for gloves industry, 1.10 percentages for rubber band industry, and 0.26 percentages for elastic industry. The rest of them are shared equal to belt and hose industry which got approximately 0.02 percentages an industry.



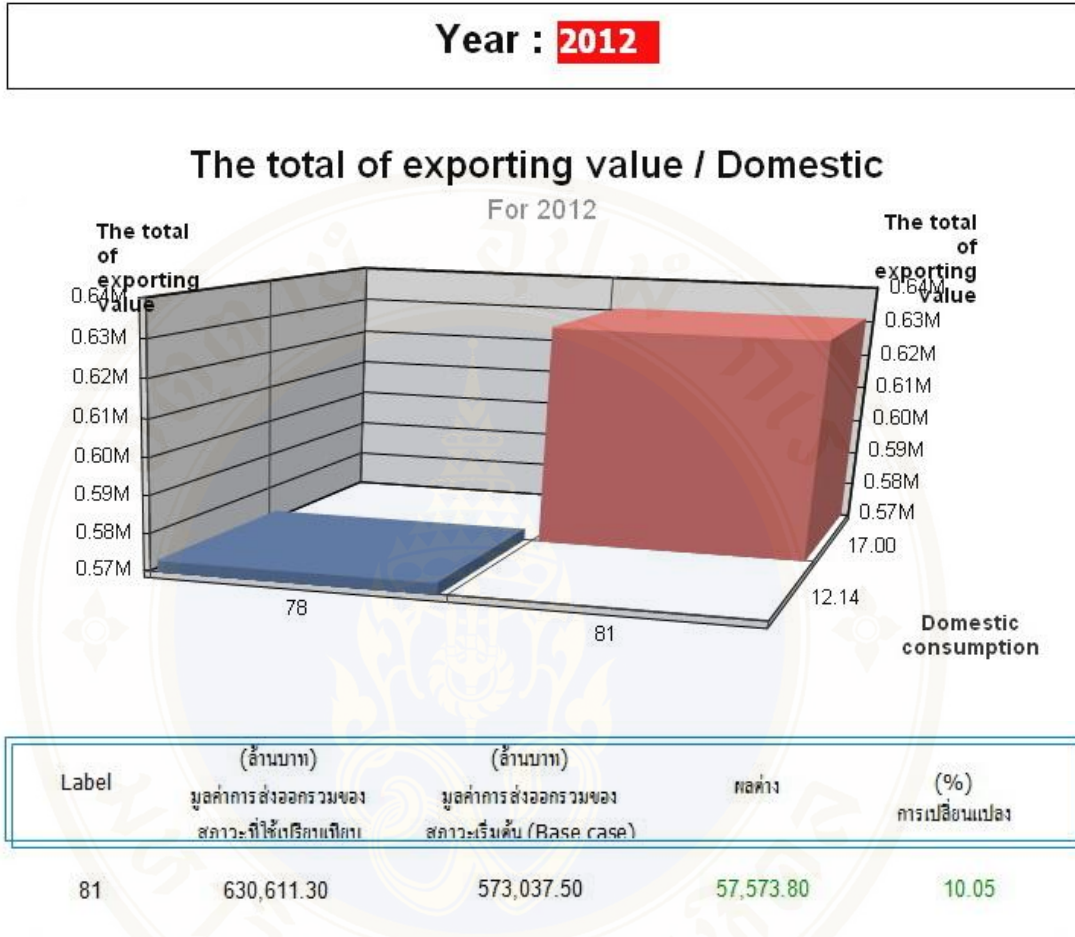
**Figure 4.16** The result of scenario2 in 2010

The technique of secondary scenario can create value to 526,374.80 million baht in 2010. It is to make the different value to 49,544.50 million baht that has changing rate approximately 10.39 percentages.



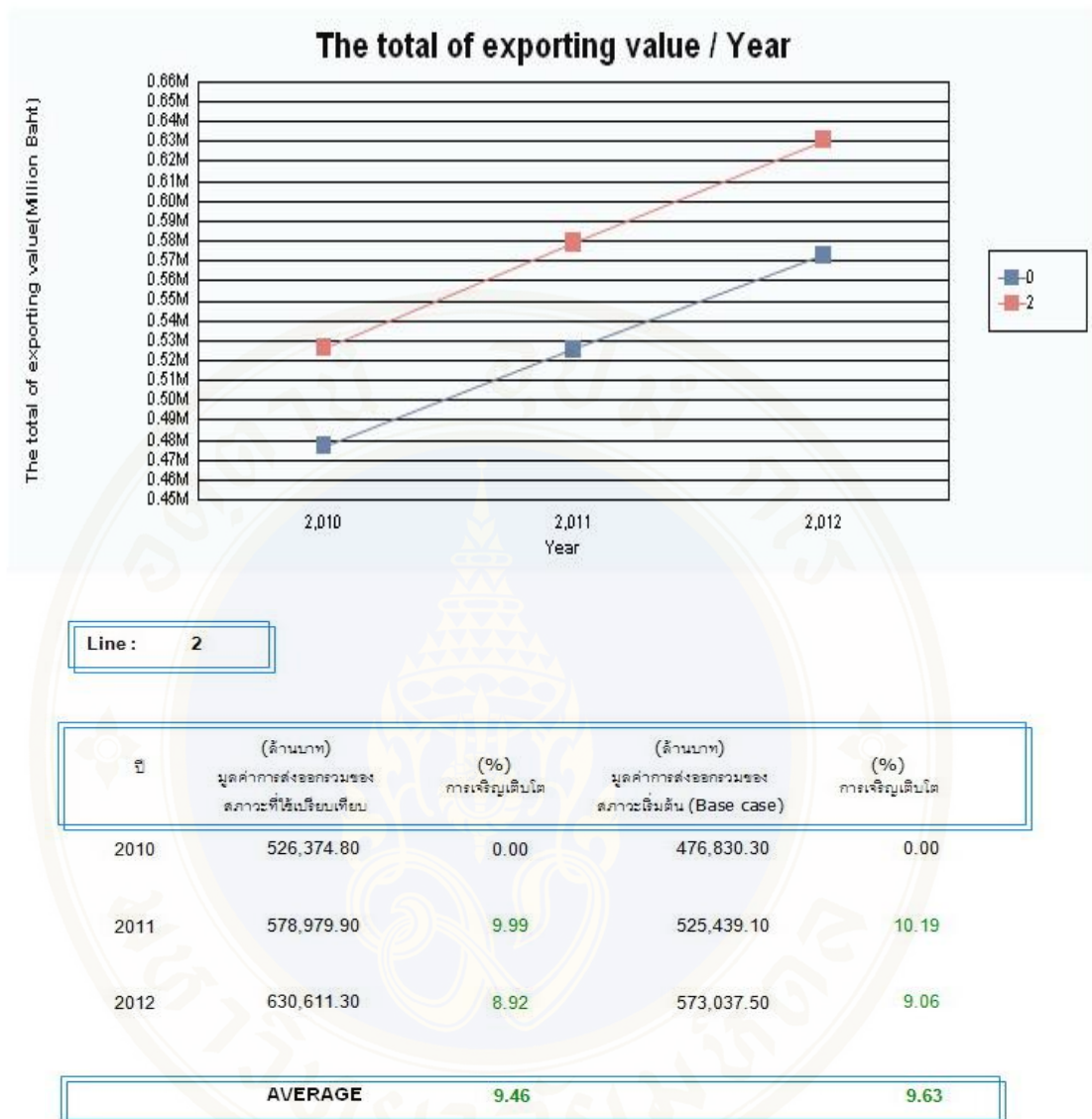
**Figure 4.17** The result of scenario2 in 2011

In the next year, the total exporting value also has increased to 578,979.90 million baht that can be seen in figure 4.17. The different value also has been increased to 53,540.80 million baht. It is thought changing rate approximately 10.19 percentages.



**Figure 4.18** The result of scenario2 in 2012

Finally, the total exporting is represented the highest value in 2012. It has created ability to 630,611.30 million baht. The different value can be seen change rate approximately 10.05 percentages. It is added value to 57,573.80 million baht.



**Figure 4.19** Comparison between growth rate of base case and scenario2 in the period 2010-2012

From figure 4.19, our technique can help rubber value to increase continuously in the period 2010-2012. Line2 displayed the technique of second scenario has impacted to average of growth rate that has approximately 9.46 percentages that has been to decrease from base case.

#### 4.2.1.2 Scenario 3

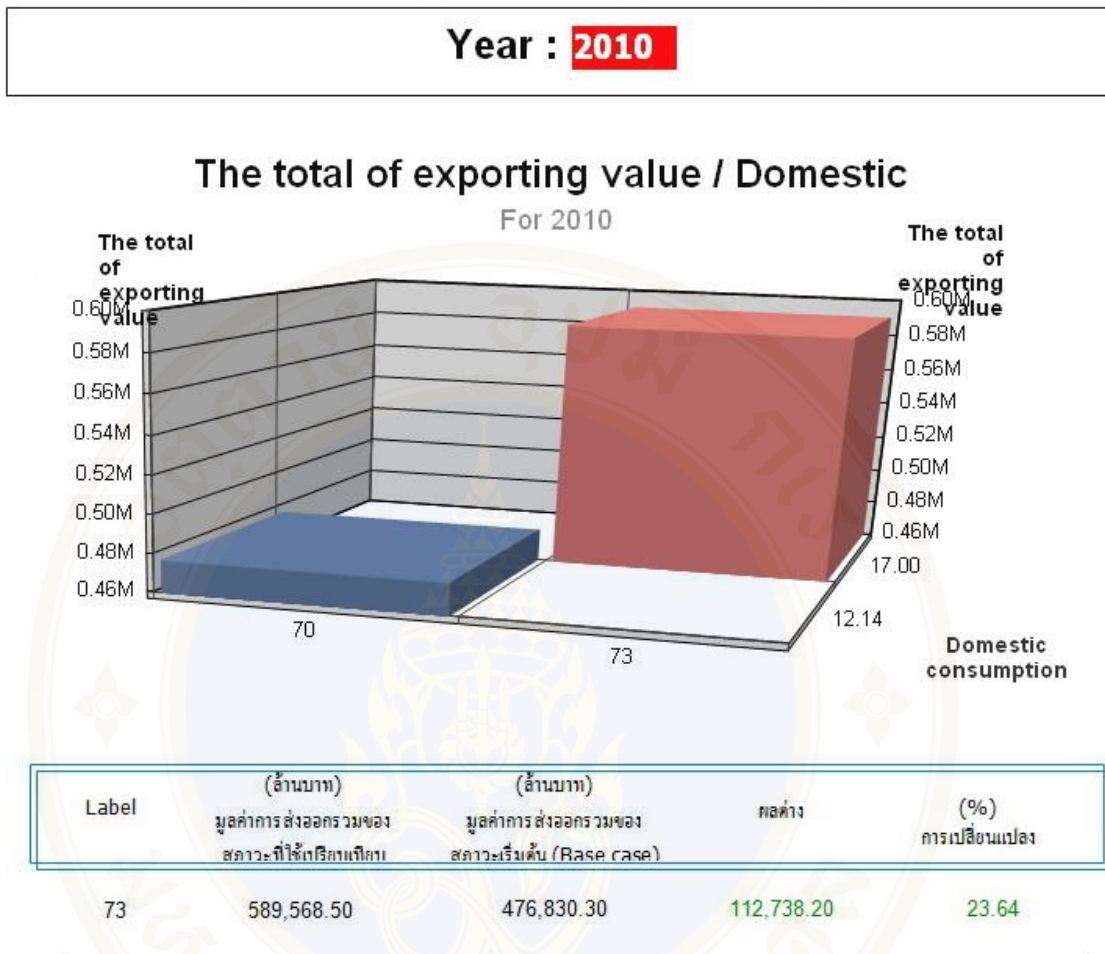
The third scenario is to simulate rubbers of domestic consumption are added into 17 percentages from normal conditions (base case). Rubbers added were added to each industry as value obtained from each industry in 2007. The details are concludes as shown below.

**Table 4.3** The rubber added was used to product champion industries as value from each industry in 2007

Year	Type	Base case	Scenario3	Add
2010	Domestic consumption	12.14	17	4.86
	<b><u>Rubber industry</u></b>			
	Tires	6.17	8.94	2.77
	Gloves	1.98	3.28	1.30
	Rubber band	2.61	2.94	0.33
	Elastic	0.62	0.72	0.10
	Belt	0.05	0.17	0.12
	Hose	0.03	0.27	0.24
	Others	0.68	0.68	0
2011	Domestic consumption	12.14	17	4.86
	<b><u>Rubber industry</u></b>			
	Tires	6.33	9.1	2.77
	Gloves	2.03	3.33	1.30
	Rubber band	2.68	3.01	0.33
	Elastic	0.64	0.74	0.10
	Belt	0.05	0.17	0.12
	Hose	0.04	0.28	0.24
	Others	0.37	0.37	0
2012	Domestic consumption	12.14	17	4.86
	<b><u>Rubber industry</u></b>			
	Tires	6.52	9.29	2.77
	Gloves	2.09	3.39	1.30

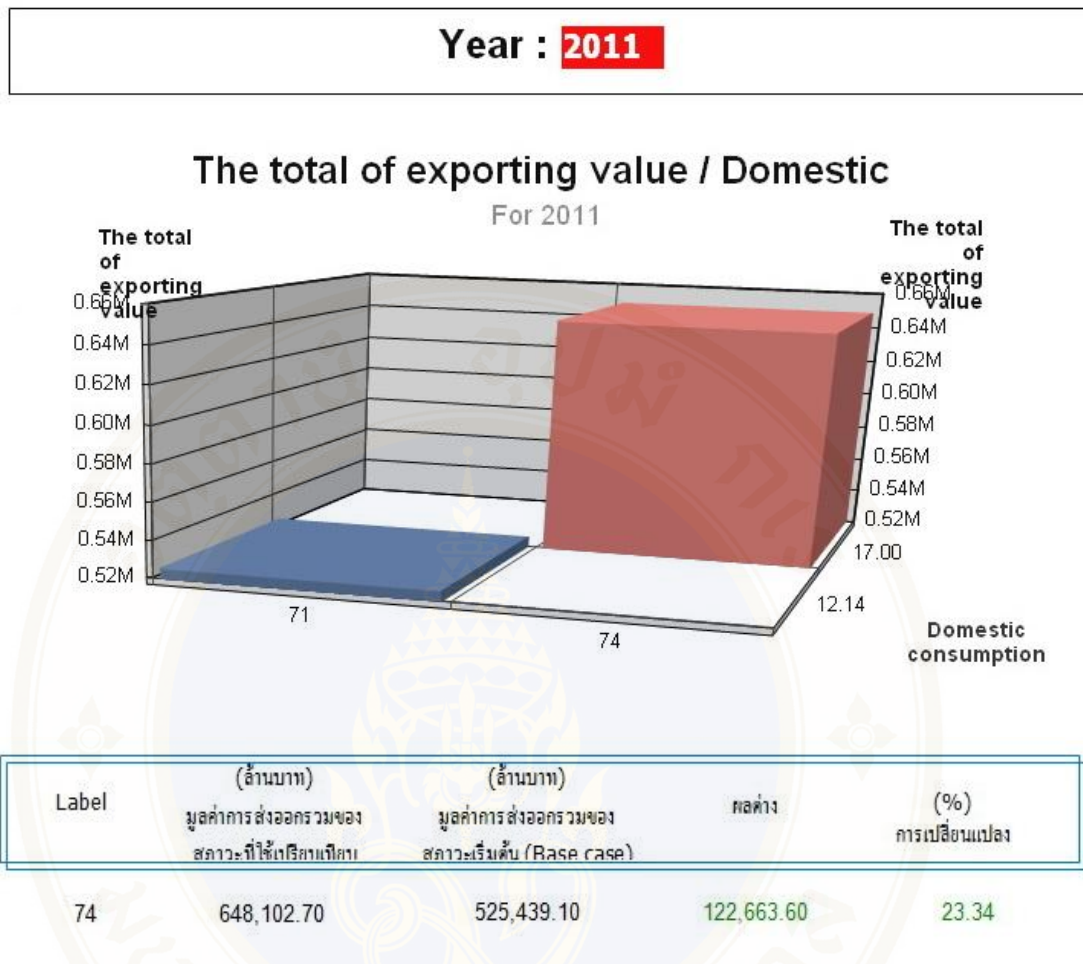
Year	Type	Base case	Scenario3	Add
	Rubber band	2.76	3.09	0.33
	Elastic	0.66	0.76	0.10
	Belt	0.05	0.17	0.12
	Hose	0.04	0.28	0.24
	Others	0.03	0.03	0

From table 4.3, Almost 4.86 percentages of rubber production were used to increase for downstream industries which compose tires, gloves, rubber band, elastic, belt, and hose industry. The natural rubbers are shared approximately 2.77 percentages for tires industry, 1.30 percentages for gloves industry, 0.33 percentages for rubber band industry, and 0.10 percentages for elastic industry. The rest of them are shared approximately 0.12 for belt industry, and approximately 0.24 for hose industry.



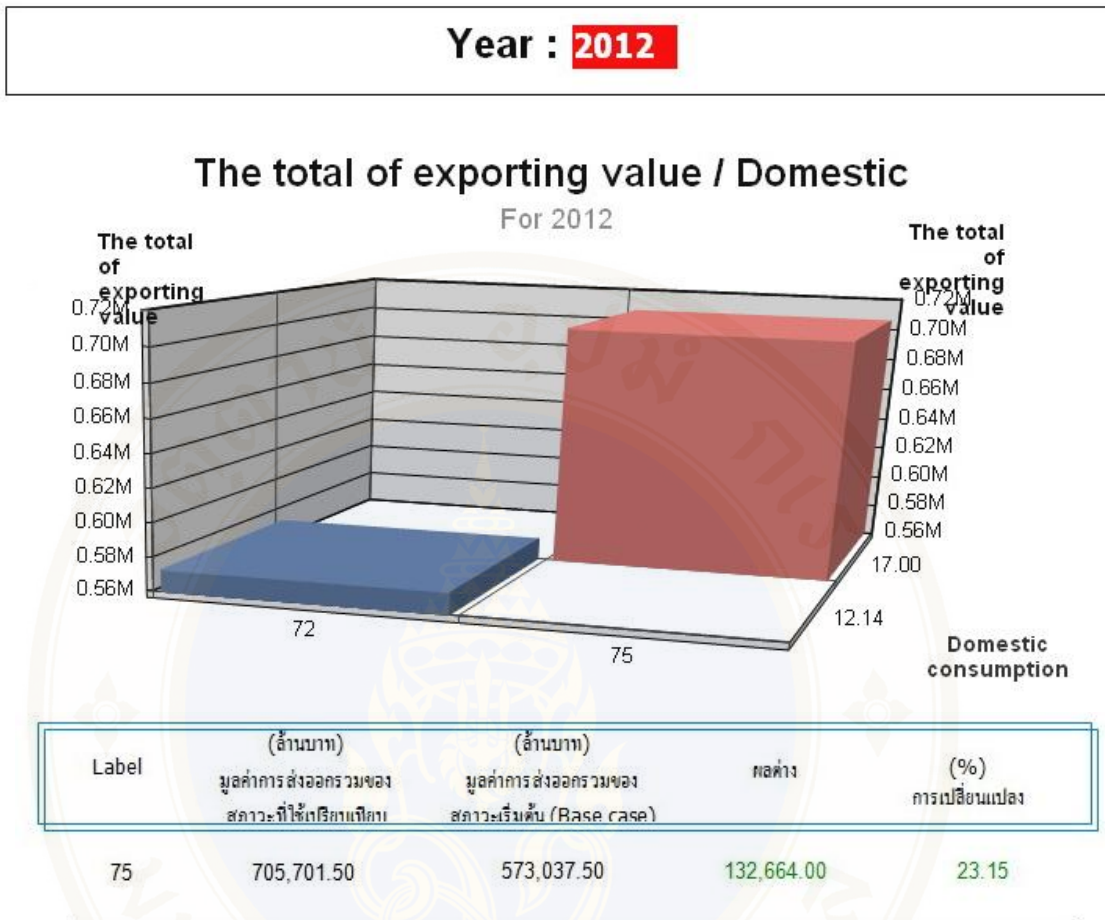
**Figure 4.20** The result of scenario3 in 2010

The technique of the third scenario also helps create rubber value to 589,568.50 million baht in 2010. Figure 4.20 representing the different value is changing approximately 23.64 percentages or thought as value creation to 112,738.20 million baht.



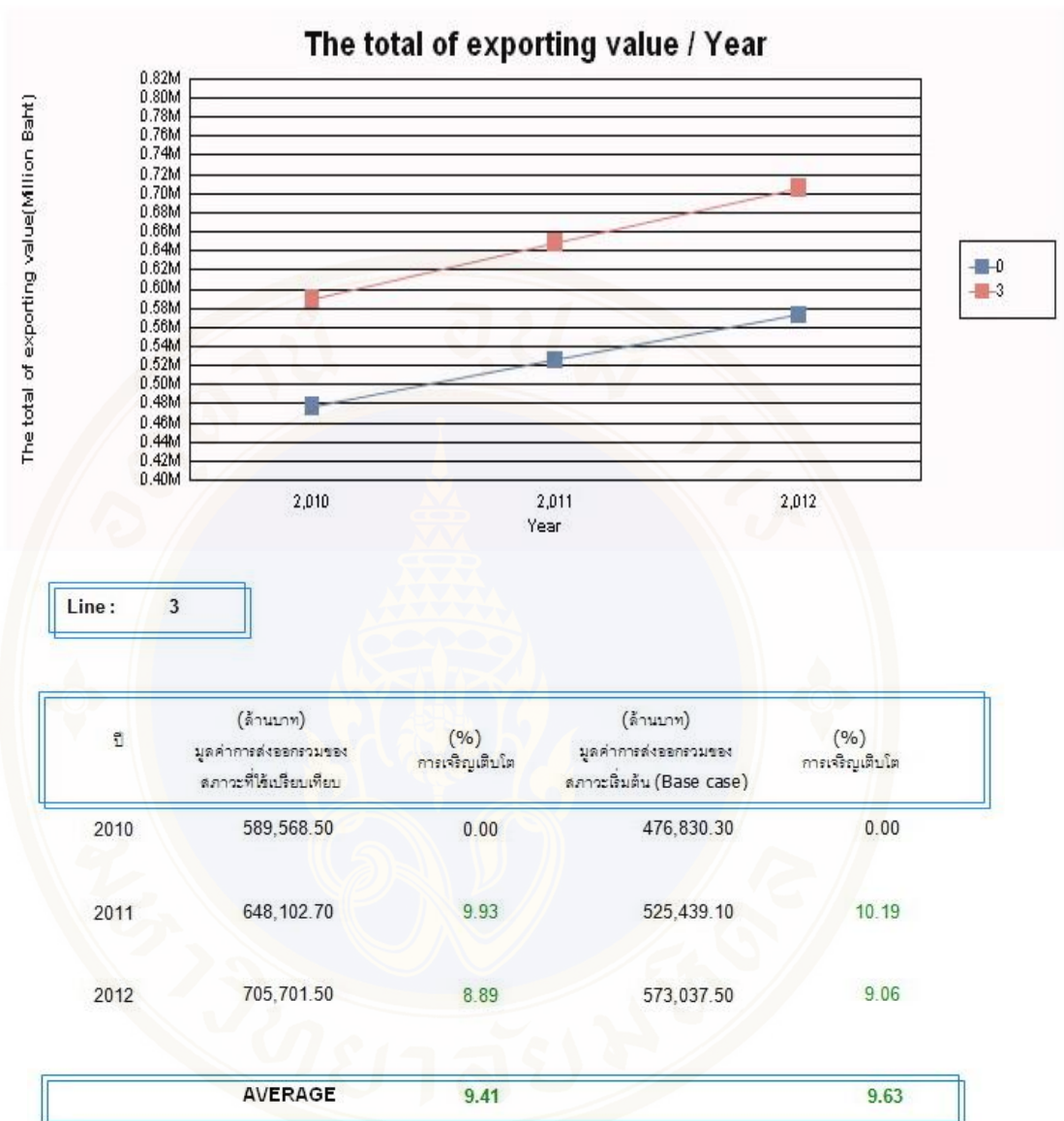
**Figure 4.21** The result of scenario3 in 2011

On the next year, the forecasting conditions also make the total exporting value to 648,102.70 million baht. The different value also is increased approximately 23.34 percentages. It can be thought value creation to 122,663.60 million baht in 2011.



**Figure 4.22** The result of scenario3 in 2012

Finally, the conditions also increase the total exporting value in 2012. It has potential to creating to 705,701.50 million baht. The different value can be seen change rate approximately 23.15 percentages. It creates the value to 132,664 million baht.



**Figure 4.23** Comparison between growth rate of base case and scenario3 in the period 2010-2012

Our technique has the impact to the total exporting value of the years that have continuously grown in the period 2010 – 2012. But, it has opportunity to grow approximately 9.41 percentages which are less than base case.

#### **4.2.2 Summary of Results**

The experiments representing the different value obtained from the strategic of rubbers manipulation which are increased the volume to 17 percentages for domestic consumption. The target has expected the total exporting value to 600,000 million baht. The results demonstrated the potential of each strategy as described below.

From the experimental results, the technique of first scenario demonstrated the natural rubbers usage that is shared to each industry by the average. It can help the rubber industry to succeeding the target in 2010 which has the total exporting value to 725,115.60 million baht. Then, the technique of second scenario also can create value to accomplish the target in 2012 which its technique demonstrated the sharing as the proportional usage of each industry in 2007. It got the total exporting value to 630,611.30 million baht. Finally, the technique of third scenario is the sharing as value obtained from each industry in 2007. It can create value to 648,102.70 million baht which also help plan to accomplish the target in 2011.

Considering the potential of scenarios is ranked to value creation for rubber industry which can be notice from the total exporting value in 2012. First, the first scenario has the highest value that has total exporting value to 869,454.10 million baht. Secondary, the third scenario can create value to 705,701.50 million baht. Third, the second scenario has the lowest value to 630,611.30 million baht.

Summary of experimental results can be seen potential value creation of each strategy that representing high possibility to accomplish this plan. Because, all scenario simulated the natural rubber usage that is increased to domestic consumption approximately 17 percentages. They have different strategy for natural rubber sharing. The results have appeared accomplishment of all strategy. While, if the natural rubber usage has remained the behavior as base case that also cannot accomplish the goal. These results representing the rubber industry can create a high value in domestic consumption.

## **CHAPTER V**

### **DISCUSSIONS**

#### **5.1 Discussions**

As the experiments in above section, it can be seen potential of all scenarios that can achieve the target value (600,000 million baht) if the natural rubbers are increased to 17 percent for the end products. The highest value creation appeared in the first scenario that succeeded in the first year (2010), the secondary value creation is the third scenario that succeeded in the second year (2011), and the lowest value creation is the second scenario that succeeded in the third year (2012). However, decision-maker should not consider only a potential of value creation but also should consider multiple view to help analyst can analyze the direction for rubber value creation as well as the strategy enabling the integrated supply chain. This chapter describes view growth and preparedness view. The growth view considered from a total exporting value in each scenario. It also can be seen the highest growth value in the first scenario, the next is the second scenario, and finally the lowest growth value displayed in the third scenario.

Moreover, the scenarios also should be considered a ready of each industry that included a trend of market shared, market growth, manufacturing, and world demand. So, rubber industries have been reviewed environment for impacts consideration of each scenario.

##### **5.1.1 Overview**

Thailand had transformed from a manufacturer for domestic and import substitution became a manufacturer for export at downstream factory. It still low when was compared export volume with natural rubber in upstream. However, the goal of rubber strategic will add the rubber usage in domestic that will be increased in downstream industry from approximately 12 percent to 17 percent for the end products. This section discussed results of the usage strategy for three scenarios rubber

added. They demonstrated the potential of each scenario to accomplish on 600,000 million baht. The most value creation succeeded the goal value approximately 725,115.60 million baht in 2010 that appeared in the first scenario used the rubber added by the average addition for each industry. Then, the third scenario added to product champion industries (not including others) as value got from each industry in 2007. It also succeeded value about 648,102.70 million baht in 2011. Finally, the second scenario added to product champion industries (not including others) as proportional to the volume used in 2007. It created the lowest value but succeeded value approximately 630,611.30 in 2012. If considered the only value in experiments, the best of strategy can be creating the most value would be the first scenario. However, situational analysis also should be considered and its repercussions will follow for each industry as well.

## **5.1.2 Reviews Industry Market Conditions (Tassakorn, P., 2008)**

### **5.1.2.1 Tires**

Tires industry was very attractiveness for foreign investors in Thailand. But, it had a disadvantage in labor cost when was compared with industry in China. That caused why china attracts more investors than Thailand. In the present, china is a number one market owner in the world while Thailand is ranked 13<sup>th</sup> with market share of 2.6 percent only. However, Thailand also has very high growth rate approximately 5.5 percent which has lower china only. It can be seen the potential has increased continuously for export markets in Thailand. Moreover, United stated is a number one importer tires in the world which has high volume increased import from Thailand. That cause the world demand has increased approximately 4 percent per year.

### **5.1.2.2 Gloves**

Glove is one of very important industries for value creation of Thailand rubber because it has potential created value the second off tires industry. Thailand classified as number two manufacturer and exporter in the world (the number one is Malaysia). We can dominate the market share of over 17 percent because world population increased awareness of the spread of an epidemic (i.e. SARS or Bird flu),

and as well as improved standards of Health-care improvement in developing countries. That affects demand of glove increased in the world by 10-12 percent or approximately 120,000 million pieces per year.

From the above situation, they can be seen the gloves are likely to increase continuously but Thailand is facing problems with high production cost that problems affect Thailand's potential growth to low as only 1.6 percent. The top five customers of Thailand were United state, Germany, United Kingdom, Netherland, and Japan.

### **5.1.2.3 Rubber Band**

Growth of Rubber band depends on the domestic textile industry because it is a component for the production of underwear, socks, and clothing. Currently, rubber had been used for rubber band that has a volume higher than gloves. Moreover, rubber band has a high growth rate about 3.3 percent while market world has an average of growth rate as only 2.5 percent.

From the above situation, they can be seen Thailand has a higher potential to increase production for export countries where the growth rate is negative. Furthermore, Domestic factory of them country should be moved to Thailand which has a lot of raw. Currently, almost 34 percent of market share was dominated with Thailand's rubber band that was ranked 2<sup>nd</sup> in the world, and the exportation was expected to grow much longer.

### **5.1.2.4 Elastic**

Elastic is a production from vulcanized which had be high increased over 3.9 percent of Thailand's production, as the demands also increased approximately 2.4 percent. Currently, Thailand is a number one exporter and manufacturer of elastic in the world. The most of importers was a United state approximately 623.9 million baht, and top subordinate were Italy, France, England, Canada, Netherland, and Australia. They created value as 144.1, 139.1, 133.7, 100.8, 93.1, and 70.2 million baht

Considering exportation of elastic that can see the growth rate had increased approximately 200 million baht per year, but volume and value of its

have a low ratio because the economic depression that affect to demand decreased. Moreover, has increased a competitors, and the advantages of them were a low labor cost. That cause also affects to volume and value of exports has decreased.

#### **5.1.2.5 Belt**

Thailand was ranked 20<sup>th</sup> for belt exporter that got value approximately 46 million dollars, but had the high growth rate over 5.5 percent. While demand were not a lot of increased in the world market that as only 2.5 percent.

However, this product has many receptors in the market i.e. Singapore, Japan, United state, and others. They cause affects the market has more growth opportunities. But, we should be facing competition with industrial country that has high technology for production.

#### **5.1.2.5 Hose**

This industry will be expanded in way with the growth of automotive and other manufacturing industries. As its exporting value of Thailand were ranked 15<sup>th</sup> which has dominated as only 1.9 percent in the world market. Thailand has the large receptors that were United State, Japan, South Africa, and Indonesia.

However, when considering the growth rate in Thailand rose 4.4 percent. While world market was increased demand approximately 2.5 percent. They can be seen Thailand was high growth when compared to countries with higher exports which most of them had lower growth rate (not include china and Hungary).

### **5.1.3 Analysis Impacts to Strategy**

As industrial situations can be analyzed the impacts when used strategy to each industry.

#### **5.1.3.1 Scenario 1**

Strategic of the first scenario used the rubber added by the average addition for each industry that increased to all industry approximately 0.81 percent. And, when was analyzed within its market situations that affected any industry as tires, gloves, and rubber band. They had needed much rubber for

responded demand, but this scenario didn't give high volume for their products. So, they didn't have full efficiency on this scenario. While the rest of industries were got high volume such as elastic, belt, and hose. Especially, belt, and hose had increasing continuously demand but they had some limitations such as inefficient production, lack technology. Those limitations affected the competitive disadvantage and make the production decline. Finally, elastic had decreased growth and value of exports. So, It should not expand the production but should be interesting cost reduction for price stability.

### **5.1.3.2 Scenario 2**

The second scenario described the rubber added to product champion industries (not including others) as proportional to the volume used in 2007. That affect to any industries had more opportunity for value creation such as tires, gloves, rubber band. They were added rubbers higher the first scenario (all of industry got 0.81 percent) percent which their rubber increased from base case as 2.62, 0.84, and 1.10 percent. Especially, the rubber band had growth rate more than global demand which can be seen ready of this industry to grow. But considered amount of rubber used compared to the value received was still seen low.

Furthermore, the rest of the industry was decreased the rubber sharing from the first scenario that including elastic, belt, and hose. They was a little affected because market had be saturation (such as elastic) or industry was not ready to grow (such as belt, and hose)

### **5.1.3.3 Scenario 3**

The third scenario added rubbers to product champion industries (not including others) as value got from each industry in 2007. Industries got the most rubber sharing as tires and gloves when were compared with other scenarios. They had high demand in the world market which can be seen the potential to create high value. Especially, tires also was one of industries had effective expansion for export. So, future it would be product which can create a high value very well. As gloves would be decreased exportation. Because faced a disadvantage in term of higher cost than competitors.

Moreover, this scenario gave few rubbers sharing for rubber band but it had high demand in the world market. So, it was bad affected to lack opportunity for growth. Finally, the rest of industry was an industry that is considered less affected such as elastic, belt, and hose.

#### **5.1.4 Summary of All Scenarios**

Three scenarios involve ways to manipulate natural rubbers which the Rubber Development Plan has a methodology to increasingly natural rubbers into 17 percent in the processing industry of country. They expected value creation reach 600,000 million baht before 2013. The results of each scenario demonstrated a value creation for rubber that has high possibility to succeed the target. The first scenario can created the most value and the fastest accomplish the goal in 2010. After that, the third scenario also succeeded in 2011. Finally, the slowest was the second scenario succeeded in 2012, and that can created the lowest value than others scenario. However, scenarios are considered growth view, and preparedness view they can seen different priority.

On opinion of growth value, it can be seen from experiments. The first scenario also had the most growth rate that approximately 9.50 percent. Then, the second scenario had growth value about 9.46 percent, and finally the third scenario had growth value about 9.41 percent.

Moreover, environments are considered preparedness of industry. They include industry market shared, manufacturing expansion, and world demand. Amount of these are considered the impacts that would occur in practical. First, the second scenario has high possibility because natural rubbers were added as the initial usage portion. It has minimal impacts for industry development. So, the developments will appear to slowly driving in each industry. Then, the third scenario drove the large industries as a highlight. That will affect in a lack of small industrials development. Finally, the first scenario gave the same priority all industry. It affects to small industry that would be highly developed the same large industry. The impacts of the second, third, and first scenario has respectively the possibility of industries.

All industries had been different impacts as each scenario. So, they should be considered the advantage, disadvantage, and possible of each scenario they also can develop industry to way of the value creation for Thailand rubber.



## CHAPTER VI

### CONCLUSION

#### 6.1 Conclusion

Purposes of this research were to develop a decision support system prototype which analyzes value creation alternatives for rubber in Thailand. In the past, almost 90 percentages of rubber productions were exported while the rest of them were consumed in domestic. They were supplied to manufacturers and processed to end products. As an obtained value, that was a downstream product, created better value from upstream. So, downstream products were more interesting in a value creation for rubber in Thailand.

From Rubber Development Plan, It described a strategy to increase the rubber of domestic consumption to 17 percentages of the total production, and wished to raise total exporting value up to approximately 600,000 million baht in 2013. Way of value creation was necessary to determine types of products. So, this study investigated product champions -- i.e. tires, gloves, rubber band, elastic, belt, and hose -- that had expected the potential of value creation in the future. The next question was about how to increase rubber can be processed to the end products, and how much these product to create value and succeed the target.

Scenario design would present the usage strategy for three scenarios rubber addition. They were built to reflect on different priorities for the rubber dispensations that can be replied the Rubber Development Plan to as follows:

- 1) Can strategy create value better than initial conditions?
- 2) Can strategy succeed the goal (600,000 million baht)?
- 3) When does strategy succeed the goal?

The first scenario was planned to add rubber to each industry by the average addition. The second scenario divided each proportional by referencing the volume which was used in 2007. The third scenario separated natural rubbers by

referencing incoming value of each industry in 2007. All of these experiments were processed using a decision support system to be developed.

The results demonstrated the potential of each scenario to accomplish on 600,000 million baht. The most value creation appeared in the first scenario that reached the goal in 2010. Then, the third scenario will succeed in 2011. Finally, the second scenario will succeed in 2012. These result can be seen all strategy creating value better initial conditions which can't success to the target.

Summary, the value creation of rubber has high possibility to succeed 600,000 million baht before 2013 when Thailand rubber has a methodology to increase natural rubbers into 17 percent in the processing industry of country. If end product industries are developed properly with environment, it can be truth. However, DSS is one of the tools to help supporting for experiments.

## **6.2 Suggestion**

This research studied about the forward analysis. It looked for value, which gartered from rubber usage, in downstream factory that was a single analysis. So, the next study also should be involve backward analysis for an appropriate production volume with market that would be considered as a related factors (i.e. cultivated area, appropriate area for cultivated).

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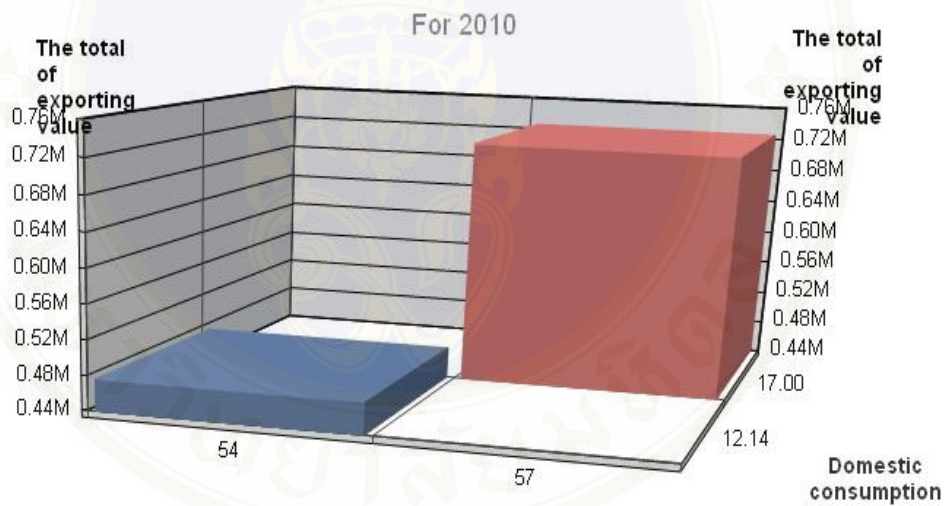


**APPENDIX A**  
**RESULT OF THE FIRST SCENARIO**

**การวิเคราะห์มูลค่าการส่งออกรวมเมื่อปริมาณการ  
ใช้ยางแปรรูปมีการเปลี่ยนแปลง**

**Year : 2010**

**The total of exporting value / Domestic**



Label	Base Case (Yes or No)	(%) ส่งออก: ใช้ภายใน	ยางยานพาหนะ	ถุงมือยาง	ยางยืด	ยางรัดของ	สายพาน	ท่อยาง	อื่น ๆ	(ล้านบาท) มูลค่าการส่งออกรวม
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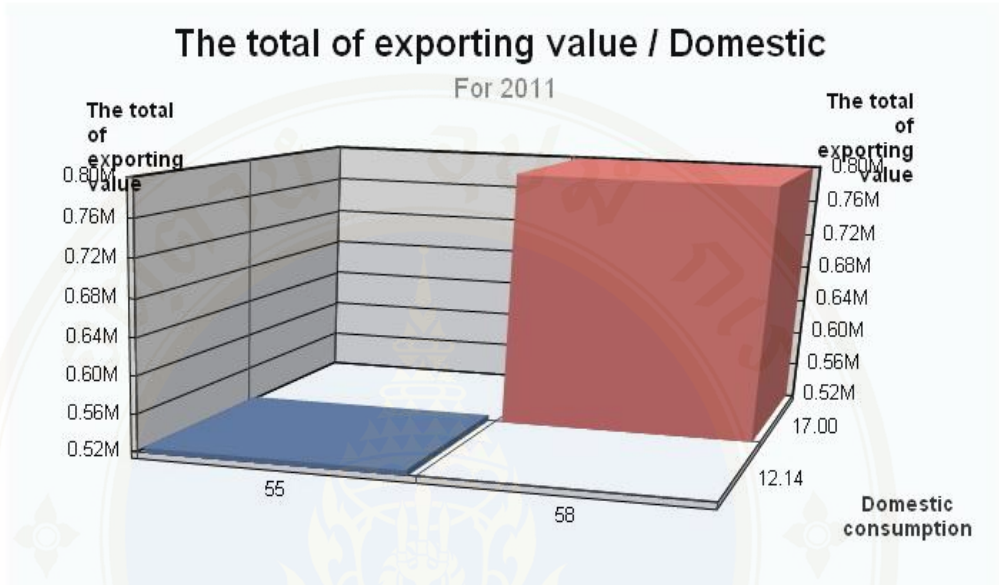
54	Y	87.86 : 12.14	6.17	1.98	2.61	0.62	0.05	0.03	0.68	476,830.30
57	N	83.00 : 17.00	6.98	2.79	3.42	1.43	0.86	0.84	0.68	725,115.60

ผลการเปรียบเทียบกับสถานะเริ่มต้น(Base case)

Year: 2010

Label	(ล้านบาท) มูลค่าการส่งออกรวมของ สถานะที่ใช้ศึกษาศึกษา	(ล้านบาท) มูลค่าการส่งออกรวมของ สถานะเริ่มต้น (Base case)	ผลต่าง	(%) การเปลี่ยนแปลง
57	725,115.60	476,830.30	248,285.30	52.07

**Year : 2011**



Label	Base Case (Yes or No)	(%) ส่งออก: ใช่/ภายใน	ยางยานพาหนะ	ถุงมือยาง	ยางยืด	ยางรัดของ	สายพาน	ท่อยาง	อื่น ๆ	(ล้านบาท) มูลค่าการส่งออกรวม
58	N	83.00 : 17.00	7.14	2.84	3.49	1.45	0.86	0.85	0.37	797,697.80
55	Y	87.86 : 12.14	6.33	2.03	2.68	0.64	0.05	0.04	0.37	525,439.10

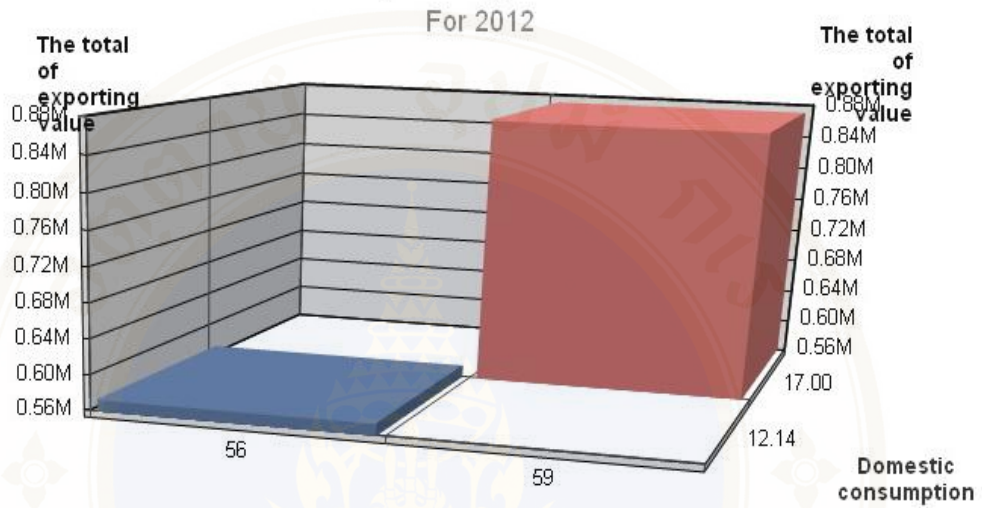
ผลการเปรียบเทียบกับสถานะเริ่มต้น(Base case)

Year: 2011

Label	(ล้านบาท) มูลค่าการส่งออก รวมของ สถานะที่ใช้ศึกษาแทน	(ล้านบาท) มูลค่าการส่งออก รวมของ สถานะเริ่มต้น (Base case)	ผลต่าง	(%) การเปลี่ยนแปลง
58	797,697.80	525,439.10	272,258.70	51.82

**Year : 2012**

### The total of exporting value / Domestic



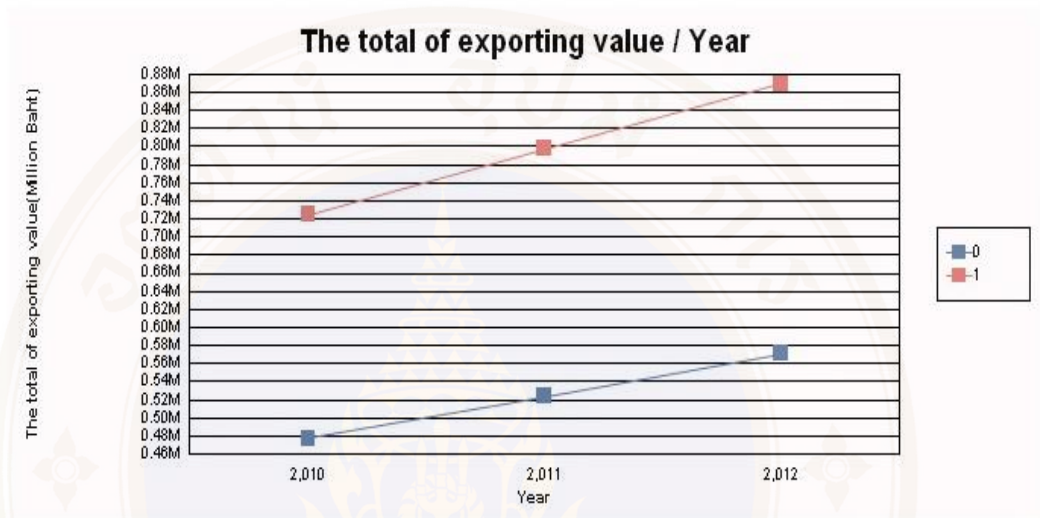
Label	Base Case (Yes or No)	(%) ส่งออก: ใช่/ภายใน	ยางยานพาหนะ	ถุงมือยาง	ยางยืด	ยางรัดข้อ	สายพาน	ท่อยาง	อื่น ๆ	(ล้านบาท) มูลค่าการส่งออกรวม
56	Y	87.86 : 12.14	6.52	2.09	2.76	0.66	0.05	0.04	0.03	573,037.50
59	N	83.00 : 17.00	7.33	2.90	3.57	1.47	0.86	0.85	0.03	869,454.10

ผลการเปรียบเทียบกับสถานะเริ่มต้น(Base case)

Year: 2012

Label	(ล้านบาท) มูลค่าการส่งออกรวมของ สถานะที่ใช้เปรียบเทียบ	(ล้านบาท) มูลค่าการส่งออกรวมของ สถานะเริ่มต้น (Base case)	ผลต่าง	(%) การเปลี่ยนแปลง
59	869,454.10	573,037.50	296,416.60	51.73

**วิเคราะห์การเจริญเติบโตของ  
มูลค่าการส่งออกรวม**



Point	Base Case (Yes or No)	(% ส่งออก:ใช้ภายใน ส่งออก:ใช้ภายนอก)		ยาง ยานพาหนะ	ถุงมือยาง	ยางยืด	ยางรัดข้อ	สายพาน	ท่อยาง	อื่นๆ	มูลค่าส่งออกรวม
0 2010	Y	87.86	12.14	6.17	1.98	2.61	0.62	0.05	0.03	0.68	477,458.30
0 2011	Y	87.86	12.14	6.34	2.03	2.68	0.64	0.05	0.04	0.37	523,977.40
0 2012	Y	87.86	12.14	6.52	2.09	2.76	0.66	0.05	0.04	0.03	570,806.70
1 2010	N	83.00	17.00	6.98	2.79	3.42	1.43	0.86	0.84	0.68	725,115.60
1 2011	N	83.00	17.00	7.14	2.84	3.49	1.45	0.86	0.85	0.37	797,697.80
1 2012	N	83.00	17.00	7.33	2.90	3.57	1.47	0.86	0.85	0.03	869,454.10

**วิเคราะห์การเจริญเติบโตของ  
มูลค่าการส่งออกรวม**

Line : 1

ปี	(ล้านบาท) มูลค่าการส่งออกรวมของ สภาวะที่ใช้เปรียบเทียบ	(%) การเจริญเติบโต	(ล้านบาท) มูลค่าการส่งออกรวมของ สภาวะเริ่มต้น (Base case)	(%) การเจริญเติบโต
2010	725,115.60	0.00	476,830.30	0.00
2011	797,697.80	10.01	525,439.10	10.19
2012	869,454.10	9.00	573,037.50	9.06
<b>AVERAGE</b>		<b>9.50</b>		<b>9.63</b>

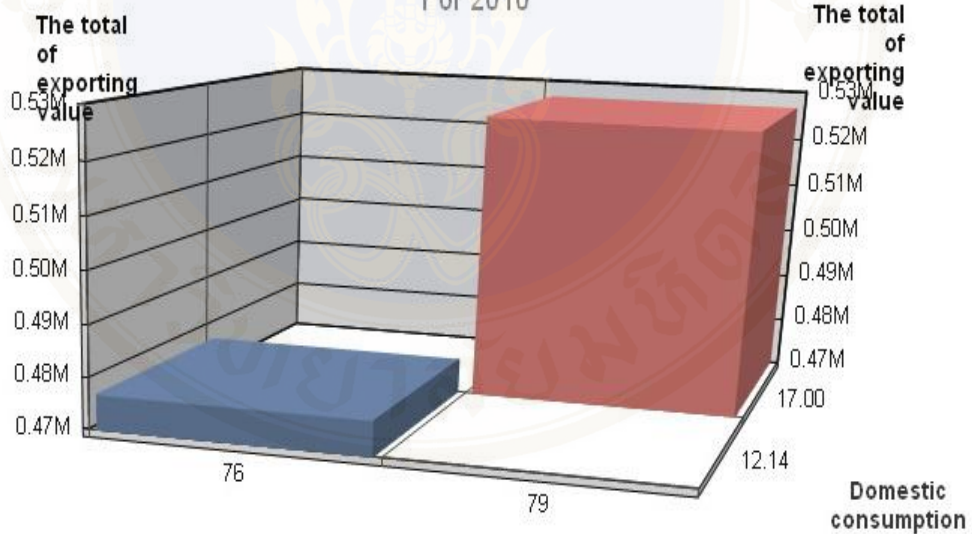
## APPENDIX B RESULT OF THE SECOND SCENARIO

**การวิเคราะห์มูลค่าการส่งออกรวมเมื่อปริมาณการใช้ยางแปรรูปมีการเปลี่ยนแปลง**

**Year : 2010**

**The total of exporting value / Domestic**

For 2010



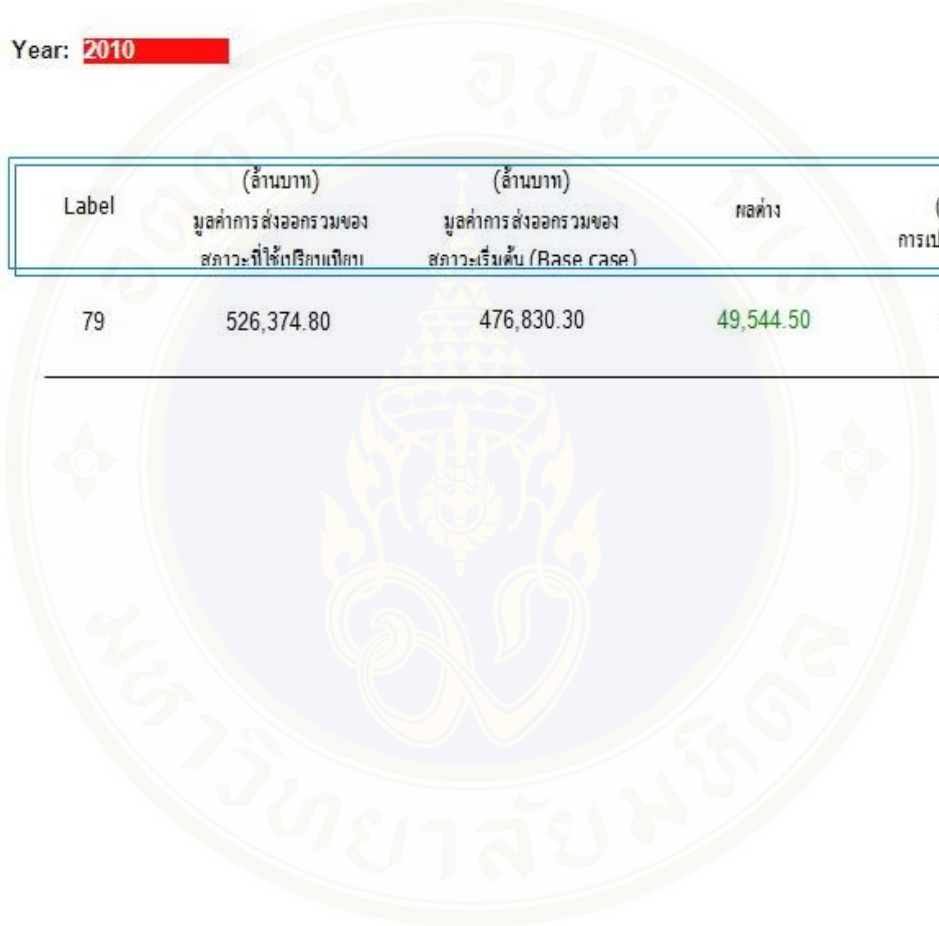
Label	Base Case (Yes or No)	(%) ส่งออก: ใช้ภายใน	ยางยานพาหนะ	ถุงมือยาง	ยางยืด	ยางรัดของ	สายพาน	ท่อยาง	อื่น ๆ	(ล้านบาท) มูลค่าการส่งออกรวม
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76	Y	87.86 : 12.14	6.17	1.98	2.61	0.62	0.05	0.03	0.68	476,830.30
79	N	83.00 : 17.00	8.79	2.82	3.71	0.88	0.07	0.05	0.68	526,374.80

ผลการเปรียบเทียบกับสถานะเริ่มต้น(Base case)

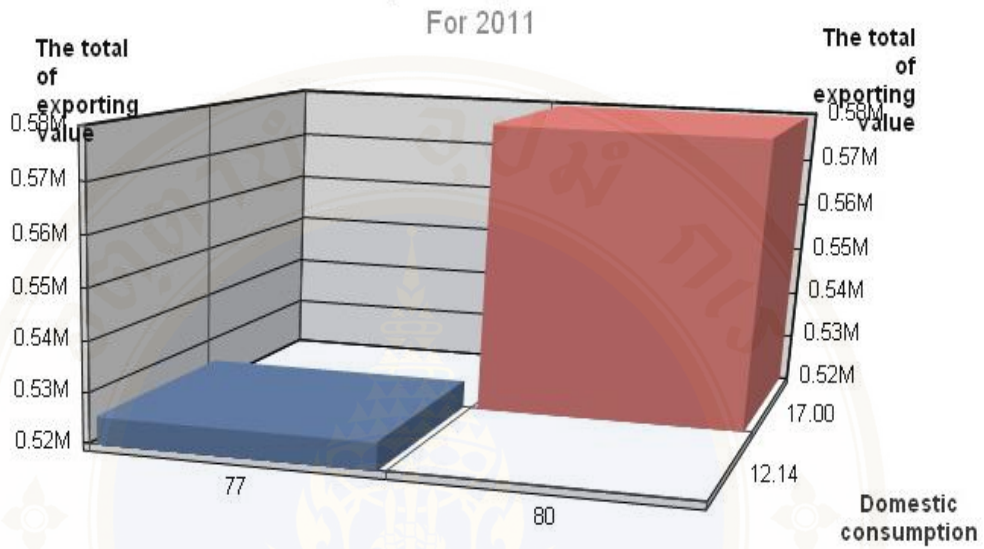
Year: 2010

Label	(ล้านบาท) มูลค่าการส่งออกรวมของ สถานะที่ใช้วิเคราะห์	(ล้านบาท) มูลค่าการส่งออกรวมของ สถานะเริ่มต้น (Base case)	ผลต่าง	(%) การเปลี่ยนแปลง
79	526,374.80	476,830.30	49,544.50	10.39



**Year : 2011**

### The total of exporting value / Domestic



Label	Base Case (Yes or No)	(%) ส่งออก : ใช้ภายใน	ยานพาหนะ	ถุงมือยาง	ยางยืด	ยางรัดของ	สายพาน	ท่อยาง	อื่น ๆ	(ล้านบาท) มูลค่าการส่งออกรวม
80	N	83.00 : 17.00	8.95	2.87	3.78	0.90	0.07	0.06	0.37	578,979.90
77	Y	87.86 : 12.14	6.33	2.03	2.68	0.64	0.05	0.04	0.37	525,439.10

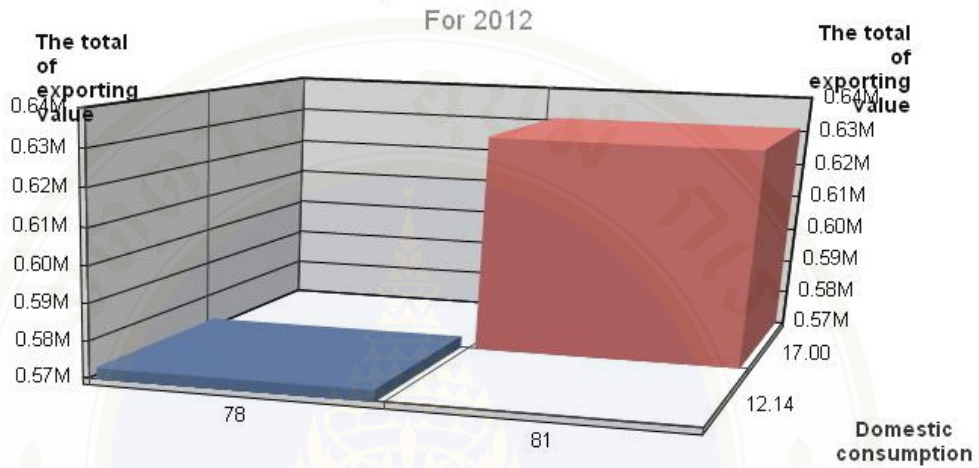
ผลการเปรียบเทียบกับสถานะเริ่มต้น(Base case)

Year: 2011

Label	(ล้านบาท) มูลค่าการส่งออกรวมของ สถานะที่ใช้วิเคราะห์	(ล้านบาท) มูลค่าการส่งออกรวมของ สถานะเริ่มต้น (Base case)	ผลต่าง	(%) การเปลี่ยนแปลง
80	578,979.90	525,439.10	53,540.80	10.19

**Year : 2012**

**The total of exporting value / Domestic**



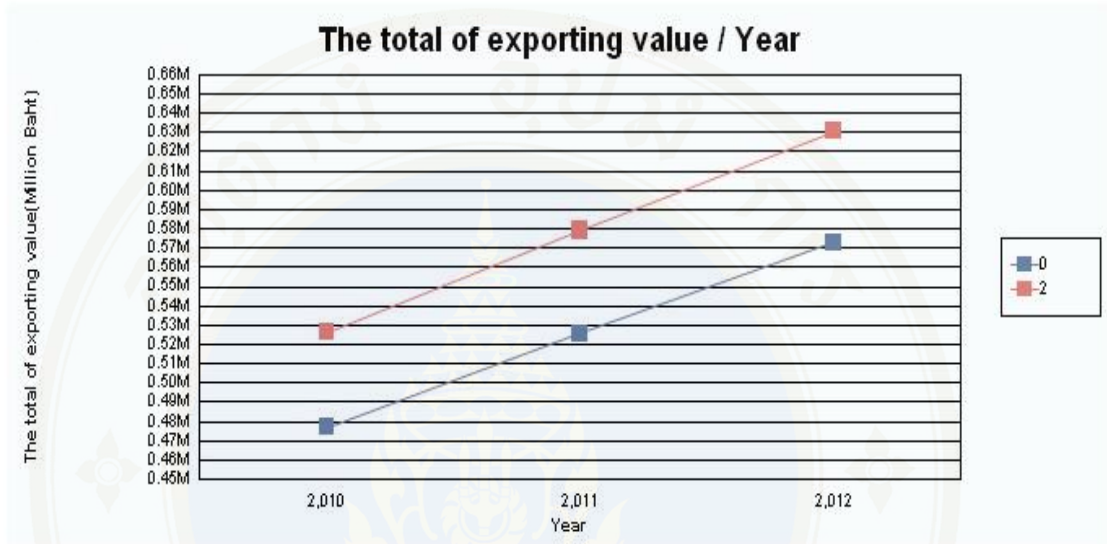
Label	Base Case (Yes or No)	(%) ส่งออก: ใช้ภายใน	ยานพาหนะ	ถุงมือยาง	ยางยึด	ยางรัดข้อม	สายพาน	ท่อยาง	อื่น ๆ	(ล้านบาท) มูลค่าการส่งออกรวม
78	Y	87.86 : 12.14	6.52	2.09	2.76	0.66	0.05	0.04	0.03	573,037.50
81	N	83.00 : 17.00	9.14	2.93	3.86	0.92	0.07	0.06	0.03	630,611.30

ผลการเปรียบเทียบกับสถานะเริ่มต้น(Base case)

Year: 2012

Label	(ล้านบาท) มูลค่าการส่งออกรวมของ สถานะที่ใช้กรณีศึกษา	(ล้านบาท) มูลค่าการส่งออกรวมของ สถานะเริ่มต้น (Base case)	ผลต่าง	(%) การเปลี่ยนแปลง
81	630,611.30	573,037.50	57,573.80	10.05

## วิเคราะห์การเจริญเติบโตของ มูลค่าการส่งออกรวม



Point	Base Case (Yes or No)	(%) ส่งออกใช้ภายใน	ยาง ยานพาหนะ	ถุงมือยาง	ยางยืด	ยางรัดของ	สายพาน	ท่อยาง	อื่น ๆ	มูลค่าส่งออกรวม	
0 2010	Y	87.86	12.14	6.17	1.98	2.61	0.62	0.05	0.03	0.68	476,830.30
0 2011	Y	87.86	12.14	6.33	2.03	2.68	0.64	0.05	0.04	0.37	525,439.10
0 2012	Y	87.86	12.14	6.52	2.09	2.76	0.66	0.05	0.04	0.03	573,037.50
2 2010	N	83.00	17.00	8.79	2.82	3.71	0.88	0.07	0.05	0.68	526,374.80
2 2011	N	83.00	17.00	8.95	2.87	3.78	0.90	0.07	0.06	0.37	578,979.90
2 2012	N	83.00	17.00	9.14	2.93	3.86	0.92	0.07	0.06	0.03	630,611.30

**วิเคราะห์การเจริญเติบโตของ  
มูลค่าการส่งออกรวม**

Line : 2

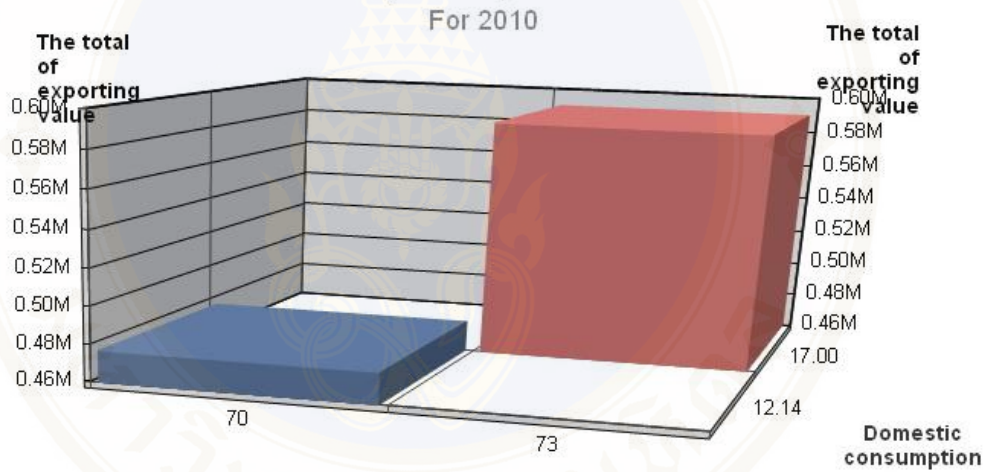
ปี	(ล้านบาท) มูลค่าการส่งออกรวมของ สภาวะที่ใช้เปรียบเทียบ	(%) การเจริญเติบโต	(ล้านบาท) มูลค่าการส่งออกรวมของ สภาวะเริ่มต้น (Base case)	(%) การเจริญเติบโต
2010	526,374.80	0.00	476,830.30	0.00
2011	578,979.90	9.99	525,439.10	10.19
2012	630,611.30	8.92	573,037.50	9.06
<b>AVERAGE</b>		<b>9.46</b>		<b>9.63</b>

## APPENDIX C RESULT OF THE THIRD SCENARIO

**การวิเคราะห์มูลค่าการส่งออกรวมเมื่อปริมาณการใช้ยางแปรรูปมีการเปลี่ยนแปลง**

**Year : 2010**

**The total of exporting value / Domestic**



Label	Base Case (Yes or No)	(%) ส่งออก : ใช้ภายใน	ยางยานพาหนะ	ถุงมือยาง	ยางยืด	ยางรัดข้อ	สายพาน	ท่อยาง	อื่น ๆ	(ล้านบาท) มูลค่าการส่งออกรวม
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70	Y	87.86 : 12.14	6.17	1.98	2.61	0.62	0.05	0.03	0.68	476,830.30
73	N	83.00 : 17.00	8.94	3.28	2.94	0.72	0.17	0.27	0.68	589,568.50

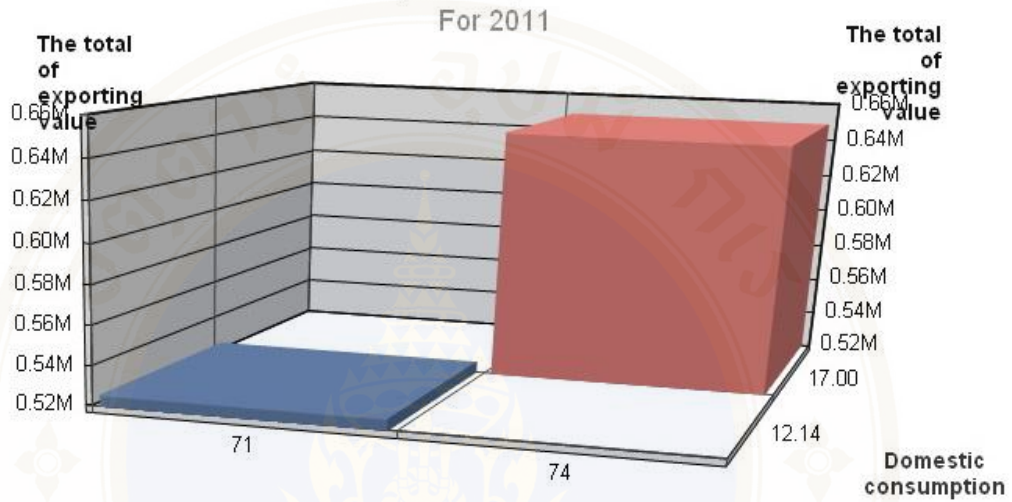
ผลการเปรียบเทียบกับสถานะเริ่มต้น(Base case)

Year: 2010

Label	(ล้านบาท) มูลค่าการส่งออกรวมของ สถานะที่ใช้ศึกษาศึกษา	(ล้านบาท) มูลค่าการส่งออกรวมของ สถานะเริ่มต้น (Base case)	ผลต่าง	(%) การเปลี่ยนแปลง
73	589,568.50	476,830.30	112,738.20	23.64

**Year : 2011**

### The total of exporting value / Domestic



Label	Base Case (Yes or No)	(%) ส่งออก: ให้ภายใน	ยานพาหนะ	สูงมือยาง	ยางยืด	ยางรัดของ	สายพาน	ท่อยาง	อื่น ๆ	(ล้านบาท) มูลค่าการส่งออกรวม
74	N	83.00 : 17.00	9.10	3.33	3.01	0.74	0.17	0.28	0.37	648,102.70
71	Y	87.86 : 12.14	6.33	2.03	2.68	0.64	0.05	0.04	0.37	525,439.10

**ผลการเปรียบเทียบกับสถานะเริ่มต้น(Base case)**

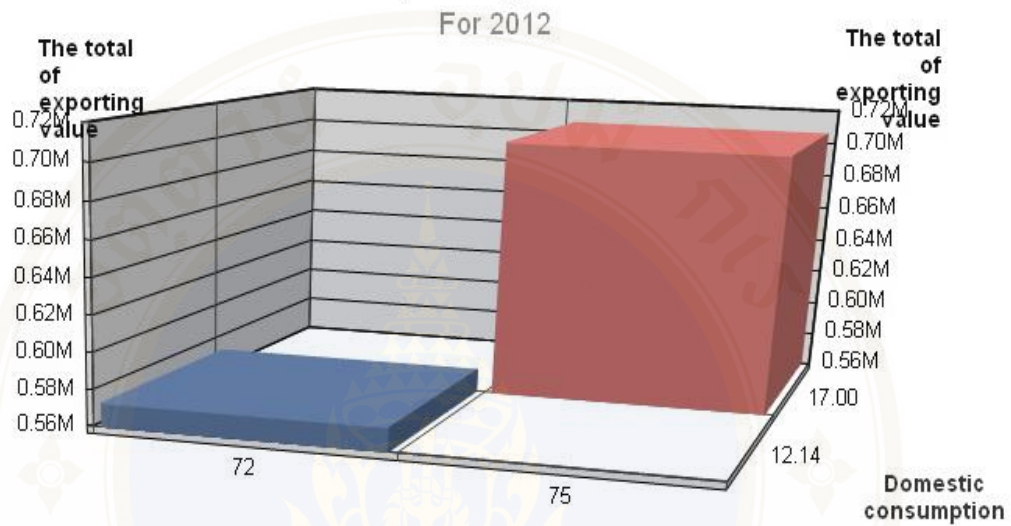
Year: **2011**

Label	(ล้านบาท) มูลค่าการส่งออกรวมของ สถานะที่ใช้เปรียบเทียบ	(ล้านบาท) มูลค่าการส่งออกรวมของ สถานะเริ่มต้น (Base case)	ผลต่าง	(%) การเปลี่ยนแปลง
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74	648,102.70	525,439.10	122,663.60	23.34
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**Year : 2012**

### The total of exporting value / Domestic



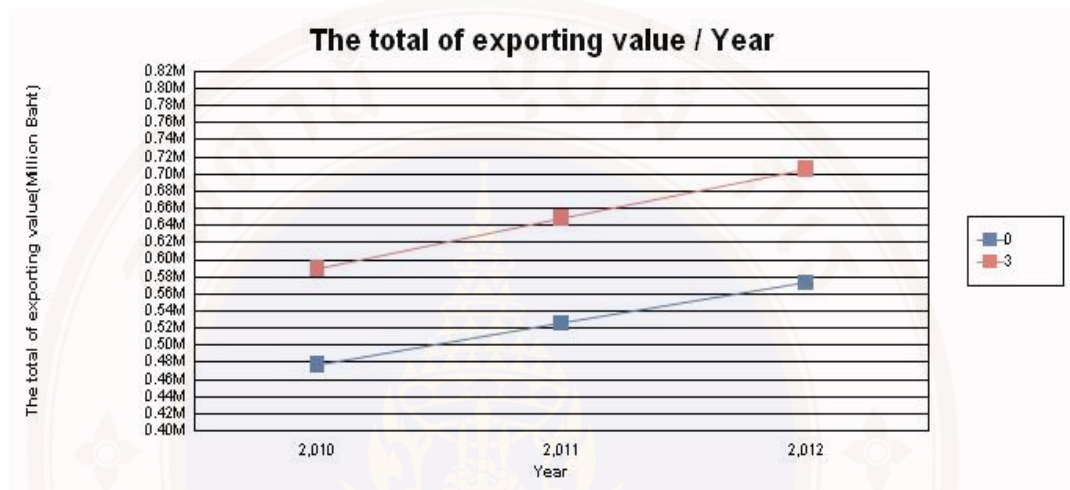
Label	Base Case (Yes or No)	(%) ส่งออก: ใช่/ภายใน	ภายนอกพหุหนะ	สูงมือยาง	ยางยืด	ยางรัดของ	สายพาน	ท่อยาง	อื่น ๆ	(ล้านบาท) มูลค่าการส่งออกรวม
72	Y	87.86 : 12.14	6.52	2.09	2.76	0.66	0.05	0.04	0.03	573,037.50
75	N	83.00 : 17.00	9.29	3.39	3.09	0.76	0.17	0.28	0.03	705,701.50

ผลการเปรียบเทียบกับสถานะเริ่มต้น(Base case)

Year: 2012

Label	(ล้านบาท) มูลค่าการส่งออกของ สถานะที่ใช้กรีกาเคิดา	(ล้านบาท) มูลค่าการส่งออกของ สถานะเริ่มต้น (Base case)	ผลต่าง	(%) การเปลี่ยนแปลง
75	705,701.50	573,037.50	132,664.00	23.15

## วิเคราะห์การเจริญเติบโตของ มูลค่าการส่งออกรวม



Point	Base Case (Yes or No)	(%)		ยาง	ถุงมือยาง	ยางยืด	ยางรัดข้อ	สายพาน	ท่อยาง	อื่นๆ	มูลค่าส่งออกรวม
		ส่งออก:	ใช้ภายใน	ยานพาหนะ							
0 2010	Y	87.86	12.14	6.17	1.98	2.61	0.62	0.05	0.03	0.68	476,830.30
0 2011	Y	87.86	12.14	6.33	2.03	2.68	0.64	0.05	0.04	0.37	525,439.10
0 2012	Y	87.86	12.14	6.52	2.09	2.76	0.66	0.05	0.04	0.03	573,037.50
3 2010	N	83.00	17.00	8.94	3.28	2.94	0.72	0.17	0.27	0.68	589,568.50
3 2011	N	83.00	17.00	9.10	3.33	3.01	0.74	0.17	0.28	0.37	648,102.70
3 2012	N	83.00	17.00	9.29	3.39	3.09	0.76	0.17	0.28	0.03	705,701.50

**วิเคราะห์การเจริญเติบโตของ  
มูลค่าการส่งออกรวม**

Line: 3

ปี	(ล้านบาท)	(%)	(ล้านบาท)	(%)
	มูลค่าการส่งออกรวมของ สภาวะที่ใช้เปรียบเทียบ		มูลค่าการส่งออกรวมของ สภาวะเริ่มต้น (Base case)	
2010	589,568.50	0.00	476,830.30	0.00
2011	648,102.70	9.93	525,439.10	10.19
2012	705,701.50	8.89	573,037.50	9.06
<b>AVERAGE</b>		<b>9.41</b>		<b>9.63</b>

## BIOGRAPHY

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