

**ACTIVITY BASED COSTING (ABC) OF PRODUCT LIFE CYCLE
IN THE DESIGN PROCESS FOR PLASTIC CALENDERING AND
CASTING INDUSTRY**

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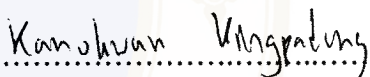
**A THESIS SUBMITTED IN PARTIAL FULFILLMENT
OF THE REQUIREMENTS FOR
THE DEGREE OF MASTER OF ENGINEERING
(INDUSTRIAL ENGINEERING)
FACULTY OF GRADUATE STUDIES
MAHIDOL UNIVERSITY
2011**

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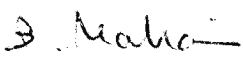
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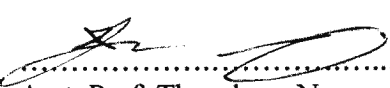
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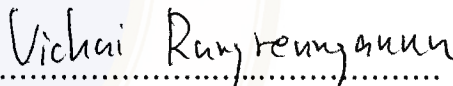

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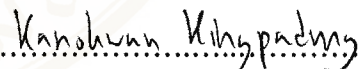

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ACKNOWLEDGEMENTS

The success of this thesis can be attributed to the extensive support and assistance from my major advisor, Dr. Kanokwan Kingpadung and my co-advisor, Assoc. Prof. Duangpun Kritchanchai. I deeply thank them for their valuable advice and guidance in this research.

I would like to thank Dr. Vichai Rungreunganun, for kindness in providing suggestions for improvement, and who was the external examiner of the thesis defense.

I would like to thank the owners of case-study factories who provide the data in making this thesis and the cooperation which is very useful to the making of this thesis.

I am grateful to all the lecturers and Industrial Engineering staff in the Faculty of Engineering, Mahidol University for their kindness and helpful all times and friends in Industrial Engineering class 1 for their kind support.

Finally, I am grateful to my family for their financial support, entire care, and love. The usefulness of this thesis, I dedicate to my father, my mother and all the teachers who have taught me since my childhood.

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ACTIVITY BASED COSTING (ABC) OF PRODUCT LIFE CYCLE IN THE DESIGN PROCESS FOR PLASTIC CALENDERING AND CASTING INDUSTRY

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THESIS ADVISORY COMMITTEE: KANOKWAN KINGPADUNG, Ph.D.,
DUANGPUN KRITCHANCHAI, Ph.D., VICHAI RUNGREUNGANUN, Ph.D.**ABSTRACT**

This research objective is to find a suitable methodology to calculate the activity based costing, by calculating through the Product Life Cycle (PLC), for the calendering and casting plastic industry. PLC can be separated into the Acquisition Phase and Production Phase. Most industries mainly calculate their costs in the production phase. However, this research will calculate the cost of the activity for the entire product life cycle, both in the production phase and acquisition phase.

The result of this research showed that, in the Acquisition Phase, the highest mix of newly designed products cost was mainly from product and process validation activity, which was 83.93%, while 22.64% was from the sub-activity for evaluating measurement systems. Product L showed the highest mix of activity cost, which was 84.29% from product and process validation activity and 23.85% from sub-activity for evaluating measurement systems. In the Production Phase, the results showed that the cost of product activity was higher than the original product by 57%. The activity cost of product L was higher than the original cost by 121%. After comparing the total cost of all products over the product life cycle and selling price, it was found that total cost was 6% higher than the selling price. Product C had its selling price higher than the activity cost over the product life cycle by 57.91%. When considering the mix from activity costs, the highest mix of original product costs was from the production activity center (production 2) at 15.30%, of which 9.39% was from the cost of the sub-activity of embossing. Product C showed the highest mix of activity costs, of which 24.72% was from the inspection activity center (production 1) and 17.72% from the sub-activity for checking re-winder release paper. The highest mix of product life cycle costs was from the raw material preparation activity center (production 2) at 46.39%, of which 15.85% was from the cost of the sub-activity of raw material preparation. Product C showed the highest mix of activity costs, which was 22.51% from the inspection activity center (production 2) and 21.61% from the sub-activity for thickness and color inspection.

KEY WORDS: ACTIVITY BASED COSTING / COST DRIVER / RESOURCE
DRIVER / PRODUCT LIFE CYCLE

148 pages

การคิดต้นทุนอิงกิจกรรมตลอดวัฏจักรชีวิตผลิตภัณฑ์ในกระบวนการออกแบบสำหรับอุตสาหกรรมรีดแผ่นและเคลือบผิวพลาสติก

ACTIVITY BASED COSTING (ABC) OF PRODUCT LIFE CYCLE IN THE DESIGN PROCESS FOR PLASTIC CALENDERING AND CASTING INDUSTRY

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บทคัดย่อ

งานวิจัยนี้มีวัตถุประสงค์เพื่อหาวิธีการคิดต้นทุนอิงกิจกรรมมาประยุกต์ใช้กับอุตสาหกรรมรีดแผ่นและเคลือบผิวพลาสติก โดยจะคิดต้นทุนอิงกิจกรรมนี้ตลอดวัฏจักรชีวิตผลิตภัณฑ์ (Product Life Cycle, PLC) ซึ่ง PLC จะแบ่งเป็น Acquisition Phase และ Production Phase ซึ่งอุตสาหกรรมส่วนใหญ่จะคิดต้นทุนในเฉพาะส่วนของ Production Phase เป็นหลัก สำหรับงานวิจัยนี้จึงทำการคิดต้นทุนอิงกิจกรรมตลอดวัฏจักรชีวิตผลิตภัณฑ์ทั้งในส่วนของการ Production Phase และ Acquisition Phase

จากผลงานวิจัยพบว่า ใน Acquisition Phase ซึ่งคือต้นทุนของการออกแบบผลิตภัณฑ์นั้น พบว่าต้นทุนของผลิตภัณฑ์ที่ออกแบบใหม่รวมทุกผลิตภัณฑ์ที่มีสัดส่วนตามศูนย์กิจกรรมสูงสุดคือ ศูนย์กิจกรรมการรับรองผลิตภัณฑ์และกระบวนการ คิดเป็นร้อยละ 80.93 เป็นต้นทุนที่เกิดจากกิจกรรมย่อยของการวิเคราะห์ระบบ คิดเป็นร้อยละ 22.64 โดยผลิตภัณฑ์ L มีสัดส่วนตามศูนย์กิจกรรมมากที่สุดคือศูนย์กิจกรรมการรับรองผลิตภัณฑ์ และกระบวนการ คิดเป็นร้อยละ 84.29 เป็นต้นทุนที่เกิดจากกิจกรรมย่อยการวิเคราะห์ระบบ คิดเป็นร้อยละ 23.85 ส่วนใน Production Phase พบว่าต้นทุนอิงกิจกรรมของการผลิตผลิตภัณฑ์ที่มีค่าสูงกว่าต้นทุนเดิมคิดเป็นร้อยละ 57 โดยผลิตภัณฑ์ L มีต้นทุนอิงกิจกรรมสูงกว่าต้นทุนเดิมคิดเป็นร้อยละ 121 และในส่วนของการคิดต้นทุนตลอดวัฏจักรชีวิตผลิตภัณฑ์ของทุกผลิตภัณฑ์เมื่อเทียบราคาขายแล้วพบว่า ราคาขายสูงกว่าต้นทุนอิงกิจกรรมตลอดวัฏจักรชีวิตผลิตภัณฑ์คิดเป็นร้อยละ 6 โดยผลิตภัณฑ์ C มีราคาขายสูงกว่าต้นทุนอิงกิจกรรมตลอดวัฏจักรชีวิตผลิตภัณฑ์คิดเป็นร้อยละ 57.91 และเมื่อพิจารณาสัดส่วนตามศูนย์กิจกรรมพบว่า ต้นทุนของผลิตภัณฑ์โดยรวมทุกผลิตภัณฑ์มีสัดส่วนสูงสุดที่ศูนย์กิจกรรมการผลิต (ผลิต 2) คิดเป็นร้อยละ 15.30 เป็นต้นทุนจากกิจกรรมย่อยของการอัดลาย คิดเป็นร้อยละ 9.39 โดยผลิตภัณฑ์ C มีสัดส่วนตามศูนย์กิจกรรมมากที่สุดคือศูนย์กิจกรรมการตรวจสอบ (ผลิต 1) คิดเป็นร้อยละ 24.72 เป็นต้นทุนเกิดจากกิจกรรมย่อยการตรวจสอบและกรอกระคาย คิดเป็นร้อยละ 17.72 ส่วนต้นทุนตลอดวัฏจักรชีวิตผลิตภัณฑ์รวมทุกผลิตภัณฑ์ที่มีสัดส่วนตามศูนย์กิจกรรมสูงสุดคือ กิจกรรมการจัดเตรียมวัตถุดิบ คิดเป็นร้อยละ 46.39 เป็นต้นทุนที่เกิดจากกิจกรรมการเตรียมวัตถุดิบคิดเป็นร้อยละ 15.85 ซึ่งผลิตภัณฑ์ C มีสัดส่วนตามศูนย์กิจกรรมมากที่สุดคือศูนย์กิจกรรมการตรวจสอบ (ผลิต 2) คิดเป็นร้อยละ 22.51 เป็นต้นทุนจากกิจกรรมย่อยการตรวจสอบความหนา และสี คิดเป็นร้อยละ 21.61

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CHAPTER I

INTRODUCTION

1.1 Background and problem statement

In the current status, Thai economics has been affected from the world economic condition which has decreased in every aspect including the economics inside the country. The investment outside the country and inside the country has decreased especially from a foreign country. The internal consumption has decreased because the consumers are more careful in the expense and due to the fact that the purchasing ability of the consumers inside and outside the country has a trend to decrease in the year 2009. The producer might need to use the strategy in the price of the goods in order to be appropriate to the need of consumers that has been changed during the economic crisis. They might turn to the goods that are not so expensive and the quality is appropriate to the price so in order to be consistent with the purchasing ability of the consumers during the economic recession, the producer must improve on their products on the quality and the price that is appropriate for the competition.

The plastic industry is one of the industry that has been affected greatly from the economic condition nowadays especially the oil price is expensive because the plastic industry is the integral mechanism in the development of the industry of the country. It creates the ability of the competition to the industry of the country by being the chain and raw material to the continuous industry such as car industry, electrical and electronic industry, construction material industry and the containing product industry etc and it is also the market supporting the growth of the petrochemical industry of the country. The value of the plastic transformation industry in the year 2006 is at 340,991 million baht as shown in the figure 1.1 and the plastic industry is important to the industry chain of the country. The industry chain is the chain that connect the value occurred of the activity in producing the goods or the product starting from the acquisition of the raw material until reaching the last consumer. The plastic industry chain will have the direct connection to the petroleum and

petrochemical industry which feed the raw material to the plastic production. Plastic industry can be divided into 2 groups which are plastic resin industry (which is end water petrochemical industry) and the plastic product industry the plastic resin industry will use monomer from the middle petrochemical industry in order to produce it into the various plastic resins such as polyethylene (PE), Polypropylene (PP), Polystyrene (PS) and polyvinylchloride (PVC) in order to be raw material feeding to the plastic product industry which would produce the various plastic products such as the plastic utilities in the house or the office, artificial leather, furniture, plastic pipe, decorations inside the car etc.

When comparing with the value of the transformation plastic industry in Thailand it is found that Thailand is at the twentieth rank. The highest export value to the nineteenth is as follows Germany, Italy, Japan, France, Belgium, United Kingdom, Canada, Netherlands, Taiwan, Austria, Spain, South Korea, Poland, Switzerland, Mexico, Czech Republic, Sweden. The first 3 is as follows - Germany has the export value around 30,122 million dollar, China has the export value around 21,099 million dollar and the US has the export value around 19,576 million dollar and others according to the figure 1.2

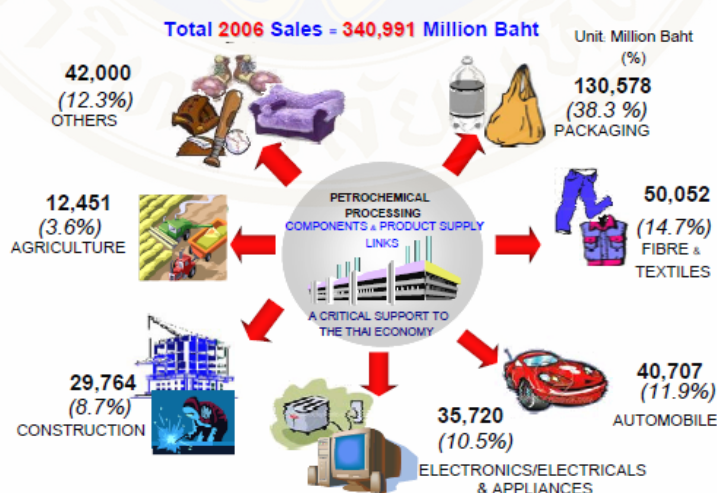


Figure 1.1 Plastic clusters - important tools in pushing the economics

Source: Petroleum institute of Thailand, May 2007

In developing the plastic industry so that we can upgrade or at least maintain the level of the plastic industry in Thailand in the world market comparing with the country that has the importance to the plastic trade in the world in regional level, they are 2 groups which is the North Asian Region which includes 1. Japan 2. South Korea 3. Taiwan 4. China and the Asian group include Malaysia which has the analysis criteria as follows 1. To be the prominent country of the trading country group or competitor of Thailand regarding the import or the export 2. To be the country with a large trading value or the important role to the plastic trade in the world or the regional level 3. to be the country that has the opportunity of the extension of the trade of the plastic product with Thailand. To sum up, China has the main strategy is that it can produce the goods in a low price because it has advantage of large market and the goods production power is larger emphasizing on the product in a large quantity so that the cost per unit is minimum which creates a high negotiation power on the price of the raw material. Malaysia has the fast development of the plastic industry in the country but one must emphasize the export because the market in the country is small. The South Korea is highly successful in creating the brand and the design of the product makes the products to be acceptable in the universal level. The creation of the brand is another factor that helps improve the value to the products because the fact that the buyer accepts the brand and they would accept the value to be paid to the brand of the goods. Taiwan is successful on the technology, the advanced production process and the development of the tools and machines such as template and dyes. Japan is outstanding on being the leader of the product design technology and to have the strong brand and there is the strong network between the end producer, raw material producer including the various support industry and the tools and machines and the compound has made the plastic industry of Japan to be strong in the whole network. (source: Petroleum Institute of Thailand, September 2008)

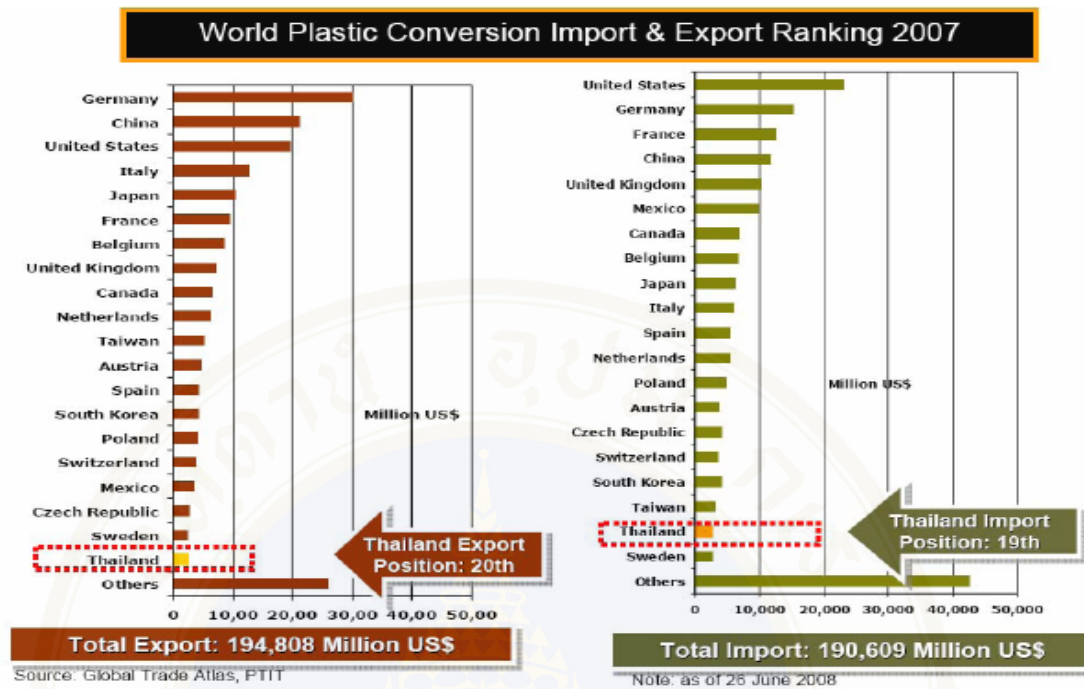


Figure 1.2 Ordering of the import and export country of plastic in the year 2007

Source: Global Trade Atlas, PTIT

So the increase of the potential in the competition of plastic industry of Thailand is highly crucial considering the production cost which is the important indicator in reflecting the ability of the potential in the competition which the production cost would comprise of the cost, raw material, labor cost and the production overhead cost. When considering the 6 production cost in the year 2006 it is found that China has the highest raw material cost which is 80 per cent of the overall production cost. Next is Thailand, South Korea, Japan, Tai Wan and Malaysia which is 78, 78, 77, 75 and 74 accordingly so Thailand has the ability in the competition on the plastic raw material higher than China but has the ability in the competition on the raw material lower than Japan. Taiwan, Malaysia and Thailand have the ability in the competition on the raw material the same as South Korea. When considering the labor cost it is found that Japan has the highest cost which is 10 per cent of the entire cost. Next is South Korea, Tai Wan, Malaysia, Thailand and China which is 9, 8, 6, 5 and 4 accordingly so Thailand has the ability in the competition on the labor of the plastic industry higher than Japan, South Korea, Tai Wan and Malaysia but has the ability in the labor competition less than China. As for the

production overhead cost it is found that Malaysia has the production overhead cost in the highest which is 20 per cent of the entire production cost. Next is Thailand, Taiwan, China, Japan and South Korea which is 17, 17, 16, 13 and 13 accordingly. Therefore, Thailand has the ability in the competition. As for other related factor relating to the production of the plastic industry higher than Malaysia but has the ability in the competition on other factors relating to the production lower than China, Japan and South Korea and Thailand has the ability in the competition on other aspects relating to the production in the same level as Taiwan according to the table 1.1

Table 1.1 The production cost structure of foreign countries and Thailand in the year 2006

Cost Structure 2006						
Item	Thailand	Taiwan	Malaysia	China	Japan	S. Korea
Raw Material	78%	75%	74%	80%	77%	78%
Labour	5%	8%	6%	4%	10%	9%
Overhead	17%	17%	20%	16%	13%	13%
Total	100%	100%	100%	100%	100%	100%

Source: Modified from PTIT of 2007

Table 1.2 The production cost structure of Thailand's Plastics from 2001-2003 and 2006

Item	2001	2002	2003	2006	AVG
Raw Material	77%	78%	79%	77%	78%
Labour	10%	10%	10%	7%	9%
Overhead	13%	12%	11%	16%	13%
Total	100%	100%	100%	100%	100.0%

Note: For 2004 and 2005 data are not show

Source: Office of Industrial Economics

When considering the production cost structure of Thailand starting from the year 2001 – 2003 and 2006 it is found that Thailand has the average production cost proportion as follows. The raw material cost is at 78 per cent. The labor cost is at 9 per cent and the production overhead cost is at 13 per cent according to the table 1.2 and when comparing with the production cost of the organization and the production cost of Thailand it is found that the raw material cost of the organization and Thailand

has the same proportion which is 78 per cent of the entire production cost. The labor cost of the organization is at 6 per cent and the labor cost of Thailand is at 9 per cent which we can see that labor cost of the organization is lower than the labor cost of Thailand and the production overhead cost of the organization is 16 per cent and the production overhead cost of Thailand is at 13 per cent which the production overhead cost of organization is higher than the production overhead cost of Thailand as the figure 1.3 so we can see that the overall production cost of the organization is higher than the production cost of Thailand.

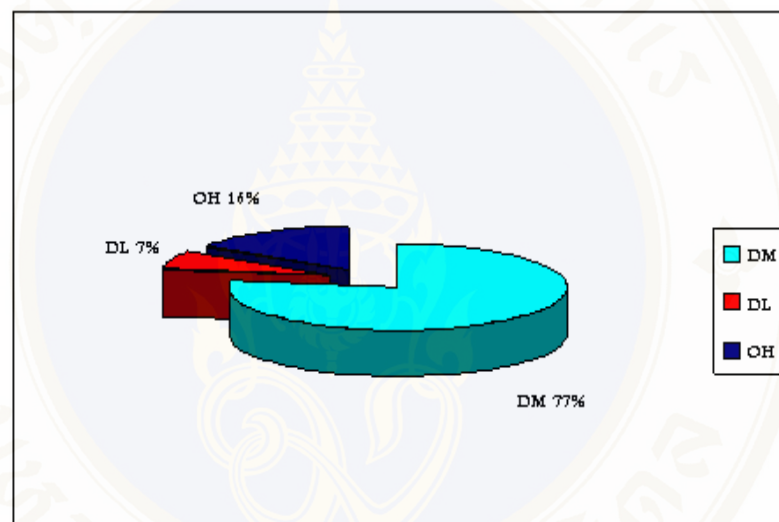


Figure 1.3 Pie Chart showing the production cost in organization's case study of year 2008

Nowadays, the competition level has increased on the competition of entrepreneur in the same area to the competition in the world market. Severe competition circumstance is an important cause that makes the information system to have more value and importance to organization more than it used to be. To know the real cost of goods or service and the work improvement is important key in fighting with competition condition that is getting more severe and in order to maintain the advantage for a long time organization needs to have strategy in developing process and product continuously so organization needs to invent new product in order to create new market that have no competitors or to have small amount of competitors and in this new invention of products that the research and technology development

including product design has come to have important role. It is necessary to evaluate the cost in the product design and the development correctly and accurately. Nowadays the organization uses original cost calculation which comprises of direct raw material value, direct labor cost and production overhead. The organization would bring labor cost and combined production overhead which calculates the cost of every product. Any product would use the same labor cost ratio and production overhead which prevents the cost received to reflect the real cost of each different product.

Therefore, it is necessary to evaluate the design cost of product and the development correctly and accurately in order to help improve the cost calculating process of the design and development of new products to have efficiency and can compete with competitors which researchers has the idea in improving calculation of the cost for design and development of product by using activity-base cost calculation with new products by calculating for the whole Product Life Cycle because if one product is outdated it can make a profit from other products and if we know the product life cycle we can prepare a new product or to make it different which can create a wall for competitors to catch up and try to make product to be in acceptable period in the market for as long as possible.

1.2 Objective

1.2.1 In order to calculate the cost per unit of the original products and the new products by using the activity-based costing.

1.2.2 In order to compare the original cost and the activity based cost of the original products and the new products.

1.2.3 To specify the strategy in cost management to the organization in order to create the competition ability.

CHAPTER II

LITERATURE REVIEW

2.1 Definition of ABC

Activity Based Costing (ABC) is the method to calculate cost of product and operation performance of each activity. Therefore, costing will be nearly the actual cost it has to assign activity and gathering cost by volume of actual activity. (Turney, 1996)

Activity Based Cost System (ABC) is reliable costing analysis system. It is a tool as good strategy for making decision on business. (Roztochki and Needy, 1999)

Activity Based Cost System (ABC) will point to several activities for outcome product and service by classify each expense on each activity and gathering to be costs of product and service. (Januszewsk , 2008)

Activity Based Cost System (ABC) is a model for utilizing resources of organization on each activity. Activity cost calculates by volume of each product. Beside of activity based cost system, several outcome supported activities whether turned out for proceeding or finishing it causes to distribute expense. (Akyol et al., 2004)

Principle logic of activity costing, it turns out from proceeding activity of business such as purchasing raw material, production process or checking and service. Therefore, costing by activity should distribute expense to several activities. (Kaplan, 1998)

2.2 Procedure Process of Activity Base Costs System

There are 5 trends for applying activity base costs as following:-

2.2.1 Activity based on costing objective (Thummanont, 2544; Akyol et al., 2004)

Activity based on costing system was settled under its objective. The management team would procedure objectives for increasing efficiency of employees' performance in which not fixed up for the whole business. These activity base costs objective might be concluded at the forth step. (Those activities were not incurred by production department.)

2.2.2 Activity analysis and verification

Activity analysis was render works to organization of business that yields output. There were many ways to consider activity analysis and verification as follows:-

1) Business process

It was divided concerned activities in alternately, for example the activities on preparing raw material, modify product, accessory component, investigation quality and delivery, etc.

2) Business process

It was divided concerned activities in alternately, for example the activities on preparing raw material, modify product, accessory component, investigations quality and delivery, etc.

3) Responsibility center

Division responsibility center and details duty onward to center for easy and appropriate to verify when comparing with the other way.

4) Interview concerned employee

Interviewing employee whom may concern to works rendered, it would be understand more details of works. Details gathered from interviewing have to analysis before verify the activity.

5) Study from dictionary

Nowadays, the company in United State of America published and distributed this activity dictionary. Activity dictionary indicated each duty details for verify activity of organization; however it could be applied, modify and presume performance of each activity in organization.

6) Activity valuation analysis

Besides knowing each activity from analysis, the gathered information was also useful for management. Moreover, analysis might be verified value added activity or non-value added activity, too. (Chen, 1996; Akyol et al., 2004)

7) Activity hierarchy

This activity was the description on behavior costs which supported costs driver and divided into 4 levels as following:-

1. Unit level - Activity level varied by production capacity on each unit of product and assortment of variable activity.
2. Batch level - Activity level varied by production capacity on batch level. (Deesilladharm, 2547)
3. Product level - Activity level varied by product level in complex, related to production and sales.
4. Non-Product level / Facility level - Activity level varied by level of support and facility which simplified business operation and not related to product unit, product group and product profile.

2.2.3 Verification of activity costs

Activity costs mean resource costs applied on various activities such as raw material costs, labor costs, overtime, machines depreciation, services and generous facility.

2.2.4 Cost Driver and Cost Driver Rate

Activity based costing are not costs of any product cost but the total cost arising from activities that many products , can not allocate those costs into the product directly. Therefore, criteria must allocate costs with activity driver into the products by the relationship of cause the cost. (Luangsakulthong, 2550)

After costs driver of each activity were settled, then figured activity rate as following:-

$$\text{Activity rate} = \frac{\text{Activity costs}}{\text{Value of costs driver}}$$

2.2.5 Product costs

Activity was incurred costs in according to activity cost accounting system. Product or service was impacted from operation. Upon figuration product costs or service costs, details of each activity based on each product or service have required, then settle costs driver and figure activity rate multiply by value of costs driver.

2.3 Cost driver principle

2.3.1 Activity drivers' selection

The factors to be considered at this stage of ABC model design consists of two classes: (Gizaw, 2006; Sohal and Chung, 1998)

1. Factors that help in choosing the number of cost drivers required by the ABC system, which contains four types of factors that determine the multiple uses of cost drivers:

1.1 Level of desired accuracy in cost information. The higher the level of accuracy, the more cost drivers need to be selected.

1.2 Product diversity. Activities are consumed in different proportions by cost objects, so the higher the degree of diversity, and the more cost drivers selected.

1.3 The relative cost of the activities aggregated. The number of the cost drivers required increases proportionally with the number of activities that represent an important percentage of the total pooled costs.

1.4 Volume diversity. When products are produced in different batches, the multiple uses of cost drivers are required.

2. Factors that help selecting the appropriate cost drivers (Chen, 1996; Hilton, 2002)

2.1 Expense of measurement. The selection of the cost driver depends on the cost associated with the cost driver. For the cost drivers for which data is more readily available, the cost of measurement decreases. The transaction drivers are the cost drivers with the lowest cost, because information related to the transaction is generated every time when an activity is performed.

2.2 Correlation. The cost drivers which accurately capture the consumption of activities by cost object will be used in the ABC model.

2.3 Behavioral effects. The cost drivers selected in ABC system have impact on the behavior of employees to the extent the individuals perceive the cost driver selected as a way to measure their performance. If the behavioral effect is not harmful for company, than the cost driver will be selected.

2.3.2 Categories of cost drivers (Gizaw, 2006; Cooper, 1989)

1. Transaction driver. These are the least expensive category of cost drivers because they reflect how many times an activity has been performed and are used when the activities are consumed in the same extent by cost objects.

2. Duration drivers. The use of transaction drivers causes a distortion into reported cost objects when the amount of activities required for different cost objects differ significantly from one cost object to another. In this case, duration drivers are the right choice, but more expensive to implement, since the model needs to track the period of time during which each activity is performed.

3. Intensity drivers. These directly charge the resources used each time an activity is undertaken. These are the most accurate cost drivers, but at the same time, the most expensive. A model that uses an intensity driver has to be implemented a job order system to record all the resources used by an activity performed.

2.4 Factors Effectuated to Anticipation Activity Costs Accounting System

Activity costs accounting system was applied to actual works, it was complicate or tough to operate, figure by following factors:- (Thummanont and Wattanasupchoke, 2545)

2.4.1 Sequence of production process

Continuously production process has easier applied on activity costs system than production to order because continuously production process, activity costs of each product were stable, fewer modify production process and similar products on the other hand production to order has many activities along to various products, it was too complicated to verify activity and settle activity costs driver.

2.4.2 Various products

Various products make known to different of product classifications. Various products would be varied to become complicated production and more volume of verified activity and costs driver.

2.4.3 Volume of various components

As producing same product category, if those products have various components it complicated to apply costs system, too. Due to various components would vary to number of production activity.

2.4.4 Production process

Each process of production was a minor production activity. If verified activity was along to major production process, it has impacted to verify production process which was more complicate to settle activity than minor production process.

2.4.5 Costs driver

On the application of activity costs system, if system has designed many costs driver, it would be complicated to set and gather its details. Indeed it resulted to assort costs into activity and various products. Moreover, it depended on grouping and reliable details of basic product costs. Costs driver were based on details.

2.4.6 Information and report for setting up system

Information of costs driver was gathered from recording actual activities on report. If information and report fixed on numbering of costs driver, it would be easy for applying. However, problem has often found as lacking of report or necessary information for designation or improvement.

2.4.7 Reform organization

Organization chart was shown number of employees in each division with different responsibility accordance with control duty. Many times reforming organization or transferring employees, it might be trouble and waste to verify activity for the new one.

2.4.8 Support from management (Gunasekaran, 1999; Majid and Sulaiman, 2008; Sohal and Chung, 1998)

If not supported by management to develop and bring to the ABC organization would be difficult to achieve. Therefore, management should perform and support the implementation of ABC to use success. Should be following:

1. Conferencing together on all levels to create a shared understanding of ABC.
2. Training to employees throughout the organization to provide knowledge to do ABC.
3. Should be prepared to support the Software in the data.

Therefore, affected factors have to take into consideration as earlier designation the system. In which it has not been paid attention, once taking into the actual operation it might be hard to resolve.

2.5 Activity-based cost management

An activity-based cost management will help support decision-making, work operation improvement and creating income from the invested property with main objective of creating value to customers by reduced cost which is a result from an analysis on various aspects (Akyol et al., 2004; Deesilatham, 2547; Gunasekaran, 1999; Gurses, 1999; Hughes, 2005; Kaszubski and Ebben, 2004; Roztoski, 1999; Sheu, 2001; Sohal and Chung, 1998) which are...

1. Attribute Analysis will categorize and include cost and performance information which is a group that can be managed and controlled. The information characteristics will help the organization to analyze in various different dimension of the management problem.

2. Strategic Analysis will find various ways that can create and maintain advantage condition from competition in the market by aiming Long-Term Objectives analyzing effectiveness to the expense in the future and profit improvement by creating clarity of cost objects.

3. Benchmarking is a method that specifies standard activity. It is used to support executive in specifying process or technique in order to increase effectiveness or efficiency of activity which ABM would promote the Benchmark work operation comparing with experts inside process and competitor.

4. Operation Analysis by searching in order to specify, measuring and improving performance of the main process and work operation inside the organization which ABM is used for analysis of What-if. Project management and work operation measurement including Constraint Analysis and Costing Process-Based.

5. Profitability Analysis is a main point for an organization with ABM as a tool supporting organization in analyzing cost and profit from product and process both before and after improvement and support analysis before issuing products (Pre-launch) and profitability improvement.

6. Process Improvement which is a heart of modern management by focusing on specifying a cause of change, loss in ineffectiveness which the process improvement also include change by little and instant change with a guidelines and

Business Process Modeling and Business Process Reengineering, quality activity, improving for leading organization.

2.6 Product Life Cycle

Product Life Cycle (PLC) means the time period starting from product design and development to the withdrawal from the market. The length of the life cycle would depend on the characteristics of the product and the selling market. Some product have a short life cycle for only one year or a few months and some product can be sold in the same way for ten or more years (Sarsananun, 2550).

The growth of any sale amount as the time goes by would be continuous cycle by dividing into 5 parts which are design and development, product recommendation, growth of the product, saturation of the product and the deterioration of the product. When the products are available on the market it would show the start of the product life cycle. The time that passes by would have more or less sale amount which is the show of that product growth. If the product has well been received from the market the sale amount would rise rapidly. When the buyers do not want that product the sale amount would decrease and finally it would disappear from the market and there would be a new product coming to the market instead of the old-fashioned product. Some part of the product might be accepted by the market but many other products cannot go into the market to make the customers to accept so the time period that each product stays in the market is not the same as the figure 2.1 but the in engineering sense the product life cycle would mean the process starting from the design until stop using the product. The engineering product cycle (Blanchard, 1998) can be divided into 2 parts as follows Acquisition Phases and Operation Phases. Each phase can be divided and there are different activities. The first phase is acquisition phase which would include 1. Study the need of customers which is a very important process because the product made must be the thing that a customer wants which is a very important step because that product must be the thing that customer wants or to be able to respond to the need of customers. 2. Preliminary design is the process preparing for the product design by using the data from the need of customers and changes it to technical data in order to help the way to respond to the need of

customers 3. The details of the design and the production planning. This step is the preparation for the readiness for the operation and prepares the resource used for the production. As for the second phase it is the Operation Phases which is the step relating to the production and delivery. The last structure of the product or the service and the stop of using the product as the figure 2.2 shows the relationship between the cost in the product cycle of the design which is found that if the time period in the design is short it would make the design cost in the product design and the production cost to decrease and to make it to respond to the market more quickly.

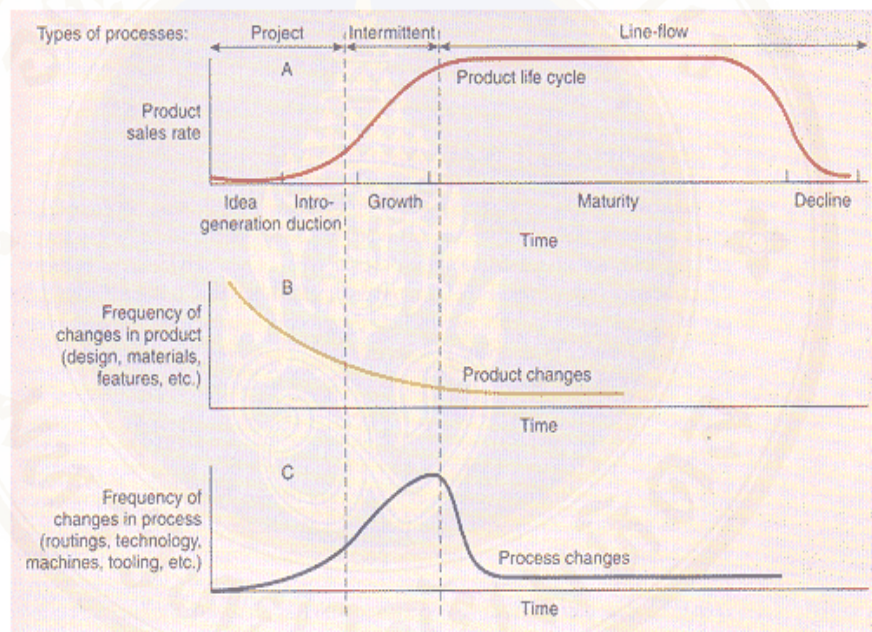


Figure 2.1 Product Life Cycle (Mark M. Davis et al., 2003)

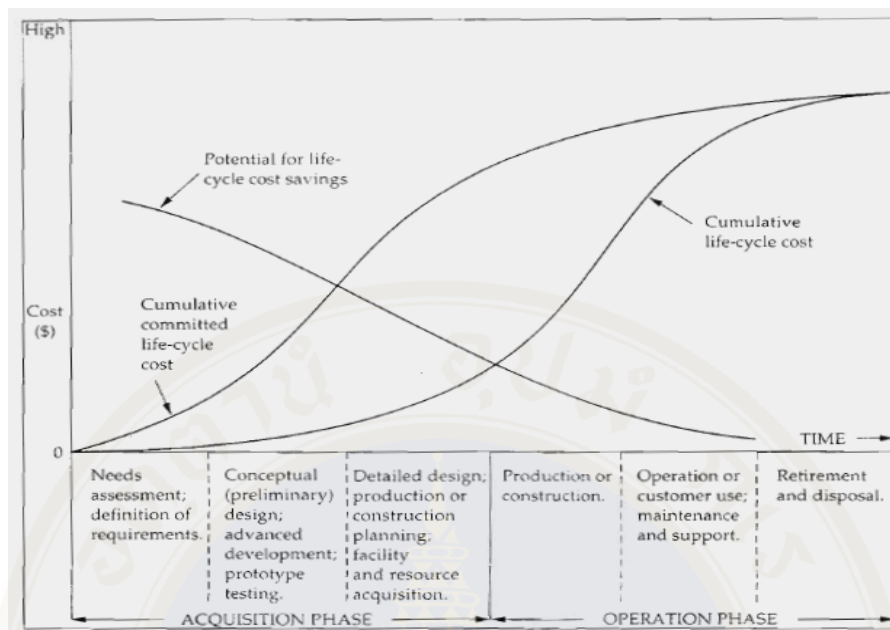


Figure 2.2 Phases of the Life Cycle and Their Relative Cost (Sullivan et al., 1997)

The cost of the product would increase around 10 times in each process as shown in the figure 2.3 (Sullivan et al., 1997)

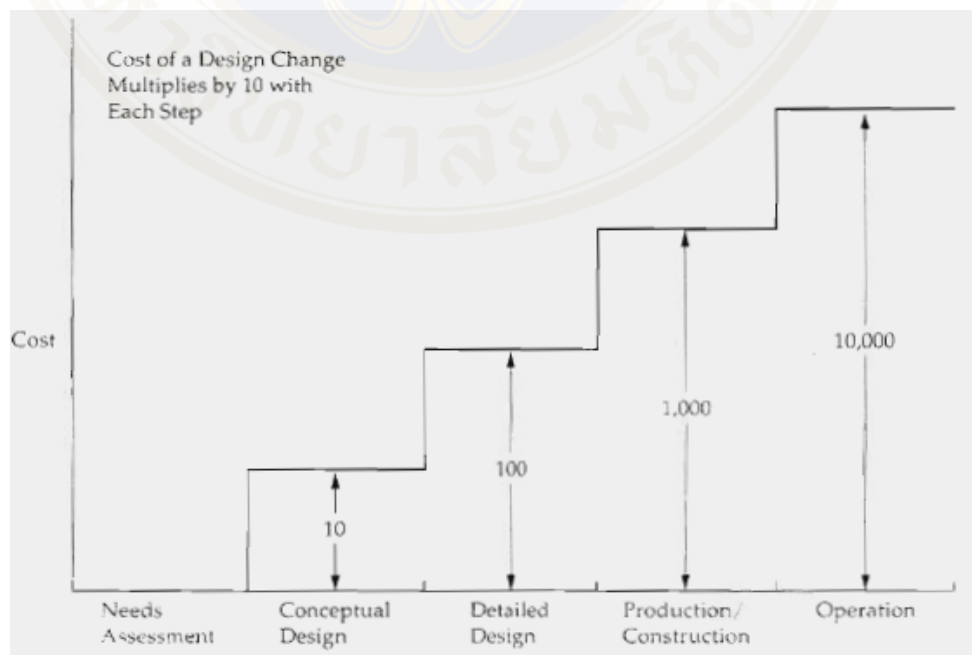


Figure 2.3 Life Cycle Step (Sullivan et al., 1997)

2.7 Life Cycle Cost

Life Cycle Cost (LCC) is a technique and method mixing between economics and engineering knowledge which is very popular in the year 1980 by considering from the entire expense happening in the work time period of one system to the investment money in the installation of the machines and the various equipments (Capital Cost), labor and installation costs, system maintenance cost which the analysis of the value for the usage period is an important tool in the decision whether that system should have the work operation process in what direction in order to create the minimum expense for the usage period (Paolo, 1998) (Blanchard, 1998) as the figure 2.4. (Haworth, 1975) simplified the definition of life cycle costing as follows: “an analytical process which considers all cost (and revenues) impacts directly attributable to a decision over the life cycle of that decision”. He condenses the benefits of life cycle costing into four basic principles:

1. Life cycle costing should be applied at all decision levels throughout the design process.
2. Life cycle costing should include the costs of functional operation with in facility.
3. The analytical process should accommodate all decision-related factors.
4. The analytical procedures and results should be compatible with the financial planning and control systems.

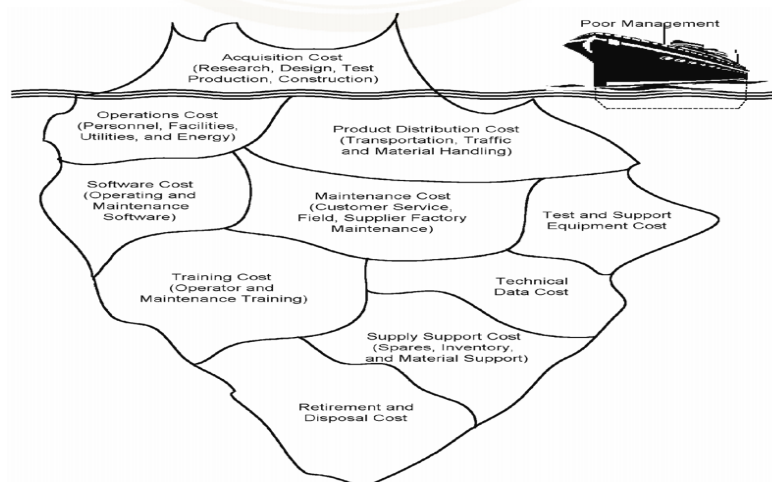


Figure 2.4 Life Cycle Cost (Blanchard, 1998)

Yongprayoon (2550) study of expense for the entire usage period of air-conditioning system by solar power by the analysis by using Life Cycle Cost Analysis (LCCA) with the order as follows 1. Specify characteristics / format of interested format 2. Specify usage period of the interested system 3. Evaluate the expense happening from the interested system 4. Calculate the expense value for the entire usage period of the interested system 5. Analyze the expense calculation result for the entire usage period of the interested system. The analysis of the value of the entire usage period is an important tool in the decision that the system should have the work process in what direction in order to reduce the expense for the entire usage period.

Booranachan (2550) study the relationship between factor to the success and the success indicator of the product development process by applying ANN (Artificial Neural Network). ANN has been created in order to predict the success of the product development process in the various aspects according to the Balance Scorecard's perspectives which uses reference data of the factor to success and the success indicator of the product development process which has been received from surveying mechanical parts industry, template and vehicles in Thailand by 96 questionnaires. Data are analyzed by dividing into 2 large groups according to the product development process happening in the organization including the group with the design and development process in the organization and the group with no design process but can create products as the customers have specified and/or can improve product according to the format or specification. Multi-level ANN network and the learning process has sufficient ability in predicting the success of the product development process when the network has been trained. It can predict correctly and accurately. The accuracy of the prediction depends on many factors such as the amount of the information available when comparing to many related parameters and the quality of the data received from the questionnaires so it can be seen that the ANN technique can be applied in predicting the success of the product development process well and have high accuracy.

Park et al. (2001) estimate of the cost by using LCC method in the design which the cost of most LCC product life cycle would be at the design process, estimation method for the product life cost in the design process requires news information and the time period for many phases of LCC. The designer will compare

LCC between different product concepts. The product in the step of Concept Design and factor of LCC would be very important in the decision in the design to use statistic analysis method and to use Neural network algorithms method as application of LCC estimation by specifying import product and to have the result as LCC as the LCC estimate for new product concepts quickly which the estimate of LCC cost by ANN technique is feasible for estimating the cost incurred in subsequent phases of the product life cycle based on design decisions at early conceptual design stages. The proposed method can be used to estimate the product LCC and gives the guidelines leading to cost-effective design decisions in the conceptual design phase.

Chaicharn (2543) knowing the product life cycle would make producer to know that producing many kinds of product which have various life cycles in order to reduce the risk of the company because when one goods is outdate the company can still make profit from other products. If one knows the product life cycle one can prepare a new product or to make it different so in order to create the wall for competitor to catch up and try to make the goods to be in the acceptable period in the market for as long as possible and (Susan, 1989) the benefits of life cycle concepts are summarized as follows:

1. The life cycle concept results in earlier actions to generate revenue or to lower costs than otherwise might be considered.
2. Better decisions should follow from a more accurate and realistic assessment of revenues and cost, at least within a particular life cycle stage
3. Life cycle thinking can promote long-term rewarding in contrast to short-term profitability rewarding.
4. The life cycle concept helps managers to understand acquisition cost vs. operating and support cost, such as to find a correct balance between investment cost and operating expenses.

2.8 Application of ABC system

2.8.1 Application of ABC system with TOC

OPT (Optimized Production Technology) or to be called nowadays TOC (Theory of Constraints) which is a method emphasizing on increasing productivity to Bottleneck area of a production line with a concept that the highest product of any production will be determine by bottle neck process but increase of productivity to the process that is not bottleneck is just work in process. Production cost in the type of pushing process behind in order to collect or to resend creates work between production waiting in the production line in a large amount. (Suntarachan, 2549)

Application of ABC and TOC for a better decision-making in order to be the decision-making information regarding the pricing / producing / buying and producing mix. The process and products are diverse which place importance on cost and the constraints is Bottleneck problem in order to utilize the information on price regarding process improvement and product on profit of the company and decision-making on both short-term and long-term. TOC would look in a short term with production capacity as constant variable consisting of labor cost and productions overhead with varied raw material cost and ABC would look in a long term with all varied production power. (Gurses, 1999; Sheu, 2001)

2.8.2 Application of ABC system with EVA

EVA is regarded as a single, simple measure that gives a real picture of stockholder wealth creation (Tully, 1998). EVA or Economic Value Added which is an economics-related work operation measuring tool and EVA shows the real profit of the business by deducting the cost for a part of shareholder or Cost of Equity that we call Opportunity Cost of business. Apart from deducting cost of debt, this real profit would show the result of the business management to have directions that would create value of the firm or destroying value of the firm. If EVA of any company has tendency to increase continuously. It is means that management of that work is successful and creates shareholders' wealth which creates satisfaction as equation 1 (Roztock and Needy, 1999)

$$\begin{aligned}
 \text{EVA} &= \text{NOPAT} - \text{Capital Charge} \\
 &= \text{NOPAT} - C \times \text{CCR}
 \end{aligned}
 \tag{1}$$

by

EVA = Profit from work operation after deducting tax - (investment cost x investment in property for business)

C = Capital

CCR = Capital Cost Rate

NOPAT = Net Profit after Tax + Total Adjustments - Tax Savings on Adjustments

ABC and EVA to apply which is suitable for small production industry by emphasizing on production cost/Product Cost in order to create credit to the information of the cost in the decision-making to the organization and to increase the potential in the competition and the long-term profitability and create wealth to shareholders and to create added value to product. ABC would give correct Operating Product Cost and only interested in Operating Cost/Expense creating income to organization but the weak point is that it does not pay attention to Capital Cost, Investment Risk and the various Cash Flow Factors such as interest rate, tax. ABC and EVA can create added value to product well and increase strategic management as follows 1. Increase sale amount 2. Reduce investment and reduce waiting 3. Reduce operation cost 4. Increase product in production line 5. Find new product that increase value more than original product 6. Stop production with the steps of ABC and EVA as follows 1. Review the company's financial information 2. Identify main activities 3. Determine operating cost for each activity 4. Select cost driver 5. Calculate operating costs for cost objects 6. Calculate capital charges for cost objects. (Roztock and Needy, 1999)

2.8.3 Product Design Process, Product Life Cycle, Life Cycle Cost and Application of ABC with product design.

2.8.3.1 Product Design Process

Booranachan (2550) the design and development process of products is the heart of the business in the production for controlling quality and the

cost of the last product. The decision in the first design process would be very important in the production. The consideration in the design process is the starting point in making customers satisfied so it is the first thing to do (Pinta, 2546) because this process is the process before production. If the product design is correct and according to the need of customers it would make the production process can produce the products correctly and according to the need of customers (Dowlatshahi, 1992). The design of the product that has the influence to the expense of the cost is at 70-80%.

Kidd and G. Thompson (2000) design and development of products is a difficult and very risky process because it requires large amount of investment and there are many challenges such as constant change, change of technology, pressure on price etc. (Sarsananun, 2550) The product design and development would have main criteria as follows 1. Specification of customer need 2. Specification of product criteria 3. Creation of product concept 4. Selection for best concept 5. Testing of concept and creating of sub-system criteria 6. Creating of format in the details 7. Test and prototype creation.

The following list is a summary of the ten design guidelines (Shields and Young, 1991)

1. The structure and process of a firm must create a human integrated enterprise.
2. Long-term success with consumers requires low expected whole life costs - not only low production costs.
3. Use only the whole life costs of a product that are relevant to a particular decision.
4. Invest more in pre-manufacturing assets and in people skills to increase the probability of low cost, higher quality and innovation.
5. Use more resources in the early phases of a product life cycle.
6. Target costing is the key to establishing cost goals for a product.
7. Cost reduction, not cost control.
8. Performance evaluation and compensation systems should reinforce a whole life cycle cost perspective.

9. All sources of organizational resistance to PLCCM (Product Life Cycle Cost Management) must be dealt with in implementing a culture of cost consciousness and continuous improvement.

10. Continuous education.

2.8.3.2 Application of ABC with product design.

Ben-Arieh and Qian (2003) apply the activity-based cost system to the product design and develop the product which the design process and the product development is a complicated process and the cost is not clear and highly risky in the product price making because it has a high cost and the product design and development is very challenging especially the beginning part of the design and the development. However, the calculation of the cost in the product design and development is still necessary and it is interesting to be used because the design cost is as high as 80% of the overall cost (P. Duverlie and J. M. Castelain, 1999) and the design is changing all the time due to the changing business environment and the customer changed that has changed. ABC would analyze the activity in designing and developing product which uses the tool of Integration Definition For Function Modeling in order to find the relationship of each activity with the steps as follows. 1. Identify the resource centers used for the design and development. 2. Identify the overall cost associated with these resource centers. 3. Find the cost drivers for the resource centers. 4. Identify the activities that participate in the design and development process. These activities are analyzed using the IDEF0 methodology 5. Calculate the cost of the activities based on resource consumption. 6. Find the activity cost drivers and calculate their values. 7. Calculate the overall process costs based on the activities performed. In applying ABC in designing and developing the product can help find the cost according to the activity which is more precise to the original cost calculation which make us know the factor which is the cause for the cost and in designing and developing the product, time and the cost for the design would highly fluctuate. If the time used in the design is great, the cost for the design will also be great. The sample in apply ABC in the design (Al-Sudairi , 2008) by using the method of Simulation Model by connecting to the cost calculation of ABC in order to find the factor and the resource in the design process (Ben-Arieh and Qian , 2008) by using the

method of cost evaluation parametric part along with ABC in order to estimate the cost for the design and develop the parts of rotational part by using the tool called IDFE0 as an analyzer from the receiving process of the need from the customers continuously until the production as prototype to customers. The analyzes of the activity in the design and development of the product to the various development of parametric cost evaluation which the various parametric cost management must use the correct method and the information must be reliable or to be the method that can be used in developing the product in the first time and there is the usage of the data in a large amount so the estimate of the parametric along with ABC can be proved to be the method that is correct and fast. From the consideration of the fact in the cost estimate and the production overhead and the implicit cost of the design is deemed that this method has increased the ability in the product in order to better evaluate the cost of the design and the development of the design.

Tornberg et al. (2000) usage of ABC by using Graphic Flowchart helps the collection of complicated and complex data of the Product Structure and the related total cost that has been made in each day starting from the buying order taking process until the goods is delivered which categorize into groups and separate the data of all the activities that has happened and gather the data of the entire cost that has happened into the Graphic Process Model (GPM) which would be the preliminary problem solving process in the estimating of the total related cost (Parametric Cost Information). ABC and GPM is a way that would help the expense data of the product that each customer want and wishes to receive appropriately. This would be a greater benefit to the designer and the developer.

2.9 Literature Analysis

The activity-based cost calculation is one of the concepts of the cost analysis which has been accepted to be a correct cost estimate method and close to the reality which is suitable for the cost calculation of the product nowadays.

The activity based calculation can be used in the various industry aspects such as Wongbuakaew (2544) uses ABC to compare the pricing of the goods in the stainless kitchen utensils producing factory. Kittiwacharapol and Ngaoprasertwongse (2543) study the estimate of the production cost in the printing industry (Kulawong, 2544) and analyze the production cost in motorcycle parts manufacturing factory by using ABC. Wisuttiapat (2547) study a way to reduce the cost of the hot structure metal manufacturing. Wetwitoon (2543) study the cost for producing weaving factory by applying ABC cost calculation method. Anuruttanoon and Runrenganun (2544) study the ABC cost system in the silver jewelry industry. Wongchuear (2548) study and analyze the real production cost in the drinking factory in order to be used in specifying the price by using cost system of ABC. Vithayakerttelret (2546) study the application of ABC concept in the medium-size business of producing cane sugar. Walker (2000) has used ABC in implementing in the book producing industry by using the work of production planning and uses the gathering of the data from customers starting from taking the book order until the customers has received the book.

Apart from the fact that ABC will be used in the various industry, ABC can be used along with other concepts such as Huges (2005) uses ABC with ABM for the planning and continuous improvement and control the organization activity in order to respond to the need of the customers with the main objective of creating the value to the customers with decreased cost (Gurses, 1999; Sheu, 2001) ABC and TOC in order to help the decision making in a better production in order to be the information in the decision-making on the price and the product mix. The process and the product would be diversified which focuses on the cost mainly and there is the restriction or the constraints as the Bottleneck problem. As for (Roztock and Needy, 1999) uses ABC and EVA which emphasizes on the production cost/product cost to increase the reliability to the data of the cost in the decision making of the organization. Yongprayoon (2550) study of expense for the entire usage period of air-conditioning system by solar power by the analysis by using Life Cycle Cost Analysis (LCCA).

Park et al. (2001) the estimate of the cost by using LCC method in the design which the cost of most LCC product life cycle would be at the design process,

estimation method for the product life cost in the design process requires news information and the time period for many phases of LCC. Booranachan (2550) to apply ANN (Artificial Neural Network) for predict the success of the product development. (Ben-Arieh and Qian, 2003; Ben-Arieh and Qian, 2008; Tornberg et al., 2000; Al-Sudairi, 2008) which would apply ABC in the design and development of the product. Summarize for research as the table 2.1.

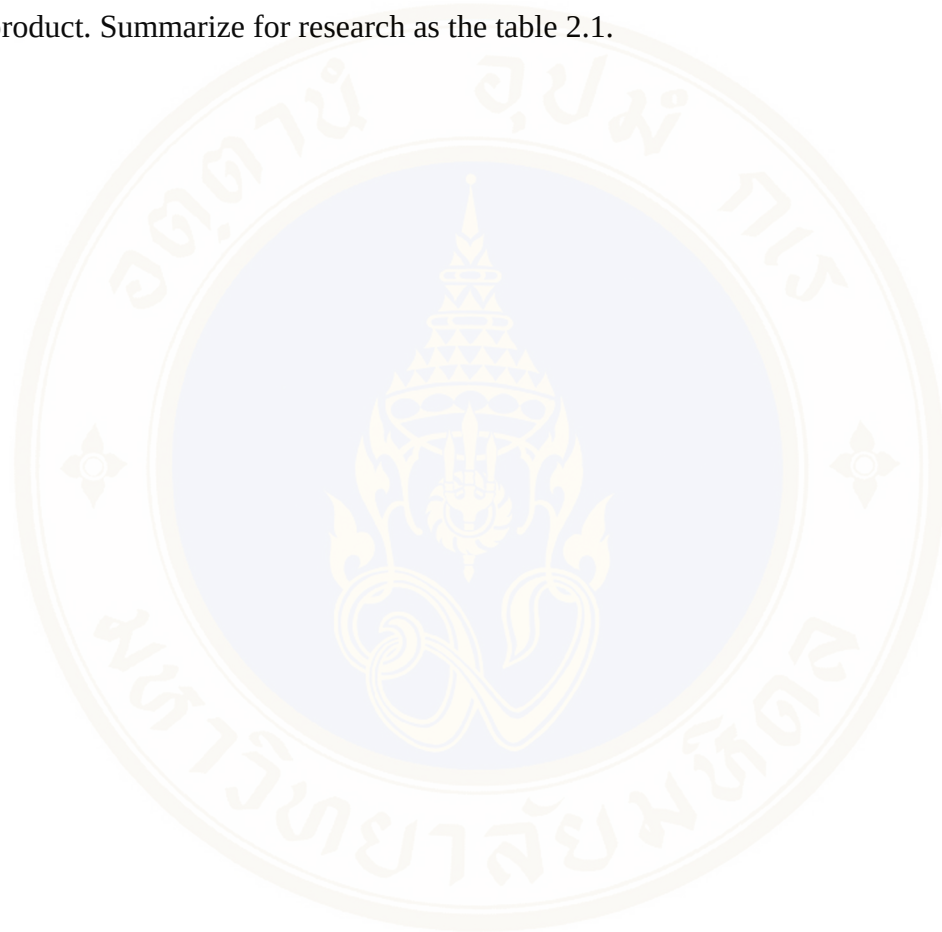


Table 2.1 Summary of Research

Author	ABC				Application of ABC			Product Life Cycle & Life Cycle Cost		ABC in Product Life Cycle	
	Definition	Procedure Process	Cost driver principle	Factors Effected	TOC	EVA	ABM			Design (Acquisition Phases)	Production (Operation Phases)
Shields & Young (1991)										x	
Turney (1996)	x										
F. Frank Chen (1996)		x	x								
Kaplan and Cooper (1988)	x										
Susan (1989)											
Amrik S. Sohal and Walter W.C Chung (1998)			x	x			x				
Tully (1998)											
Aysepinar Gurses (1999)					x						
A.Gunasekaran (1999)							x				
Gunasekaran (1999)				x							
Kidd and G.Thompson (1999)										x	
Narcyz Roztock (1999)						x					
Narcyz Roztock and Kim LaScola Needy (1999)						x					
Curtis Walker (2000)											x
David Ben-Arieh*, Li Qian (2000)										x	
Katja Tornberg, Milikka Jansen, and Jari Paranko (2000)										x	
Roztock and Needy (2000)	x										
Chwen Sheu (2001)					x						
J.-H. Park*, K.-K. Seo*, D. Wallace* and K.4. Lee3 (2001)											
Hilton (2002)			x						x		
M.Gupta and K.Galloway (2003)							x				
Derya Eren Akyol, Gonca Tuncel, and G. Mirac Bayhan (2004)	x	x					x				
Michael A.Kaszubski (2004)							x				
Andrew Hughes (2005)							x				
Arkadiusz Januszewski (2005)	x										
Mesfin Gizaw (2006)			x								
Jamaliah (2008)				x							
Abdulslam A. Al-Sudairi (2008)										x	
David Ben-Arieh*, Li Qian (2008)										x	

Table 2.1 Summary of Research (Cont.)

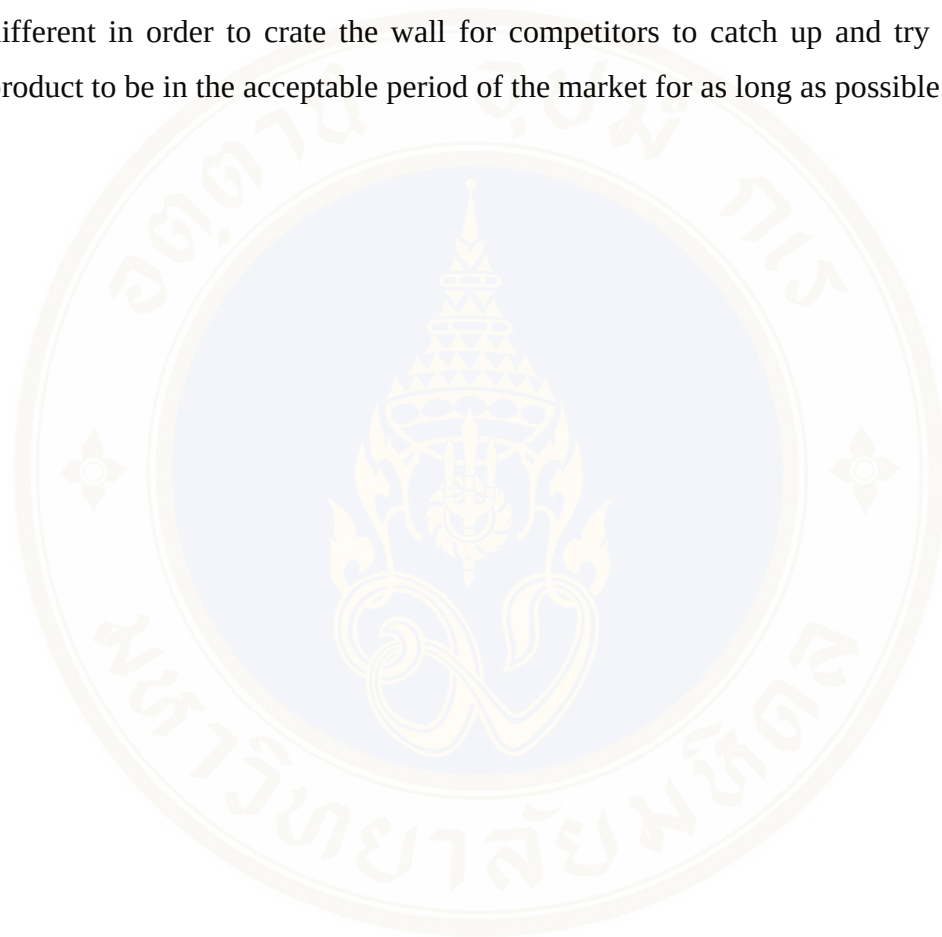
Author	ABC					Product Life Cycle & Life Cycle Cost	ABC in Product Life Cycle	
	Definition	Procedure Process	Cost driver principle	Factors Effected	Application of ABC		Design (Acquisition Phases)	Production (Operation Phases)
Wetwitoon (2543)					TOC			X
					EVA			X
Kititiwatcharapol and Ngooprasertwongse (2543)					ABM			X
								X
Anurutanoon and Runrenganun (2544)								X
								X
Kulawong (2544)								X
								X
Wongbuaekaw (2544)								X
								X
Vithayakerttiet (2546)								X
							X	
Pinta (2546)								
								X
Wisuttipat (2547)								X
								X
Wongbuaekaw (2544)						X		
							X	
Sarsananun (2550)								
						X		
Yongprayoon (2550)								
Luangsakulthong (2550)		X						X

From the said research work review it is found that the researches in the past mostly focuses on using ABC in calculation the production cost. Only small part of them that would focus and give interest to the design cost and the product development which is a very important beginning and from the data of petroleum institution of Thailand in designing product design and the plastic industry process of Thailand still lacks the research and systematic development when comparing with various countries such as Malaysia which supports the research and development and systematic product design and there is the setting up of responsible work unit in both affairs directly, China has supported the development of Reverse Engineering by copying first and then further advance it. The important point is that Chinese personnel has the potential in learning by the said method. South Korean and Japanese has a business operation in a large business group which makes it to have a high capital in supporting the research and development.

Moreover, the format of research and development still has the connection between the researchers and users. As for Taiwan, the private sector supports the research and development but it is a smaller ratio than South Korean and Japan. It can be seen that the said countries have placed importance on design greatly so in order to strengthen the plastic industry of Thailand to be in the same league as other countries. Thailand should have the strategy to develop product and technology and the management in order to fulfill the research and develop the product because Thailand still lacks systematic research and development and it still lacks the connection between networks in studying the industrial sector which makes the development of industry to go very slowly. If we can organize the technology management and support the research between the public and private sector we can truly answer the need of the market and regarding the product design Thailand does not seriously support the plastic product design especially the process of the design and the production that depends on high-level technology. (source: Petroleum Institute of Thailand, September 2551)

Therefore, the research has applied Activity Based Costing (ABC) in the design and development of the product for the entire product life cycle in order to create the benefit to the cost management for the plastic industry of Thailand. This is because the production cost on the production overhead of the industrial production of

Thailand has a higher cost than competitors and in order to know the life cycle of each product can make the producer to know that many types of product which has various life cycles to help reduce the risk that would happen because when one product is outdated the company can still make profit from other products. If they know the product life cycle they would be able to prepare issuing new product or to make it different in order to create the wall for competitors to catch up and try to make the product to be in the acceptable period of the market for as long as possible.



CHAPTER III

RESEARCH METHODOLOGY

This chapter is about the research methodology from the beginning to the end of doing this research.

3.1 Framework of Research

Flow chart was shown on Figure 3.1: Explanation for more understand framework of research.

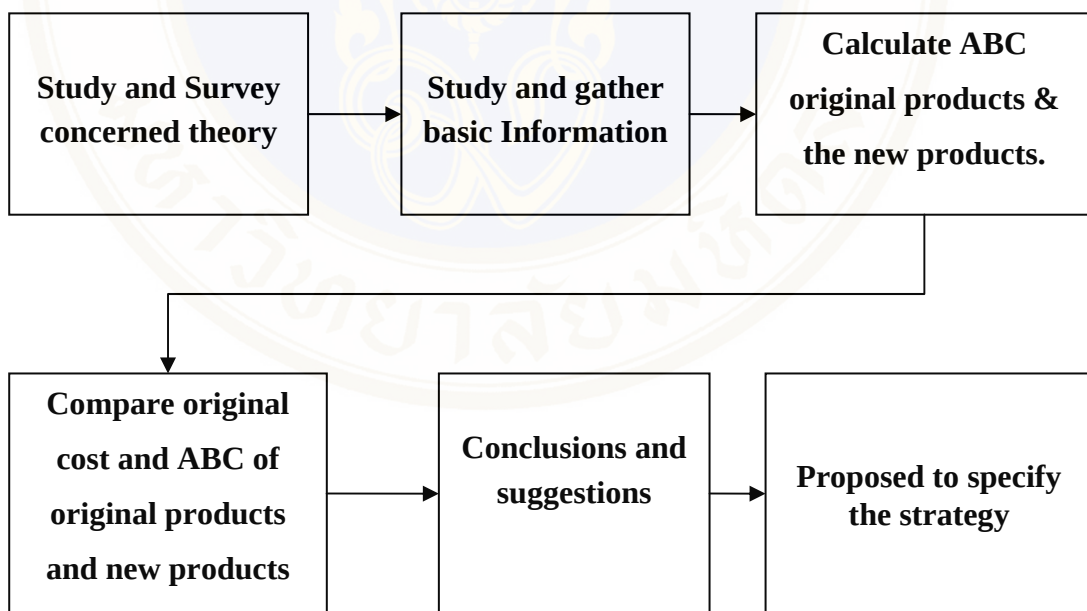


Figure 3.1 Research plan

3.2 Step of Research Methodology

3.2.1 Study and survey subject concerned theory, analysis and solve problem.

3.2.2 Study and gather basic information in the example factory by collected details and activity costs into 2 parts:-

3.2.2.1 Collect information from secondary details by gathering information from many sources of the company such as organization, sales, production, costs of each product and various expenses, etc.

3.2.2.2 Collect information from discussion concerned person for learning duty and relationship of all circumstance activities insist upon continually analysis.

There were 2 support tools directed towards to summary and analysis the activity information for fulfillment and more understanding whatever related and organization of incurred costs.

1) Procedure flow chart

Procedure flow chart was step of operation which has reflected in vain of work instruction on various activities of each department, not specific that operated (block diagram).

2) Process flow chart

Process flow chart was step of operation which has reflected in vain of resolving on work process of related and concerned activities.

3.2.3 Calculate activity based costing of the original products and the new products.

1) Collect all costs details of each activity.

2) Breakdown and divide costs of each activity next to main or support productions.

3) Procedure each activity offensive for grouping and consider which efforts were applied on production expenses. On this thesis has obstructed analysis for finding activity offensive.

4) Figuration on costs rate of each based activity upon settlement the effort costs of each based activity, then calculate production expenses.

5) Managerial costs of each product along to collection or topic activity were applied in production. Calculate total production costs of original products and the new products and calculate the cost per unit of the original products and the new products.

3.2.4 Compare the original cost and activity based costing of the original products and the new products.

3.2.5 Conclusions and suggestions

From exclusively study and suggestions on this thesis have directions to unit costs and logical of primary costs and based activity costs also suggestions for any proposed on additional research and written inclusive report.

3.2.6 Proposed to specify the strategy in cost management to the organization.

3.3 Research Time

Table 3.1: Demonstrate research time

Activities	Month							
	2	4	6	8	10	12	14	16
1. Study and Survey concerned theory								
2. Study and gather basic Information								
3. Calculate ABC original products & the new products.								
4. Compare original cost and ABC of original products and new products								
5. Conclusions and suggestions								
6. Proposed to specify the strategy								

CHAPTER IV

CASE STUDY ON INFORMATION GATHERING

4.1 General Information

This case was studied in the downstream of plastic industry (Tier 3) who was a manufacture and sales plastic sheet and synthetic leather for supplying to ended products producers (Tier 2) for example:- automotive industry for automotive interior part, furniture industry for sofa, sport industry for football, etc. The plastic industry has also supplied products into roll and sheet to general industries for making many kinds of applications.

The company in this study case has registered the capital investment at 211,750,040 baht and managed with family style. Main products were synthetic leather, flexible film sheet and car flooring. There were 455 employees and 2 main machines which were calendering and oven. This plastic industry have 7 groups of support machines, they were foaming machine, embossing machine, printing machine, laminating machine, surfacing machine, inspection machine and cut sheet machine. The policy in line of good operation as follows:-

1. Marketing: Target sales 970 million baht per yearly.
2. Production: Supervision quality control system. Also, continuously fulfillment with trained and developed employees to maintain high productivity and lower yields.
3. Services: Services was the important thing in competitive business and carried on the company's policy as preserving standard of good services, paying more attention to personal development and services improvement right to requirement of the present business.

4.2 Structure and Responsibility of the Company

The organization chart displays all division of company as shown in figure 4.1. The company in this case study was organized with 7 divisions and 20 subdivisions.



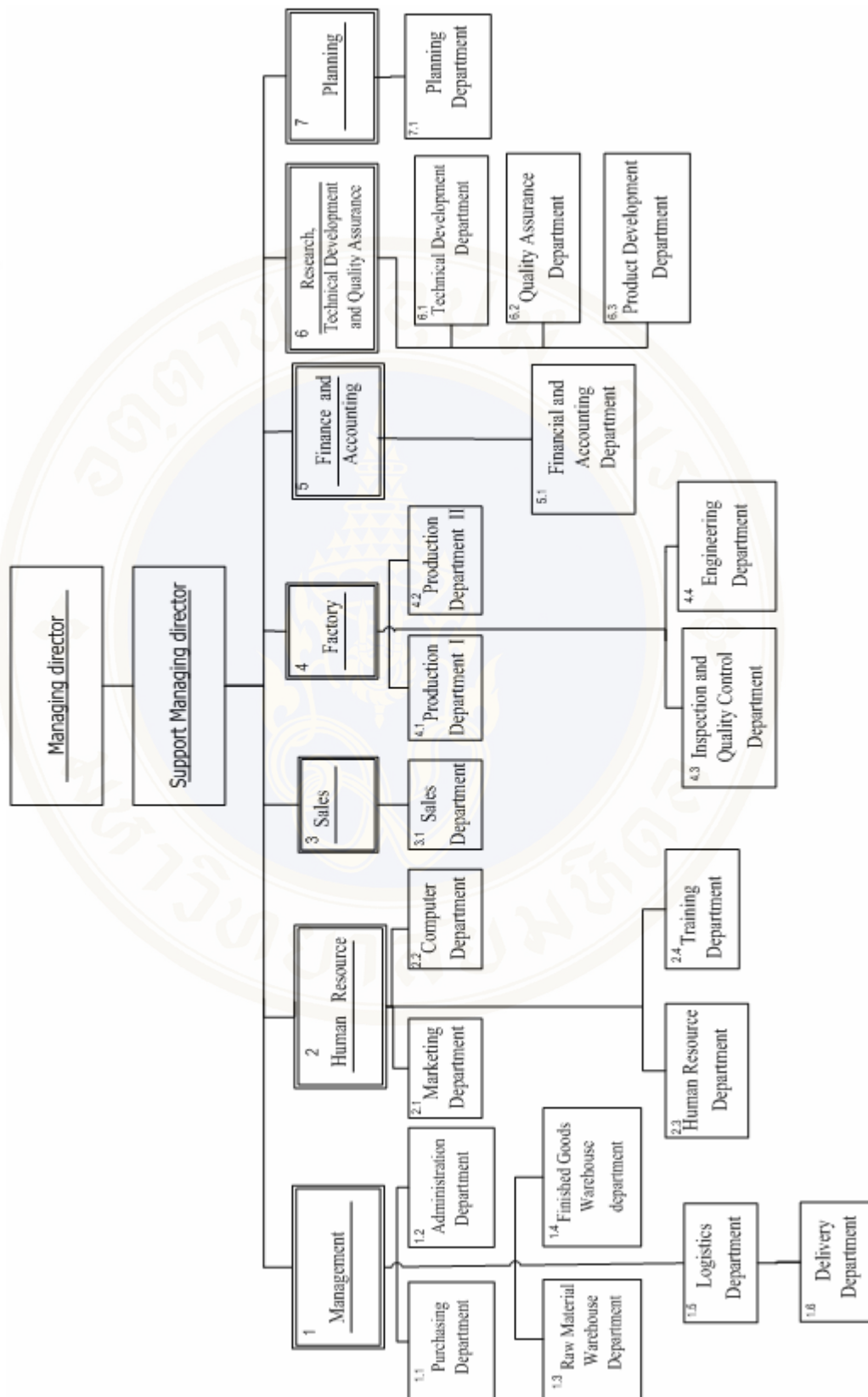


Figure 4.1 Organization Chart of Company

4.3 Products

Products of the company in this case study covered with 3 categories.

4.3.1 Flexible film/sheet

1. Opaque film sheet, opaque plastic applied into album, dress cabinet, shadow curtain, table cloth, shower curtain, apron, etc.
2. Transparent film sheet, transparent plastic applied into glass house, pencil case, book cover, diary, bag, etc.
3. Film sheet with printing, transparent or opaque plastic with color printing decoration applied into table cloth, blowing-air product, folding chair, shower curtain, dress cabinet, etc.

4.3.2 Synthetic leather

1. Normal leather, plastic sheet laminated with fabric backing applied into automotive industry, furniture, bag, shoe, etc.
2. Sponge leather, plastic sheet laminated with foam and fabric backing applied into automotive industry, furniture, shoe, etc.
3. Sponge leather, plastic sheet laminated with foam without fabric backing applied into automotive industry, such as door panel, etc.

4.3.3 Car flooring

Car flooring plastic sheet without foam and fabric backing applied for car mat or any purposes, etc. Car flooring has classified into 2 processes: 1. Product was casting process 2. Product was calendering process.

4.4 Production Processes

4.4.1 There were 2 main machines for production processes.

Products have been produced by using machine process of calendering and/ or oven and output became semi-finished goods which were proceeded to the next process until finished.

Machines processes were as details following:-

1. Calendering process (See Figure 4.2 and 4.3)

1.1 Prepare raw material compounds such as PVC resin, plasticizer, stabilizer, filler, etc. at control room

1.2 Blow to banbury mixer

1.3 Mix roll # A for 1st crumbing

1.4 Strain at wire strainer extruder

1.5 Mix roll # B for 2nd crumbing

1.6 Press and roll with calendering machine

1.7 Down heat by cooling roller

1.8 Laminate plastic sheet with fabric by using embossing roll

1.9 Down heat by cooling roller

1.10 Roll package by using rewinder machine

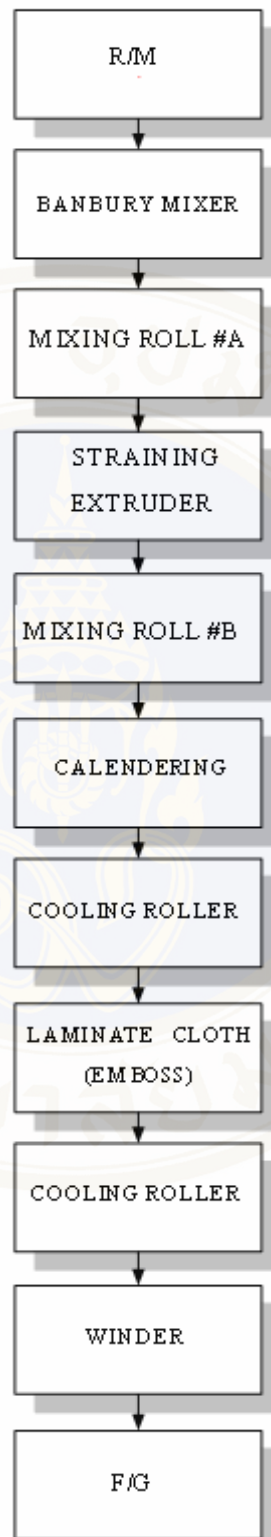


Figure 4.2 Calendering Process System

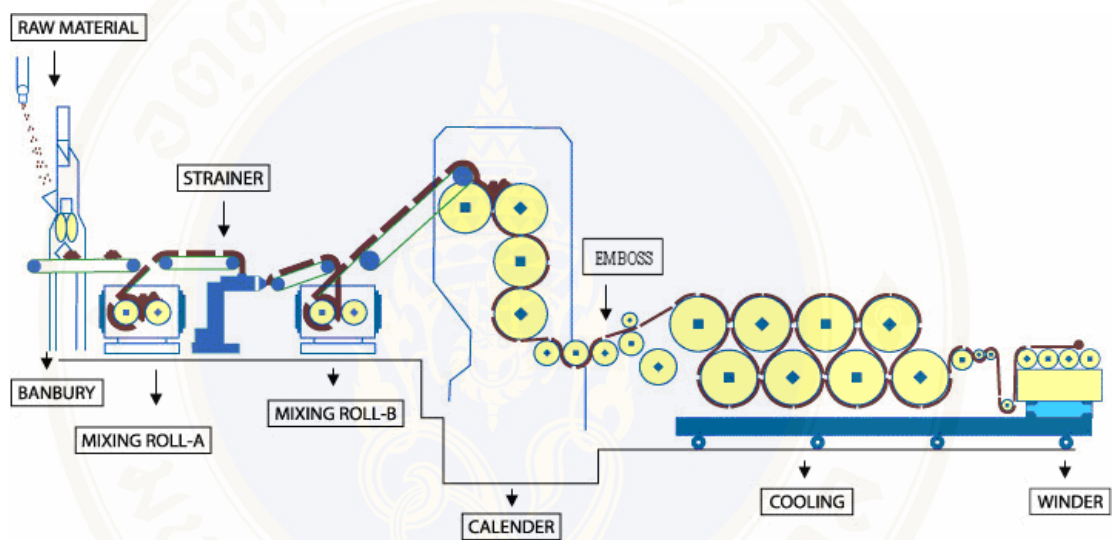


Figure 4.3 Calendering Machine

2. Oven process (See Figure 4.4 and 4.5)

Synthetic leather sheet was a highlight product which has used oven machine process. Output products were finished in one process. The grain design on synthetic leather sheet was shown by release paper which coated with silicone. Release paper has rewinded from the roll, then coated on paper by pouring PVC compound with sticky pigment and carried to oven machine. In case of synthetic leather sheet was required deep designed pattern, it might be embossed with embossing roller machine.

2.1 Prepare PVC compounds with pigment and additive spinning with mixer machine (with vacuum system)

2.2 Extrude to three rolls mill

2.3 Pour all compounds on top of release paper and proceed with coating machine. Required thickness would be controlled with doctor knife.

2.4 Go through oven#1 with standard temperature for steadily skin layer.

2.5 Pour PVC compounds with additive and blow agent for making sponge layer surfaced on skin layer.

2.6 Go through oven # 2 with standard temperature for steadily sponge layer.

2.7 Coat glue on the top of sponge layer and laminated with fabric

2.8 Go through oven # 3 with temperature at around 180-220°C for drying and blowing agent.

2.9 Remove release paper from synthetic leather sheet and rolled package by using rewinder machine.

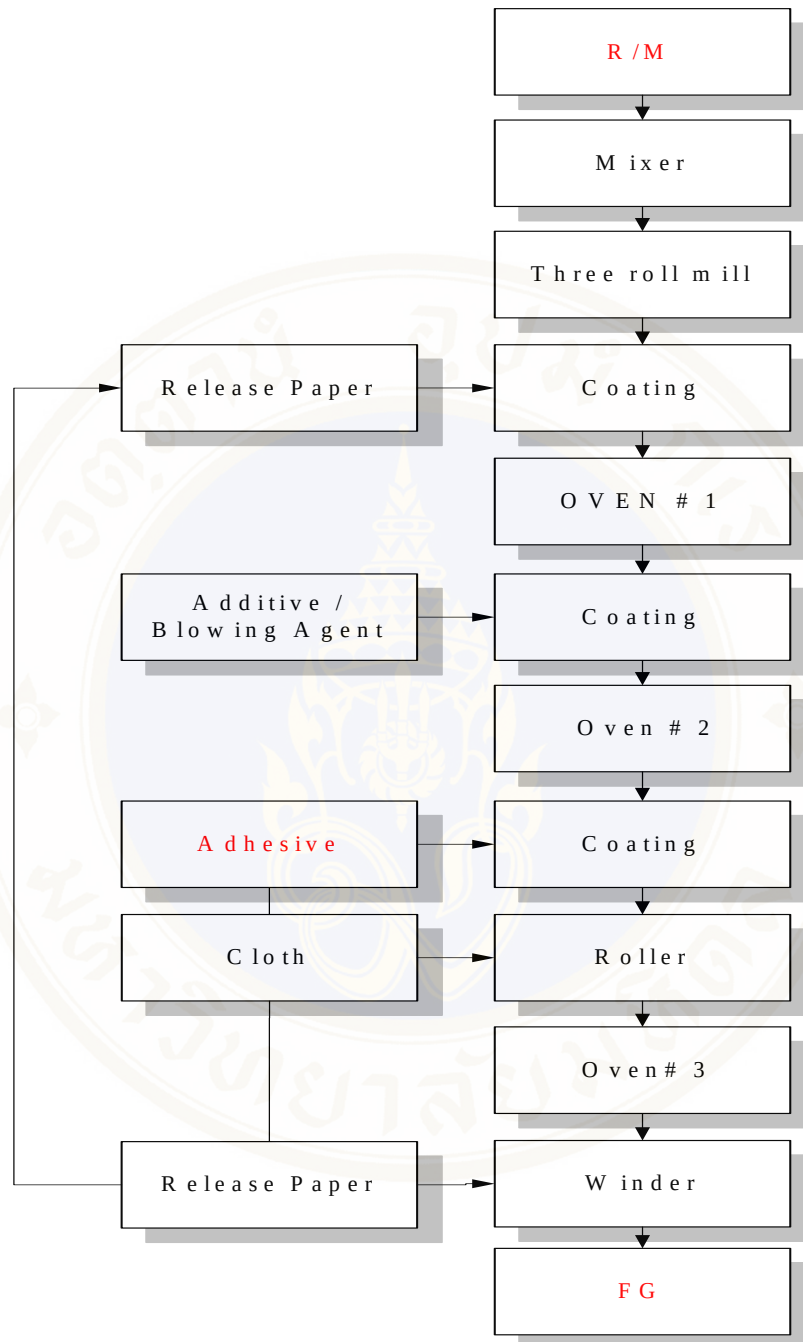


Figure 4.4 Oven Process System

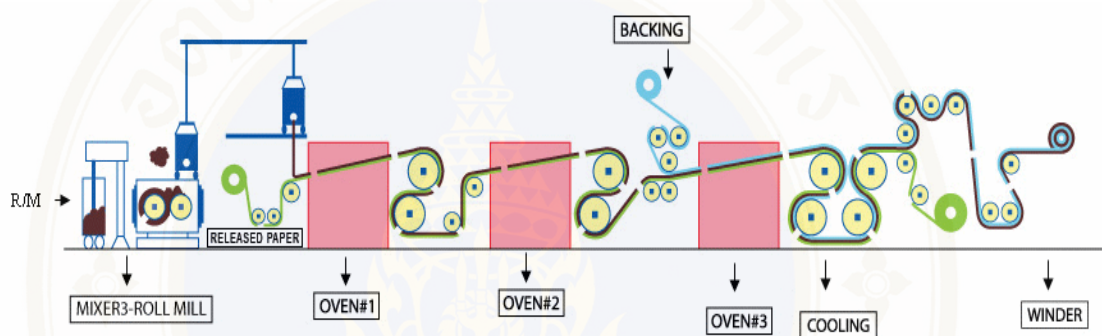


Figure 4.5 Oven Machine

4.4.2 Support on production processes were process for ready-made finished product.

This progression supported has 7 machines groups as follows:-

1. Foaming machine was applied for risen foam and could set embossing roll at the end machine line. Logo or trademark would be printed on the back of fabric.
2. Embossing machine was applied for embossing as required grain.
3. Printing machine was applied for color printing.
4. Laminating machine was applied for laminate plastic sheet with foam or fabric as thickness of customers' requirement.
5. Surfacing machine was applied for coating or priming skin layer. It would be glossy or matted depend on customers' requirement.
6. Inspection machine was furnished at the ended of the process line for check-over all finished products as standard quality.

7. Cut sheet machine was applied for trimming or cutting piece size.

Before the step of designing product and production process, it will show the overall picture of the overall procedure of product manufacturing starting from receiving order from customers until delivering products to customers as shown in the figure 4.6



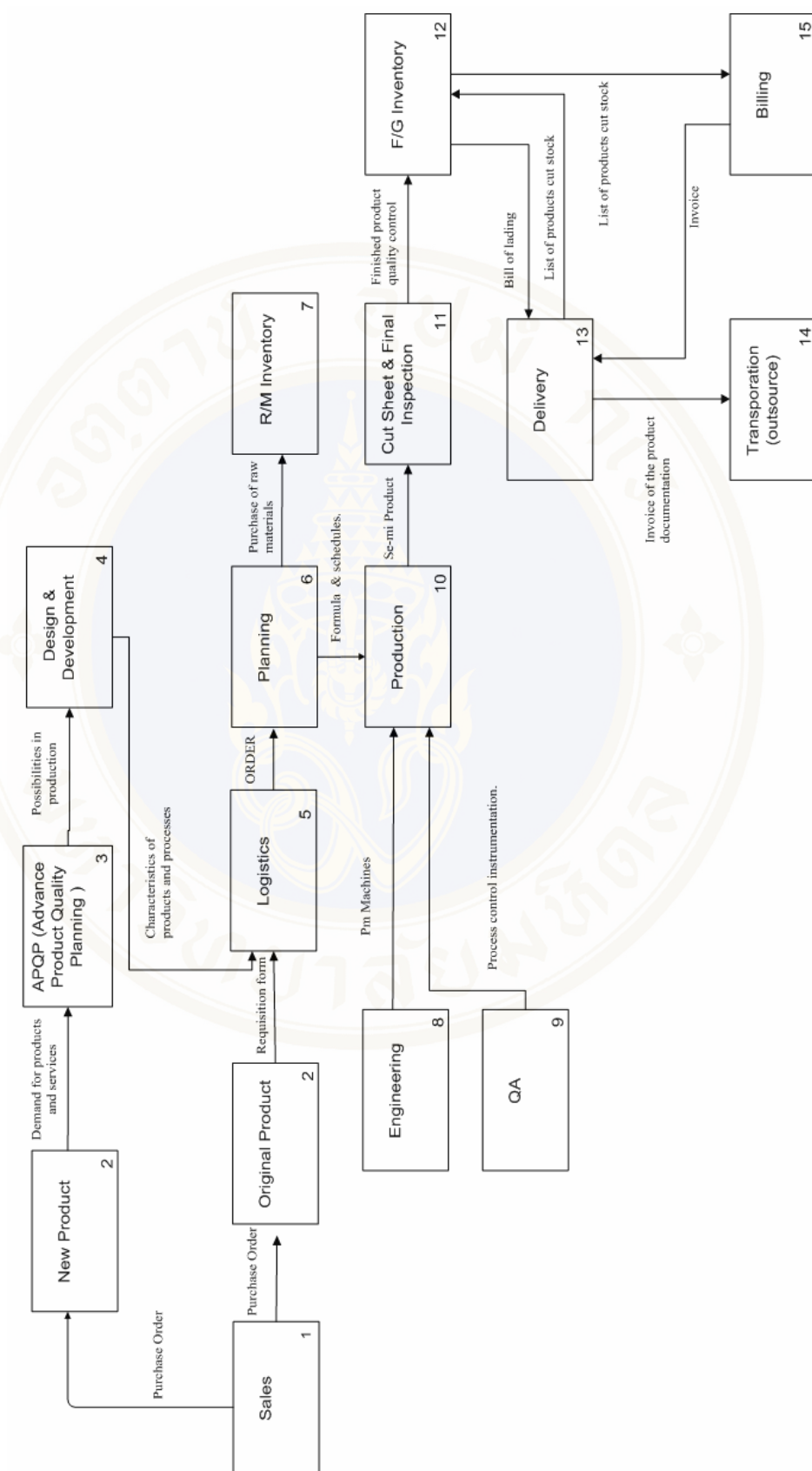


Figure 4.6 Step for receive order from customers until delivery

4.5 Product design and new product manufacturing

4.5.1 Product design process has procedure as follows. Show in figure

4.7

- 1) Planning
- 2) Product design and development
- 3) Process design and development
- 4) Inspection to accept product and process
- 5) Production
- 6) Reverse data evaluation and correction

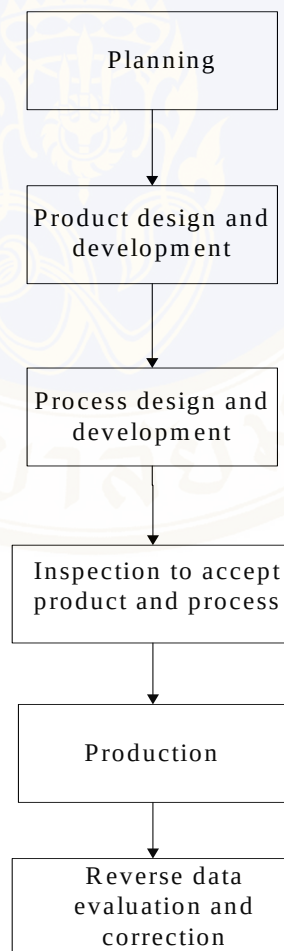


Figure 4.7 Step Product design and new product manufacturing

The details of each process are as follows:

1) Regarding planning, APQP (Advanced Product Quality Planning) would make the work plan for the work operation in each project in order to specify the time in specifying time period in the work operation of each step and to know the completed time and the following by conference in order to know the problem that happen during the work operation and to know the advancement of each project. Show in figure 4.8

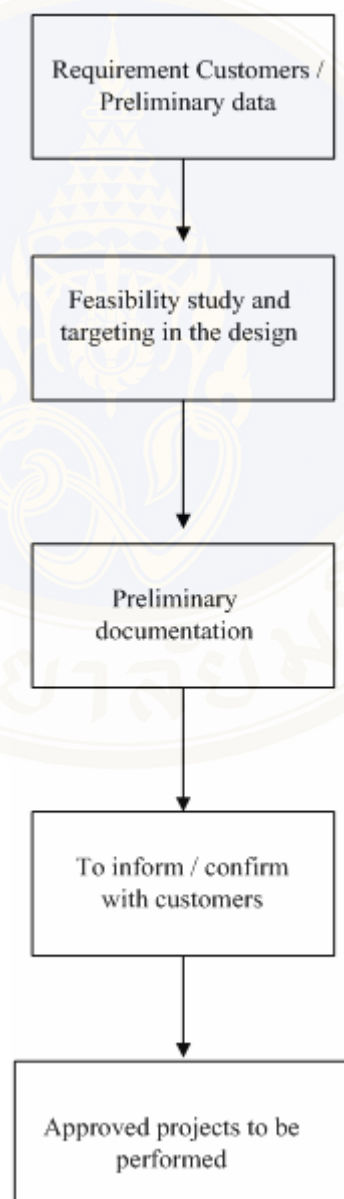


Figure 4.8 Step of planning

2) As for product design and development, after team APQP has acquired preliminary information such as customers data, product specifications, product sample which would deliver all of the information to the research department and product research/technique development department and to analyze and design the product and the production process by analyzing DFMEA (Design Failure Modes and Effects Analysis) and the formula and the production process and when the data is complete the design data would be brought to the conference APQP in order to review and verify the design and to apply the data in the process. Show in figure 4.9

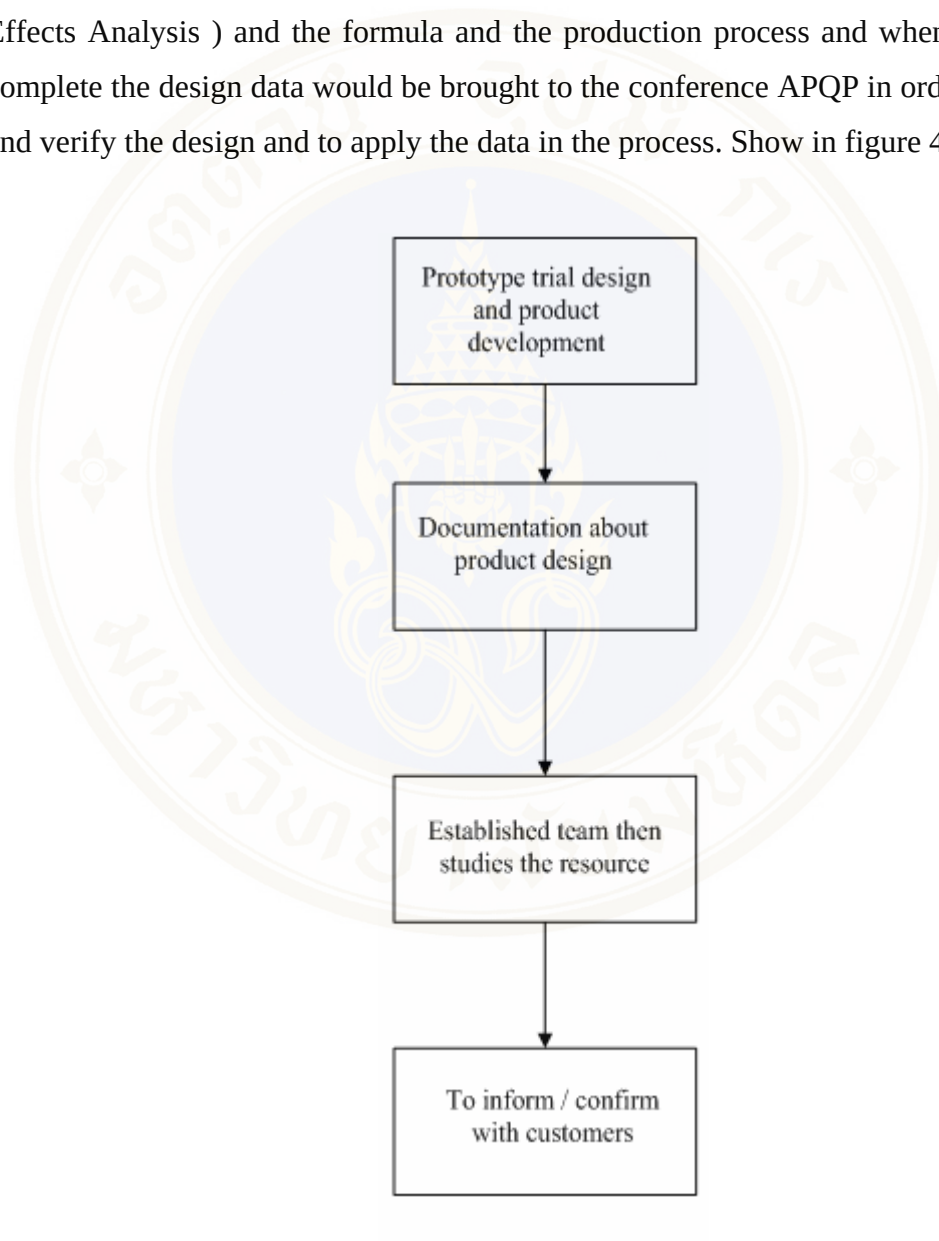


Figure 4.9 Step of product design and development

3) Process design and development of the various related unit would bring the data of each work unit into review meeting before test production and also record in the test details. Show in figure 4.10

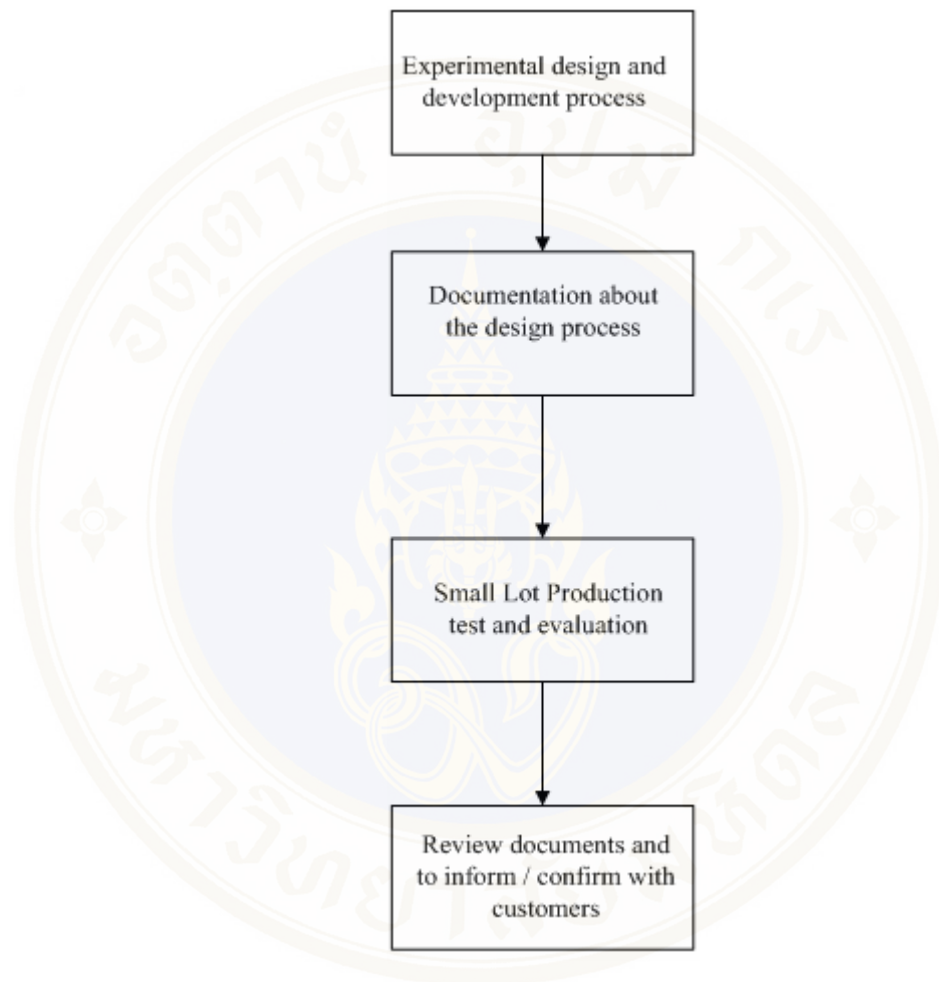


Figure 4.10 Step of process design and development

4) Inspection to accept product and the process of testing design and development after the production in order to see whether the test result receive from the production is consistent with the Specification required by customers or not. After that the test will be recorded. In the case that the test is not according to the Specification that the customers wants there would be the meeting to notify and analyze the cause and find the solution. In the case the test result acquired is consistent

with the Specification that the customers want and sample product would be sent to customers. Show in figure 4.11

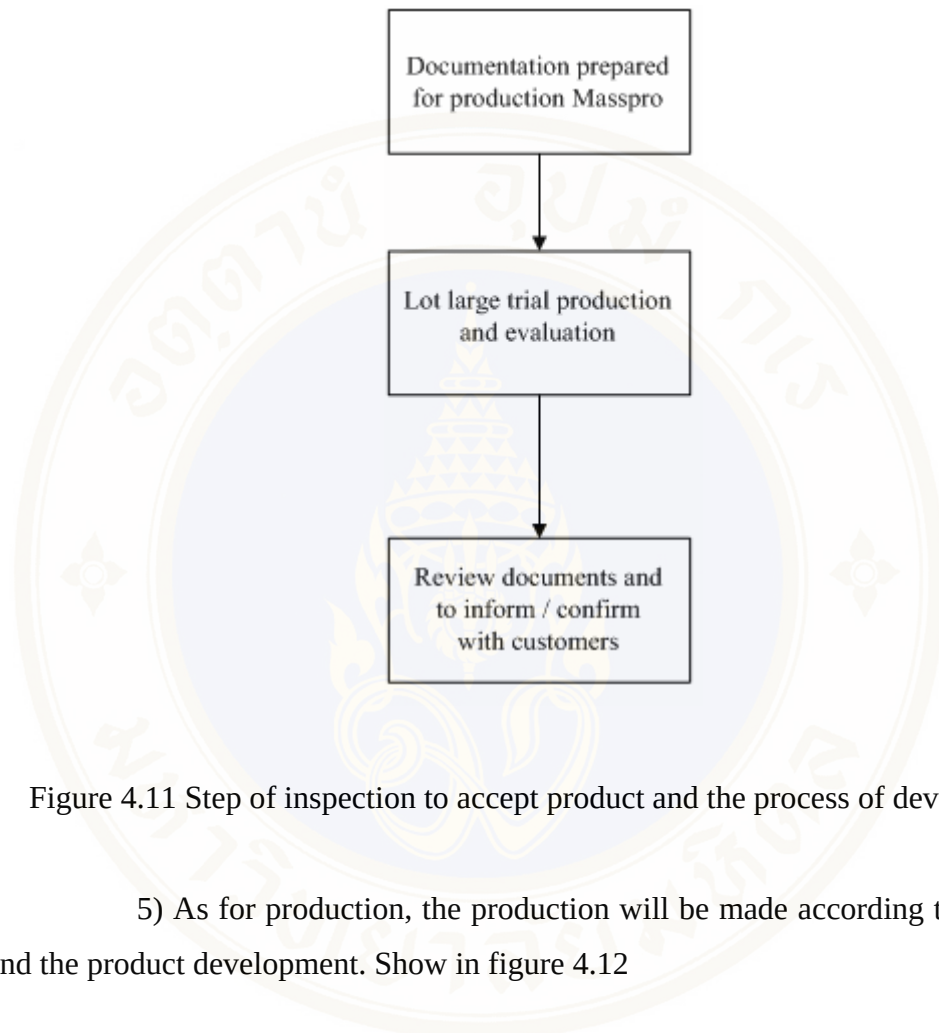


Figure 4.11 Step of inspection to accept product and the process of development

5) As for production, the production will be made according to the design and the product development. Show in figure 4.12

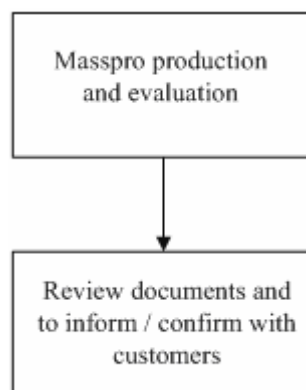


Figure 4.12 Step for production

6) Reverse data evaluation and operation and see the feedback from the customers whether the product made to the customers is consistent with the customers or not. The measurement will be made from the satisfaction of customers and the delivery and the service and to conclude the product that has been achieved. Show in figure 4.13

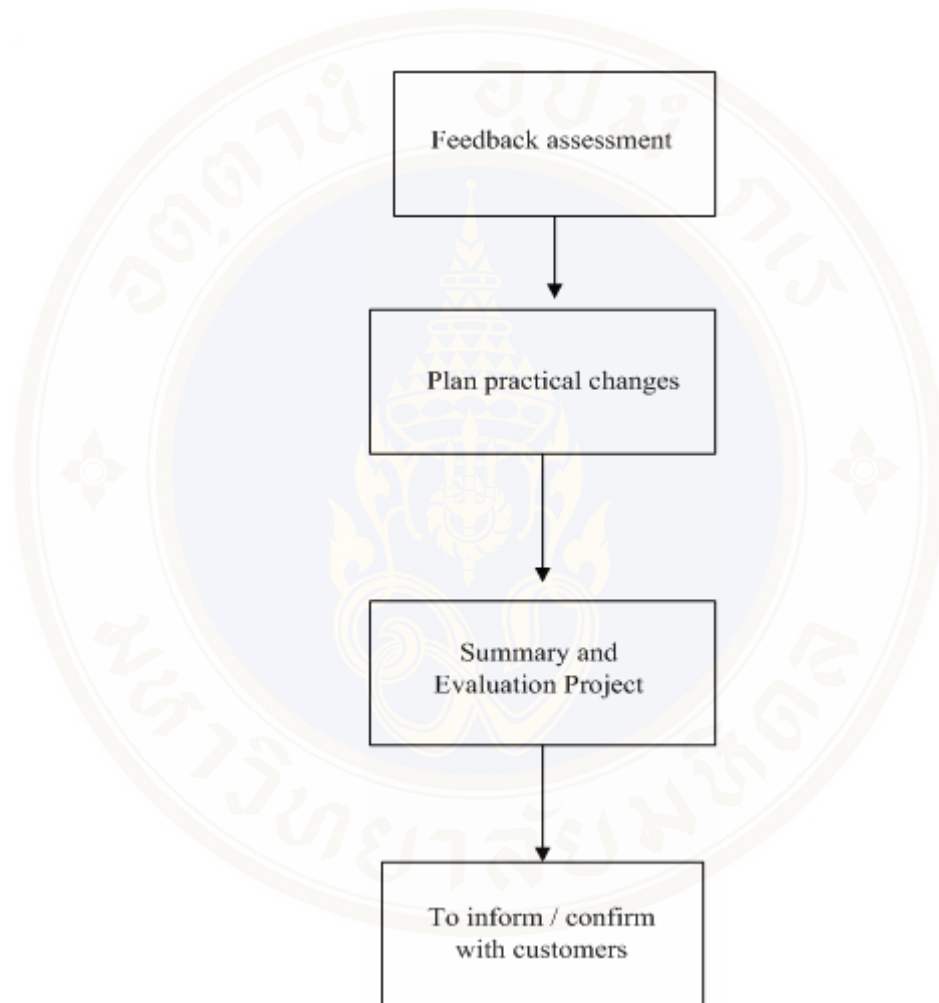


Figure 4.13 Step of reverse data evaluation and operation

4.6 Activity Cost Analysis

The cost analysis of the activity to be mentioned can be divided into 2 types which are 1. The analysis of the activity cost of production 2. The analysis of the activity cost of the design of new products.

4.6.1 The analysis of the activity cost of the productions

4.6.1.1 Analysis and specification of activity

To analyze and specify the activity of sample factories will activity center which would happen according to the responsible centers. After that details of sub-activity that happened from the activity center would be specified.

1.) The analysis and specification of responsible center divided into 2 types

1.1) The analysis and specification of responsible center for production cost.

From the analysis of the organizational plan and the work characteristics in the sample factories can specify the responsible center into department levels and unit levels consisting of 7 departments and total of 9 units with the details as follows, raw material warehouse department, production planning, production, finished goods warehouse, technique research & development, engineering and quality control & assurance. As for production department, there would be 3 sub-units which are production 1, production 2 and inspection. The details can be seen in the table 4.1.

Table 4.1 Specification of responsible center of productions activity

Responsibility Center	
Department	Section
Raw Material Warehouse	Raw Material Warehouse
Planning	Planning
Production	Production I
	Production II
	Inspection
Finished Goods Warehouse	Finished Goods Warehouse
Technical Research & Development	Technical Research & Development
Engineering	Engineering
Quality Control & Assurance	Quality Control & Assurance

1.2) The analysis and specification of responsible center for design cost.

From the analysis of organizational plan and the characteristics of the work in the sample factory can specify the responsibility center including 4 departments level and 4 unit level which are sale, logistics, APQP team, technique development and product research can be shown in the table 4.2

Table 4.2 Specification of responsibility center of design activity

Responsibility Center	
Department	Section
Sales	Sales
Logistics	Logistics
APQP TEAM	APQP TEAM
Technical Research & Development	Technical Research & Development

2) Analysis and specification of activity center divided into 2 types

2.1) Analysis and specification of activity center for production cost.

From the analysis and specification of responsible center, main activity center can be verified as follows.

1. Material specification activity is work coordination activity and management of raw material, spare parts and various consuming materials to be used in the production.

2. Production supporting activity is an activity that helps the production to go on smoothly according to the standard and time schedule such as the making of production plan, receiving of goods delivery document, making of design and production development, production of equipments and machine improvement.

3. Raw material preparation activity is the activity that would help the preparation of various raw materials before production

4. Production activity is production activity with sub-activity such as raw material mixing, starch boiling, baking, coloring etc.

5. Inspection activity is an activity that prevents and inspects the damage during activity.

6. Quality control activity is activity in the follow-up, coordination and management on the goods quality

2.2) Analysis and specification of activity center for design cost

From the analysis and specification of responsibility center, we can specify the main activity center as follows.

1. Acceptance of customer needs is acknowledged activity of customer needs to be complete when there is contact with customers in every selling activity and to notify the delivery of goods and various conditions to customers.

2. Inspection of the need of customers is activity inspecting need document from the sale

3. The consideration of the production possibility is the consideration of the product possibility that has been designed in various aspects such as market analysis, risk analysis, belief study in the product etc.

4. The making of experiment plan is the activity making experiment plan of product that has been designed before actual productions

5. The evaluation of feedback and revision is activity in the evaluation that the designed products have the quality according to the need of the customers or not. If it is not consistent, the customer must rectify such as delivery and service and the satisfaction result of customers.

6. The making of operation plan is activity in the planning in order to design products such as to make preliminary list of raw material, to make flowchart of the process, basic analysis of features of product and basic analysis of features of the process

7. Product design is the product design to make the product according to the design specification specified by customers such as making DFMEA, making design review document, changing specification etc.

8. Design of production process is design activity of production process of products in order to make the production process to respond to the products designed

9. Product certification and process is product guaranty activity and production process of products that has been designed that it passes the specification specified by customers or not such as study of ability of basic process, test of production guaranty, evaluation of product containing, arranging of production control plan etc.

3) Analysis and specifications of activity details

The analysis of the details of sub-activity in each activity center helps analyze activity drive by studying the details of sub-activity to collect information in the factory. For example, the production activity 2 consists of 2 main activities which are production and inspection. The production activity consisting of 5

sub-activities which are coating of course polish before compressing, compressing, coating of course polish after compressing, fixing of sponge level and surface, heating and the inspection activity consists of 2 sub-activities which are inspection of the thickness and color and inspection of course polish details can be seen in the table 4.3-4.4.

Table 4.3 Analysis of activity details of productions

Responsibility Center	Activity Center	Activity
Raw Material Warehouse	Raw Material Control	Taken in raw material Keep & storage Taken out raw material
Planning Production	Support production	Prepare production plan Follow-up for production Issue formulation Modify formulation
Production I	Preparing raw material	Prepare raw material Prepare release paper Weighing pigment Weighing material
	Production	Mixing & spinning raw material Boiling Sheeting Roll #1 Filter or strain Sheeting Roll #2 Sheeting roll skin layer and lamination foam layer Sheeting roll foam layer and lamination with fabric Blowing agent Grinding Tinting colour Air vacuum Surface or coating skin layer Oven drying
	Check Quality	Check re-winder release paper Check thickness and colourr

Table 4.3 Analysis of activity details of production (Cont.)

Responsibility Center	Activity Center	Activity
Production II	Production	Surface glossy or matting before embossing Emboss Surface glossy or matting after embossing Laminate foam layer with skin layer Heating in oven
	Check Quality	Check thickness and colour Check glossy
Inspection	Inspection	Inspection & Packaging
Finished Goods Warehouse	Support production	Acquire key-in stock card Move goods Storage goods Take in-out finished goods Check key-in stock card
Technical Research & Development	Support production	Design & Development Issue formulation for production sample Follow up & Review designed product
Engineering	Support production	Maintenance & Prevention machinery Modify & Improve machine
Quality Control & Assurance	Quality Control	Random check product before delivery to customer

Table 4.4 Analysis of activity details of product design activity

Responsibility Center	Activity Center	Activity
Sales	Taking requirement from a customer	Check product demand (customer orders).
Logistics	Checking sales order form	Receiving the notification requirements of the customer Check the notification requirements of the customer Save the document needs of the customer invoice.
APQP TEAM	Considering the possibility of manufacturing	Market Analysis Risk analysis Reliability of the product. Product benchmark Process benchmark Results of the feasibility study
	The experimental plan.	Plan for conducting experiments
	Feedback,Assessment and Corrective Action	Delivery and Service Customer Satisfaction.
R & D	Planning operations.	Preliminary bill of materials (BOM). Preliminary process flow chart Preliminary identification of special product characteristics Preliminary identification of special process characteristics
	Product design	Preparation DFMEA (Design Failure Mode Effect Analysis) Design verification Design review Prototype Build - Control Plan Specifications Changes Drawing Changes Special Product Characteristics

Table 4.4 Analysis of activity details of product design activity (Cont.)

Responsibility Center	Activity Center	Activity
R & D	Process design	Packaging Standards and Specifications Product/Process Quality System Review Process Flow Chart Characteristics Matrix Preparation PFMEA (Process Failure Mode Effect Analysis) Pre-Launch Control Plan Measurement System Analysis Plan Packaging Specification
	Product and Process Validation	Significant Production Run Measurement Systems Evaluation Preliminary Process Capability Study Production Part Approval (PPAP) Production Validation Testing Packaging Evaluation Production Control Plan Quality Planning Sign-off

4) Activity Hierarchy divides into 2 parts

4.1) Analysis activity hierarchies of production cost are classified into 4 levels as following:-

1. Unit-level activities: are performed for each unit of product , such as production activity
2. Batch-level activities: are undertaken every time when a batch is produced, such as check quality activity, check quality, quality control activity
3. Product-sustaining activities: are those activities that are only performed during production, such as raw material control activity
4. Facility-Sustaining activities: are those activities that help to run the production system as a whole, such as support activity of engineering. This can be shown in the table 4.5

4.2) Analysis activity hierarchies of design cost are classified into 4 levels as following:-

1. Unit-level activities: are performed for each unit of product, such as planning operations activity, product design activity, process design activity, product and process validation activity

2. Batch-level activities: are undertaken every time when a batch is produced

3. Product-sustaining activities: are those activities that are only performed during production, such as taking requirement from a customer activity, checking requirement of customer activity, experimental plan activity.

4. Facility-Sustaining activities: are those activities that help to run the production system as a whole, such as considering the possibility of manufacturing activity, feedback, assessment and corrective action activity. This can be shown in the table 4.6

Table 4.5 Analysis activity hierarchies of production cost

Responsibility Center	Activity Center	Activity	Activity Hierarchy
Raw Material Warehouse	Raw Material Control	Taken in raw material	Product Sustaining Level
		Keep & storage	Product Sustaining Level
		Taken out raw material	Product Sustaining Level
Planning Production	Support production	Prepare production plan	Product Sustaining Level
		Follow-up for production	Product Sustaining Level
		Issue formulation	Product Sustaining Level
		Modify formulation	Product Sustaining Level
Production I	Preparing raw material	Prepare raw material	Unit-Level
		Prepare release paper	Unit-Level
		Weighing pigment	Unit-Level
		Weighing material	Unit-Level
	Production	Mixing & spinning raw material	Unit-Level
		Boiling	Unit-Level
		Sheeting Roll #1	Unit-Level
		Filter or strain	Unit-Level
		Sheeting Roll #2	Unit-Level
		Sheeting roll skin layer and lamination foam layer	Unit-Level
		Sheeting roll foam layer and lamination with fabric	Unit-Level
		Blowing agent	Unit-Level
		Grinding	Unit-Level
		Tinting colour	Unit-Level
		Air vacuum	Unit-Level
		Surface or coating skin layer	Unit-Level
		Oven drying	Unit-Level
	Check Quality	Check re-winder release paper	Batch-Level
		Check thickness and colour	Batch-Level
Production II	Production	Surface glossy or matting before embossing	Unit-Level
		Emboss	Unit-Level
		Surface glossy or matting after embossing	Unit-Level
		Laminate foam layer with skin layer	Unit-Level
		Heating in oven	Unit-Level
	Check Quality	Check thickness and colour	Batch-Level
		Check glossy	Batch-Level
Inspection	Inspection	Inspection & Packaging	Batch-Level
Finished Goods Warehouse	Support production	Acquire key-in stock card	Product Sustaining Level
		Move goods	Product Sustaining Level
		Storage goods	Product Sustaining Level
		Take in-out finished goods	Product Sustaining Level
		Check key-in stock card	Product Sustaining Level
Technical Research & Development	Support production	Design & Development	Product Sustaining Level
		Issue formulation for production sample	Product Sustaining Level
		Follow up & Review designed product	Product Sustaining Level
Engineering	Support production	Maintenance & Prevention machinery	Facility Sustaining Level
		Modify & Improve machine	Facility Sustaining Level
Quality Control & Assurance	Quality Control	Random check product before delivery to customer	Batch-Level

Table 4.6 Analysis activity hierarchies of design cost

Responsibility Center	Activity Center	Activity	Activity Hierarchy
Sales	Taking requirement from a customer	Check product demand (customer orders).	Product Sustaining Level
Logistics	Checking requirement of customer	Receiving the notification requirements of the customer Check the notification requirements of the customer Save the document needs of the customer invoice.	Product Sustaining Level
APQP TEAM	Considering the possibility of manufacturing	Market Analysis Risk analysis Reliability of the product. Product benchmark Process benchmark Results of the feasibility study	Facility Sustaining Level
	The experimental plan.	Plan for conducting experiments	Product Sustaining Level
	Feedback, Assessment and Corrective Action	Delivery and Service Customer Satisfaction.	Facility Sustaining Level
R & D	Planning operations.	Preliminary bill of materials (BOM). Preliminary process flow chart Preliminary identification of special product characteristics Preliminary identification of special process characteristics	Unit-Level
	Product design	Preparation DFMEA. Design verification Design review Prototype Build - Control Plan Specifications Changes Drawing Changes Special Product Characteristics	Unit-Level
	Process design	Packaging Standards Product/Process Quality System Review Process Flow Chart Characteristics Matrix Preparation PFMEA. Pre-Launch Control Plan Measurement System Analysis Plan Packaging Specification	Unit-Level
	Product and Process Validation	Significant Production Run Measurement Systems Evaluation Preliminary Process Capability Study Production Part Approval (PPAP) Production Validation Testing Packaging Evaluation Production Control Plan Quality Planning Sign-off	Unit-Level

4.6.2 Allocation of activity cost

From the analysis and specification of activity, the resource cost will be allocated to the activity cost group of each responsibility center. The allocation of resource cost into the activity can be used as resource drive as criteria in the allocation.

1) Allocation resource cost

The resource cost received from accounting department is resource cost consisting of many departments. The allocation method of this resource cost will be performed by allocating resource cost to department, responsibility center and activity center respectively. Some part of resource cost cannot be allocated directly and resource drive must be used as criteria in the allocation. The guideline in the allocation of resource cost into activity can be explained in the figure 4.14-4.15

From the figure 4.14 which shows the resource allocation of sample factories which divides the resource level into department level as follows.

1) Resource level 1 is the level of the total resource allocation of the company into the department level.

2) Resource level 2 is the level of the total resource allocation of the company into the work unit level.

3) Resource level 3 is the level of the total resource allocation of the company into the activity level.

4) Resource level 4 is the level of the total resource allocation of activity into product.

The allocation of data in each resource level would be different. If the data allocated is close to the resource level 4 it would make the calculation to be more accurate.

2) The specification of resource drive

As for the resource cost which cannot be allocated into activity or product directly is the fact that there are many activities in each activity center which makes the resource cost in this part to allocate the cost into activity according to the criteria having the relationship with the cost of those resource by having the resource drive such as usage area (square meter), amount of machines, amount of tools and equipments, usage quantity, amount of employees etc as shown in the table 4.3

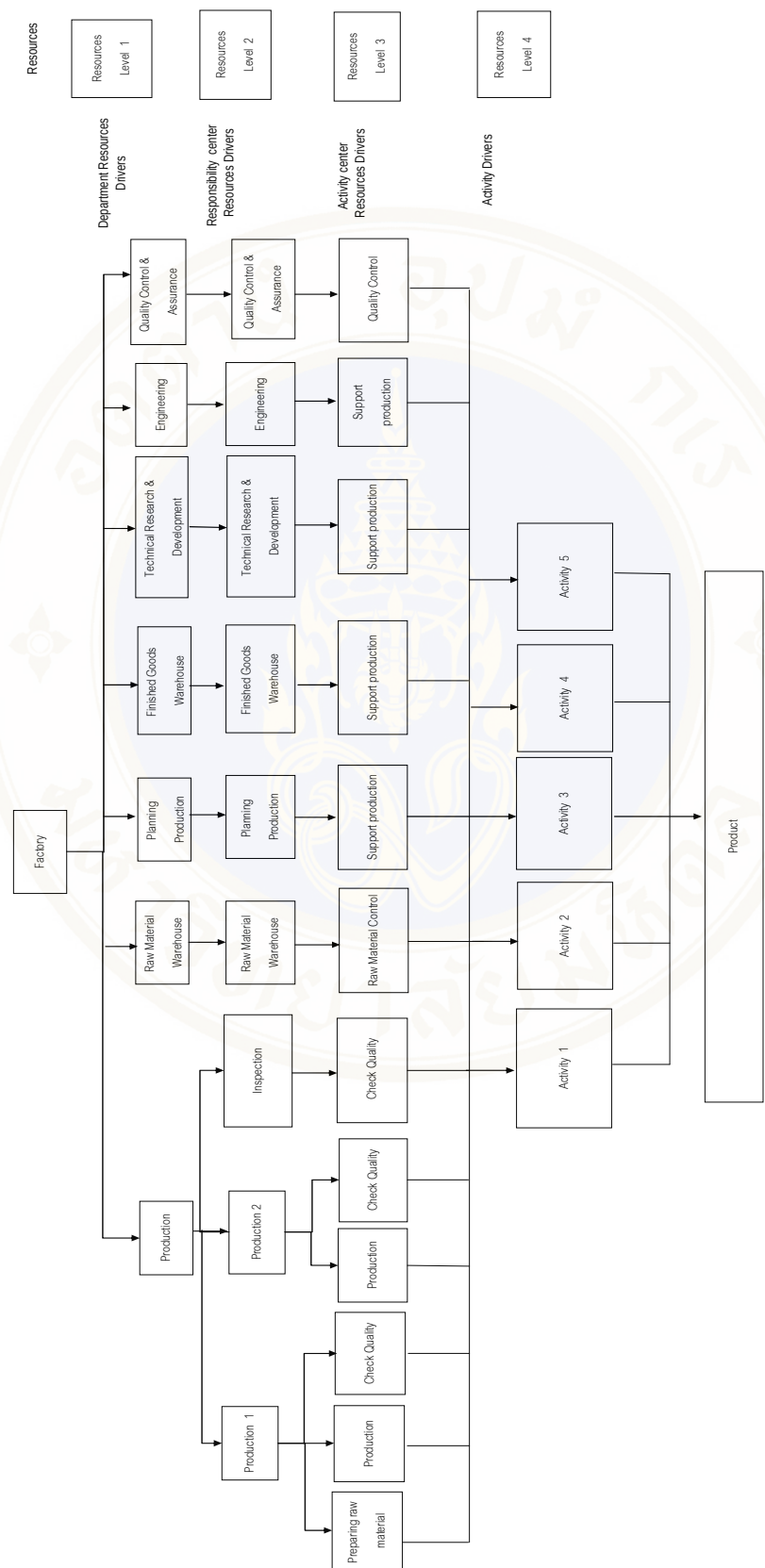


Figure 4.14 Allocation of resource cost of product activity

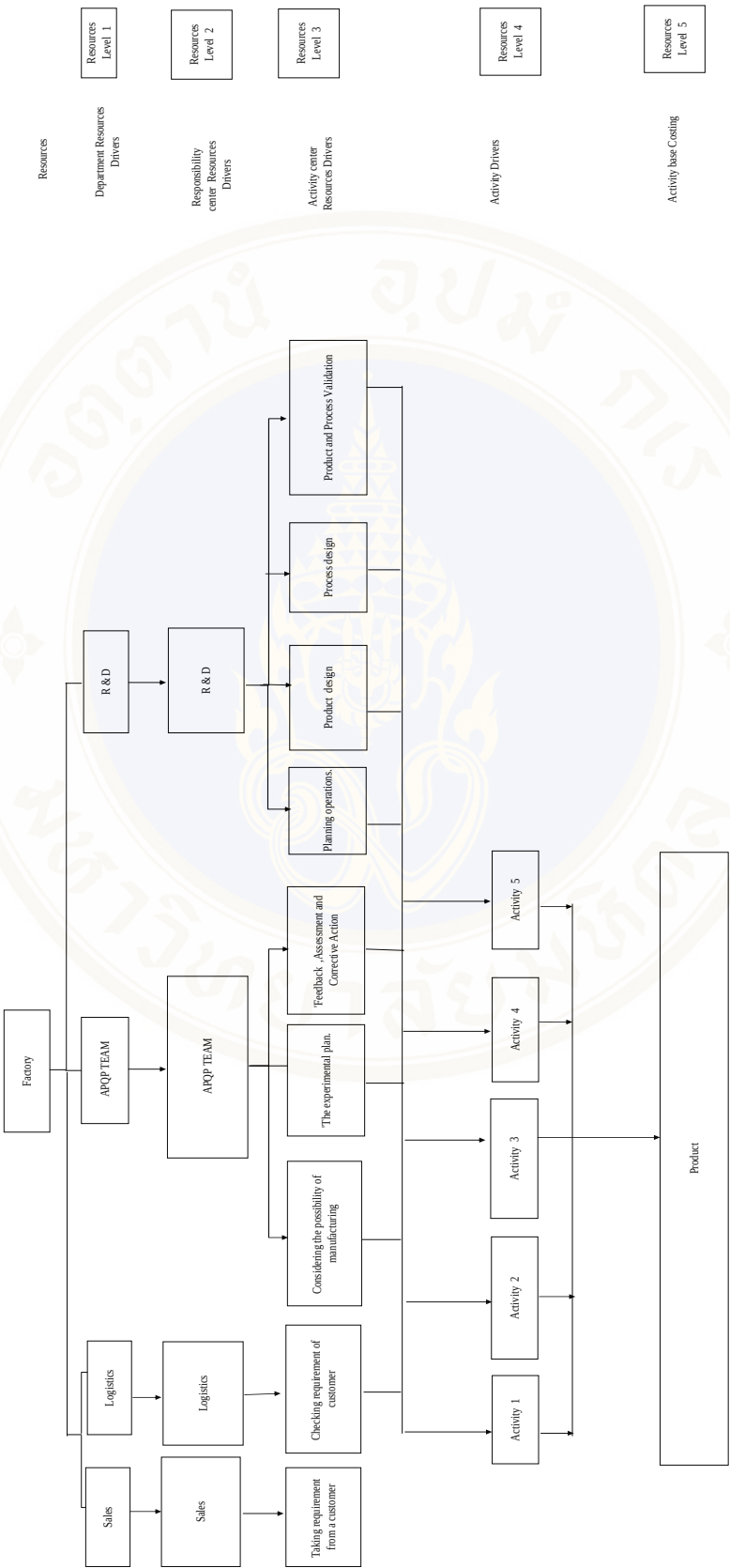


Figure 4.15 Allocation of resource cost of design activity

Table 4.7 Resource driver in each level of activity resource of production cost

Type resource	Resource Driver		
	Resource Level 1	Resource Level 2	Resource Level 3
Depreciation - Factory building.	Power Machine (Machine Hour)	Power Machine (Machine Hour)	Power Machine (Machine Hour)
Depreciation - Improvements - the factory building	Power Machine (Machine Hour)	Power Machine (Machine Hour)	Power Machine (Machine Hour)
Depreciation - Machinery	Power Machine (Machine Hour)	Power Machine (Machine Hour)	Power Machine (Machine Hour)
Depreciation - Equipage	Power Machine (Machine Hour)	Power Machine (Machine Hour)	Power Machine (Machine Hour)
Depreciation - Infrastructure.	Power Machine (Machine Hour)	Power Machine (Machine Hour)	Power Machine (Machine Hour)
Depreciation - Machine improvements.	Power Machine (Machine Hour)	Power Machine (Machine Hour)	Power Machine (Machine Hour)
Electricity	Direct	Direct	Direct
Fuel Oil	Direct	Direct	Direct
Repair-Building	Square meter area.	Square meter area.	Square meter area.
Repair-Machinery	Number of machinery	Number of machinery	Number of machinery
Repair-Equipage	Number of tools	Number of tools	Number of tools
Repair-Office equipment.	Number of office equipment	Number of office equipment	Number of office equipment
Release Paper Used	Direct	Direct	Direct
Water Supply	Direct	Direct	Direct
Core Paper	Number of use	Center of the activities of production department	Center of the activities of production department
Supplies	Proportion of use	The center of each department is responsible.	The center of each department is responsible.
Packaging materials.	Proportion of use	The center of each department is responsible.	The center of each department is responsible.
Premium machine.	Number of machinery	Number of machinery	Number of machinery
Mobile phone and Pager	Proportion of use	The center of each department is responsible.	The center of each department is responsible.
Internet	Proportion of use	The center of each department is responsible.	The center of each department is responsible.
Security.	Square meter area.	Square meter area.	Square meter area.
Miscellaneous expenses	Number of employees.	Number of employees.	Number of employees.

Table 4.8 Resource driver in each level of activity resource of design cost

Type Resource	Resource Driver		
	Resource Level 1	Resource Level 2	Resource Level 3
Mobile Phone	Proportion of use	The center of each department is responsible.	The center of each department is responsible.
Inventory consumes & Sparepart	Direct	Direct	Direct
Baggage inventory	Proportion of use	The center of each department is responsible.	The center of each department is responsible.
Fuel	Proportion of use	The center of each department is responsible.	The center of each department is responsible.
Repair-Machinery	Direct	Direct	Direct
Repair-Equipage	Proportion of use	The center of each department is responsible.	The center of each department is responsible.
Testing Fee	Number of products tested.	Number of products tested.	Number of products tested.
Testing Product	Number of products tested.	Number of products tested.	Number of products tested.
Sample Product	Number of samples.	Number of samples.	Number of samples.
Delivery(by Post)	Number of products shipped.	Number of products shipped.	Number of products shipped.
Other Expense	Number of employees	Number of employees	Number of employees

4.6.3 Specification of activity cost drive and the calculation of activity cost rate

1) The specification of activity cost driver

When the resource cost has been allocated in each activity, we would receive activity cost. The said activity cost cannot be allocated into products directly because the following cost is not the cost of any product but it is total activity cost that happens to many products. The specification of drive to be activity cost is the specification of allocation of this activity into products according to the relationship of those activities. The details of the activity drive specification such as production activity of production department 1 has the activity drive which is the time used in the production (minute), the number of the filter, number baking, number of making vacuum, number of smashing, number of drying etc. This can be shown in the table 4.9 – 4.10

Table 4.9 Activity Driver in each activity of the product cost

Responsibility Center	Activity Center	Activity	Activity Driver	Source Data
Raw Material Warehouse	Raw Material Control	Taken in raw material Keep & storage Taken out raw material	Number of taken in Number of storage Number of taken out	Report of raw material warehouse Report of raw material warehouse Report of raw material warehouse
Planning Production	Support production	Prepare production plan Follow-up for production Issue formulation Modify formulation	Number of production plan Number of follow-up Number of issue formulation Number of modify formulation	Interview and Indepth inquire Interview and Indepth inquire Interview and Indepth inquire Interview and Indepth inquire
Production I	Preparing raw material	Prepare raw material	Number of prepare	Report of production
		Prepare release paper	Number of prepare	Report of production
		Weighing pigment	Number of weighing of pigment	Report of production
		Weighing material	Number of weighing of material	Report of production
	Production	Mixing & spinning raw material	Number of spinning	Report of production
		Boiling	Number of boiling	Report of production
		Sheeting Roll #1	Number of rolling#1	Report of production
		Filter or strain	Number of strain	Interview and Indepth inquire
		Sheeting Roll #2	Number of rolling#2	Report of production
		Sheeting roll skin layer and lamination foam layer	Number of sheeting roll skin layer and lamination foam layer	Report of production
		Sheeting roll foam layer and lamination with fabric	Number of sheeting roll foam layer and lamination with fabric	Report of production
		Blowing agent	Number of blowing	Report of production
		Grinding	Number of grinding	Interview and Indepth inquire
		Tinting colour	Number of tinting	Interview and Indepth inquire
		Air vacuum	Number of vacuum	Interview and Indepth inquire
		Surface or coating skin layer	Number of coated	Interview and Indepth inquire
		Oven drying	Number of drying	Interview and Indepth inquire
Production II	Check Quality	Check re-winder release paper	Number of checking release paper	Interview and Indepth inquire
		Check thickness and colour	Number of checking thickness and colour	Report of production
	Production	Surface glossy or mating before embossing	Number of surface	Report of production
		Emboss	Number of emboss	Report of production
		Surface glossy or mating after embossing	Number of surface	Report of production
		Laminate foam layer with skin layer	Number of laminate	Report of production
		Heating in oven	Number of drying	Report of production
Inspection	Check Quality	Check thickness and colour	Number of checking thickness and colour	Report of production
		Check glossy	Number of checking glossy	Report of production
Inspection	Inspection	Inspection & Packaging	Number of inspection	Report of production
Finished Goods Warehouse	Support production	Acquire key-in stock card	Number of key-in stock card	Report of finished goods warehouse
		Move goods	Number of moving	Report of finished goods warehouse
		Storage goods	Number of storage goods	Report of finished goods warehouse
		Take in-out finished goods	Number of taken-out	Report of finished goods warehouse
		Check key-in stock card	Number of check key-in stock card	Report of finished goods warehouse
Technical Research & Development	Support production	Design & Development	Number of product designed	Interview and Indepth inquire
		Issue formulation for production sample	Number of sample formulation	Interview and Indepth inquire
		Follow up & Review designed product	Number of finished product design	Interview and Indepth inquire
Engineering	Support production	Maintenance & Prevention machinery	Number of checking	Interview and Indepth inquire
		Modify & Improve machine	Number of modify & improve machine	Interview and Indepth inquire
Quality Control & Assurance	Quality Control	Random check product before delivery to customer	Number of random checking	Record of work

Table 4.10 Activity Driver in each activity of the design cost

Responsibility Center	Activity Center	Activity	Activity Driver	Source Data
Sales	Taking requirement from a customer	Check product demand (customer orders).	Number of customer order	Interview and Indepth inquire
Logistics	Checking requirement of customer	Receiving the notification requirements of the customer Check the notification requirements of the customer Save the document needs of the customer invoice.	Number of receiving Number of check Number of No.Save document	Interview and Indepth inquire
APQP TEAM	Considering the possibility of manufacturing	Market Analysis Risk analysis Reliability of the product. Product benchmark Process benchmark Results of the feasibility study	Number of market analysis report Number of risk analysis report Number of reliability report Number of product benchmark report Number of process benchmark report Number of results of the feasibility study report	Report of market analysis report Report of risk analysis report Report of reliability report Report of product benchmark report Report of process benchmark report Report of results of the feasibility study report
	The experimental plan.	Plan for conducting experiments	Number of plan experiments	Report of APQP Team
	Feedback,Assessment and Corrective Action	Delivery and Service Customer Satisfaction.	Number of product delivery and Service Number of product	Report of APQP Team Report of APQP Team
R & D	Planning operations.	Preliminary bill of materials (BOM). Preliminary process flow chart Preliminary identification of special product characteristics Preliminary identification of special process characteristics	Number of BOM Number of process flow chart Number of document's special product characteristics Number of document's special process characteristics	Report of BOM Report of process flow chart Report of document's special product characteristics Report of document's special process characteristics
	Product design	Preparation DFMEA. Design verification Design review Prototype Build - Control Plan Specifications Changes Drawing Changes Special Product Characteristics	Number of DFMEA of product Number of document of design verification Number of document of design review Number of prototype build - control plan Number of No.Specifications Changes Number of drawing changes Number of special product characteristics	Report of R&D Report of R&D Report of R&D Report of R&D Report of R&D Report of R&D Report of R&D
	Process design	Packaging Standards Product/Process Quality System Review Process Flow Chart Characteristics Matrix Preparation PFMEA. Pre-Launch Control Plan Measurement System Analysis Plan Packaging Specification	No.Packaging Standards No.Product/Process Quality System Review No.Process Flow Chart No.Characteristics Matrix No.PFMEA of Product No.Pre-Launch Control Plan No.Measurement System Analysis Plan No.Packaging Specification	Report of R&D Report of R&D Report of R&D Report of R&D Report of R&D Report of R&D Report of R&D Report of R&D
	Product and Process Validation	Significant Production Run Measurement Systems Evaluation Preliminary Process Capability Study Production Part Approval (PPAP) Production Validation Testing Packaging Evaluation Production Control Plan Quality Planning Sign-off	No.Product Run No.Measurement Systems Evaluation No.Preliminary Process Capability Study No.Production Part Approval (PPAP) No.Production Validation Testing No.Packaging Evaluation No.Production Control Plan No.Quality Planning Sign-off	Report of R&D Report of R&D Report of R&D Report of R&D Report of R&D Report of R&D Report of R&D Report of R&D

2) Calculation of activity cost rate

When the activity drive has been specified, the calculation of activity cost rate per cost driver unit according to the formula as follows.

$$\text{Activity cost rate} = \text{activity cost} / \text{amount of cost drive}$$

4.6.4. Allocation of cost into products

When the activity cost rate has been calculated, the activity cost will be allocated into the products by multiplying activity cost with the activity usage amount of the product and the activity cost of those products will be received. When we combine the direct raw material cost, direct labor cost, production cost and we would receive the total cost per meter as shown in the calculation in the chapter 5.

CHAPTER V

RESULTS

The calculation of the production cost and the design cost has been designed by using the calculation of the cost according to activity standard in the sample factories. We can separate the production cost used in the calculation for 3 types which are direct raw material cost, direct labor cost and production expense cost. The direct raw material cost will be allocated into the products as they are used in the production. The direct labor cost will be allocated into the products according to the direct labor cost. As for the production cost can be divided into production cost that can calculate into the product directly and the production cost that cannot calculate into the product directly which would be allocated according to the system of activity base cost according to the process that has been mentioned in the chapter 4. As for the details of the calculation of the 2 product costs which are divided according to the product in 3 types which are C, F and L with the details as follows.

5.1 The calculation of the production cost by the activity base system

The calculation of the production cost that is used in the calculation is divided into 3 types which are direct raw material cost, direct labor cost and production expense cost in the production.

5.1.1 The direct raw material cost according to the table 5.1

The direct raw material cost consisting 5 types as follows.

- 1) Compound is a mixture of raw materials used in the production of various kinds, such as plasticizer, stabilizer
- 2) Pigment is a color used for the production of decorative products.
- 3) Fabric is raw material used in products, such as cloth weaving, knitting , nonwoven.

4) Adhesive raw material is sandwiched between the fabric and sheet.

5) Surface material is a coating on the product to have a shadow side. Details of calculating the direct material equation 1.

Direct raw material = Amount of each material used x cost per unit (1)

By, amount raw material that used from actual production and price calculation system from FIFO weight average.

Table 5.1 Calculation of direct raw material cost of the product

Item	Month	RM	Cost /Kgs	Quantity (Kgs.)				Amount (Baht)			
				C	F	L	Total	C	F	L	Total
1	February	Compound	54.14	5,448.00	186,746.00	449,614.00	641,808.00	294,958.35	10,110,552.94	24,342,401.70	34,747,912.99
		Fabric	32.18	-	-	91,760.00	91,760.00	-	-	2,952,974.44	2,952,974.44
		Pigment	161.15	160.96	6,202.00	15,495.32	21,858.28	25,938.11	999,429.56	2,497,014.00	3,522,381.67
		Adhesive	67.16	213.00	7,300.00	17,581.89	25,094.89	14,304.94	490,263.13	1,180,788.01	1,685,356.08
		Surface	52.76	422.36	14,474.00	34,850.82	49,747.18	22,284.98	763,691.66	1,838,833.82	2,624,810.46
Total				6,244.32	214,722.00	574,451.21	780,521.17	357,486.38	12,363,937.29	32,812,011.97	45,533,435.65
2	March	Compound	54.14	2,562.00	247,938.00	447,393.26	697,893.26	138,708.39	13,423,528.61	24,222,169.36	37,784,406.36
		Fabric	32.18	-	-	86,456.00	86,456.00	-	-	2,782,283.76	2,782,283.76
		Pigment	161.15	85.12	8,234.00	15,702.00	24,021.12	13,716.78	1,326,878.91	2,530,319.73	3,870,915.41
		Adhesive	67.16	100.22	9,714.00	16,000.00	25,814.22	6,730.71	652,385.76	1,074,549.33	1,733,665.81
		Surface	52.76	198.68	19,216.00	42,800.00	62,214.68	10,482.95	1,013,893.81	2,258,256.40	3,282,633.16
Total				2,946.02	285,102.00	608,351.26	896,399.28	169,638.83	16,416,687.09	32,867,578.58	46,171,271.34
3	April	Compound	54.14	3,830.00	223,126.00	279,938.02	506,894.02	207,358.75	12,080,190.39	15,156,031.03	27,443,580.17
		Fabric	32.18	-	-	56,088.00	56,088.00	-	-	1,804,995.97	1,804,995.97
		Pigment	161.15	127.20	7,410.00	9,209.64	16,746.84	20,497.81	1,194,094.33	1,484,099.72	2,698,691.86
		Adhesive	67.16	149.80	8,724.00	13,228.00	22,101.80	10,060.47	585,898.02	888,383.66	1,484,342.15
		Surface	52.76	296.98	17,294.00	31,200.00	48,790.98	15,669.56	912,483.32	1,646,205.60	2,574,358.48
Total				4,403.98	256,554.00	358,463.66	601,830.66	253,586.59	14,772,666.07	20,979,715.98	36,005,968.64
4	May	Compound	54.14	4,616.00	135,624.00	321,222.00	461,462.00	249,913.32	7,342,773.78	17,391,173.23	24,983,860.32
		Fabric	32.18	-	-	67,302.00	67,302.00	-	-	2,165,879.31	2,165,879.31
		Pigment	161.15	153.20	4,504.00	11,542.00	16,199.20	24,687.62	725,803.09	1,859,950.98	2,610,441.68
		Adhesive	67.16	180.52	5,302.00	12,872.00	18,354.52	12,123.60	356,078.79	864,474.94	1,232,677.33
		Surface	52.76	357.86	10,512.00	30,998.00	41,867.86	18,881.77	554,644.66	1,635,547.47	2,209,073.90
Total				5,307.58	155,942.00	412,938.00	563,317.72	305,606.31	8,979,300.30	23,917,025.93	33,201,932.54
5	June	Compound	54.14	11,588.00	147,426.00	546,005.44	705,019.44	627,382.05	7,981,741.92	29,561,098.53	38,170,222.49
		Fabric	32.18	-	-	119,906.00	119,906.00	-	-	3,858,754.94	3,858,754.94
		Pigment	161.15	384.88	4,896.00	20,253.82	25,534.70	62,022.00	788,972.45	3,263,828.83	4,114,823.28
		Adhesive	67.16	453.14	5,764.00	10,760.00	16,977.14	30,432.58	387,106.40	722,634.43	1,140,173.40
		Surface	52.76	898.28	11,426.00	56,419.24	68,743.52	47,395.95	602,870.04	2,976,848.36	3,627,114.35
Total				13,324.30	169,512.00	753,344.50	936,180.80	767,232.57	9,760,690.81	40,383,165.08	50,911,088.46
6	July	Compound	53.43	9,242.00	236,346.00	587,657.64	633,245.64	493,796.98	12,627,888.00	20,712,418.32	33,834,103.29
		Fabric	31.35	-	-	144,944.40	144,944.40	-	-	4,543,354.69	4,543,354.69
		Pigment	167.28	306.98	7,848.00	11,798.46	19,953.44	51,352.23	1,312,829.14	1,973,670.32	3,337,851.68
		Adhesive	68.15	361.40	9,240.00	20,025.62	29,627.02	24,629.41	629,706.00	1,364,746.00	2,019,081.41
		Surface	52.76	716.00	18,318.00	41,285.10	60,319.10	37,778.31	966,512.63	2,178,325.73	3,182,616.67
Total				10,626.38	271,752.00	605,711.22	888,089.60	607,556.93	15,536,935.77	30,772,515.06	46,917,007.75
7	August	Compound	52.13	19,258.00	193,490.00	383,912.86	596,660.86	1,003,964.48	10,087,085.18	20,014,273.19	31,105,322.84
		Fabric	28.44	-	-	134,960.72	134,960.72	-	-	3,837,608.07	3,837,608.07
		Pigment	168.26	638.00	6,424.00	13,829.34	20,891.34	107,347.75	1,080,880.83	2,326,878.65	3,515,107.23
		Adhesive	66.89	752.00	7,564.00	11,356.26	19,672.26	50,299.27	505,935.79	759,589.95	1,315,825.01
		Surface	52.76	1,492.00	14,996.00	39,904.60	56,392.60	78,722.40	791,233.95	2,105,486.62	2,975,442.96
Total				22,140.00	222,474.00	583,963.78	828,577.78	1,240,333.90	12,465,135.74	29,043,836.48	42,749,306.12
8	September	Compound	54.14	37,686.00	184,622.00	456,076.01	678,384.01	2,040,345.16	9,995,558.16	24,692,259.17	36,728,162.49
		Fabric	32.18	-	-	103,608.00	103,608.00	-	-	3,334,260.85	3,334,260.85
		Pigment	161.15	1,250.00	6,130.00	15,632.00	23,012.00	201,432.92	987,827.02	2,519,039.48	3,708,299.42
		Adhesive	67.16	1,472.00	7,218.00	15,862.00	24,552.00	98,858.54	484,756.07	1,065,281.35	1,648,895.95
		Surface	52.76	2,920.00	14,310.00	45,584.00	62,814.00	154,067.96	755,038.53	2,405,148.59	3,314,255.08
Total				43,328.00	212,280.00	636,762.01	892,370.01	2,494,704.58	12,223,179.78	34,015,989.44	48,733,873.80
9	October	Compound	54.14	11,152.00	154,700.00	304,462.00	470,314.00	603,776.71	8,375,561.13	16,483,775.65	25,463,113.50
		Fabric	32.18	-	-	64,178.00	64,178.00	-	-	2,065,344.31	2,065,344.31
		Pigment	161.15	370.40	5,136.00	9,982.00	15,488.40	59,688.60	827,647.57	1,608,562.70	2,495,898.87
		Adhesive	67.16	436.00	6,048.00	1,816.00	8,300.00	29,281.47	406,179.65	121,961.35	557,422.47
		Surface	52.76	864.00	11,990.00	34,240.00	47,094.00	45,587.23	632,628.37	1,806,605.12	2,484,820.72
Total				12,822.40	177,874.00	414,678.00	605,374.40	738,334.02	10,242,016.72	22,086,249.13	33,066,599.87
Total (RM)				121,142.98	1,966,212.00	4,948,663.64	6,992,661.42	6,934,480.10	112,760,549.57	266,878,087.66	383,290,484.17
Avg. / Month				13,460.33	218,468.00	549,851.52	776,962.38	770,497.79	12,528,949.95	29,653,120.85	42,587,831.57

5.1.2 Direct labor cost

The calculation of the production cost will use direct labor cost which is expense that the factory pays to employees who make the production directly. The direct labor cost here is salary of production employees. The labor cost of each product per hour of the machines can be calculated as equation 2.

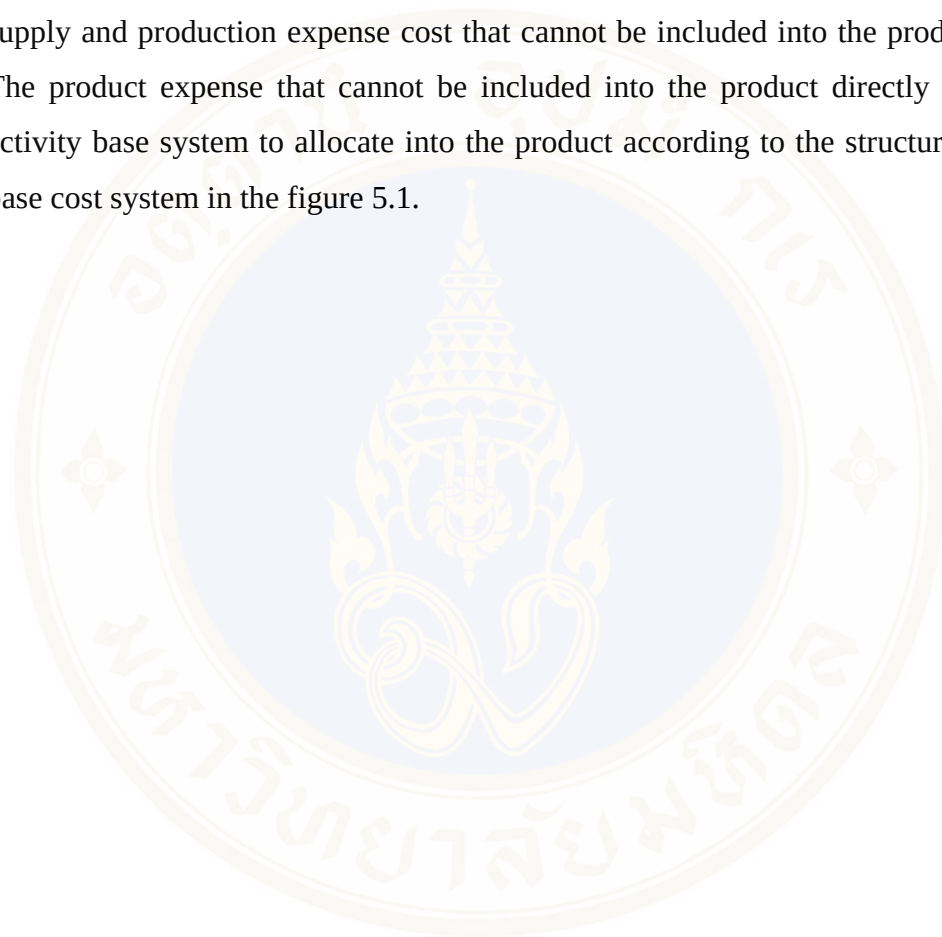
The labor cost of each production per machine hour = direct labor cost of the production department / total hour of machine usage of each product x hour of machine usage of product (2)

Table 5.2 Labor cost of each product per machine hour

Month	Direct Labour of Production (Baht)	Hour of machine usage of product				Labour of Product / Hour (Baht)			
		C	F	L	รวม	C	F	L	รวม
February	5,153,176	43	872	1,986	2,901	76,383	1,548,973	3,527,821	5,153,176
March	5,393,534	22	616	1,419	2,057	57,685	1,615,176	3,720,673	5,393,534
April	5,357,126	23	715	1,592	2,330	52,882	1,643,925	3,660,320	5,357,126
May	5,336,014	59	846	1,921	2,826	111,403	1,597,405	3,627,206	5,336,014
June	5,266,482	64	919	2,076	3,059	110,185	1,582,183	3,574,115	5,266,482
July	5,278,990	45	1,034	2,373	3,452	68,816	1,581,250	3,628,923	5,278,990
August	5,227,516	38	1,077	2,483	3,598	55,210	1,564,768	3,607,538	5,227,516
September	5,261,814	77	1,079	2,543	3,699	109,532	1,534,874	3,617,408	5,261,814
October	5,286,412	64	1,096	2,448	3,608	93,772	1,605,850	3,586,790	5,286,412
Total	47,561,064	435	8,254	18,841	27,530	735,868	14,274,403	32,550,793	47,561,064
Avg. / Month	5,284,563	48	917	2,093	3,059	81,763	1,586,045	3,616,755	5,284,563

5.1.3 Production expense cost

Production expense cost is the total cost happening in the production apart from direct raw material cost and direct labor cost that has been mentioned. The expense in the production will be divided into 2 parts which are production cost that can be included into the product directly such as electricity, furnace oil, paper, water supply and production expense cost that cannot be included into the product directly. The product expense that cannot be included into the product directly will use the activity base system to allocate into the product according to the structure of activity base cost system in the figure 5.1.



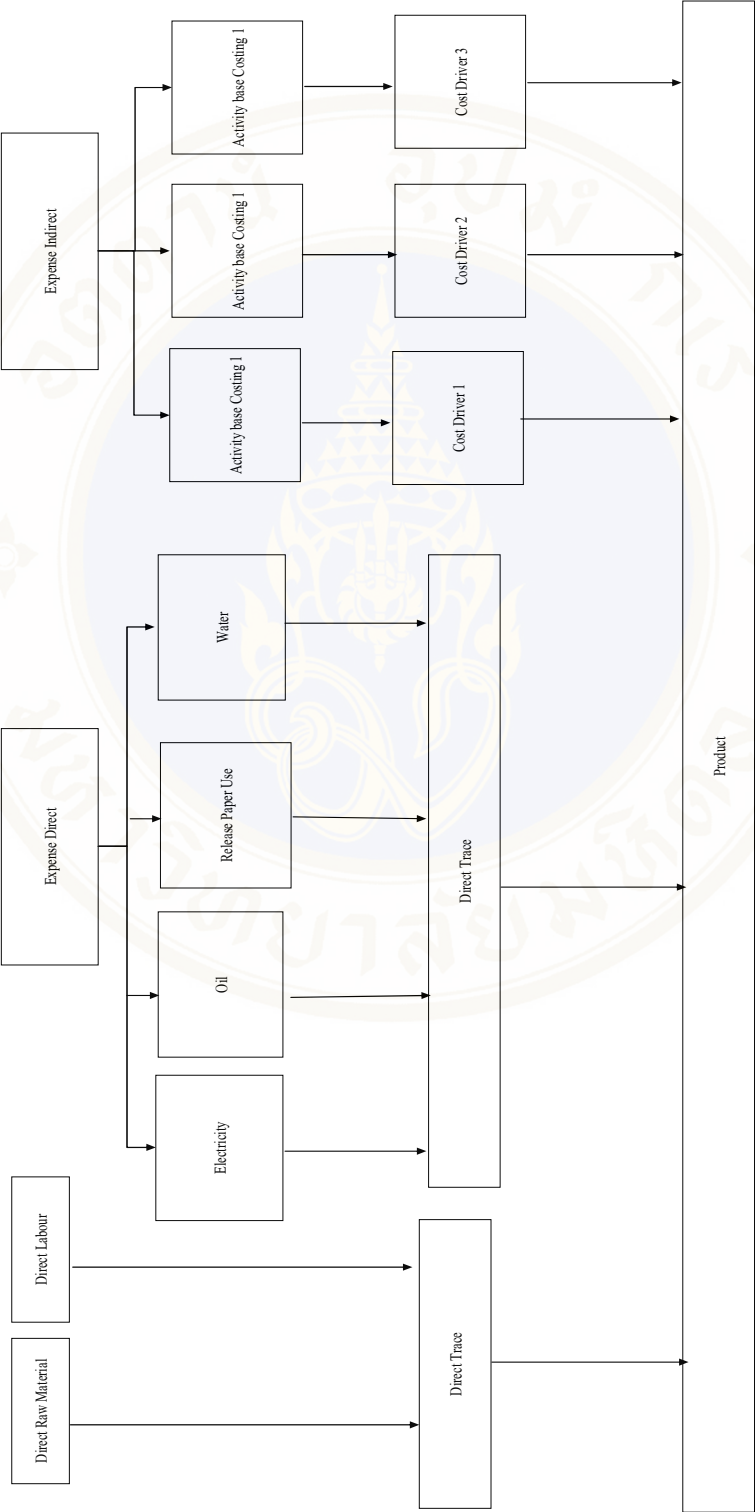


Figure 5.1 Structure of activity base costing in the calculation of production cost

5.1.3.1 As for the production expense that can be included in the product directly that can be included into the product directly, we will consider 4 values which are electricity, fuel oil, release paper used, water supply cost as expense from February to October 2010 which are in total of 45,443,186 baht. The production expense has increased and decreased since February to October 2010 which is in fluctuating manner according to the table 5.3.

Table 5.3 List of expense cost included into the product directly of the calculation of production cost

Item	Month	Production expense that can be included in the product directly (Bath)				
		Electricity	Fuel Oil	Release Paper Used	Water Supply	Total
1	February	2,251,518	3,040,192	535,446	142,950	5,970,106
2	March	2,269,286	2,942,352	1,202,450	149,634	6,563,722
3	April	1,501,440	1,578,910	497,752	104,332	3,682,434
4	May	1,852,596	2,193,224	204,774	154,334	4,404,928
5	June	2,231,062	166,413	851,460	166,413	3,415,348
6	July	1,873,240	2,198,366	594,557	130,552	4,796,714
7	August	2,081,549	2,752,934	930,032	142,094	5,906,610
8	September	1,873,240	2,198,366	594,557	130,552	4,796,714
9	October	2,081,549	2,752,934	930,032	142,094	5,906,610
Total						45,443,186

5.1.3.2 Production cost that cannot be included into the product directly

As for the production expense cost that cannot be included into the product directly, it will use the method of activity base method to apply with the production cost and after that the activity cost will be allocated by allocating the resource cost according to the resource level from RL1, RL2, RL3, RL4 and specify the resource drive. Each resource level has the details as follows.

1) RL1 level will allocate each production expense into the responsibility center by using criteria in the allocation according to the resource cost drive as seen in the table 5.4

2) RL 2 level will allocate the production cost that has been allocated into the process 1. In the process 2, the resource drive must be specified again in order to allocate the resource cost in each responsibility to distribute to each department in the table 5.5

3) RL 3 level, when each item of the cost has been allocated into the department according to the process 2, we must specify the resource drive in the process 3 in order to allocate each production expense in each department to be distributed to activity as in the table 5.6 and 5.7.

4) RL 4 level is the last step in the allocation of the expense cost in the production of each item from the level 3 allocating the production cost in each item into activity in the level 4 will allocate the cost from the level 3 into each minor activity by using the criteria in allocating resource from the cost drive specified in the level 4 as in the table 5.8.

When it has been through the allocation of production expense cost in each item in 4 levels, each expense cost will be distributed into each activity and the next step is to specify the drive of each activity in order to find total activity cost drive. When we know the amount of all activity cost drive we would know the amount of activity cost drive in the product we wish to calculate to find the cost per unit as in the table 5.9.

Table 5.4 The production expense received from the allocation of responsibility center to each activity center (RL1) on February 2010

Month	February	Resource Driver of each department										Expense of each department as allocation to resource driver (Bath)						
Type of resource	List Expenses (Baths)	Resource Driver (RL 1)	Resource Driver of each department							Expense of each department as allocation to resource driver (Bath)								
			Production	Planning Production	Raw Material Warehouse	Finished Goods Warehouse	Technical Research & Development	Engineering	Quality Control & Assurance	Resource Driver (Total)	Production	Planning Production	Raw Material Warehouse	Finished Goods Warehouse	Technical Research & Development	Engineering	Quality Control & Assurance	Total Expenses
Depreciation - Factory building Depreciation - Improvements - the factory building Depreciation - Machinery Depreciation - Equipage Depreciation - Infrastructure Depreciation - Machine Improvements Repair-Building Repair-Machinery Repair-Equipage Repair-Office equipment Core Paper Supplies Packaging materials Premium machine Mobile phone and Pager Internet Security Miscellaneous expenses	196,627	Machine Hour	5261	0	0	0	0	0	0	5261	196,627	0	0	0	0	0	0	196,627
	24,829	Machine Hour	5261	0	0	0	0	0	0	5261	24,829	0	0	0	0	0	0	24,829
	520,271	Machine Hour	5261	0	0	0	0	0	0	5261	520,271	0	0	0	0	0	0	520,271
	982,452	Machine Hour	5261	0	0	0	0	0	0	5261	982,452	0	0	0	0	0	0	982,452
	798	Machine Hour	5261	0	0	0	0	0	0	5261	798	0	0	0	0	0	0	798
	97,036	Machine Hour	5261	0	0	0	0	0	0	5261	97,036	0	0	0	0	0	0	97,036
	0	Square meter area	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	137,048	Number of machinery	2	0	0	0	0	0	0	2	137,048	0	0	0	0	0	0	137,048
	31,552	Number of tools	1	0	1	0	0	1	0	3	10,517	0	10,517	0	0	10,517	0	31,552
	0	Number of office equipment	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	175,760	Number of use	5000	0	0	0	0	0	0	5000	175,760	0	0	0	0	0	0	175,760
	701,252	Proportion of use	0.5	0.2	0.1	0.1	0.1	0	0	1	350,626	140,250	70,125	70,125	70,125	0	0	701,252
	321,462	Proportion of use	0.8	0	0.1	0.1	0	0	0	1	251,170	0	32,146	32,146	0	0	0	321,462
27,484	Number of machinery	37	0	0	0	0	0	0	37	27,484	0	0	0	0	0	0	27,484	
4,624	Proportion of use	0.3	0.1	0.1	0.1	0.2	0.1	0.1	1	1,387	462	462	462	925	462	462	4,624	
46,200	Proportion of use	0.2	0.1	0.1	0.1	0.2	0.1	0.2	1	9,240	4,620	4,620	4,620	9,240	4,620	9,240	46,200	
141,600	Square meter area	11,126	119	1,281	2,659	357	861.5	150	16,844.5	93,534	1,000	10,769	24,876	3,001	7,158	1,261	141,600	
54,276	Number of employees	320	23	12	34	23	12	11	405	39,827	2,870	4,242	1,497	2,870	1,497	1,372	54,276	
Total	3,453,270																3,453,270	

Table 5.5 Allocation of expense of the production of the company to each department (RL2) on February 2010

Month	February	Expense of each department as allocation to resource driver (Bath)													
Type of resource	List Expenses (Baths)	Resource Driver of each department						Resource Driver (RL 2)							
		Production			Inspection and Quality Control			Production I	Production II	Inspection	Raw Material Warehouse	Finished Goods Warehouse	Technical Research & Development	Engineering	Quality Control & Assurance
		Production I	Production II	Inspection and Quality Control	Production I	Production II	Inspection								
Depreciation - Factory building.	186,627	4,406	837	18	0	0	0	0	0	0	0	0	0	0	0
Depreciation - Improvements - the factory building	24,829	4,406	837	18	0	0	0	0	0	0	0	0	0	0	0
Depreciation - Machinery	520,271	4,406	837	18	0	0	0	0	0	0	0	0	0	0	0
Depreciation - Equipage	982,462	4,406	837	18	0	0	0	0	0	0	0	0	0	0	0
Depreciation - Infrastructure.	768	4,406	837	18	0	0	0	0	0	0	0	0	0	0	0
Depreciation - Machine Improvements.	97,036	4,406	837	18	0	0	0	0	0	0	0	0	0	0	0
Repair-Building	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Repair-Machinery	137,048	2	0	0	0	0	0	0	0	0	0	0	0	0	0
Repair-Equipage	31,562	1	0	1	0	1	0	0	0	0	10,517	0	0	0	0
Repair-Office equipment.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Core Paper	175,760	1	1	1	0	0	0	0	0	58,587	0	0	0	0	0
Supplies	701,262	1	1	1	1	1	1	0	0	116,875	70,125	70,125	70,125	0	0
Packaging materials.	321,462	1	1	1	0	1	1	0	0	85,723	0	32,146	0	0	0
Premium machine.	27,484	6	16	15	0	0	0	0	0	11,865	0	0	0	0	0
Mobile phone and Pager	4,624	1	1	1	1	1	1	1	1	462	462	462	925	462	462
Internet	46,200	1	1	1	1	1	1	1	1	3,080	4,620	4,620	9,240	4,620	9,240
Security.	141,600	6,163	4,163	800	119	1,281	2,980	587	851.5	34,986	1,000	40,769	24,876	7,156	1,261
Miscellaneous expenses	54,276	140	100	80	23	12	34	23	12	9,982	2,870	1,497	4,242	1,497	1,372
Total	3,443,270														974
															3,443,270

Table 5.6 Resource drive of responsibility center to each activity center (RL3) on February 2010

Month	February	Resource Driver of each department												
Type of resource	List Expenses	Resource Driver (RL 3)												
	(Baths)	Production I			Production II		Inspection	Planning Production	Raw Material Warehouse	Finished Goods Warehouse	Technical Research & Development	Engineering Support production	Quality Control	Resource Driver (Total)
		Preparing raw material	Production	Check Quality	Production	Check Quality	Inspection	Support production	Raw Material Warehouse	Support production	Support production	Support production	Quality Control	
Depreciation - Factory building.	186,627	1,469	1,469	1,469	419	419	18	0	0	0	0	0	0	5,261
Depreciation - Improvements - the factory building.	24,829	1,469	1,469	1,469	419	419	18	0	0	0	0	0	0	5,261
Depreciation - Machinery	520,271	1,469	1,469	1,469	419	419	18	0	0	0	0	0	0	5,261
Depreciation - Equipage	982,452	1,469	1,469	1,469	419	419	18	0	0	0	0	0	0	5,261
Depreciation - Infrastructure.	798	1,469	1,469	1,469	419	419	18	0	0	0	0	0	0	5,261
Depreciation - Machine Improvements.	97,036	1,469	1,469	1,469	419	419	18	0	0	0	0	0	0	5,261
Repair-Building	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Repair-Machinery	137,048	0	2	0	0	0	0	0	0	0	0	0	0	2
Repair-Equipage	31,552	0	1	0	0	0	1	0	1	0	0	0	0	3
Repair-Office equipment.	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Core Paper	175,760	0	1	0	1	0	1	0	0	0	0	0	0	3
Supplies	701,252	0	1	0	1	0	1	1	1	1	1	0	0	7
Packaging materials.	321,462	1	1	0	1	0	1	0	1	1	0	0	0	6
Premium machine.	27,464	0	6	0	46	0	15	0	0	0	0	0	0	37
Mobile phone and Pager	4,624	0	1	0	1	0	1	1	1	1	1	1	1	9
Internet	46,200	0	1	0	1	0	1	1	1	1	1	1	1	9
Security.	141,600	1,000	4,500	663	2,700	1,463	800	119	1,281	2,959	357	852	150	16,944
Miscellaneous expenses	54,276	60	50	30	60	40	80	23	12	34	23	12	11	435
Total	3,453,270													

Table 5.7 Production expense received from the allocation of responsibility center to each activity center (RL-3) on February 2010

Month	February	Expense of each department as allocation to resource driver (Bath)												
Type of resource	List Expenses (Baths)	Resource Driver (RL-3)												
		Production I			Production II		Inspection	Planning Production	Raw Material Warehouse	Finished Goods Warehouse	Technical Research & Development	Engineering Support production	Quality Control & Assurance	Total Expenses
		Preparing raw material	Production	Check Quality	Production	Check Quality								
Depreciation - Factory building.	186,627	52,104	52,104	52,104	14,838	14,838	639	0	0	0	0	0	0	186,627
Depreciation - Improvements - the factory building	24,829	6,932	6,932	6,932	1,974	1,974	85	0	0	0	0	0	0	24,829
Depreciation - Machinery	520,271	145,254	145,254	145,254	41,365	41,365	1,780	0	0	0	0	0	0	520,271
Depreciation - Equipage	992,452	274,289	274,289	274,289	78,111	78,111	3,362	0	0	0	0	0	0	992,452
Depreciation - Infrastructure.	798	223	223	223	63	63	3	0	0	0	0	0	0	798
Depreciation - Machine improvements.	97,036	27,091	27,091	27,091	7,715	7,715	332	0	0	0	0	0	0	97,036
Repair-Building	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Repair-Machinery	137,048	0	137,048	0	0	0	0	0	0	0	0	0	0	137,048
Repair-Equipage	31,452	0	19,517	0	0	0	19,517	0	10,517	0	0	0	0	31,452
Repair-Office equipment.	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Core Paper	175,760	0	58,597	0	58,597	0	58,597	0	0	0	0	0	0	175,760
Supplies	701,252	0	100,179	0	100,179	0	100,179	100,179	100,179	100,179	100,179	0	0	701,252
Packaging materials.	321,462	53,577	53,577	0	53,577	0	53,577	0	53,577	53,577	0	0	0	321,462
Premium machine.	27,484	0	4,457	0	11,895	0	11,142	0	0	0	0	0	0	27,484
Mobile phone and Pager	4,624	0	514	0	514	0	514	514	514	514	514	514	514	4,624
Internet	46,200	0	5,133	0	5,133	0	5,133	5,133	5,133	5,133	5,133	5,133	5,133	46,200
Security.	141,600	6,407	37,831	5,574	22,684	22,684	6,725	1,000	10,769	24,876	3,001	7,158	1,261	141,600
Miscellaneous expenses	54,276	7,486	6,239	3,743	7,486	4,991	9,992	2,870	1,497	4,242	2,870	1,497	1,372	54,276
Total	3,453,270	575,363	919,974	515,210	404,126	161,357	262,557	109,696	182,187	188,521	111,697	14,303	8,281	3,453,270

Table 5.8 Allocation of production expense of activity center to each sub-activity (RL4) on February 2010

Month	Responsibility Center (1)	Activity Center (2)	Expenses (Bath) (3)	Resource Driver (RL4) (4)	Activity (5)	Number Resource Drivers	Resource Drivers (Totals) (7)	Activity Base Costing (8) = [(3)/(7)*(6)]
February	Raw Material Warehouse	Raw Material Control	182,187	Work time (Minutes)	Taken in raw material Keep & storage Taken out raw material	2,520 3,780 2,520	8,820	52,053 78,080 52,053
		Support production		Work time (Minutes)	Prepare production plan Follow-up for production Issue formulation Modify formulation	2,520 1,260 5,040 1,260		27,424 13,712 54,848 13,712
	Production I	Preparing raw material	575,363	Work time (Minutes)	Prepare raw material Prepare release paper Weighing pigment Weighing material	5,040 3,780 5,040 5,040	18,900	153,430 115,073 153,430 153,430
		Production		Work time (Minutes)	Mixing raw material Sheeting and lamination Filter or strain Oven drying & Rise	12,240 24,295 1,200 10,975		215,697 428,135 21,147 193,405
Production II	Check Quality	Check Quality	515,210	Work time (Minutes)	Rise & laminate of Casting Check re-winder release paper Check thickness and colour	3,495 2,520 900	3,420	61,590 379,628 135,581
		Production		Work time (Minutes)	Surface glossy or matting before embossing Emboss Surface glossy or matting after embossing	2,111 21,680 1,768		32,414 332,895 27,148
		Check Quality		Work time (Minutes)	Laminate foam layer with skin layer Heating in oven Check thickness and colour	760 0 4,500		11,670 0 96,879
				Inspection	Work time (Minutes)	Check glossy Inspection & Packaging		
Inspection	Finished Goods Warehouse	Support production	188,521	Work time (Minutes)	Acquire key-in stock card Move goods Storage goods Take in-out finished goods Check key-in stock card	1,260 2,520 3,780 1,890 1,260	10,710	22,179 44,358 66,537 33,288 22,179
		Support production		Work time (Minutes)	Design & Development Issue formulation for production sample Follow up & Review designed product	5,040 2,520 2,520		55,848 27,924 27,924
	Technical Research & Development	Support production	111,697	Work time (Minutes)	Maintenance & Prevention machinery Modify & Improve machine Random check product before delivery to customer	5,040 3,780 7,560	8,820	8,173 6,130 8,281
		Support production		Work time (Minutes)				
Quality Control & Assurance			8,281	Work time (Minutes)		7,560	7,560	8,281
Total			3,453,270					3,453,270

Table 5.9 The activity based costing per unit of all products on February 2010

Month	Responsibility Center (1)	Activity Center (2)	Activity (3)	ABC (4)	Cost Driver (5)	Total amount cost driver (6)	Activity Rate (7) = (4)/(6)	Amount Cost Driver of Product (8)			Product Cost (Baht) : (8) = (7) * (8)			
								C	F	L	C	F	L	Total
February	Raw Material Warehouse	Raw Material Control	Taken in raw material Keep & storage Taken out raw material	52,053	Number of taken in	80	651	2	24	54	1,201	15,616	35,136	52,053
				79,080	Number of storage	80	976	2	24	54	1,952	23,524	52,704	79,080
				52,053	Number of taken out	155	338	5	34	116	1,679	11,418	38,856	52,053
Planning Production	Support production	Prepare production plan Follow-up for production Issue formulation Modify formulation	27,424	Number of production plan	13	2,110	1	2	10	2,110	4,219	21,095	27,424	
			13,712	Number of follow-up	13	1,055	1	2	10	1,055	2,110	10,548	13,712	
			54,648	Number of issue formulation	117	469	9	20	88	4,219	9,376	41,253	54,648	
Production I		Prepare raw material Prepare release paper Weighing pigment Weighting material	13,712	Number of modify formulation	4	3,428	0	1	3	0	3,428	10,264	13,712	
			153,430	Number of prepare	117	1,311	9	20	88	11,802	26,227	115,400	153,430	
			115,073	Number of prepare	37	3,110	9	0	28	27,991	0	87,802	115,073	
	Mixing raw material	Mixing & spinning raw material Boiling Grinding Tinting colour Air vacuum	153,430	Number of weighing of pigment	117	1,311	9	20	88	11,802	26,227	115,400	153,430	
			43,139	Number of weighing of material	117	1,311	9	20	88	11,802	26,227	115,400	153,430	
			43,139	Number of spinning	67	644	9	20	38	5,796	12,877	24,467	43,139	
	Sheeting and lamination	Sheeting Roll #1 Sheeting Roll #2 Sheeting roll skin layer and lamination foam layer Sheeting roll foam layer and lamination with fabric	43,139	Number of boiling	69	625	0	20	49	0	12,504	30,635	43,139	
			43,139	Number of grinding	37	1,166	9	0	28	10,483	0	32,646	43,139	
			43,139	Number of tinting	37	1,166	9	0	28	10,483	0	32,646	43,139	
	Filter or strain	Filter or strain Blowing agent Surface or coating skin layer Oven drying Check re-winder release paper	43,139	Number of vacuum	29	1,468	9	0	20	13,386	0	29,751	43,139	
			107,034	Number of rolling#1	70	1,529	0	22	48	0	33,639	73,394	107,034	
			107,034	Number of rolling#2	70	1,529	0	22	48	0	33,639	73,394	107,034	
	Oven drying & Blowing	Surface or coating skin layer Oven drying Check re-winder release paper	107,034	Number of sheeting roll skin layer and lamination foam layer	50	2,611	0	0	50	0	0	107,034	107,034	
			107,034	Number of sheeting roll foam layer and lamination with fabric	41	2,611	0	0	41	0	0	107,034	107,034	
			21,147	Number of strain	70	302	0	22	48	0	6,646	14,501	21,147	
	Raw Material Control	Acquire key-in stock card Move goods Storage goods Take in-out finished goods Check key-in stock card	193,405	Number of coating	77	2,512	0	0	77	0	0	193,405	193,405	
			30,795	Number of coated	47	655	9	0	38	5,897	0	24,888	30,795	
			30,795	Number of drying	47	655	9	0	38	5,897	0	24,888	30,795	
Production II	Inspection	Finished Goods Warehouse	Check thickness and colour Surface glossy or mating before embossing Emboss Surface glossy or mating after embossing Laminate foam layer with skin layer Heating in oven Check thickness and colour Check glossy Inspection & Packaging	379,628	Number of checking release paper	37	10,280	9	0	28	92,342	279,406	379,628	
				153,591	Number of checking thickness and colour	117	1,159	29	0	88	33,606	0	101,976	153,591
				32,414	Number of surface	117	277	9	20	88	2,493	5,541	24,380	32,414
			Acquire key-in stock card Move goods Storage goods Take in-out finished goods Check key-in stock card	332,895	Number of emboss	107	3,111	9	10	88	28,001	31,112	272,783	332,895
				27,148	Number of surface	117	232	9	20	88	2,098	4,641	20,419	27,148
				11,670	Number of laminate	8	1,468	0	0	8	0	0	11,670	11,670
			Check key-in stock card	0	Number of drying	0	0	0	0	0	0	0	0	
				98,979	Number of checking thickness and colour	117	828	29	0	88	24,013	0	72,866	98,979
				64,478	Number of checking glossy	234	276	30	28	176	8,268	7,715	48,496	64,478
Technical Research & Development	Support production	Design & Development Issue formulation for production sample Follow up & Review designed product Maintenance & Prevention machinery	262,557	Number of inspection	117	2,244	9	20	88	20,197	44,881	197,479	262,557	
			22,779	Number of key-in stock card	120	173	10	22	96	1,733	3,812	16,834	22,779	
			44,358	Number of moving	128	347	10	22	96	3,465	7,624	33,268	44,358	
Engineering	Support production	Modify & Improve machine Random check product before delivery to customer	66,537	Number of storage goods	128	500	10	22	96	5,198	11,436	49,933	66,537	
			33,268	Number of taken-out	111	300	8	20	83	2,398	5,844	24,676	33,268	
			22,779	Number of check key-in stock card	126	173	10	22	96	1,733	3,812	16,834	22,779	
Quality Control & Assurance	Quality Control	Design & Development Issue formulation for production sample Follow up & Review designed product Maintenance & Prevention machinery Modify & Improve machine Random check product before delivery to customer	55,848	Number of of product designed	8	6,881	1	1	6	6,881	41,886	55,848		
			27,824	Number of sample formulation	8	3,491	1	1	6	3,491	3,491	20,843	27,824	
			27,824	Number of finished product design	8	3,491	1	1	6	3,491	3,491	20,843	27,824	
			Number of checking	8,173	Number of checking	8	1,022	1	1	6	1,022	6,130	8,173	
				6,130	Number of modify & improve machine	120	51	12	18	90	613	919	4,507	6,130
				8,281	Number of random checking	63	131	2	8	53	263	1,022	6,096	8,281
				3,453,270	Total Product Cost (Bahts)			303,009			302,102			2,453,229

5.1.3.3 Summary of the calculation of total cost of production

From the above calculation we can summarize the cost of production of each product consisting of labor cost, material cost, direct and indirect production cost since February to October 2010 with the details according to the table 5.10 such as total cost of production of C product consisting of labor cost 3,527,472 baht, raw material cost 32,812,013 baht, production expense 7,190,517 baht, total cost 43,530,002 baht and the total cost of every product which are divided into 2 parts which are the summary of production expense cost and summary of product cost as follows :

1) Summary of production expense

Production expense that can be included into the product directly	45,667,832	baht
Production expense that cannot be included into the product directly	35,078,017	baht
Total production expense	80,745,849	baht

2) Summary of total cost

Material Cost	385,517,857	baht
Labor cost	47,561,066	baht
Total production expense	80,745,849	baht
Total cost of products	513,824,772	baht

Table 5.10 Total cost of product on February to October 2010

Month	Direct Labour					Direct Raw Material					Production expense					Total production expense					Total cost				
											Direct production expense					Indirect production expense									
	C	F	L	Total	Avg	C	F	L	Total	Avg	C	F	L	Total	C	F	L	Total	Avg	C	F	L	Total	Avg	
February	76,383	1,540,973	3,527,821	5,133,177	1,717,726	357,486	12,363,937	32,812,013	45,533,436	15,177,812	439,239	369,394	383,520	2,700,181	3,453,285	9,423,391	3,441,130	1,262,892	15,316,961	43,530,651	60,110,084	20,085,680			
March	57,885	1,615,176	3,720,673	5,930,529	1,797,045	189,639	16,416,687	32,867,578	49,453,904	16,484,635	1,110,784	1,574,705	3,038,233	6,563,722	4,385,801	10,949,523	3,849,841	1,974,990	20,385,425	43,435,546	65,795,961	21,492,320			
April	52,882	1,643,925	3,680,200	5,357,127	1,785,789	253,388	14,772,666	29,959,715	38,016,989	12,801,990	238,116	646,441	1,951,530	3,655,187	3,209,136	9,165,173	3,102,724	988,164	17,487,246	31,972,859	50,420,269	16,889,423			
May	111,403	1,397,405	3,627,206	5,336,014	1,778,671	385,686	8,979,300	23,917,027	33,201,933	11,067,311	362,049	724,088	2,774,437	3,860,584	3,476,072	7,336,656	2,445,552	1,038,941	11,697,539	33,138,013	45,874,603	15,291,534			
June	110,185	1,382,183	3,574,115	5,266,483	1,755,494	767,293	9,780,690	40,383,165	50,913,088	16,970,363	273,228	580,609	3,383,656	4,157,533	4,444,106	8,571,729	2,857,243	1,380,104	12,528,810	50,639,386	64,749,300	21,383,100			
July	68,816	1,381,250	3,628,923	5,289,989	1,759,663	607,557	15,536,936	30,772,515	46,917,008	15,639,003	575,806	639,362	2,530,126	3,765,294	3,955,954	7,721,240	2,573,749	1,680,425	18,128,884	40,128,886	59,097,245	19,972,415			
August	55,210	1,584,768	3,607,538	5,227,516	1,742,305	1,240,334	12,465,136	29,943,836	42,743,306	14,249,769	349,408	686,815	3,980,078	4,990,301	4,917,244	9,905,545	3,303,515	2,101,438	15,267,676	40,151,253	57,884,367	19,294,789			
September	109,532	1,534,874	3,617,480	5,261,814	1,753,988	2,494,705	12,222,180	34,015,988	48,733,873	16,244,624	396,423	792,945	4,442,161	5,631,429	3,390,151	9,223,500	3,104,527	3,353,945	15,080,660	44,835,562	63,789,267	21,073,089			
October	93,772	1,605,650	3,586,791	5,286,412	1,762,137	738,334	10,242,017	21,081,989	29,111,340	10,671,447	402,723	872,567	3,597,536	4,927,065	3,674,178	8,547,004	2,649,001	1,380,131	13,226,562	31,029,463	45,944,756	15,281,365			
Total	739,880	14,274,404	32,530,734	47,536,018	15,853,689	6,934,482	112,761,549	285,822,826	386,517,857	128,305,952	4,013,076	9,747,773	34,008,118	45,667,832	35,780,117	100,743,949	26,915,283	15,327,530	139,091,783	339,225,459	513,824,772	171,274,924			
Avg. Month	81,763	1,586,045	3,616,755	5,284,513	1,761,521	771,488	12,528,651	29,553,071	42,856,317	14,274,439	464,653	839,864	3,778,687	5,074,204	3,887,557	8,971,761	2,980,337	1,723,281	15,452,420	39,813,340	57,093,641	19,089,547			

5.2 The calculation of the design cost by activity based costing

The calculation of the design cost used in the calculation is divided into 3 types which are direct raw material cost, direct labor cost and expense cost in the production

5.2.1 Direct raw material cost according to the table 5.11

The direct raw material cost consisting 5 types as follows.

- 1) Compound is a mixture of raw materials used in the production of various kinds, such as plasticizer, stabilizer
- 2) Pigment is a color used for the production of decorative products.
- 3) Fabric is raw material used in products such as cloth weaving, knitting , nonwoven.
- 4) Adhesive raw material is sandwiched between the fabric and sheet.
- 5) Surface material is a coating on the product to have a shadow side. Details of calculating the direct material as equation 3.

Direct raw material = Amount of each material used x cost per unit (3)

By, amount raw material that used from actual production and price calculation system from FIFO weight average.

Table 5.11 Calculation of direct raw material cost for design product

Item	Month	RM	Cost /Kgs	Quantity (Kgs.)				Amount (Baht)			
				C	F	L	Total	C	F	L	Total
1	July	Compound	53.43	1,758.00	342.24	5,190.00	7,290.24	93,929.35	18,285.77	277,299.97	389,515.09
		Fabric	31.35	-	-	3,200.00	3,200.00	-	-	100,305.60	100,305.60
		Pigment	167.28	20.36	9.24	319.50	349.10	3,405.86	1,545.69	53,446.60	58,398.15
		Adhesive	68.15	-	-	285.64	285.64	-	-	19,466.37	19,466.37
		Surface	52.76	44.00	12.00	388.00	444.00	2,321.57	633.16	20,472.04	23,426.77
รวม				1,822.36	363.48	8,995.14	11,124.98	99,656.79	20,464.61	470,990.58	591,111.98
2	August	Compound	52.13	4,404.00	-	-	4,404.00	229,590.80	-	-	229,590.80
		Fabric	28.44	-	-	-	-	-	-	-	0.00
		Pigment	168.26	52.80	-	-	52.80	8,883.95	-	-	8,883.95
		Adhesive	66.89	-	-	-	-	-	-	-	0.00
		Surface	52.76	164.00	-	-	164.00	8,653.13	-	-	8,653.13
รวม				4,620.80	-	-	4,620.80	247,127.88	-	-	238,474.75
3	September	Compound	54.14	1,421.60	-	12,903.40	14,325.00	76,966.37	-	698,598.68	775,565.05
		Fabric	32.18	-	-	7,200.00	7,200.00	-	-	231,706.80	231,706.80
		Pigment	161.15	9.80	-	455.60	465.40	1,579.23	-	73,418.27	74,997.50
		Adhesive	67.16	-	-	525.98	525.98	-	-	35,324.47	35,324.47
		Surface	52.76	226.00	-	662.90	888.90	11,924.44	-	34,976.59	46,901.03
รวม				1,657.40	-	21,084.98	22,516.38	90,470.04	0.00	1,074,024.81	1,164,494.85
4	October	Compound	54.14	-	967.04	5,672.00	6,639.04	-	52,356.19	307,085.86	359,442.05
		Fabric	32.18	-	-	3,582.00	3,582.00	-	-	115,274.13	115,274.13
		Pigment	161.15	-	15.74	228.60	244.34	-	2,536.44	36,838.05	39,374.50
		Adhesive	67.16	-	-	-	-	-	-	-	0.00
		Surface	52.76	-	62.62	296.00	358.62	-	3,304.02	15,617.85	18,921.87
รวม				-	1,045.40	9,482.60	10,465.38	0.00	58,196.65	474,815.89	533,012.55
5	November	Compound	54.14	-	-	5,374.00	5,374.00	-	-	290,951.94	290,951.94
		Fabric	32.18	-	-	3,400.00	3,400.00	-	-	109,417.10	109,417.10
		Pigment	161.15	-	-	192.00	192.00	-	-	30,940.10	30,940.10
		Adhesive	67.16	-	-	187.20	187.20	-	-	12,572.23	12,572.23
		Surface	52.76	-	-	276.00	276.00	-	-	14,562.59	14,562.59
รวม				-	-	9,429.20	9,429.20	-	-	458,443.95	458,443.95
6	December	Compound	54.14	1,880.00	778.00	13,508.00	16,166.00	101,784.45	42,121.44	731,332.13	875,238.02
		Fabric	32.18	-	-	7,578.00	7,578.00	-	-	243,871.41	243,871.41
		Pigment	161.15	13.40	19.00	464.00	496.40	2,159.36	3,061.78	74,771.90	79,993.04
		Adhesive	67.16	-	-	486.00	486.00	-	-	32,639.44	32,639.44
		Surface	52.76	380.00	26.00	670.00	1,076.00	20,049.94	1,371.84	35,351.21	56,772.99
Total				2,273.40	823.00	22,706.00	25,802.40	123,993.75	46,555.06	1,117,966.08	1,288,514.89
Total (RM)				10,373.96	2,231.88	71,697.92	83,959.14	561,248.47	125,216.32	3,596,241.31	4,282,706.10
Avg. / Month				1,728.99	371.98	11,949.65	13,993.19	93,541.41	20,869.39	599,373.55	713,784.35

5.2.2 Labor cost

Labor cost of design can be divided into 2 types with the details as follows.

5.2.2.1 The cost of direct labor from R&D department is direct labor cost of R&D which is the main work unit of the product design as the table 5.15 - 5.17 with the details as follows.

Labor cost of each product per machine hour = Direct labor cost of R&D department /
hour of total machine usage of each product x hour of work of each product (4)

Table 5.12 Labor cost of each product per hour

Month	Direct Labour of Production (Baht)	Hour of machine usage of product				Labour of Product / Hour (Baht)			
		C	F	L	รวม	C	F	L	รวม
July	142,400	68	72	192	332	29,166	30,882	82,352	142,400
August	139,800	304	0	0	304	139,800	0	0	139,800
September	139,800	12	0	294	306	5,482	0	134,318	139,800
October	148,936	0	132	174	306	0	64,247	84,689	148,936
November	148,180	0	0	180	180	0	0	148,180	148,180
December	148,780	8	64	320	392	3,036	24,291	121,453	148,780
Total	867,896	392	268	1,160	1,820	177,485	119,419	570,992	867,896
Avg. / Month	144,649	65	45	193	303	29,581	19,903	95,165	144,649

5.2.2.2 Indirect labor cost from various supporting departments which is in the product design team (APQP) as the table 5.16 with the details as follows.

Indirect labor cost of each production department participating in the meeting of July 2010 = amount of labor cost per day per hour x time in the meeting x amount of meeting week of July (5)

Table 5.13 Labor cost of each department in APQP team

Month	Labor cost of each department in APQP team						Total
	Production	Sales	R&D	Production Planning	QA	Purchase	
July	5,278,990	200,570	142,400	474,718	1,012,160	456,410	7,565,248
August	5,227,516	202,886	139,800	469,126	1,011,878	457,984	7,509,190
September	5,261,814	202,374	139,800	470,788	1,010,512	464,789	7,550,077
October	5,286,412	213,774	148,936	591,474	1,057,118	488,017	7,785,731
November	5,357,126	213,664	148,180	589,532	1,029,786	491,923	7,830,211
December	5,153,176	214,744	148,780	591,262	1,027,174	494,461	7,629,597
Total	31,565,034	1,248,012	867,896	3,186,900	6,148,628	2,853,584	45,870,054

Table 5.14 Amount of employee in each department

Amount of employee in each department						Total
Production	Sales	R&D	Production Planning	QA	Purchase	
300	25	12	10	20	8	375

Table 5.15 Amount of employee joining in APQP team

Amount of employee joining in APQP team						Total
Production	Sales	R&D	Production Planning	QA	Purchase	
7	7	6	3	2	1	26

Table 5.16 Indirect labor cost joining APQP team

Month	Indirect labor cost joining APQP team						Total
	Production	Sales	R&D	Production Planning	QA	Purchase	
July	4,927	2,246	2,848	5,697	4,049	2,282	22,049
August	5,544	2,582	3,177	6,397	4,599	2,602	24,903
September	4,911	2,267	2,796	5,649	4,042	2,324	21,989
October	37,541	2,602	3,238	7,715	4,596	2,652	58,345
November	38,043	2,601	3,221	7,690	4,477	2,673	58,706
December	36,595	2,614	3,234	7,712	4,466	2,687	57,309
Total	52,924	9,698	12,059	25,458	17,286	9,860	127,285

5.2.3 Cost of production expense

Production Expense is the total expense happening in the production apart from direct raw material cost and direct labor cost that has been mentioned above. The expense in the production will be divided into 2 parts which are the production expense that can be included into the product directly such as labor cost, raw material cost and production cost that cannot be included into product. The production expense cost that cannot be included in the product directly will use the activity base system to allocate into product according to the activity base cost system according to the figure 5.2.

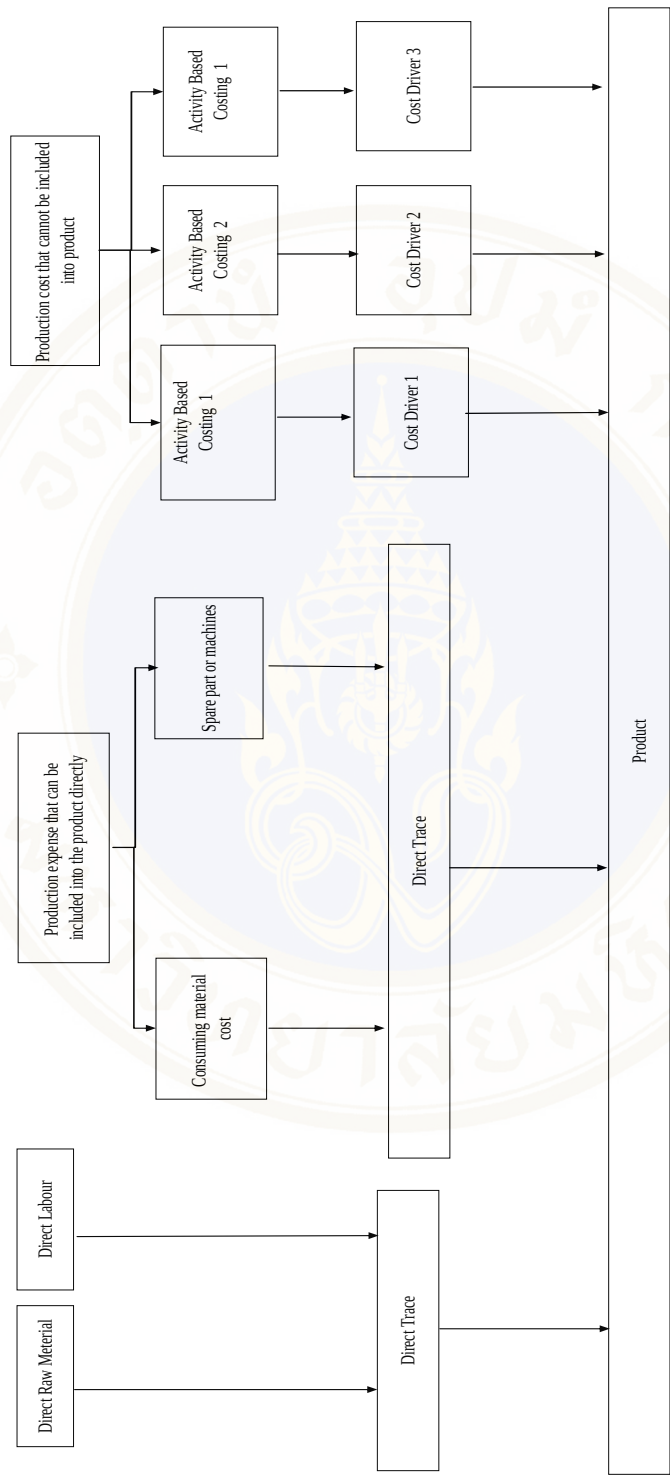


Figure 5.2 Structure of activity based costing of design cost

5.2.3.1 The production expense that can be included into product directly will be considered by 2 values which are consuming material cost and Spare part or machines which are expense from July to December in 2010 by showing the table 5.17.

Table 5.17 Item of production expense cost included in the product directly of the calculation of product design

Item	Month	Production expense that can be included in the product directly (Bath)		
		Consuming material cost	Spare part or machines	Total
1	July	20,000	1,520,000	1,540,000
2	August	26,000	520,000	546,000
3	September	16,000	660,000	676,000
4	October	8,000	870,000	878,000
5	November	16,000	690,000	706,000
6	December	8,000	864,000	872,000
Total		94,000	5,124,000	3,640,000
Average / Month		15,667	854,000	606,667

5.2.3.2 Production expense that cannot be included into the product directly that has been mentioned in the chapter 4 and after that the activity cost will be allocated by allocating resource cost according to the resource level starting from RL1 resource level into resource level RL2, RL3 and RL4 accordingly. The details of each resource level are as follows.

1) RL 1 level will allocate the total resource cost of the company into each department level as the table 5.18.

2) RL 2 level will allocate the total resource cost of the company into each work unit as in the table 5.19.

3) RL 3 level will allocate the total resource cost of the work unit into activity level as in the table 5.20.

4) RL 4 level will allocate the total resource cost of activity into product as in the table 5.21.

When we have the cost of each activity we would use activity drive as a criteria in the allocation into the product by calculating the activity rate in order to know the cost per unit of the activity drive and then multiply the amount of activity drive of products used in the production with the activity rate and we would have the activity cost per product as shown in the table 5.22.

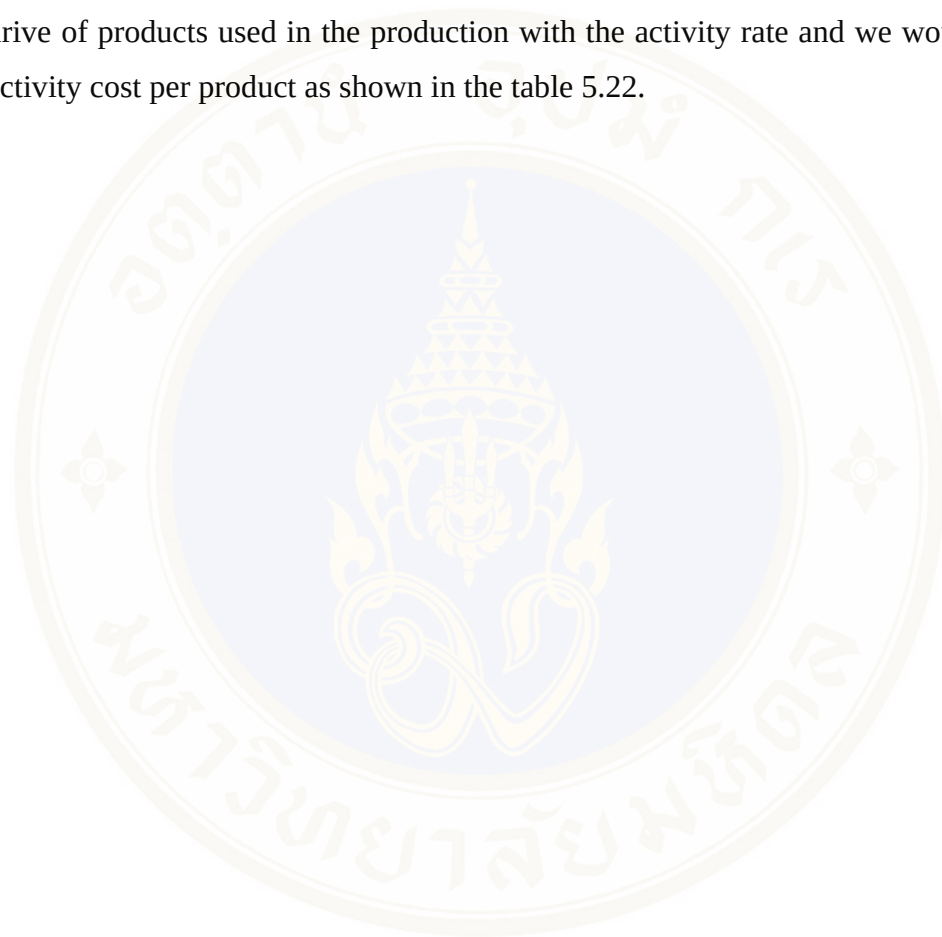


Table 5.18 The allocation of production expense (Design) of the company to each department (RL1) on July, 2010

Month	July												
Type of resource	List Expenses (Baths)	Resource Driver (RL 1)	Resource Driver of each department					Expense of each department as allocation to resource driver (Bath)					Total Expenses
			Sales	Logistics	Team A P Q P	R & D	Resource Driver (Total)	Sales	Logistics	Team A P Q P	R & D		
			0.2	0.3	0.0	0.5	1.0	1,291	1,937	0	3,228	6,456	
			0.1	0.0	0.0	0.9	1	950	0	0	8,550	9,500	
			0.0	0.0	0.0	1.0	1	0	0	0	600	600	
			0.1	0.0	0.0	0.9	1	284	0	0	2,556	2,840	
			0.0	0.0	0.0	3.0	3	0	0	0	40,000	40,000	
			0.0	0.0	0.0	3.0	3	0	0	0	10,000	10,000	
			0.0	0.0	0.0	2.0	2	0	0	0	62,724	62,724	
			1.0	0.0	0.0	1.0	2	1,150	0	0	1,150	2,300	
22,150	25.0	7.0	26.0	12.0	70	7,911	2,215	8,227	3,797	22,150			
573	156,570											156,570	

Table 5.19 The allocation of production expense (design) of the company to each department (RL2) on July, 2010

Month	July																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																	
Type of resource	List Expenses (Bahts)	Resource Driver (RL 2)	Resource Driver of each department					Expense of each department as allocation to resource driver (Baht)					Total Expenses																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																					
			Sales	Logistics	Team A P P	R & D	Resource Driver (Total)	Sales	Logistics	Team A P P	R & D																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																							
			1	0	0	1	2	3,228	0	0	0	3,228		6,456																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																				
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			0	0	0	1	1	0	0	0	0	600		600																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																				
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Table 5.20 The allocation of production expense (design) of the company to each department (RL3) on July, 2010

Month	July	Expense of each department as allocation to resource driver (Bath)																		
Type of resource	List Expenses (Baths)	Resource Driver of each department										Resource Driver (RL 3)								
		Team APQP						R & D				Resource Driver (Total)								
		Sales	Logistics	The experimental plan.		Feedback, Assessment and Corrective Action		Planning operations	Product design	Process design	Product and Process Validation	Taking requirement from a customer	Checking requirement of customer	considering the possibility of manufacturing	The experimental plan.	Feedback, Assessment and Corrective Action	Planning operations	Product design	Process design	Product and Process Validation

Table 5.21 The allocation of production expense (design) of the company to each department (RL4) on July, 2010

Month	July	Expense (Bahts) (3)	Resource Driver (RL4) (4)	Activity (5)	Number Resource (6)	Resource Drivers (Totals) (7)	Activity Base Costing (8) = (3)/(7)*(6)
Responsibility Center (1)	(Activity Center)(2)						
Sales	Taking requirement from a customer	17,709	Work time (Minutes)	Check product demand (customer orders).	162	162	17,709
Logistics	Checking requirement of customer	2,215	Work time (Minutes)	Receiving the notification requirements of the customer Check the notification requirements of the customer Save the document needs of the customer invoice.	243 270 270	783	687 764 764
Team AROF	Considering the possibility of manufacturing	3,164	Work time (Minutes)	Market Analysis Risk analysis Reliability of the product. Product benchmark Process benchmark Results of the feasibility study	1,080 1,080 1,080 1,080 1,080 1,080	6,480	527 527 527 527 527 527
	The experimental plan.	2,531		Plan for conducting experiments	540	540	2,531
	Feedback, Assessment and Corrective Action	2,531		Delivery and Service Customer Satisfaction	720 3,240	3,960	460 2,071
R & D	Planning operations	64,971		Preliminary bill of materials (BOM). Preliminary process flow chart Preliminary identification of special product characteristics Preliminary identification of special process characteristics	540 162 1,080 1,080	2,862	12,259 3,678 24,517 24,517
	Product design	2,276		Preparation DFMEA. Design verification Design review Prototype Build - Control Plan Specifications Changes Drawing Changes Special Product Characteristics	1,080 1,080 1,080 1,080 60 30 540		497 497 497 497 28 14 248
	Product process	2,276	Work time (Minutes)	Packaging Standards Product/Process Quality System Review Process Flow Chart Characteristics Matrix Preparation PFMEA. Pre-Launch Control Plan Measurement System Analysis Plan Packaging Specification	540 270 1,080 540 1,080 162 1,080 540		232 116 464 232 464 70 464 232
	Product and Process Validation	58,897		Significant Production Run Measurement Systems Evaluation Preliminary Process Capability Study Production Part Approval (PPAP) Production Validation Testing Packaging Evaluation Production Control Plan Quality Planning Sign-off	2,520 1,680 1,680 1,080 1,260 420 252 1,680	10,572	14,039 9,359 9,359 6,017 7,019 2,240 1,404 9,359

Table 5.22 Activity based costing per product unit of all design product on July , 2010

Month	Responsibility Center (1)	Activity Center (2)	Activity	ABC (4)	Cost Driver (5)	Total amount cost driver (6)	Activity Rate (7) = (4) / (6)	Amount Cost Driver of Product (8)				Product Cost (Baths) : (8) * (7) * (9)					
								C	F	L	TH	C	F	L	TH		
Sales	Logistics	Tableting requirement from a customer	Check product demand (customer orders).	17,709	Number of customer order	4	4,427	1	1	2	4	4,427	8,854	17,709	TH		
		Checking requirement of customer	Receiving the notification requirements of the customer Check the notification requirements of the customer Save the document needs of the customer invoice.	687 764 764	Number of receiving Number of check Number of No.Save document	9 9 9	76 85 85	2 2 2	1 1 1	6 6 6	9 9 9	153 170 170	76 85 85	458 509 509	687 764 764		
Team APQP	Considering the possibility of manufacturing	Market Analysis	Market Analysis	527	Number of market analysis report	9	59	2	1	6	9	117	59	352	527		
		Risk analysis	Reliability of the product.	527	Number of risk analysis report	9	59	2	1	6	9	117	59	352	527		
		Product benchmark	Product benchmark	527	Number of product benchmark report	9	59	2	1	6	9	117	59	352	527		
		Process benchmark	Process benchmark	527	Number of process benchmark report	9	59	2	1	6	9	117	59	352	527		
		Results of the feasibility study	Results of the feasibility study report	527	Number of results of the feasibility study report	9	59	2	1	6	9	117	59	352	527		
		Plan for conducting experiments	Plan for conducting experiments	2,531	Number of plan experiments	9	281	2	1	6	9	563	281	1,688	2,531		
		Delivery and Service	Delivery and Service	460	Number of product delivery and Service	7	66	1	1	5	7	66	66	329	460		
		Customer Satisfaction	Customer Satisfaction	2,071	Number of product	9	230	2	1	6	9	460	230	1,381	2,071		
		Preliminary bill of materials (BOM).	Preliminary process flow chart	12,259	Number of BOM	9	1,362	2	1	6	9	2,724	1,362	8,172	12,259		
		Preliminary process flow chart	Preliminary identification of special product characteristics	3,678	Number of process flow chart	9	409	2	1	6	9	817	409	2,452	3,678		
R & D	Product design	Preliminary identification of special product characteristics	Preliminary identification of special product characteristics	24,517	Number of document of special product characteristics	9	2,724	2	1	6	9	5,448	2,724	16,346	24,517		
		Preliminary identification of special process characteristics	Preliminary identification of special process characteristics	24,517	Number of document of special process characteristics	9	2,724	2	1	6	9	5,448	2,724	16,346	24,517		
		Preparation DFMEA.	Preparation DFMEA.	487	Number of DFMEA of product	9	55	2	1	6	9	110	55	331	487		
		Design verification	Number of document of design verification	487	Number of document of design verification	9	55	2	1	6	9	110	55	331	487		
		Design review	Number of document of design review	487	Number of document of design review	9	55	2	1	6	9	110	55	331	487		
		Prototype Build - Control Plan	Number of prototype build - control plan	487	Number of prototype build - control plan	9	55	2	1	6	9	110	55	331	487		
		Specifications Changes	Number of No-Specifications Changes	28	Number of No-Specifications Changes	2	14	0	1	1	2	0	14	14	28		
		Drawing Changes	Number of drawing changes	14	Number of drawing changes	2	7	0	1	1	2	0	7	7	14		
		Special Product Characteristics	Number of special product characteristics	248	Number of special product characteristics	1	248	0	0	1	1	0	0	248	248		
		Packaging Standards	No Packaging Standards	232	No Packaging Standards	9	26	2	1	6	9	52	26	155	232		
Product and Process Validation	Product process	Product/Process Quality System Review	Product/Process Quality System Review	116	No Product/Process Quality System Review	9	13	2	1	6	9	26	13	77	116		
		Process Flow Chart	Process Flow Chart	464	No Process Flow Chart	9	52	2	1	6	9	103	52	310	464		
		Characteristics Matrix	Characteristics Matrix	232	No Characteristics Matrix	9	26	2	1	6	9	52	26	155	232		
		Preparation PFMEA.	No PFMEA of Product	464	No PFMEA of Product	9	52	2	1	6	9	103	52	310	464		
		Pre-Launch Control Plan	No Pre-Launch Control Plan	70	No Pre-Launch Control Plan	9	8	2	1	6	9	15	8	46	70		
		Measurement System Analysis Plan	No Measurement System Analysis Plan	464	No Measurement System Analysis Plan	9	52	2	1	6	9	103	52	310	464		
		Packaging Specification	No Packaging Specification	232	No Packaging Specification	9	26	2	1	6	9	52	26	155	232		
		Significant Production Run	No Product Run	14,039	No Product Run	11	1,276	2	1	8	11	2,553	1,276	10,210	14,039		
		Measurement Systems Evaluation	No Measurement Systems Evaluation	9,359	No Measurement Systems Evaluation	11	851	2	1	8	11	1,702	851	6,807	9,359		
		Preliminary Process Capability Study	No Preliminary Process Capability Study	9,359	No Preliminary Process Capability Study	11	851	2	1	8	11	1,702	851	6,807	9,359		
Product and Process Validation	Product and Process Validation	Prediction Part Approval (PPAP)	Prediction Part Approval (PPAP)	6,017	No Prediction Part Approval (PPAP)	9	669	2	1	6	9	1,337	669	4,011	6,017		
		Production Validation Testing	Production Validation Testing	7,019	No Production Validation Testing	11	638	2	1	8	11	1,276	638	5,105	7,019		
		Packaging Evaluation	Packaging Evaluation	2,340	No Packaging Evaluation	11	213	2	1	8	11	425	213	1,702	2,340		
		Production Control Plan	No Production Control Plan	1,404	No Production Control Plan	11	128	2	1	8	11	255	128	1,021	1,404		
		Quality Planning Sign-off	No Quality Planning Sign-off	9,359	No Quality Planning Sign-off	9	1,040	2	1	6	9	2,080	1,040	6,240	9,359		
Total Product Cost (Baths)						33,426									18,960	104,164	156,570

5.2.3.3 Summary of the calculation of design cost

From the calculation above we can conclude the sum of the total cost of the product design consisting labor cost, material cost, direct and indirect production cost separating on a monthly basis starting from July to December 2010 with the details in the table 5.23 such as the cost of product design "L" in July consisting of labor cost 97,052 baht, raw material 470,991 baht, production expense 1,130,830 baht, total cost 1,698,873 baht and the total cost of every product by separating into 2 parts which are summary of production expense and the summary of product cost as follows.

1) Summary of production cost

Production expense that can be included into product directly	5,217,999	baht
Production expense that cannot be included into product	1,068,137	baht
Total production cost	6,286,136	baht

2) Summary of total cost of production of product

Raw material cost	4,282,706	baht
Labor cost	1,128,319	baht
Total expense cost	6,286,136	baht
Total cost of design	11,697,161	baht

Table 5.23 Total cost of all product design on July to December, 2010

Month	Direct Labour					Direct Raw Material					Total production expense										Total cost				
	C	F	L	Total	Avg	C	F	L	Total	Avg	C	F	L	Total	Avg	C	F	L	Total	Avg	C	F	L	Total	Avg
July	54,068	30,882	97,052	182,002	60,667	99,657	20,465	470,991	591,112	197,037	342,222	171,111	1,026,666	1,539,999	33,426	19,980	104,164	156,570	1,696,569	565,523	529,973	241,438	1,698,873	2,468,688	823,228
August	164,702	0	0	164,702	54,901	247,128	0	0	247,128	82,376	546,000	0	0	546,000	126,406	0	0	126,406	672,406	224,135	1,094,236	0	0	1,094,236	361,412
September	6,228	0	155,462	161,790	53,930	90,470	0	1,074,025	1,164,495	388,165	26,000	0	650,000	676,000	7,889	0	224,055	231,944	907,944	302,648	130,687	0	2,103,542	2,234,229	744,743
October	0	89,250	117,599	206,849	68,950	0	58,197	474,816	533,013	177,671	0	376,286	501,714	878,000	182,190	65,428	116,622	182,190	1,600,050	333,350	0	589,161	1,210,751	1,799,912	599,971
November	0	0	206,806	206,806	68,962	0	0	459,444	459,444	152,815	0	0	706,000	706,000	0	0	180,545	180,545	886,545	285,515	0	0	1,551,875	1,551,875	517,292
December	15,772	30,658	159,680	206,109	68,697	123,994	46,555	1,117,966	1,288,515	429,505	193,778	96,888	591,333	872,000	199,622	4,358	156,494	199,622	1,062,622	354,207	383,314	178,460	2,015,463	2,557,227	852,409
Total	240,870	150,790	736,659	1,128,319	376,106	561,248	125,216	3,356,241	4,282,706	1,427,598	1,008,000	644,206	3,465,713	5,217,999	197,491	88,766	781,880	1,068,137	6,206,136	2,095,379	2,107,609	1,009,658	8,530,463	11,697,161	3,899,054
Avg /Month	40,145	25,132	122,777	188,053	62,684	93,541	20,869	593,374	713,794	237,938	164,667	107,381	577,619	869,667	329,15	14,794	130,313	178,023	1,047,689	349,230	351,268	168,176	1,430,082	1,948,527	649,942

5.3 The calculation of the product life cycle cost by the activity based costing

The calculation of the product life cycle cost that is used in the calculation is divided into 3 types which are direct raw material cost, direct labor cost and production expense cost by direct raw material and direct labor uses data of production calculation in 5.1 and that activity cost will be allocated by allocating resource cost according to the resource level starting from RL1 resource level into resource level RL2, RL3 and RL4 accordingly. The details of each resource level as table 5.24-5.29.

When we have the cost of each activity we would use activity drive as a criteria in the allocation into the product by calculating the activity rate in order to know the cost per unit of the activity drive and then multiply the amount of activity drive of products used in the production with the activity rate and we would have the activity cost per product as shown in the table 5.30.

Table 5.24 The production expense (PLC) received from the allocation of responsibility center to each activity center (RL1) on July 2010

Month	July	Expense of each department																						
Type of resource	List Expenses (Baths)	Resource Driver of each department																						
		as allocation to resource driver (Bath)																						
		Resource Driver (RL 1)																						
		Sales	Logistics	Team ARPP	R & D	Planning Production	Production	Raw Material Warehouse	Finished Goods Warehouse	Engineering	Quality Control & Assurance	Resource Driver (Total)	Sales	Logistics	Team ARPP	R & D	Planning Production	Production	Raw Material Warehouse	Finished Goods Warehouse	Engineering	Quality Control & Assurance	Total Expenses	
Depreciation - Factory building.	199,464	0	0	0	0	0	0	0	0	0	0	5,540	0	0	0	0	0	199,464	0	0	0	0	199,464	
Depreciation - Improvements - the fa	27,489	0	0	0	0	0	0	0	0	0	0	5,540	0	0	0	0	0	27,489	0	0	0	0	27,489	
Depreciation - Machinery	558,089	0	0	0	0	0	0	0	0	0	0	5,540	0	0	0	0	0	558,089	0	0	0	0	558,089	
Depreciation - Equipage	1,036,982	0	0	0	0	0	0	0	0	0	0	5,540	0	0	0	0	0	1,036,982	0	0	0	0	1,036,982	
Depreciation - Infrastructure.	883	0	0	0	0	0	0	0	0	0	0	5,540	0	0	0	0	0	883	0	0	0	0	883	
Depreciation - Machine improvement	107,432	0	0	0	0	0	0	0	0	0	0	5,540	0	0	0	0	0	107,432	0	0	0	0	107,432	
Repair-Building	12,204	0	0	0	0	0	0	0	0	0	0	350	0	0	0	0	0	12,204	0	0	0	0	12,204	
Repair-Machinery	106,758	0	0	0	0	0	0	5	0	0	0	5	0	0	0	0	0	106,758	0	0	0	0	106,758	
Repair-Equipage	449,178	1	0	0	1	0	0	3	1	0	1	0	7	64,168	0	0	64,168	0	192,505	64,168	0	64,168	449,178	
Repair-Office equipment.	0	0	0	0	7	7	15	4	5	4	2	44	0	0	0	0	0	0	0	0	0	0	0	
Core Paper	266,544	0	0	0	0	0	0	7,582	0	0	0	7,582	0	0	0	0	0	266,544	0	0	0	0	266,544	
Supplies	548,909	0	0	0	0	0	0.1	0.4	0.3	0.2	0	0	1	0	0	0	54,891	219,564	164,673	109,782	0	548,909		
Packaging materials.	367,377	0.1	0	0	0.1	0	0.8	0.1	0.1	0	0	1	30,615	0	0	0	30,615	0	244,918	30,615	0	367,377		
Fuel	500	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	500	0	0	0	0	500		
Testing Fee	40,000	0	0	0	3	0	0	0	0	0	0	3	0	0	0	0	40,000	0	0	0	0	40,000		
Testing Product	10,000	0	0	0	3	0	0	0	0	0	0	3	0	0	0	0	10,000	0	0	0	0	10,000		
Sample Product	62,724	0	0	0	2	0	0	0	0	0	0	2	0	0	0	0	62,724	0	0	0	0	62,724		
Delivery(Vy Post)	2,300	1	0	0	1	0	0	0	0	0	0	2	1,150	0	0	1,150	0	0	0	0	0	2,300		
Premium machine.	27,485	0	0	0	0	0	0	37	0	0	0	37	0	0	0	0	0	27,485	0	0	0	0	27,485	
Mobile phone and Pager	3,169	0.1	0.1	0.0	0.1	0.2	0.4	0.1	0.2	0.1	0.1	1	226	226	0	0	226	453	226	453	226	226	3,169	
Internet	46,200	0.1	0.1	0	0.1	0.2	0.1	0.1	0.1	0.1	0.1	1	4,620	4,620	0	0	4,620	9,240	4,620	4,620	4,620	4,620	46,200	
Security.	141,600	140	140	414	357	119	11,261	1,281	2,959	8515	150	17,557.5	1,130	1,130	3,343	2,882	961	89,833	10,343	23,891	6,875	1,211	141,600	
Miscellaneous expenses	56,191	25	7	26	12	23	320	12	34	12	11	482	2,914	816	3,031	1,599	2,681	37,305	1,399	3,964	1,389	1,282	56,191	
Σ	4,071,477																						Total	4,071,477

Table 5.26 Resource drive of responsibility center (PLC) to each activity center (RL3) on July 2010

Month	July	Resource Drive of each department																				
Type of resource	List Expenses	(Baht)	Resource Drive (RL 3)	Resource Drive of each department																		
				Sales	Logistics	Trans ADQP		Printing operations	R&D		Planning Production	Production I		Production II	Inspection	Raw Material Warehouse	Finished Goods Warehouse	Engineering	Quality Control & Assurance			
						The experimental plan	Feedback, Assessment and Corrective Action		Product design	Process design		Product and Process Validation	Support production							Preparing raw material	Production	Check Quality
Type of resource	Resource Drive (RL 3)	(Baht)	Resource Drive (RL 3)	Checking requirement of customer	Considering the possibility of manufacturing	The experimental plan	Feedback, Assessment and Corrective Action	Printing operations	Product design	Process design	Product and Process Validation	Support production	Preparing raw material	Production	Check Quality	Inspection	Raw Material Warehouse	Finished Goods Warehouse	Engineering	Quality Control	Resource Drive (Total)	
				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5,540
				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5,540
				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5,540
				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5,540
				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5,540
				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5,540
				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5,540
				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5,540
				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5,540
				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5,540
				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5,540
				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5,540
				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5,540
				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5,540
				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5,540
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5,540				
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5,540				
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5,540				
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5,540				
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5,540				
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5,540				
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5,540				
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5,540				
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5,540				
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5,540				
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5,540				
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5,540				
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5,540				
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5,540				
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5,540				
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5,540				
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5,540				
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5,540				
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5,540				
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5,540				
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5,540				
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5,540				
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5,540				
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5,540				
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5,540				
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5,540				
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5,540				
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5,540				
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5,540				
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5,540				
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5,540				
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5,540				
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5,540				
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5,540				
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5,540				
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5,540				
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5,540</				

Table 5.27 Production expense received from the allocation of responsibility center to each activity center (RL-3) on July 2010

Month	July	Resource Drive of each department																		
List Expenses	(Baht)	Resource Drive (RL 3)																		
		R & D				Planning Production		Production I		Production II		Inspection	Raw Material Warehouse	Finished Goods Warehouse	Engineering	Quality Control & Assurance	Resource Driver (Total)			
		Product design		Process design		Product and Process Validation		Support production		Preparing raw material								Production		Check Quality
		Checking requirement of customer		The experimental plan		Feedback, Assessment and Corrective Action		Trans APQP		Support production		Production		Check Quality		Production		Check Quality		
		Sales Logistics		Considering the possibility of manufacturing																
Depreciation - Factory building	199,464	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		0	199,464	
Depreciation - Improvements - de factor	27,489	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	27,489		
Depreciation - Machinery	555,089	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	555,089		
Depreciation - Equipage	1,056,982	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1,056,982		
Depreciation - Infrastructure	883	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	883		
Depreciation - Machine improvements	107,452	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	107,452		
Repair Machinery	106,758	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	106,758		
Repair Equipage	449,178	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	449,178		
Repair Office equipment	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
Cost Paper	266,544	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	266,544		
Supplies	548,969	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	548,969		
Packaging materials	367,377	61,229	0	0	0	0	0	0	0	61,229	0	61,229	0	61,229	0	0	0	367,377		
Fuel	500	0	0	0	0	0	0	0	0	250	0	0	0	0	0	0	0	500		
Traning Fee	40,000	0	0	0	0	0	0	0	0	40,000	0	0	0	0	0	0	0	40,000		
Traning Product	10,000	0	0	0	0	0	0	0	0	10,000	0	0	0	0	0	0	0	10,000		
Sample Product	62,724	0	0	0	0	0	0	0	0	62,724	0	0	0	0	0	0	0	62,724		
Delivery (by Post)	2,700	1,150	0	0	0	0	0	0	0	1,150	0	0	0	0	0	0	0	2,700		
Prerun machine	27,485	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	27,485		
Mobile phone and Paper	3,169	203	0	0	0	0	0	0	0	203	0	203	0	203	0	0	0	3,169		
Internet	46,200	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	46,200		
Security	141,600	1,130	1,130	1,114	1,114	721	721	721	721	5,133	0	5,133	0	5,133	0	5,133	5,133	141,600		
Miscellaneous expenses	56,191	2,914	816	1,166	933	933	233	466	466	233	2,681	6,995	5,329	3,087	6,995	9,326	1,399	56,191		
YTD	4,071,477	10,881	1,946	2,280	2,047	63,966	33,521	33,521	118,756	196,548	580,036	1,600,435	520,598	457,739	305,552	286,460	77,864	4,071,477		

Table 5.28 The allocation of production expense (PLC) to each department (RL4) on July, 2010

Month	Activity Center (1)	Expenses (Bath) (3)	Resource Driver (RL4) (4)	Activity (5)	Number Resource Drivers	Resource Drivers (Totals) (7)	Activity Base Costing (8) = (6)*(7)/(6)
Sales	Activity Center (2)						
	Taking requirement from a customer	130,881	Work time (Minutes)	Check product demand (customer orders)	108	108	130,881
	Checking requirement of customer	1,946	Work time (Minutes)	Receiving the notification requirements of the customer Check the notification requirements of the customer Save the document needs of the customer invoice.	243 270 270	783	604 671 671
	Considering the possibility of manufacturing	2,280	Work time (Minutes)	Market Analysis Risk analysis Reliability of the product Product benchmark Process benchmark Results of the feasibility study	1,080 1,080 1,080 1,080 1,080 1,080	6,480	380 380 380 380 380 380
Team APQP	The experimental plan.	2,047		Plan for conducting experiments	540	540	2,047
	Feedback Assessment and Corrective Action	2,047		Delivery and Service Customer Satisfaction	720 3,240	3,960	372 1,675
	Planning operations	63,366		Preliminary bill of material (BOM) Preliminary process flow chart Preliminary identification of special product characteristics Preliminary identification of special process characteristics	180 54 90 90	414	27,811 8,343 13,906 13,906
				Preparation DFMEA Design verification Design review Prototype Build - Control Plan Specification Changes Drawing Changes Special Product Characteristics	360 180 180 180 54 54 90	1,098	10,991 5,495 5,495 5,495 1,649 1,649 2,748
R & D			Work time (Minutes)	Packaging Standards Product/Process Quality System Review Process Flow Chart Characteristics Matrix Preparation PFMEA Pre-Launch Control Plan Measurement System Analysis Plan Packaging Specification	180 120 360 240 360 54 360 240		3,152 2,102 6,305 4,203 6,305 946 6,305 4,203

Table 5.28 The allocation of production expense (PLC) to each department (RL4) of July, 2010 (Cont.)

Responsibility Center (1)	Activity Center (2)	Expenses (Bath) (3)	Resource Driver (RL4) (4)	Activity (5)	Number Resource Drivers	Resource Drivers (Totals) (7)	Activity Base Costing (8) = (3)/(7)*(6)
R & D	Product and Process Validation	118,755	Work time (Minutes)	Significant Production Run	900		13,307
				Measurement System Evaluation	360		7,323
				Preliminary Process Capability Study	360		7,323
				Production Part Approval (PPAP)	860	5,538	19,528
				Production Validation Testing	1,890		38,446
Planning Production	Support production	100,548	Work time (Minutes)	Prediction Validation Testing	630		12,815
				Packaging Evaluation	378		7,689
				Prediction Control Plan	360		7,323
				Quality Planning Sign-off	3,000		25,137
				Prepare production plan	1,500	12,000	12,569
Production I	Preparing raw material	588,056	Work time (Minutes)	Issue Foundation	6,000		50,274
				Modify formulation	1,500		12,569
				Prepare raw material	8,240		179,878
				Prepare release paper	6,750	27,000	147,009
				Weighting pigment	6,750		147,009
Production I	Production	1,040,435	Work time (Minutes)	Weighting material	5,250		114,340
				Mixing raw material	9,000		184,257
				Shredding and lamination	25,260		517,147
				Filter or strain	900	50,820	18,426
				Oven drying & Rate	10,980		224,793
Production II	Check Quality	520,488	Work time (Minutes)	Rise & laminate of Cutting	4,680		95,813
				Check re-winder release paper	10,500	12,750	428,719
				Check thickness and colour	2,250		91,868
				Surface glossy or matting before embossing	11,640		115,654
				Emboss	26,880		262,458
Production II	Production	457,739	Work time (Minutes)	Surface glossy or matting after embossing	8,040	46,880	78,503
				Laminate foam layer with skin layer	240		2,143
				Heating in oven	80		781
				Check thickness and colour	5,040	8,064	190,845
				Check glossy	3,024		114,507
Inspection	Raw Material Warehouse	172,816	Work time (Minutes)	Inspection & Packaging	61,625	61,625	286,460
				Taken in raw material	3,000		53,174
				Keep & storage	4,500	9,750	79,761
				Taken out raw material	2,250		39,881
				Acquire key-in stock card	2,250		20,342
Finished Goods Warehouse	Support production	124,761	Work time (Minutes)	Move goods	3,300		29,834
				Storage goods	4,500	13,800	40,683
				Take in out finished goods	2,250		20,342
				Check key-in stock card	1,500		13,561
				Maintenance & Prevention machinery	5,040	8,820	44,494
Quality Control & Assurance	Quality Control	7,915	Work time (Minutes)	Modify & improve machine	3,780		33,370
				Random check product before delivery to customer	7,560	7,560	7,915

Table 5.29 The activity based costing per unit (PLC) of all product on July , 2010

Month	Activity Center (2)	Activity (3)	ABC (4)	Cost Driver (5)	Total amount cost driver (6)	Activity Rate (7) = (4) / (6)	Amount Cost Driver of Product (8)	Product Cost (Baht) : (9) = (7) * (8)				
Responsibility Center (1)								C	F	L	Total	
Sales	Taking requirement from a customer	Check product demand (customer orders).	130,881	Number of customer order	4	32,720	1	32,720	32,720	65,440	130,881	
		Receiving the notification requirements of the customer	604	Number of receiving	9	67	2	134	67	403	604	
Logistics	Checking requirement of customer	Check the notification requirements of the customer	671	Number of check	9	75	2	149	75	447	671	
		Save the document needs of the customer invoice.	671	Number of No.Save document	9	75	2	149	75	447	671	
Team AXQP	Considering the possibility of manufacturing	Market Analysis	380	Number of market analysis report	9	42	2	84	42	253	380	
		Risk analysis	380	Number of risk analysis report	9	42	2	84	42	253	380	
		Reliability of the product.	380	Number of reliability report	9	42	2	84	42	253	380	
		Product benchmark	380	Number of product benchmark report	9	42	2	84	42	253	380	
		Process benchmark	380	Number of process benchmark report	9	42	2	84	42	253	380	
		Results of the feasibility study	380	Number of results of the feasibility study report	9	42	2	84	42	253	380	
		Plan for conducting experiments	2,047	Number of plan experiments	9	227	2	455	227	1,385	2,047	
		Delivery and Service	372	Number of product delivery and Service	7	53	1	53	53	266	372	
		Customer Satisfaction.	1,675	Number of product	9	186	2	372	186	1,116	1,675	
		Preliminary bill of materials (BOM).	27,811	Number of BOM	9	3,090	2	6,180	3,090	18,541	27,811	
R & D	Planning operations	Preliminary process flow chart	8,343	Number of process flow chart	9	927	2	1,854	927	5,562	8,343	
		Preliminary identification of special product characteristics	13,906	Number of document of special product characteristics	9	1,545	2	3,090	1,545	9,270	13,906	
		Preliminary identification of special process characteristics	13,906	Number of document of special process characteristics	9	1,545	2	3,090	1,545	9,270	13,906	
		Preparation DFMEA.	10,931	Number of DFMEA of product	9	1,221	2	2,442	1,221	7,327	10,931	
	Product design	Design verification	5,495	Number of document of design verification	9	611	2	1,221	611	3,664	5,495	
		Design review	5,495	Number of document of design review	9	611	2	1,221	611	3,664	5,495	
		Prototype Build - Control Plan	5,495	Number of prototype build - control plan	9	611	2	1,221	611	3,664	5,495	
		Specifications Changes	1,649	Number of No.Specifications Changes	2	824	0	1	0	824	1,649	
		Drawing Changes	1,649	Number of drawing changes	2	824	0	1	0	824	1,649	
		Special Product Characteristics	2,748	Number of special product characteristics	1	2,748	0	1	0	2,748	2,748	
R & D	Product process	Packaging Standards	3,152	Number of packaging Standards	9	350	2	701	350	2,102	3,152	
		Product/Process Quality System Review	2,102	Number of product/Process Quality System Review	9	234	2	467	234	1,401	2,102	
		Process Flow Chart	6,305	Number of process Flow Chart	9	701	2	1,401	701	4,203	6,305	
		Characteristics Matrix	4,203	Number of characteristics Matrix	9	467	2	934	467	2,802	4,203	
		Preparation PFMEA.	6,305	Number of PFMEA of Product	9	701	2	1,401	701	4,203	6,305	
		Pre-Launch Control Plan	946	Number of Pre-Launch Control Plan	9	105	2	210	105	630	946	
		Measurement System Analysis Plan	6,305	Number of Measurement System Analysis Plan	9	701	2	1,401	701	4,203	6,305	
		Packaging Specification	4,203	Number of Packaging Specification	9	467	2	934	467	2,802	4,203	
		Significant Production Run	18,307	Number of Product Run	11	1,664	2	3,329	1,664	13,315	18,307	
		Measurement Systems Evaluation	7,323	Number of Measurement Systems Evaluation	11	666	2	1,331	666	5,305	7,323	
Product and Process Validation	Validation	Preliminary Process Capability Study	7,323	Number of Preliminary Process Capability Study	11	666	2	1,331	666	5,305	7,323	
		Production Part Approval (PPAP)	18,528	Number of Production Part Approval (PPAP)	9	2,170	2	4,340	2,170	13,619	18,528	
		Production Validation Testing	38,446	Number of Production Validation Testing	11	3,495	2	6,990	3,495	27,961	38,446	
		Packaging Evaluation	12,815	Number of Packaging Evaluation	11	1,165	2	2,330	1,165	9,320	12,815	
		Production Control Plan	7,689	Number of Production Control Plan	11	699	2	1,398	699	5,592	7,689	
		Quality Planning Sign-off	7,323	Number of Quality Planning Sign-off	9	814	2	1,627	814	4,882	7,323	

Table 5.29 The activity based costing per unit (PLC) of all product on July , 2010 (Cont.)

Month	Responsibility Center	Activity Center	Activity	ABC	Cost Driver	Total amount cost driver	Activity Rate	Amount Cost Driver of Product (B)	Product Cost (Bath) : (B) = (7) * (8)	Total
(1)	(2)	(3)	(4)	(5)	(6)	(7) = (4) / (6)	(8)	(9)	(10)	(11)
Planning Production	Support production	Prepare production plan	25,137	Number of production plan	25	1,005	2	4	19	20,111
		Follow-up for production	12,569	Number of follow-up	25	503	2	4	19	1,005
		Issue formulation	50,274	Number of issue formulation	75	670	9	10	56	6,033
		Modify formulation	12,569	Number of modify formulation	8	1,571	1	1	6	1,571
Production I	Preparing raw material	Prepare raw material	179,678	Number of prepare	88	2,042	9	23	56	18,376
		Prepare release paper	147,009	Number of prepare	15	9,801	2	0	13	19,601
		Weighting pigment	147,009	Number of weighing of pigment	88	1,671	9	23	56	15,035
		Weighting material	114,340	Number of weighing of material	88	1,299	9	23	56	11,694
		Mixing & spinning raw material	36,851	Number of spinning	26	1,417	2	11	13	2,835
		Boiling	36,851	Number of boiling	61	604	7	11	43	4,229
		Grinding	36,851	Number of grinding	15	2,467	2	0	13	4,914
		Tuning colour	36,851	Number of tuning	15	2,467	2	0	13	4,914
		Air vacuum	36,851	Number of vacuum	2	18,426	2	0	0	36,851
		Sheeting Roll #1	129,287	Number of rolling#1	58	2,229	7	8	43	15,604
		Sheeting Roll #2	129,287	Number of rolling#2	58	2,229	7	8	43	15,604
		Sheeting roll skin layer and lamination foam layer	129,287	Number of sheeting roll skin layer and lamination foam layer	43	3,007	0	0	43	0
Production II	Sheeting and lamination	Sheeting roll foam layer and lamination with fabric	129,287	Number of sheeting roll foam layer and lamination with fabric	43	3,007	0	0	43	0
		Filter or strain	18,426	Number of strain	58	318	7	8	43	2,224
		Blowing agent	224,793	Number of drying	43	5,228	0	0	43	0
		Surface or coating skin layer	47,907	Number of coated	17	2,818	2	2	13	5,636
		Oven drying	47,907	Number of drying	15	3,194	2	0	13	6,888
		Check re-winder release paper	428,719	Number of checking release paper	15	28,581	2	0	13	57,163
		Check thickness and colour	91,868	Number of checking thickness and colour	16	5,742	3	0	13	17,225
		Surface glossy or matting before embossing	113,654	Number of surface	58	1,960	2	0	56	3,919
		Emboss	262,458	Number of emboss	58	4,525	2	0	56	9,050
		Surface glossy or matting after embossing	78,503	Number of surface	58	1,354	2	0	56	2,707
		Laminate foam layer with skin layer	2,343	Number of laminate	2	1,172	0	0	2	0
		Heating in oven	781	Number of drying	7	112	7	0	0	781
Inspection	Raw Material Control	Check thickness and colour	190,845	Number of checking thickness and colour	24	7,952	9	2	13	71,567
		Check glossy	114,507	Number of checking glossy	34	3,368	2	6	26	67,366
		Inspection & Packaging	286,460	Number of inspection	35	8,185	3	6	26	24,554
		Taken in raw material	53,174	Number of taken in	62	858	2	0	60	1,715
		Keep & storage	79,761	Number of storage	86	927	2	24	60	1,855
		Taken out raw material	39,881	Number of taken out	155	257	10	29	116	2,573
		Acquire key-in stock card	20,342	Number of key-in stock card	165	123	4	15	146	483
		Move goods	29,834	Number of moving	187	160	2	39	146	319
		Storage goods	40,683	Number of storage goods	182	224	2	34	146	447
		Take in-out finished goods	20,342	Number of taken-out	151	135	3	34	114	484
		Check keys in stock card	13,561	Number of check key-in stock card	142	96	4	24	114	382
		Maintenance & Prevention machinery	44,494	Number of checking	20	2,225	7	2	11	15,573
Engineering	Support production	Modify & improve machine	33,370	Number of modify & improve machine	16	2,086	7	3	6	14,598
		Random check product before delivery to customer	7,915	Number of random checking	60	132	2	2	56	264
Quality Control & Assurance	Quality Control									
Total Product Cost (Bath)										401,407

Table 5.30 Total cost of product life cycle of all product on July to October, 2010

Month	Direct Labour						Direct Raw Material						Total production expense						Total cost					
	Direct Labour						Direct Raw Material						Total production expense						Total cost					
	C	F	L	FW	ค่าเฉลี่ย	รวม	C	F	L	FW	ค่าเฉลี่ย	C	F	L	FW	ค่าเฉลี่ย	รวม	C	F	L	FW	ค่าเฉลี่ย	รวม	Avg
July	60,737	1,300,940	3,623,306	5,270,901	1,791,664	607,557	15,536,956	30,772,515	46,917,006	15,633,003	575,606	639,392	2,530,126	3,765,294	49,165	404,655	3,153,007	4,071,477	7,856,771	2,912,257	1,749,735	10,162,001	40,126,954	60,032,770
August	54,453	1,555,532	3,607,531	5,277,516	1,742,505	1,240,334	12,465,136	29,943,806	42,749,306	14,249,769	349,408	666,065	3,940,078	4,991,001	540,344	894,951	3,591,821	5,017,116	10,007,417	3,335,006	2,178,539	5,507,494	40,703,266	57,994,239
September	109,621	1,534,696	3,617,497	5,243,014	1,753,090	2,494,705	12,223,100	34,015,000	48,733,073	16,244,624	386,423	732,045	4,442,161	5,621,493	407,097	352,143	3,015,911	3,065,951	9,497,300	3,145,793	3,498,646	1,490,204	45,013,557	62,493,067
October	94,400	1,694,094	3,597,208	5,286,412	1,762,137	738,334	10,742,017	21,009,989	32,011,540	10,670,447	402,723	872,597	3,597,556	4,072,205	537,777	334,166	2,965,634	3,885,978	8,709,004	2,918,389	1,772,694	13,053,554	31,013,367	46,017,556
Total	277,211	6,085,900	14,441,542	21,064,233	7,018,244	5,008,990	50,467,289	114,063,320	170,411,527	58,083,842	1,710,160	2,991,780	14,549,911	19,253,069	2,007,254	1,955,866	12,748,373	16,731,523	35,599,373	11,997,124	9,133,555	61,770,983	156,083,144	227,457,633
Average Month	81,003	1,571,465	3,610,386	5,266,063	1,754,561	1,270,733	12,516,807	28,715,092	42,402,802	14,200,961	425,540	747,947	3,637,175	4,914,463	501,414	493,974	3,187,083	4,020,001	8,997,843	2,999,201	2,282,309	15,490,233	39,150,706	56,064,400
																								10,854,003

5.3.1 Summary of the calculation of product life cycle cost

From the calculation above we can conclude the sum of the total cost of the product design consisting labor cost, material cost, direct and indirect production cost separating on a monthly basis starting from July to October 2010 with the details in the table 5.31 such as product life cycle cost "C" in July consisting of labor cost 3,629,306 97,052 baht, raw material 30,772,515 baht, production expense 5,725,133 baht, total cost 40,126,954 baht and the total cost of every product by separating into 2 parts which are summary of production expense and the summary of product cost as follows.

1) Summary of production cost

Production expense that can be included into product directly	19,259,850 baht
Production expense that cannot be included into product	16,731,523 baht
Total production cost	35,991,373 baht

2) Summary of total cost of production of product

Raw material cost	170,411,527 baht
Labor cost	21,054,733 baht
Total expense cost	35,991,373 baht
Total cost of product life cycle	227,457,633 baht

5.4 Research result

5.4.1 Calculation of production cost

From the calculation of activity base cost of the product, it makes us know the total production cost in the amount of 513,824,772 baht which consists of direct raw material cost of 385,517,857 baht which is 75.03% of the production cost. The direct labor cost is at 47,561,066 baht which is 9.06% and the expense cost is at 80,745,849 baht which is 15.71%. According to the table 5.32 it is found that the expense cost in the production of the activity base cost increases 48,360,695 baht which is 10.65%.

Table 5.31 The comparison of the production cost between the original cost and the activity based costing

Expense	Original Cost Amount (Bath)	Activity Base Costing Amount(Bath)
Direct Labour	47,561,066	47,561,066
Direct Raw Material	385,517,857	385,517,857
Product Expense	32,385,154	80,745,849
Total	465,464,077	513,824,772

Table 5.32 Quantity of the production of the product starting from February to October, 2010

Month	Quantity (Metre)				Avg. (Metre)
	C	F	L	Total	
Febraury	1,624	98,657	57,228	157,509	52,503
March	1,564	73,894	68,024	143,482	47,827
April	1,142	66,499	50,740	118,381	39,460
May	1,376	35,211	58,395	94,982	31,661
June	3,454	43,938	66,380	113,772	37,924
July	2,855	70,439	56,590	129,884	43,295
August	5,254	57,667	57,366	120,287	40,096
September	11,232	55,024	64,811	131,067	43,689
October	3,324	46,106	55,164	104,594	34,865
Total	31,825.0	547,434.5	534,698.0	1,113,957.5	371,319.2
Avg (Metre/Month)	3,536.11	60,826.06	59,410.89	123,773.06	41,257.69

From the table 5.32 total quantity of products starting on February to October, 2010 is at 1,113,957.3 meters. The average per month of quantity of product is at 371,319.2 meters per month which is found that the product group F has the highest product quantity of 60,826.06 meter per month. Next is the product group L which has the production amount of 59,410.89 meter per month and the last one is the product group C which has the production amount of 3,536.11 meters per month.

Table 5.33 Comparison of total product cost between the original cost and the activity base costing on February-October, 2010

Month	Original Cost (Bath/Metre)				AVG (Bath/Metre)	Activity Based Costing (Bath/Metre)				AVG (Bath/Metre)	Difference Between ABC & Original Cost (Baths/Metre)						AVG (Bath/Metre)	% Difference	
	C	F	L	Total		C	F	L	Total		C	% Difference	F	% Difference	L	% Difference			Total
February	852	186	292	1,330	443	778	155	761	1,694	555	-74	-872	-31	-16.53	469	160.49	364	121	27
March	496	200	260	956	319	1,262	276	639	2,176	725	766	154.40	76	37.94	379	145.60	1,220	407	128
April	542	214	331	1,087	362	848	263	630	1,741	590	306	56.44	49	22.89	299	90.37	654	218	60
May	546	214	332	1,092	364	755	332	567	1,655	552	209	38.26	118	55.25	235	70.93	563	188	52
June	414	212	309	935	312	457	285	763	1,505	502	43	10.47	73	34.50	454	146.89	570	190	61
July	426	186	316	928	309	502	257	709	1,548	516	156	36.52	71	38.38	393	124.40	620	207	67
August	409	182	290	881	294	400	265	706	1,371	457	-9	-2.24	83	45.48	416	143.54	490	163	56
September	411	192	297	900	300	298	273	692	1,263	421	-113	-27.39	81	42.27	395	132.93	363	121	40
October	522	214	330	1,066	355	478	287	592	1,347	449	-44	-8.40	73	34.04	252	76.25	281	94	26
Total	4,618	1,800	2,757	9,175	3,058	5,857.6	2,393.6	6,048.5	14,298.8	4,767	1,240	249	594	294	3,291	1,091	5,125	1,708	517
Avg (Per/Month)	513.11	200.00	306.33	1,019.44	339.81	650.85	265.96	672.05	1,508.06	530	138	28	66	33	366	121	569	190	57

From the table 5.33 it shows the comparison of activity based costing and the original cost from July to October, 2010. The total activity based costing is at 14,280.6 baht and the total original cost is at 9,175 baht. The different is at 57 %. If we separate according to the product group it is found that the product L has the most different cost which is the total activity based costing is at 6,029.4 baht and the total original cost is at 2,757 baht which is different at the rate of 121%. Next is the product F which has the total activity based costing is at 2,393.6 baht and the original cost is at 1,800 baht. The difference is at 33% and lastly the product C has the total activity based costing of 5,857.5 baht and the original cost of 4,618 baht. The difference is at 28%.

5.4.2 Analysis of production proportion at the activity and sub-activity center that has been allocated

Regarding the analysis of the production cost ratio at activity center, it is found that an activity center that causes the most cost is production activity center and then it is prepare raw material center, production department 1 inspection activity, sheeting and lamination activity center, check quality activity center. As for sub-activity that has been allocated of the production activity center that causes the most cost is emboss activity and surface glossy or matting after embossing, surface glossy or matting before embossing, laminate foam layer with skin layer and heating in oven activity. If we separate according to the product group we would find that product A has the cost percentage of the products the most. The activity center that causes the most cost is inspection activity center of production department 1 and then mixing raw material activity, prepare raw material activity, production activity, inspection activity center of the production department 2. As for production B it has the cost percentage next in rank. The activity center that causes the most cost is prepare raw material activity center and then production activity center, quality inspection activity center, sheeting and lamination activity center, raw material control activity center of raw material warehouse department. As for product C, it has the percentage ratio of the cost in the last in line. The activity centers that causes the most cost is production activity center and then prepare raw material activity center, inspection activity center

of the production department 1, sheeting and lamination sheeting activity center, check quality activity center, raw material control activity center of raw material warehouse department with the details according to table 5.34.

Table 5.34 Production proportion at the activity and activity that has been allocates.

Activity Center	Allocate Activity	Production cost of proportion							
		C	%	F	%	L	%	Total	%
Raw Material Control	Taken in raw material	17,909	0.49	132,644	2.90	490,449	1.83	641,006	1.83
	Keep & storage	23,146	0.63	260,298	5.70	678,060	2.53	961,510	2.74
	Taken out raw material	19,008	0.52	107,484	2.35	367,273	1.37	493,768	1.41
	Total	60,063	1.63	500,426	10.96	1,535,783	5.72	2,096,284	5.98
Support production	Prepare production plan	19,028	0.52	42,800	0.94	184,435	0.69	246,265	0.70
	Follow-up for production	9,514	0.26	21,400	0.47	92,217	0.34	123,132	0.35
	Issue formulation	44,773	1.22	84,034	1.84	363,720	1.36	492,530	1.40
	Modify formulation	11,037	0.30	20,248	0.44	91,846	0.34	123,132	0.35
	Total	84,353	2.30	168,482	3.69	732,218	2.73	985,060	2.81
Preparing raw material	Prepare raw material	109,042	2.97	257,134	5.63	960,031	3.58	1,326,215	3.78
	Prepare release paper	190,464	5.18	14,832	0.32	803,435	2.99	1,008,737	2.88
	Weighing pigment	117,721	3.20	259,817	5.69	962,129	3.59	1,339,676	3.82
	Weighing material	113,454	3.09	244,848	5.36	918,328	3.42	1,276,638	3.64
	Total	530,681	14.44	776,631	17.01	3,643,924	13.58	4,951,268	14.11
Mixing raw material	Mixing & spinning raw material	75,484	2.05	66,359	1.45	243,970	0.91	385,817	1.10
	Boiling	14,644	0.40	89,030	1.95	282,139	1.05	385,815	1.10
	Grinding	88,822	2.42	0	0.00	296,991	1.11	385,815	1.10
	Tinting colour	91,461	2.49	0	0.00	294,353	1.10	385,816	1.10
	Air vacuum	356,062	9.69	0	0.00	29,751	0.11	385,823	1.10
	Total	626,472	17.05	155,390	3.40	1,147,204	4.27	1,929,086	5.50
Sheeting and lamination	Sheeting Roll #1	18,373	0.50	260,938	5.71	774,718	2.89	1,054,036	3.00
	Sheeting Roll #2	18,373	0.50	260,938	5.71	774,718	2.89	1,054,036	3.00
	Sheeting roll skin layer and lamination foam layer	0	0.00	19,233	0.42	1,034,796	3.86	1,054,030	3.00
	Sheeting roll foam layer and lamination with fabric	0	0.00	19,233	0.42	1,034,796	3.86	1,054,030	3.00
	Total	36,747	1.00	560,341	12.27	3,619,030	13.49	4,216,131	12.02
Filter or strain	Filter or strain	2,781	0.08	42,295	0.93	134,733	0.50	179,810	0.51
	Total	2,781	0.08	42,295	0.93	134,733	0.50	179,810	0.51
Oven drying & Blowing	Blowing agent	47,302	1.29	36,919	0.81	1,776,731	6.62	1,860,954	5.31
	Total	47,302	1.29	36,919	0.81	1,776,731	6.62	1,860,954	5.31
Rise & laminate of Casting	Surface or coating skin layer	72,923	1.98	5,743	0.13	281,122	1.05	359,790	1.03
	Oven drying	73,689	2.01	0	0.00	286,099	1.07	359,790	1.03
Check Quality	Total	146,613	3.99	5,743	0.13	567,221	2.11	719,581	2.05
	Check re-winder release paper	634,529	17.27	0	0.00	2,366,694	8.82	3,001,241	8.56
	Check thickness and colour	273,866	7.45	171,460	3.75	1,163,806	4.34	1,609,144	4.59
	Total	908,396	24.72	171,460	3.75	3,530,501	13.16	4,610,385	13.14

Table 5.34 Production proportion at the activity and activity that has been allocates (Cont.)

Activity Center	Allocate Activity	Proportion of production cost							
		C	%	F	%	L	%	Total	%
Production	Surface glossy or matting before embossing	77,412	2.11	113,617	2.49	731,588	2.73	922,622	2.63
	Emboss	230,565	6.27	452,296	9.90	2,611,307	9.73	3,294,184	9.39
	Surface glossy or matting after embossing	81,110	2.21	139,776	3.06	796,764	2.97	1,017,656	2.90
	Laminate foam layer with skin layer	0	0.00	0	0.00	123,382	0.46	123,382	0.35
	Heating in oven	8,616	0.23	0	0.00	0	0.00	8,617	0.02
	Total	397,704	10.82	705,689	15.45	4,263,041	15.89	5,366,460	15.30
Check Quality	Check thickness and colour	225,291	6.13	227,370	4.98	987,681	3.68	1,440,353	4.11
	Check glossy	51,771	1.41	111,106	2.43	359,337	1.34	522,218	1.49
	Total	277,062	7.54	338,476	7.41	1,347,018	5.02	1,962,571	5.59
Inspection	Inspection & Packaging	262,871	7.15	580,577	12.71	2,500,057	9.32	3,343,525	9.53
	Total	262,871	7.15	580,577	12.71	2,500,057	9.32	3,343,525	9.53
Raw Material Control	Acquire key-in stock card	20,462	0.56	39,933	0.87	178,329	0.66	238,725	0.68
	Move goods	34,653	0.94	71,325	1.56	355,639	1.33	461,619	1.32
	Storage goods	68,133	1.85	119,169	2.61	499,186	1.86	686,493	1.96
	Take in-out finished goods	34,184	0.93	62,023	1.36	247,037	0.92	343,246	0.98
	Total	157,432	4.28	292,450	6.40	1,280,191	4.77	1,730,083	4.93
Check Quality	Check key-in stock card	20,492	0.56	40,481	0.89	167,857	0.63	228,831	0.65
	Total	20,492	0.56	40,481	0.89	167,857	0.63	228,831	0.65
Support production	Design & Development	12,895	0.35	43,833	0.96	167,896	0.63	224,625	0.64
	Issue formulation for production sample	6,447	0.18	21,917	0.48	83,948	0.31	112,313	0.32
	Follow up & Review designed product	6,447	0.18	21,917	0.48	83,948	0.31	112,313	0.32
	Total	25,790	0.70	87,667	1.92	335,792	1.25	449,251	1.28
Support production	Maintenance & Prevention machinery	22,666	0.62	23,790	0.52	101,605	0.38	148,062	0.42
	Modify & Improve machine	62,521	1.70	68,379	1.50	99,470	0.37	230,373	0.66
	Total	85,187	2.32	92,169	2.02	201,074	0.75	378,435	1.08
Quality Control & Assurance	Random check product before delivery to customer	4,845	0.13	11,443	0.25	54,202	0.20	70,490	0.20
	Total	4,845	0.13	11,443	0.25	54,202	0.20	70,490	0.20
Total		3,674,789	100	4,566,638	100.0	26,836,575	100.0	35,078,202	100

From the table 5.34 we can conclude that activity center that has the highest ratio of the total cost of every product is production activity center of the production department 2 which is 15.30 per cent. Most of the cost is from emboss activity which is 9.39 per cent. If we split them according to the product group we would find that product C has the highest ratio of the product and activity center that has the most cost is inspection activity center of the production department 1 which is 24.72 per cent. Most of the cost is from sub-activity of the inspection and check re-winder release paper which is 17.72 per cent and then product F which has the highest

cost percentage ratio which is prepare raw material activity of the production department 1 which is 17.01. Most of the cost is from sub-activity of weighing pigment color which is 5.69 per cent. The last in line is product L, it has the most cost percentage ratio which is production activity center of the production department 2 which is 15.89 per cent. Most of the cost is from emboss activity which is 9.73 per cent. From the said conclusion we can analyze that the cause is from the fact that the said product has diversity and many thickness levels. Therefore, the guideline that can reduce the cost is to gather the order amount to be produced as the thickness is the same pattern so that they can be produced at the same time and the production time can be reduced.

5.4.3 The calculation of the design cost

From the calculation of the activity based costing of the product, it makes us know the total design cost which consists of direct raw material cost of 1,128,319 baht which is 10%. The direct labor cost of 4,282,706 baht which is 37% and the expense cost in the production of 6,286,136 baht which is 54%.

Table 5.35 the design cost of July to December separating according to the products

Expense	Product			Activity Base Costing Amount (Bath)	%
	C	F	L		
Direct Labour	240,870	150,790	736,659	1,128,319	10
Direct Raw Material	561,248	125,216	3,596,241	4,282,706	37
Product Expense	1,305,491	733,052	4,247,593	6,286,136	54
Total	2,107,609	1,009,058	8,580,493	11,697,161	100

Table 5.36 The amount of product that has been designed in every product starting on July to December separating according to the product

Month	Quantity (Metre)			Total	Avg. (Metre)
	C	F	L		
July	400	3,000	1,600	5,000	1,667
August	400	0	0	400	133
September	400	0	3,600	4,000	1,333
October	0	2,500	1,600	4,100	1,367
November	0	0	1,500	1,500	500
December	400	600	3,600	4,600	1,533
Total	1,600	6,100	11,900	19,600	6,533
Avg (Metre/Month)	267	1,017	1,983	3,267	1,089

From the table 5.36 the amount of product design starting from July to December 2010 is in the total of 19,600 meters. The average amount per month of the amount of the product design is at 3,267 meters per month. It is found that the product group F has the highest production amount of 6,100 meters per month. Next is the product group L which has the production amount of 1,983 meter per month and the last one is the product group C which has the production amount of 267 meter.

Table 5.37 Cost of product design

Month	Activity Based Costing (Bath/Metre)			Total	Avg (Bath/Metre)
	C	F	L		
July	1,323	80	1,062	2,465	822
August	2,711	0	0	2,711	904
September	327	0	584	911	304
October	0	236	757	993	331
November	0	0	1,035	1,035	345
December	908	297	560	1,765	588
Total	5,269	613	3,998	9,880	3,293
Avg (Metre/Month)	878	102	666	1,647	549

From the table 5.37, the activity base costing of the product design starting on July to December 2010 is in the total of 9,880 baht. The average amount per month of the activity cost of the product design is at 549 baht which is found that the product group C has the activity based costing of the product design of 878 baht. Next is the product group L which has the activity based costing of the product design of 666 baht and the last one is the product group F which has the activity based costing of the product design of 102 baht.

Table 5.38 The amount of product designed and passed the standard test separating by months

Month	C			F			L			Total		
	Pass	No Pass	Total	Pass	No Pass	Total	Pass	No Pass	Total	Pass	No Pass	Total
July	1	1	2	1	0	1	5	1	6	7	2	9
August	1	0	1	0	0	0	0	0	0	1	0	1
September	1	0	1	0	0	0	19	6	25	20	6	26
October	0	0	0	0	3	3	4	0	4	4	3	7
November	0	0	0	0	0	0	3	1	4	3	1	4
December	1	1	2	1	0	1	4	2	6	6	3	9
Total	4	2	6	2	3	5	35	10	45	41	15	56
AVG	0.67	0.33	1.00	0.33	0.50	0.83	5.83	1.67	7.50	6.83	2.50	9.33
%	66.67	33.33	100.00	40.00	60.00	100.00	77.78	22.22	100.00	73.21	26.79	100.00

From the table 5.38 it is the summary of the amount of the product that has been designed in 3 groups. There is a test in order to verify that the said product has passed the standard required by customer or not. In every product group there is the design amount of 56 items. It has passed the customer standard for 41 items which is 73.21 per cent and the rest in the amount of 15 items have not passed the standard group according to the customers in the rate of 26.79 per cent. If we separate according to group it is found that the product C has the product design and the product amount that has been designed for 45 items. It has passed the standard of the customers for 35 items which is 77.78 per cent and the rest is 10 items do not pass the standard of customer in the amount of 22.22 per cent. The product group F has the product amount that has been designed of 5 items which passes the customer standard for 2 items which is 40 per cent and the remaining 3 items do not pass the customer standard in the amount of 60 per cent and the product group L has the total designed amount of 6 items which passes the customer standard of 4 items which is 66.67 per cent and the rest of 2 items do not pass the standard group of customer in the amount of 33.33 per cent.

Table 5.39 The design cost per product unit separating in months

Month	Activity Based Costing (Bath/Metre)						Amount Product Design									Cost per amount product design (Bath/Metre)									
	C			F			L			Total Product Design			C			F			L			Total cost per amount product design			
	C	F	L	Total	AVG	Pass	No	Total	Pass	No	Total	Pass	No	Total	Pass	No	Total	Pass	No	Total	Pass	No	Total		
July	1,323	80	1,062	2,465	822	1	1	2	1	0	1	5	1	6	7	2	9	1,323	662	80	80	212	177	352	274
August	2,711	0	0	2,711	904	1	0	1	0	0	0	0	0	0	1	0	1	2,711	2,711	0	0	0	0	2,711	2,711
September	327	0	584	911	304	1	0	1	0	0	0	19	6	25	20	6	26	327	327	0	0	31	23	46	35
October	0	236	757	993	331	0	0	0	0	3	3	4	0	4	4	3	7	0	0	0	79	189	189	248	142
November	0	0	1,035	1,035	345	0	0	0	0	0	0	3	1	4	3	1	4	0	0	0	345	259	345	259	
December	908	297	560	1,765	588	1	1	2	1	0	1	4	2	6	6	3	9	908	454	297	297	140	93	294	196
Total	5,269	613	3,998	9,880	3,293	4	2	6	2	3	5	35	10	45	41	15	56	5,269	4,154	377	456	917	742	3,996	3,617
Avg/Month	878	102	666	1,647	549	0.7	0.3	1.0	0.3	0.5	0.8	5.8	1.7	7.5	6.8	2.5	9.3	878.2	692.3	62.8	75.9	152.9	123.6	666	603

From the table 5.39 it is found that the activity based costing per the designed product amount of every product group is at 3,616 baht per item and the activity based costing per the amount of the designed product of every product that has passed the standard of customers is at 3,966 baht per item. If we consider the cost per the product we will see that good product comparing with total product has higher cost of 379 baht per item which if we analyze according to the group we would find that the product C has the activity based costing per the designed product amount per month of 4,153 baht and the activity based costing per the designed product amount which pass the standard of customers is at 5,269 baht. The product F has the activity based costing per the amount of the designed product on the average of 456 baht and the activity based costing per designed product amount has passed the standard of customers of 378 baht and the product L the activity based costing per the amount of designed product on the average per month is at 741 baht and the activity cost per the amount of designed product which passes the standard of customers is at 917 baht.

5.4.4 Analysis of the design cost ratio at the arranged activity and sub-activity center

Regarding the analysis of the design cost at activity center it is found that activity that causes the cost the most is product and process validation activity center and then planning operations activity center, taking requirement from a customer activity center, product design activity center, product and product process activity center, considering the possibility activity center, feedback, assessment and corrective action activity center, checking requirement of customer activity center and experimental plan activity center. As for sub-activity that has been allocated of product and process validation activity center that creates the most cost is measurement systems evaluation activity and then preliminary process capability study activity, production part approval activity, packaging evaluation activity, production validation testing activity, production control plan activity, quality planning sign-off activity and significant production run activity. If we separate according to the product group we would find that product L has the highest product cost percentage ratio. The activity center that creates the most cost is product and process validation activity center and then planning operations activity center, product

design and process activity center, considering the possibility activity center, feedback, assessment and corrective action activity center, checking requirement of customer activity center and experimental plan activity center. As for the product B and A, they have the cost ratio next in rank. The activity center that causes the most cost is product design activity center and then planning operations activity center, taking requirement from a customer activity center, product design and process activity center, product design activity center, product process activity center, considering the possibility activity center, feedback, assessment and corrective action activity center, checking requirement of customer activity center and experimental plan activity center with the details according to the table 5.40.

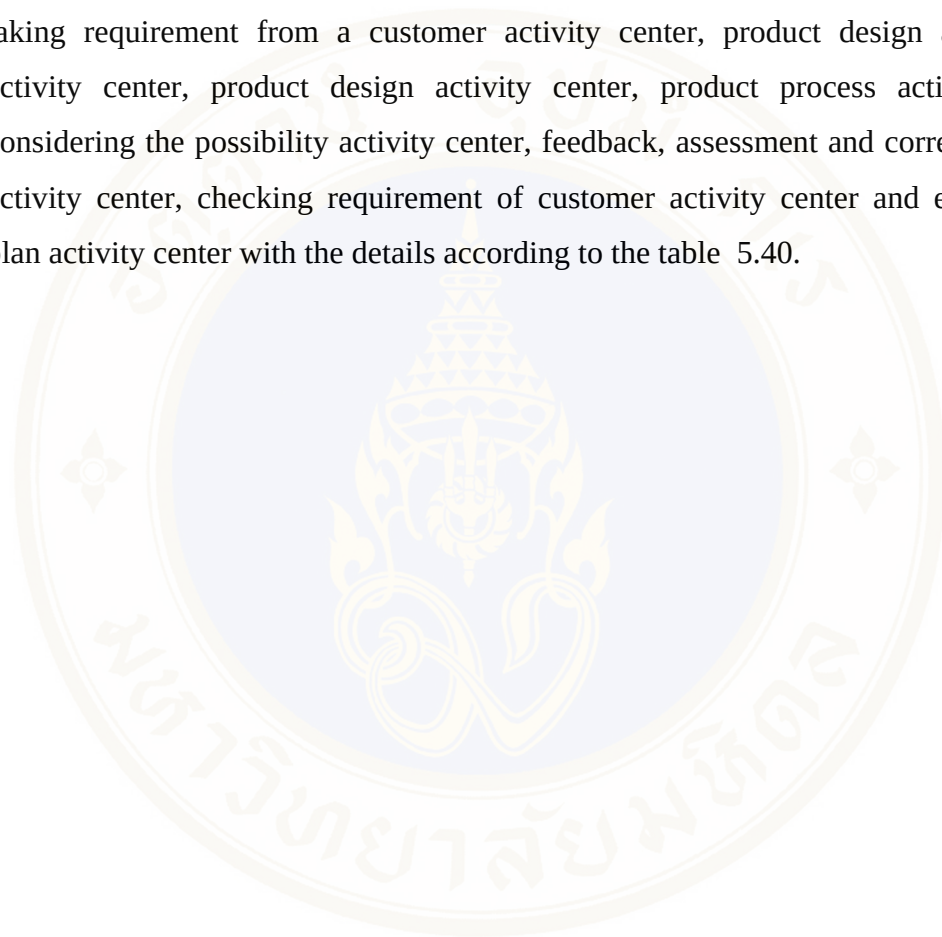


Table 5.40 Design proportion at the activity and activity that has been allocates.

Activity Center	Allocate Activity	Design cost of proportion							
		C	%	F	%	L	%	Total	%
Taking requirement from a customer	Check product demand (customer orders).	12,768	7.21	6,817	8.46	22,695	3.29	42,279	4.47
	Total	12,768	7.21	6,817	8.46	22,695	3.29	42,279	4.47
Checking requirement of customer	Receiving the notification requirements of the customer	0	0.00	0	0.00	0	0.00	0	0.00
	Check the notification requirements of the customer	802	0.45	166	0.21	1,486	0.22	2,453	0.26
	Save the document needs of the customer invoice.	891	0.50	184	0.23	1,651	0.24	2,726	0.29
	Total	1,693	0.96	349	0.43	3,137	0.46	5,179	0.55
Considering the possibility of manufacturing	Market Analysis	891	0.50	184	0.23	1,651	0.24	2,726	0.29
	Risk analysis	560	0.32	127	0.16	754	0.11	1,441	0.15
	Reliability of the product.	560	0.32	127	0.16	754	0.11	1,441	0.15
	Product benchmark	560	0.32	127	0.16	754	0.11	1,441	0.15
	Process benchmark	560	0.32	127	0.16	754	0.11	1,441	0.15
	Results of the feasibility study	560	0.32	127	0.16	754	0.11	1,441	0.15
	Total	3,893	2.09	819	1.02	5,420	0.79	9,932	1.05
The experimental plan.	Plan for conducting experiments	560	0.32	127	0.16	754	0.11	1,441	0.15
	Total	560	0.32	127	0.16	754	0.11	1,441	0.15
Feedback,Assessment and Corrective Action	Delivery and Service	2,111	1.19	610	0.76	3,351	0.49	6,072	0.64
	Customer Satisfaction.	398	0.22	133	0.17	1,344	0.20	1,876	0.20
	Total	2,509	1.42	743	0.92	4,695	0.68	7,947	0.84
Planning operations	Preliminary bill of materials (BOM).	2,043	1.15	999	1.24	5,317	0.77	8,359	0.88
	Preliminary process flow chart	3,787	2.14	1,785	2.22	9,849	1.43	15,421	1.63
	Preliminary identification of special product characteristics	1,136	0.64	535	0.66	2,955	0.43	4,626	0.49
	Preliminary identification of special process characteristics	7,575	4.28	3,569	4.43	19,698	2.86	30,842	3.26
	Total	14,542	8.21	6,888	8.55	37,819	5.49	59,249	6.26
Product design	Preparation DFMEA.	7,575	4.28	3,569	4.43	19,698	2.86	30,842	3.26
	Design verification	460	0.26	145	0.18	778	0.11	1,383	0.15
	Design review	460	0.26	145	0.18	778	0.11	1,383	0.15
	Prototype Build - Control Plan	460	0.26	145	0.18	778	0.11	1,383	0.15
	Specifications Changes	460	0.26	145	0.18	778	0.11	1,383	0.15
	Drawing Changes	21	0.01	14	0.02	43	0.01	78	0.01
	Special Product Characteristics	17	0.01	7	0.01	36	0.01	60	0.01
	Total	9,453	5.34	4,171	5.18	22,889	3.32	36,513	3.86
Product process	Packaging Standards	35	0.02	45	0.06	450	0.07	530	0.06
	Product/Process Quality System Review	550	0.31	254	0.31	1,183	0.17	1,986	0.21
	Process Flow Chart	275	0.16	127	0.16	591	0.09	993	0.10
	Characteristics Matrix	1,100	0.62	507	0.63	2,366	0.34	3,973	0.42
	Preparation PFMEA.	550	0.31	254	0.31	1,183	0.17	1,986	0.21
	Pre-Launch Control Plan	1,100	0.62	507	0.63	2,366	0.34	3,973	0.42
	Measurement System Analysis Plan	165	0.09	76	0.09	355	0.05	596	0.06
	Packaging Specification	1,100	0.62	507	0.63	2,366	0.34	3,973	0.42
	Total	4,876	2.75	2,276	2.83	10,859	1.58	18,011	1.90
Product and Process Validation	Significant Production Run	550	0.31	254	0.31	1,183	0.17	1,986	0.21
	Measurement Systems Evaluation	34,454	19.45	15,595	19.36	164,325	23.85	214,374	22.64
	Preliminary Process Capability Study	22,969	12.97	10,396	12.90	109,550	15.90	142,916	15.10
	Production Part Approval (PPAP)	22,969	12.97	10,396	12.90	109,550	15.90	142,916	15.10
	Production Validation Testing	19,648	11.09	9,780	12.14	70,196	10.19	99,624	10.52
	Packaging Evaluation	17,227	9.73	7,797	9.68	82,163	11.92	107,187	11.32
	Production Control Plan	5,742	3.24	2,599	3.23	27,388	3.97	35,729	3.77
	Quality Planning Sign-off	3,445	1.95	1,559	1.94	16,433	2.38	21,437	2.26
	Total	127,005	71.71	58,377	72.46	580,787	84.29	766,170	80.93
Total		177,101	100	80,567	100	689,054	100	946,721	100

From the table 5.40 we can conclude that the activity center that has the highest design cost ratio of every product is product and process validation activity center which is 80.93 per cent. Most of the cost is from sub-activity of measurement systems evaluation which is 22.64 per cent. If we separate it in product groups we would find that product L has the highest product cost percentage and the activity center that has the most cost is product and process validation activity center which is 84.29 per cent. Most of the cost is from sub-activity of measurement systems evaluation which is 23.85 per cent and then product F which has the highest cost percentage which is product and process validation activity center which is 72.46 per cent. Most of the cost is from sub-activity of measurement systems evaluation which is 19.36 per cent. The last one is product C which has the percentage ratio of the cost the most is product and process validation activity center which is 71.71 per cent. Most of the cost is from sub-activity of measurement systems evaluation which is 19.45 per cent. From the analysis conclusion it is found that the activity cost of the product design is from the fact that the designed product is diverse product which uses the calculation by using Excel program. Therefore, the guideline that can reduce the cost is to use the application program in order to support diverse measuring analysis in an accurate and prompt manner.

5.4.5 The calculation of the product life cycle cost

From the calculation of the activity based costing of the product, it makes us know the total product life cycle cost which consists of direct raw material cost of 170,411,527 baht which is 75%. The direct labor cost of 21,054,733 baht which is 9% and the expense cost in the production of 35,991,373 baht which is 16%.

Table 5.41 The product life cycle cost of July to October separating according to the products

Expense	Product			Activity Base Costing Amount (Bath)	%
	C	F	L		
Direct Labour	327,211	6,285,980	14,441,542	21,054,733	9
Direct Raw Material	5,080,930	50,467,269	114,863,328	170,411,527	75
Product Expense	3,725,414	4,967,685	27,298,274	35,991,373	16
Total	9,133,555	61,720,933	156,603,144	227,457,633	100

Table 5.42 The amount of product that has been designed in all product starting on July to October separating according to the product

Month	Quantity (Metre)				Avg. (Metre)
	C	F	L	Total	
July	3,255	73,439	58,190	134,884	44,961
August	5,654	57,667	57,366	120,687	40,229
September	11,632	55,024	65,395	132,051	44,017
October	3,324	48,606	55,921	107,851	35,950
Total	23,865.0	234,736.0	236,872.0	495,473.0	165,157.7
Avg (Metre/Month)	5,966.25	58,684.00	59,218.00	123,868.25	41,289.42

From the table 5.42 the amount of product life cycle cost starting from July to October 2010 is in the total of 495,473 meters. The average amount per month of the amount of the product life cycle cost is at 165,157.7 meters per month. It is found that the product group L has the highest production amount of 59,218 meters per month. Next is the product group F which has the production amount of 58,684 meter per month and the last one is the product group C which has the production amount of 5,966.25 meter.

Table 5.43 The product life cycle cost per product unit separating in months

Month	Direct Labour						Direct Raw Material						Total production expense						Total cost						
	Direct Labour						Direct Raw Material						Total production expense						Total cost						
	C	F	L	57M	63M	67M	C	F	L	57M	63M	67M	C	F	L	Total	Avg	C	F	L	Total				
July	60,737	1,300,940	3,929,306	5,709,991	1,759,664	60,737	15,336,936	30,772,515	49,497,000	15,639,003	575,006	639,562	2,530,126	3,065,294	49,055	44,655	3,175,007	4,074,777	7,899,771	2,632,257	1,749,765	10,162,001	40,128,954	60,082,770	20,000,923
August	54,463	1,595,532	3,807,531	5,727,516	1,742,315	1,204,334	12,465,136	29,049,836	42,749,206	14,249,769	343,400	600,015	3,900,078	4,900,301	540,344	804,951	3,350,001	5,017,116	10,007,417	3,358,006	2,108,230	15,600,434	40,202,266	57,904,229	19,928,000
September	109,621	1,534,696	3,607,497	5,591,814	1,753,899	2,494,705	12,222,180	34,015,590	48,733,873	16,244,674	306,423	792,945	4,442,161	5,161,429	437,897	321,143	3,015,911	3,006,951	9,457,200	3,145,793	3,480,949	14,000,064	45,001,557	63,433,067	21,444,555
October	94,400	1,604,804	3,307,208	5,206,432	1,762,137	739,334	10,242,017	21,030,890	32,041,340	10,670,147	402,723	872,567	3,397,536	4,072,806	537,177	334,166	2,965,634	3,008,978	8,709,884	2,903,268	1,777,654	13,063,534	31,081,367	46,007,536	15,335,652
Total	327,211	6,085,980	14,441,542	21,054,733	7,000,244	5,000,430	50,467,269	114,883,233	164,002,282	58,000,842	1,700,160	2,949,120	14,549,001	19,258,901	2,007,454	1,175,806	12,740,273	16,731,623	35,941,373	11,997,124	9,433,555	61,726,033	159,603,144	227,457,633	75,019,211
Average Month	80,803	1,521,495	3,610,386	5,263,683	1,751,561	1,250,108	12,616,817	28,715,802	41,000,561	14,000,061	429,540	747,947	3,687,475	4,904,983	510,014	403,974	3,037,093	4,102,891	9,097,943	2,999,281	2,282,290	15,430,233	38,631,706	56,064,400	18,954,003

From the table 5.43 it shows the comparison of product life cycle cost and price of original cost from July to October, 2010. The total activity based costing is at 5,444.7 baht and price of total original cost is at 5,776 baht. The difference is at 26 %. If we separate according to the product group it is found that the product C has the most different cost which is the total activity based costing is at 2,600 baht and price of total original cost is at 1,749.9 baht which is different at the rate of 232%. Next is the product L which has the total activity based costing is at 2,092 baht and price of the original cost is at 2,637.5 baht. The difference is at 79.89% and lastly the product F has the total activity based costing of 1,084 baht and price of the original cost of 1,057.3 baht. The difference is at 10.71.

5.4.6 Analysis of the cost ratio for the entire product life cycle at activity and sub-activity center that has been arranged

Regarding the analysis of the cost ratio for the entire product life cycle at activity center it is found that activity center that causes the cost the most is raw material preparation activity center and then inspection activity center (production 2), inspection activity center (production 1), sheeting and lamination activity center, activity center of random check product before delivery to customer, mixing raw material activity center, production activity center. As for sub-activity that has been arranged of prepare raw material activity center that causes the most cause is prepare raw material activity and then prepare release paper activity, weighing pigment, weighing material activity. If we separate according to the product group we would find that product A has the percentage ratio of the cost the most. The activity center that causes the most cost is inspection activity center (production 2) and then inspection activity center (production 1), prepare raw material activity center, mixing raw material activity center, sheeting and lamination activity center. As for the product B, it has the percentage of the cost of product in the next rank. The activity center that causes the most cost is prepare raw material activity center and then raw material control activity center, product and process validation activity center, inspection activity center (production 1), raw material control activity center. As for the product C, it has the percentage ratio of the cost of the product in the last rank. The activity center that causes the most cost is production activity center and then production

activity center (production 1), sheeting and lamination activity center, prepare raw material activity center, quality control activity center with the details as in the table 5.44.

Table 5.44 Product life cycle proportion at the activity and activity that has been allocates.

Activity Center	Allocate Activity	Proportion of product life cycle cost							
		C	%	F	%	L	%	รวม	%
Taking requirement from a customer	Check product demand (customer orders).	34,824	1.73	72,061	3.65	145,519	1.14	252,404	6.52
	Total	34,824	1.73	72,061	3.65	145,519	1.14	252,404	6.52
Checking requirement of customer	Receiving the notification requirements of the customer	383	0.02	10,233	0.52	1,245	0.01	11,862	0.55
	Check the notification requirements of the customer	426	0.02	11,370	0.58	1,384	0.01	13,180	0.61
	Save the document needs of the customer invoice.	426	0.02	11,370	0.58	1,384	0.01	13,180	0.61
	Total	1,235	0.06	32,973	1.67	4,013	0.03	38,221	1.76
Considering the possibility of manufacture	Market Analysis	240	0.01	5,517	0.28	752	0.01	6,509	0.30
	Risk analysis	240	0.01	5,517	0.28	752	0.01	6,509	0.30
	Reliability of the product.	240	0.01	5,517	0.28	752	0.01	6,509	0.30
	Product benchmark	240	0.01	5,517	0.28	752	0.01	6,509	0.30
	Process benchmark	240	0.01	5,517	0.28	752	0.01	6,509	0.30
	Results of the feasibility study	240	0.01	5,517	0.28	752	0.01	6,509	0.30
	Total	1,439	0.07	33,103	1.68	4,512	0.04	39,054	1.78
The experimental plan.	Plan for conducting experiments	1,296	0.06	1,678	0.08	3,877	0.03	6,851	0.18
	Total	1,296	0.06	1,678	0.08	3,877	0.03	6,851	0.18
Feedback, Assessment and Corrective Action	Delivery and Service	53	0.00	322	0.02	1,000	0.01	1,375	0.03
	Customer Satisfaction.	1,209	0.06	1,382	0.07	3,598	0.03	6,189	0.16
	Total	1,262	0.06	1,704	0.09	4,598	0.04	7,564	0.19
Planning operations	Preliminary bill of materials (BOM).	12,023	0.60	26,057	1.32	26,788	0.21	64,868	2.13
	Preliminary process flow chart	3,607	0.18	7,817	0.40	8,036	0.06	19,460	0.64
	Preliminary identification of special product characteristics	6,012	0.30	13,029	0.66	13,394	0.11	32,434	1.06
	Preliminary identification of special process characteristics	6,012	0.30	13,029	0.66	13,394	0.11	32,434	1.06
	Total	27,653	1.38	59,931	3.03	61,611	0.48	149,196	4.89
Product design	Preparation DFMEA.	2,638	0.13	12,891	0.65	33,561	0.26	49,090	1.05
	Design verification	1,319	0.07	6,445	0.33	16,780	0.13	24,545	0.52
	Design review	1,319	0.07	6,445	0.33	16,780	0.13	24,545	0.52
	Prototype Build - Control Plan	1,319	0.07	6,445	0.33	16,780	0.13	24,545	0.52
	Specifications Changes	0	0.00	2,419	0.12	4,945	0.04	7,364	0.16
	Drawing Changes	0	0.00	2,419	0.12	4,945	0.04	7,364	0.16
	Special Product Characteristics	49	0.00	3,033	0.15	9,191	0.07	12,273	0.23
	Total	6,645	0.33	40,098	2.03	102,982	0.81	149,725	3.17
Product process	Packaging Standards	1,966	0.10	8,545	0.43	11,239	0.09	21,749	0.62
	Product/Process Quality System Review	1,311	0.07	5,697	0.29	7,492	0.06	14,500	0.41
	Process Flow Chart	3,932	0.20	17,090	0.86	22,477	0.18	43,499	1.24
	Characteristics Matrix	2,621	0.13	11,393	0.58	14,985	0.12	28,999	0.82
	Preparation PFMEA.	3,932	0.20	17,090	0.86	22,477	0.18	43,499	1.24
	Pre-Launch Control Plan	590	0.03	2,563	0.13	3,372	0.03	6,525	0.19
	Measurement System Analysis Plan	3,932	0.20	17,090	0.86	22,477	0.18	43,499	1.24
	Packaging Specification	2,621	0.13	11,393	0.58	14,985	0.12	28,999	0.82
	Total	20,904	1.04	90,860	4.60	119,504	0.94	231,268	6.58
Product and Process Validation	Significant Production Run	13,280	0.66	26,256	1.33	46,019	0.36	85,555	2.35
	Measurement Systems Evaluation	5,312	0.26	10,502	0.53	18,407	0.14	34,222	0.94
	Preliminary Process Capability Study	5,312	0.26	10,502	0.53	18,407	0.14	34,222	0.94
	Production Part Approval (PPAP)	17,987	0.90	28,502	1.44	44,768	0.35	91,258	2.69
	Production Validation Testing	27,888	1.39	55,137	2.79	96,639	0.76	179,665	4.94
	Packaging Evaluation	9,296	0.46	18,379	0.93	32,213	0.25	59,888	1.65
	Production Control Plan	5,578	0.28	11,027	0.56	19,328	0.15	35,933	0.99
	Quality Planning Sign-off	6,745	0.34	10,688	0.54	16,788	0.13	34,222	1.01
	Total	91,399	4.55	170,995	8.65	292,570	2.29	554,964	15.50
Support production	Prepare production plan	10,963	0.55	21,927	1.11	104,152	0.82	137,042	2.47
	Follow-up for production	5,482	0.27	10,963	0.55	52,076	0.41	68,521	1.24
	Issue formulation	32,890	1.64	36,545	1.85	204,650	1.61	274,084	5.09
	Modify formulation	8,565	0.43	8,565	0.43	51,391	0.40	68,521	1.26
	Total	57,900	2.88	78,000	3.95	412,268	3.23	548,168	10.07

Table 5.44 Product life cycle proportion at the activity and activity that has been allocates (Cont.)

Activity Center	Allocate Activity	Proportion of product life cycle cost							
		C	%	F	%	L	%	W	%
Preparing raw material	Prepare raw material	69,542	3.46	177,718	8.99	432,704	3.39	679,963	15.85
	Prepare release paper	74,178	3.70	0	0.00	482,156	3.78	556,333	7.48
	Weighing pigment	56,898	2.83	145,405	7.36	354,030	2.78	556,333	12.97
	Weighing material	44,254	2.20	113,093	5.72	275,357	2.16	432,704	10.09
	Total	244,871	12.20	436,216	22.08	1,544,247	12.11	2,225,334	46.39
Mixing raw material	Mixing & spinning raw material	12,590	0.63	69,247	3.50	81,838	0.64	163,675	4.77
	Boiling	18,782	0.94	29,515	1.49	115,377	0.91	163,675	3.33
	Grinding	21,823	1.09	0	0.00	141,852	1.11	163,675	2.20
	Tinting colour	21,823	1.09	0	0.00	141,852	1.11	163,675	2.20
	Air vacuum	163,675	8.15	0	0.00	0	0.00	163,675	8.15
	Total	238,694	11.89	98,762	5.00	480,918	3.77	818,375	20.66
Sheeting and lamination	Sheeting Roll #1	58,482	2.91	66,836	3.38	359,245	2.82	484,563	9.11
	Sheeting Roll #2	58,482	2.91	66,836	3.38	359,245	2.82	484,563	9.11
	Sheeting roll skin layer and lamination foam layer	0	0.00	0	0.00	484,563	3.80	484,563	3.80
	Sheeting roll foam layer and lamination with fabric	0	0.00	0	0.00	484,563	3.80	484,563	3.80
	Total	116,964	5.83	133,673	6.77	1,687,617	13.24	1,938,254	25.83
Filter or strain	Filter or strain	6,622	0.33	7,568	0.38	40,680	0.32	54,870	1.03
	Total	6,622	0.33	7,568	0.38	40,680	0.32	54,870	1.03
Oven drying & Blowing	Blowing agent	0	0.00	0	0.00	843,445	6.62	843,445	6.62
	Total	0	0.00	0	0.00	843,445	6.62	843,445	6.62
Rise & laminate of Casting	Surface or coating skin layer	23,997	1.20	23,997	1.21	155,978	1.22	203,971	3.63
	Oven drying	27,196	1.35	0	0.00	176,775	1.39	203,971	2.74
	Total	51,193	2.55	23,997	1.21	332,752	2.61	407,941	6.38
Check Quality	Check re-winder release paper	136,911	6.82	0	0.00	889,919	6.98	1,026,830	13.80
	Check thickness and colour	185,444	9.24	0	0.00	803,590	6.30	989,034	15.54
	Total	322,354	16.06	0	0.00	1,693,509	13.28	2,015,863	29.34
Production	Surface glossy or matting before embossing	13,198	0.66	0	0.00	369,543	2.90	382,741	3.56
	Emboss	34,048	1.70	0	0.00	953,333	7.48	987,381	9.17
	Surface glossy or matting after embossing	14,332	0.71	0	0.00	401,298	3.15	415,630	3.86
	Laminate foam layer with skin layer	0	0.00	0	0.00	20,372	0.16	20,372	0.16
	Heating in oven	18,340	0.91	0	0.00	0	0.00	18,340	0.91
	Total	79,917	3.98	0	0.00	1,744,546	13.68	1,824,464	17.67
Check Quality	Check thickness and colour	433,685	21.61	96,374	4.88	626,434	4.91	1,156,493	31.40
	Check glossy	18,096	0.90	54,289	2.75	235,251	1.85	307,637	5.49
	Total	451,781	22.51	150,663	7.63	861,685	6.76	1,464,129	36.89
Inspection	Inspection & Packaging	109,954	5.48	219,908	11.13	952,933	7.47	1,282,795	24.08
	Total	109,954	5.48	219,908	11.13	952,933	7.47	1,282,795	24.08
Raw Material Control	Taken in raw material	8,646	0.43	0	0.00	259,365	2.03	268,011	2.47
	Keep & storage	9,349	0.47	112,191	5.68	280,477	2.20	402,016	8.34
	Taken out raw material	12,968	0.65	37,608	1.90	150,432	1.18	201,008	3.73
	Total	30,963	1.54	149,799	7.58	690,274	5.41	871,036	14.54
Raw Material Control	Acquire key-in stock card	2,248	0.11	8,429	0.43	82,044	0.64	92,721	1.18
	Move goods	1,867	0.09	36,413	1.84	136,314	1.07	174,594	3.01
	Storage goods	2,833	0.14	48,165	2.44	206,825	1.62	257,823	4.20
	Take in-out finished goods	2,561	0.13	29,026	1.47	97,324	0.76	128,911	2.36
	Total	9,509	0.47	122,033	6.18	522,507	4.10	654,050	10.75
Check Quality	Check key-in stock card	2,421	0.12	14,525	0.74	68,995	0.54	85,941	1.40
	Total	2,421	0.12	14,525	0.74	68,995	0.54	85,941	1.40
Support production	Maintenance & Prevention machinery	34,536	1.72	9,867	0.50	54,271	0.43	98,675	2.65
	Modify & Improve machine	62,008	3.09	26,575	1.34	53,150	0.42	141,733	4.85
	Total	96,544	4.81	36,442	1.84	107,421	0.84	240,408	7.50
Quality Control & Assurance	Random check product before delivery to customer	907	0.05	907	0.05	25,390	0.20	27,204	0.29
	Total	907	0.05	907	0.05	25,390	0.20	27,204	0.29
	Total	2,007,254	100.00	1,975,896	100.00	12,748,373	100.00	16,731,523	300.00

From the table 5.44 we can conclude that activity center that has the highest total cost ratio of every product is prepare raw material activity center which is at 46.93 per cent. Most of the cost is from sub-activity of prepare raw material which is 15.85 per cent. If we separate according to the product group we would find that product C has the highest product cost and the activity center that has the highest cost is inspection activity center (production 2) which is 22.51 per cent. Most of the cost is from check thickness and colour sub-activity center which is 21.61 per cent and then product F which has the cost percentage the most is prepare raw material (production 1) which is 22.08 per cent. Most of the cost is from preparing raw material activity which is 8.99 per cent. The last in line is product L which as the highest cost percentage which is production activity center (production 2) which is 13.68 per cent. Most of the cost is from emboss activity which is 7.48 per cent. From the mentioned conclusion we can analyze that if we want to reduce the cost of activity of each product we must bring the highest ratio of the allocated sub-activity to consider finding the way by using the industrial engineering tool to help such as work improvement principle, movement and time study etc.

CHAPTER VI

DISCUSSION AND RECOMMENDATION

This chapter describes contribution from a research through discussion and conclusion. The objective of the research is to calculate the cost per unit of product and to calculate the cost of product design by using the system of activity base of sample factories and compare the calculated cost received from the activity base cost and the original cost calculation. The calculation consists of direct raw material cost, direct labor cost and the expense cost in the production. The expense cost of the activity base cost system will divide the calculation into 2 types which is the cost that can be included into product directly and the cost that cannot be included into the product directly.

6.1 Research Summary

This research has the objective to find the way to calculate the activity based costing for apply it to calendering and casting plastic industry. This activity based costing will be used for product life cycle (PLC) and PLC will be separated into acquisition phase and production phase. Most of the industry would calculate the cost only the production phase. As for this research, it has calculated the activity based costing in the part of production phase and acquisition phase. In other words, calculate the activity based costing in the part of production activity and design activity in 3 groups of product which are product C, product F and product L which can be concluded as follows.

1. Regarding the cost of the product that has been newly designed, it is found that the cost of the activity in the product design process that passes the customer standard from maximum to minimum are product C which has the average cost at 878.20 baht per meter per month, product L which has the average cost of 152.90 baht per meter per month and product F which has the average cost of 63.00 baht per meter per month.

2. Regarding the cost of the original product it is found that the activity based costing in the production process from maximum to minimum is product L with the average cost of 669.93 baht per meter per month, product C has the average cost of 650.85 baht per meter per month and the product F it has the average cost of 265.96 baht per meter per month. If we compare the activity based costing and the original cost in every group of product it is found that the activity based costing is higher than the original cost at the rate of 57 per cent. The product L has the activity base cost higher than the original cost at the rate of 121 per cent, product F has the activity base cost higher than the original cost at the rate of 33 per cent and the product C has the activity base cost higher than the original cost at the rate of 28 per cent respectively.

3. The cost for the entire product life cycle is the activity based costing in the new product design process and the production process from maximum to minimum it is found that the product L has the average cost at 659.75 baht per meter per month, product C has the average cost of 437.50 baht per meter per month and the product F has the average cost of 264.50 baht per meter per month. If we compare between the selling price and the activity based costing for the entire product life cycle in every product group it is found that the selling price is higher than activity base cost for the entire product life cycle of every product at 6 per cent. Product C has a higher price than the activity base cost for the entire product life cycle at the rate of 57.91 per cent and product F has selling price higher than the activity based costing for the entire product life cycle at the rate of 2.62 per cent whereas the product L has selling price lower than activity based costing for the entire product life cycle at the rate of 20.02 per cent.

Therefore, in the overall picture we must pay attention to the product L because in the production process that has original cost that does not reflect the reality for a double rate. We must find the cause and solve it and if we consider the cost for the entire life cycle we would find that the selling price is lower. This shows that we must find the real cause that happens and later the product F because regarding the production process which has the original cost that does not reflect the reality. These both products are massively produced. The product F is produced on the average of 60,826.06 meters per month and product L is produced on the average 59,410.89 meters per month whereas the product C has the lowest production level on the

average of 3,536.11 meters per month. If we look at the design process we must pay attention to the product C because it has the highest activity base cost per unit and when we consider the ratio according to the activity center of calculation of the activity base cost in the production process and the activity base cost in the design we can conclude as follows.

1. The cost of the product that has been newly designed in every product that has the highest ratio according to the activity center is the product and process validation activity center which is 80.93 per cent, it is the cost from sub-activity of measurement systems evaluation at the rate of 22.64 per cent. If we separate according to the product group it is found that the product L has the highest ratio of the activity center which is the product and process validation activity center which is 84.29 per cent which is the cost that happens from sub-activity of measurement systems evaluation which is 23.85 per cent.

2. The original cost of product in every product that has the highest ratio according to the activity centers production activity center (production2) which is 15.30 per cent which is the cost that is from emboss activity which is 9.39 per cent. If we separate according to the product group we would find that the product C that has the highest ratio at activity center is inspection activity center (production 1) which is 24.72 per cent which is the cost that is from sub-activity of check re-winder release paper at the rate of 17.72 per cent.

3. The cost for the entire product life cycle in every product that has the highest ratio according to the activity center which is the prepare raw material activity which is 46.39 per cent which is the cost that is from prepare raw material activity at the rate of 15.85 per cent. If we separate according to the product group we would find that the product C that has the highest ratio according to the activity center is inspection activity center (production 2) at the rate of 22.51 per cent which is the cost that is from sub-activity of check thickness and color at the rate of 21.61 per cent

From the calculation of the activity base cost in the 3 types as mentioned above we can analyzed that the calculation of the activity base cost can reflect the each product cost and it makes us know the history of the cost that happened clearly which simplify the control process in each sub-activity that has high activity cost and from the objective to specify the strategy in managing the cost to the company in creating

the ability the researcher has proposed the strategy in managing the cost to the company as follows.

1. To increase the selling price to the product in order to increase the profit because in the research the activity base cost is higher than the original cost which makes the real cost of that company to lose the profit in the profit that they should get and when we consider the cost of each product we would find that the product L is interesting and we should increase the selling price the most because it is the product that has the selling price lower than the cost the most when comparing to other products moreover we should increase the value to the product C of product design activity by reducing the cost and increase the quality to the product in order to create the competition ability with other producers.

2. Reduce the cost in the various sub-activities that has high level of the cost. We might reduce the amount of the activity to the minimum which would cause to reduce the cost of the activity and when we consider the cost regarding sub-activity that has high cost of each product and we find that the product C should reduce the cost the most and then the product F and L. The sub-activity that should be improved in order to reduce the cost of the product is product C. The sub-activity that should reduce the cost is the check thickness and color of check quality activity center (production 2). Regarding the product F, the sub-activity that should reduce the cost is prepare raw material activity of raw material preparation activity center (production 1) and product L the sub-activity that should be reduced of the cost is the sub-activity that inspects the check thickness and color of check quality activity center (production 2).

Both of the guidelines in specifying the said strategy must be conducted together in order to help make the decision on goods selling price to customers or to improve the process in order to create the competition advantage with other products in the same type of industry.

6.2 Problem and obstacles

1. The analysis and calculation of the cost by using activity based costing method must use the resource cost data or the various expenses from the accounting department of the company. The said information is the secret of the company which prevents the received cost to reflect the actual amount.

2. Collection and gathering of the information to be used to calculate the cost of that activity, the company does not keep the data so that it can be used properly so there must be additional interview and inquiry to get the information. Therefore, the data to be used in the analysis to calculate to find the activity based costing might have discrepancy.

6.3 Recommendation

1. The cost driver used in this research uses the cause and reason of the inquiry from related agencies and from collecting and gathering of related information. Therefore, to choose this driver might not be appropriate and might not reflect the real cost. For example, raw material receiving, disbursing and using activity might not reflect the actual number so if we want the cost to reflect the fact we should use the statistics in the analysis in order to find the appropriate cost driver.

2. This research is the study and collecting of actual fact of the entire activity during one period and if the data is changed such as changed production process it might reflect the validity of the result.

3. This research should be made additionally in the product cost of the sub group of the product C, F and L in order to receive the cost that reflects the fact of each product the most.

4. The activity cost account program should be used properly and the special program of the company must be used. The maker must understand the activity cost account system and understand the production process of the company in order to create the calculation program so that it is consistent with the company.

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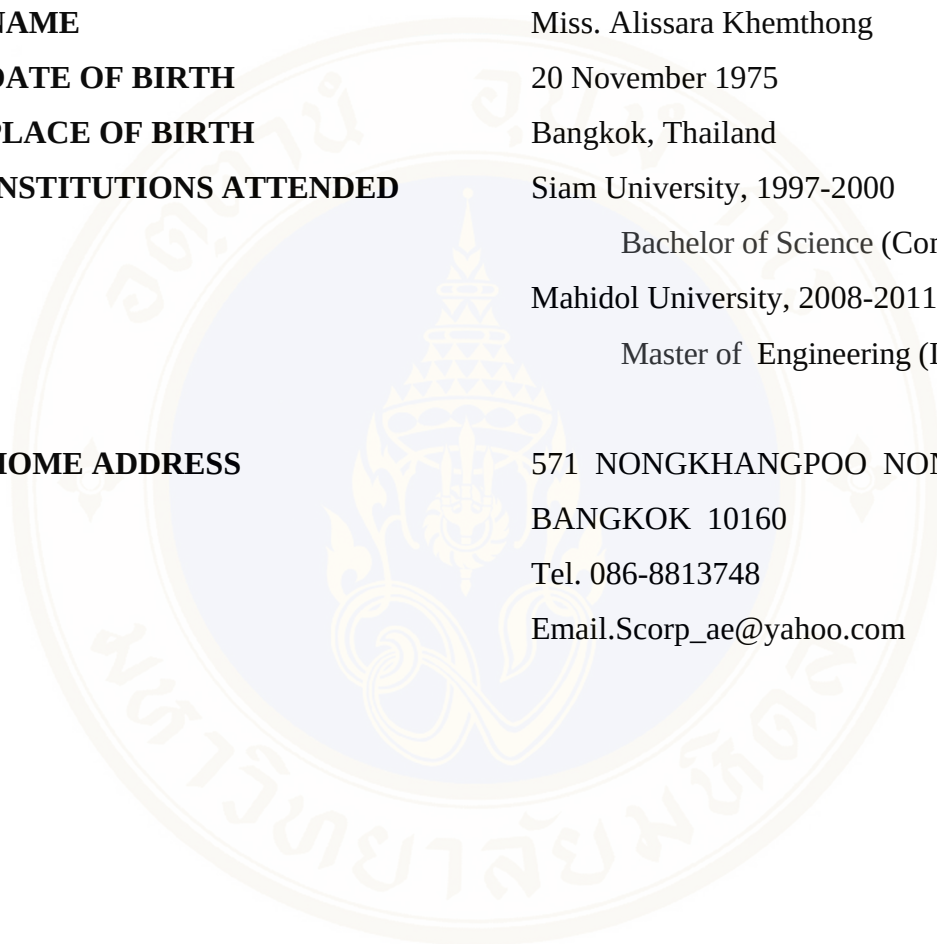
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