APPLYING ACTIVITY-BASED COSTING AND ACTIVITY-BASED MANAGEMENT METHODS TO ESTIMATE MANUFACTURING COSTS AND ACTIVITIES

By

KANOKPORN KLEOSAKUL

Submitted in Partial Fulfillment of the Requirements for the Degree of

MASTER OF SCIENCE IN SUPPLY CHAIN MANAGEMENT

Martin de Tours School of Management and Economics
Assumption University
Bangkok, Thailand

August 2018

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A Final Report of the Six-Credit Course
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Master of Science Program in Supply Chain Management

Declaration of Authorship Form

I, Kanokporn Kleosakul declare that this project and the work presented in it are my own and has been generated by me as the result of my own original research.

APPLYING ACTIVITY-BASED COSTING AND ACTIVITY-BASED MANAGEMENT METHODS TO ESTIMATE MANUFACTURING COSTS AND ACTIVITIES

I confirm that:

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2. Where any part of this project has previously been submitted for a degree or any other qualification at this University or any other institution, this has been clearly stated;

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Signed Kanokporn Kl.

Date 25/09/2018.

Assumption University
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Master of Science Program in Supply Chain Management

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ADVISOR'S STATEMENT

I confirm that this project has been carried out under my supervision and it represents the original work of the candidate.

Signed _____

(Dr. Srobol Smutkupt)

Date 28/9/18

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Kanokporn Kleosakul
Assumption University
August, 2018

ABSTRACT

At this present, the intense competition in many industries has led many companies aware of the costs and resources utilization within the organization. The key issue that all companies take into account is the cost reduction while maintaining and building on the business process improvement in order to satisfy the customer requirement.

The purpose of this research was to study the model of Activity-Based Costing (ABC) and Activity-Based Management (ABM) as an alternative option to calculate the product cost of the traditional costing system which provides more reasonable cost estimation and enhances resource and activity management. The data of three selected products were collected for the study from the existing production activities and support production activities to compute the product cost according to the ABC method. Then, propose the appropriated improvement solutions to manage resources and activities. The results of the research showed that the proposed improvement action can help the company minimize the wasted resources that spend on non-value added activity. The proposed solution can save over 1 million baht in labor cost of the maintenance department annually.

The findings indicate the important implications for AAA company to understand the cause and effect relationship between cost, activity, and product which provide the perspective on the cost driver of the manufacturing costs and the solutions for saving costs in the organization.

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and hereby certify that the verbiage, spelling and format is commensurate with the quality of internationally acceptable writing standards for a master degree in supply chain management.

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Date 30/09/2018

CHAPTER I

GENERALITIES OF THE STUDY

In today's business, buyers are demanding better quality products and services at lower price, while many companies need to consider the ways to identify the cost incurred to product and service in order to improve the company's profit (Gunasekaran, 1999). In the same way, AAA company has encountered high cost of production from raw materials cost, equipment cost and labor cost which are increasing. The company has also received an impact from the new competitor and substitute product in the market. So, reducing costs is a target that the company has been trying to achieve in the production area. Even though the company has already implemented many reducing cost policies, the management team is still not satisfied with the result.

The company's current cost calculation method uses the standard costing system. It tends to be misleading the calculation of the company's resource usage because the traditional costing system allocates the cost information by using simplistic and arbitrary methods (Swenson, 1995). Activity-based costing (ABC) approach could be an alternative option which provides more accurate and more reasonable cost estimation based on the actual performance and activities. The traditional costing system uses volume to allocate overhead costs that cause the product costs over or under cost estimation (Haroun, 2015). Gunasekaran (1999) stated that ABC can be used to improve a traditional costing system which is the new method based on a common logic that the cost is generated from products or services consume activities, activities consume resources and resources consume cost.

Therefore, the researcher decided to study ABC model to leverage efficiency and effectiveness of the company and increase the ability to survive in a highly competitive environment.

1.1 Background of the Research

AAA company was established in the 1960s as a limited company. The company mainly manufactures and distributes cement-based products with an experience of more than 50 years. The company creates innovation in building material products as one of the major players in the cement industry in Thailand.

In the beginning, the company had only one factory and warehouse in Samutprakarn to support small amount of customers. Over the years with the growing number of customers, the company has gained better reputation, knowledge, and experience which made the owner expand his business. Currently, the company has office in Bangkok as its headquarters and operates five manufacturing plants around the country, producing and distributing products to local and international markets with a vast distribution network worldwide.

1.2 Statement of the Problems

AAA company is confronted with the problem of higher production costs due to the rising of the materials price, minimum wage, equipment price as well as improving product and service quality. Moreover, the competitive price from competitors both local and overseas causes the company earn lower profits per unit. The researcher has considered the calculation method of operation expenses that can increase the accuracy of costing information and appropriate for the actual operation in order to support decision-making for strategic management, operational improvement, and use limited resources effectively.

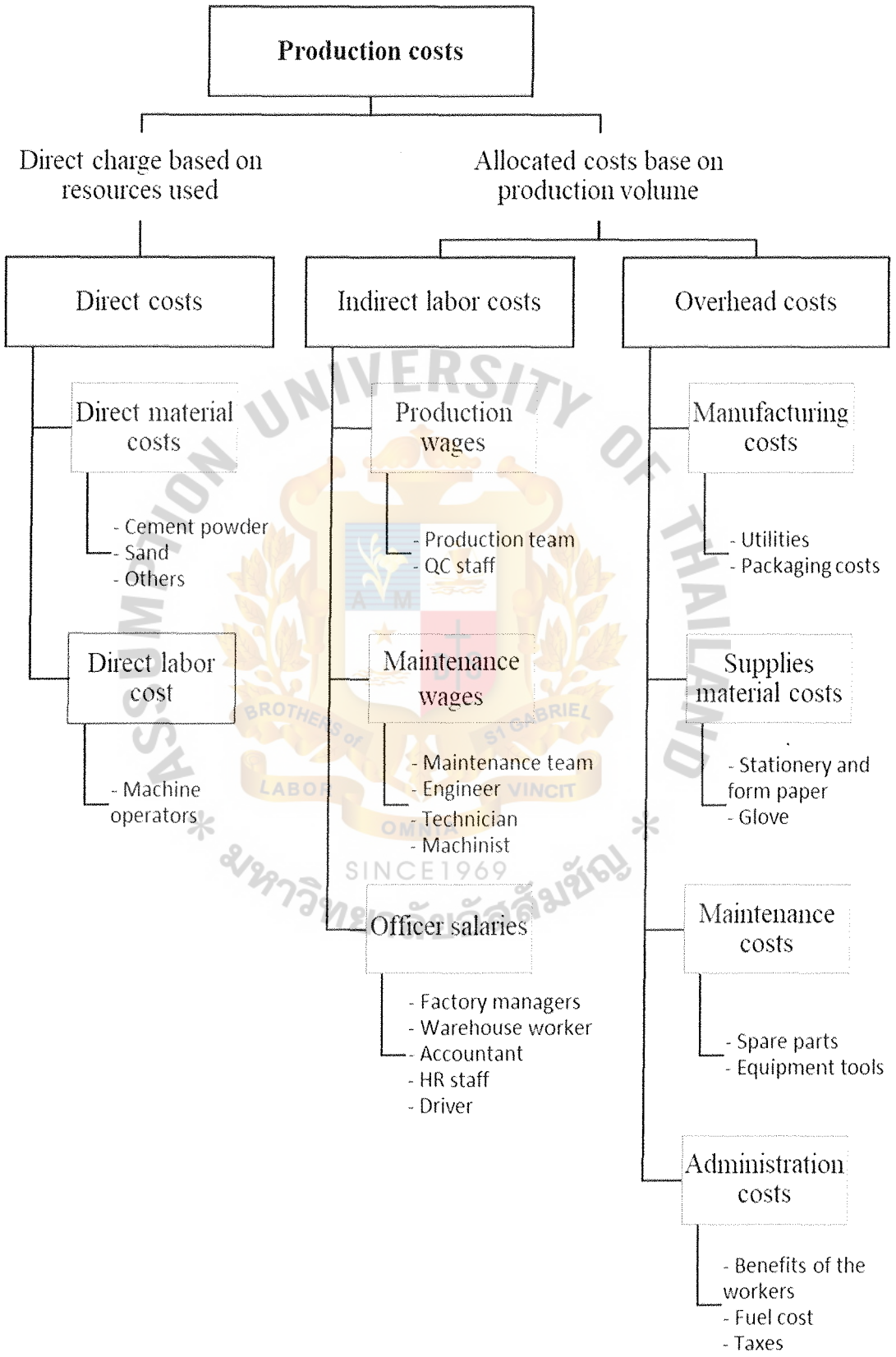
Table 1.1: Breakdown of Direct and Indirect Expenses (2013 – 2017)

	2013	2014	2015	2016	2017
Direct expense					
Raw material expense	62.88%	60.37%	58.93%	55.85%	53.38%
Direct labor	5.10%	5.34%	5.30%	5.06%	4.73%
Indirect expense					
Indirect labor	5.35%	6.03%	7.17%	9.74%	10.79%
Utilities expense	6.34%	6.10%	7.04%	7.19%	9.96%
Transportation expense	1.40%	1.29%	1.40%	1.50%	1.67%
Maintenance expense	7.38%	7.36%	5.75%	5.75%	5.25%
Depreciation expense	5.56%	5.94%	6.10%	6.64%	7.69%
Other	5.98%	7.56%	8.39%	8.26%	6.53%
Total indirect expense	37.12%	39.63%	41.07%	44.15%	46.62%

Source: Company's data

Table 1.1 indicates the company's direct and indirect expenses from 2013 to 2017. It shows the percentage of the company's expenses which are direct and indirect. Direct expenses include raw materials expense and direct labor while indirect expenses include indirect labor, utility expense, transportation expenses, maintenance expenses, depreciation expenses, and others. The proportion of indirect expenses increased slightly by two or three percent annually, so the cost reduction was the goal of the company. Although the company had a project to reduce costs, such as improving production formula, controlling raw materials and maintenance parts consumption, and handling defective products to increase productivity to reduce the raw material and maintenance cost, but the management still was not satisfied with the overall result. Due to the above problem, the company used the ABC model to find an opportunity to improve and reduce indirect expenses because ABC is the concept and methodology of cost management for decision-making to improve work processes which will respond to unnecessary costs reduction. Unlike traditional costing that takes into account only numerical results.

Figure 1.1: Production Costs Structure



Source: Author

Figure 1.1 indicates the production cost based on direct charging and production volume. For the direct charge, the company calculated based on the recorded amount used in the production line consistent with the costs incurred. If there is a lot of production in that period, it will have high volume resource usage of production costs. On the other hand, allocated costs based on the volume of production means if the product A has a higher proportion of production than the product B, these expenses will be allocated to the product A more than product B.

However, in the traditional cost calculation, the company combines the indirect labor cost and overhead cost then weigh it equally to the units produced. Despite the fact that these costs are varied based on the number of operations (such as number of times setup machine, number of times repairing machine, number of times inspect, or number of times service customer, etc.) rather than direct relationship to the production unit. Furthermore, some items of supplies expenses can be used in many departments besides production process (i.e. glove, plastic wrap, and some spare parts).

In addition, direct labor is machine operated while indirect labor refers to production team, QA/QC staff, maintenance team, other officers, etc. which the group of indirect labor cost might not properly be allocated to the products. For example, the maintenance department is assigned to repair a machine that produces the product B more than the machine that produces the product A. But this cost will be allocated to the product A rather than the product B because the product A has a higher volume of production.

Regarding the current manufacturing processes, the company still needs to rely on the co-operation between workers and semi-automatic machinery. Both have the indirect costs, and expenses vary by production volume, manufacturing procedures, and product categories because the time that we set up the machine and do the trial run are different. The power consumption for each machine is also different based on each production procedures. Moreover, the cost of machine maintenance and repair for each machine depends on the machine's lifespan which makes the cost different.

Therefore, the author considers that the standard costing method could not indicate the detail of manufacturing cost for each activity. The cost of each product might be distorted from the actual operation. This research has attempted to answer the research question **"How can ABC and ABM methods help find the cost drivers of the manufacturing cost and reduce the operation cost?"**

1.3 Research Objectives

The purpose of this research was to specify and classify each activity in the production processes in order to realize the actual operation spending of each function, clearly distinguish each cost of production activity, and understand the details of operation expenses. The following are the objectives of this project:

1.3.1 To study the costs and expenses that impact to the company activities by applying ABC.

1.3.2 To identify the activity that is not cost-effective.

1.3.3 To suggest a solution which can help the company eliminate non-value added activity.

1.3.4 To simulate the result of cost saving

1.4 Scope of the Research

The scope of this research has focused mainly on studying the current operation of production activities and calculating the true cost of manufacturing costs of AAA company specifically on the factory at A branch based on the concept of Activity-based costing (ABC) approach. The researcher expected that the new method would help the company find the solution for saving cost and managing the production activities more efficiently. The primary data were collected by interviewing employees involved in the production activities and observing the actual operation. The secondary data were

gathered from historical data of the company by using financial data from January 01, 2017 to December 31, 2017.

1.5 Significance of the Research

The researcher expects that after applying the ABC model to find the activity costs of the manufacturing by identifying the production activities and cost driver for each activity, the company will understand the cost factors better. The company will have clear figures which will help to leverage its performance and to make better decisions for improvement and development of working processes based on ABC information to increase competitiveness in the market. In addition, ABC method is a helpful system that can help managers to plan for better proper internal processes, target costs, and pricing policies.

1.6 Limitations of the Research

This research was limited to the production costs and production processes of AAA company at A branch concentrating on the sole machine No.15 from the preparation of raw materials to packing finished product, including major product models 405, 406 and 407. The other machines and products from other factories were not included in this study. Due to limited time, the researcher was not able to cover all the products produced in the company and the results of this research may have been different depending on the situation in that period. This study also excluded depreciation expense, head office expense, promotion activity, and selling expense because these pieces of information cannot be published publicly. Finally, this study might not have been suitable for the other organizations even in the same industry because of the difference in production processes, operation processes, product type, and business scale.

1.7 Definition of Terms

Activity-based costing (ABC)	A method used for computing a cost which is based on assigning the resource costs to activities performed and then calculating each product or service cost as to how much it is used for those activities (Blocher, Chen, Cokins, & Lin, 2005).
Activity driver	A factor which is used to measure how intense and frequent for the usage of individual work activity to cost objects that consume activity (Cokins, 2001).
Activity-based management (ABM)	An integrated approach that is intended to improve the activities performed to reduce cost (Hansen & Mowen, 2006).
Cost allocation	To set indirect costs for the company's departments or products (Hilton, Maher, & Selto, 2003).
Cost driver	A measurement of particular activity or resource that incurs cost to product or service, e.g. labor hours, machine hours, or computer time used (Cokins, 2010).
Cost object	It can be any item (e.g. customers, products, processes, work unit, or projects) which costs are quantified (Cokins, 2001).
Cost pools	A group or set of cost items which can be defined in several ways such as by type of cost, source or responsibility (Blocher et al., 2005).

Direct costs	The costs that are directly and physically associated with manufacturing products (Hansen & Mowen, 2006).
Overhead costs	Overhead costs which include various expenses in the organization except for direct labor and direct materials essential to produce a product or service (Hansen & Mowen, 2006).
Product cost	The three cost elements for manufacturing company which are direct materials, direct labor, and overhead needed to complete the product (Blocher et al., 2005).
Prime cost	It is direct costs such as direct material and direct labor cost (Hilton et al., 2003).
Push strategy	It refers to "make to stock" which means companies will forecast the demand in advance and produce in advance before the actual demand arrives (Jacobs, Berry, Whybark, & Vollmann, 2011).
Pull strategy	It refers to "make to order" which the companies will produce when the signal is given for the actual demand to avoid inventory cost (Jacobs et al., 2011).
Resource driver	It is the factor of measurement of the organization's activities being consumed as to the number of resource, e.g. square feet occupied (Cokins, 2001).

Support departments	The department does not work directly with the product but necessary for the production process to operate (Hilton et al., 2003).
Target cost	It is the cost of goods or services that meet the needs of the customer and the profit target of the company (Hilton et al., 2003).

CHAPTER II

REVIEW OF RELATED LITERATURE

In this chapter, the author attempts to review all related literatures and theory concentrating on production cost calculation method. It includes an explanation of traditional costing, activity-based costing, and activity-based management. The author also describes the perspective of traditional product costs and activity-based costs calculation in order to understand the difference between the two methods.

2.1 Traditional Costing System

Traditional costing system is also referred to as conventional system, functional-based cost system, volume-based system, standard cost system, or classical cost system, widely used in many companies than the activity-based costing system (Hansen & Mowen, 2006). Hilton et al. (2003) mentioned that proportion of the manufacturing costs is classified into three types which are direct materials, direct labor, and overhead.

2.1.1 Direct materials

The resources used as the physical component of the manufactured goods or services. Those materials costs can be measured based on the quantity consumed from physical observation, which direct material costs can be charged directly to products (Hansen & Mowen, 2006).

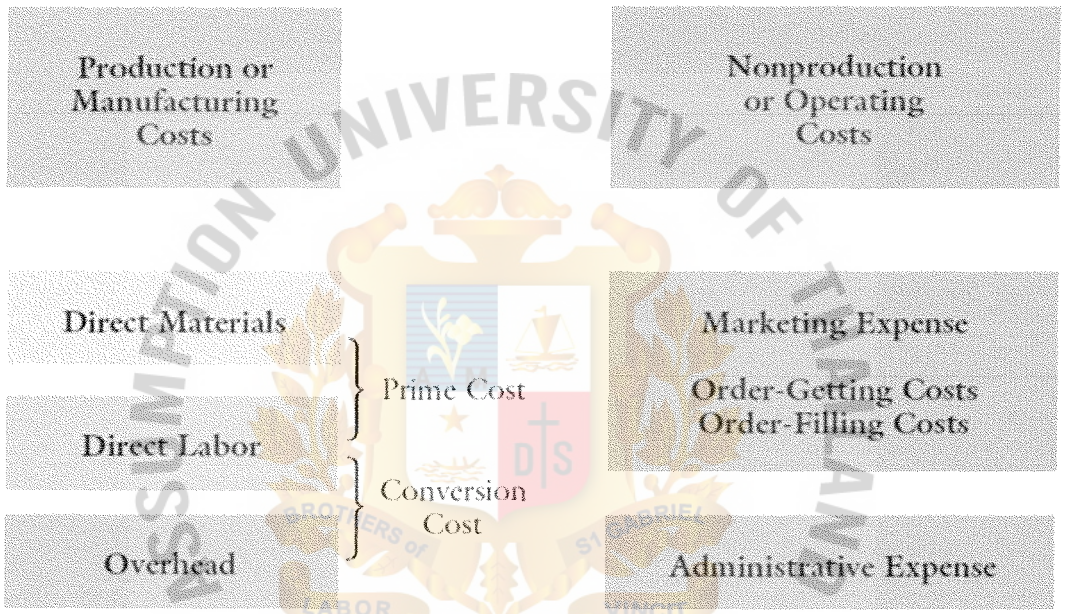
2.1.2 Direct labor

The labor that transforms raw material into finished products which can be physically observed by measuring the amount of labor used. Same as direct materials, direct labor costs can be traced to the products (Hansen & Mowen, 2006).

2.1.3 Factory overhead

Other costs that involve various items needed for the production process, such as indirect materials (e.g. repair parts, cleaning materials, material handling), indirect labor (e.g. technicians, supervisor, managers), and facility (e.g. depreciation of building and machinery, insurance of factory and equipment, utilities) (Hilton et al., 2003).

Figure 2.1: Production and Non-Production Costs



Source: Hansen and Mowen (2006)

Figure 2.1 presents the cost concept between production cost and non-production cost. The other expenses for running business incurred in a particular period, i.e. the general, selling and administrative cost or operating expenses are considered as non-manufacturing costs (Blocher et al., 2005).

The advantages of a traditional cost calculation are explained by Hansen and Mowen (2006). It is difficult to measure all resources consumed by each product; therefore, standard method provides simplicity and a convenient way to allocate costs by assuming all costs related to the number of units produced or direct labor hours. Hilton et al. (2003) suggested that if the proportion of direct costs is a lot higher than indirect costs, the accuracy of expense information is not necessary for the company's strategy.

The organization might not need to apply ABC method because it is not worth to implement costly and complex system. The traditional cost is mostly prepared in an aggregate level for external financial reporting rather than an internal user which is not needed in the detailed level for management purpose. Examples are government agencies, creditors, or investors who are external users requiring financial reports, such as balance sheet, income statement and cash flow statement. However, the organization that especially uses cost leadership strategy may not appropriately use only traditional costing method because it needs to understand all cost details and require cost management in order to improve its competitive advantage (Blocher et al., 2005).

2.2 Activity-Based Costing (ABC)

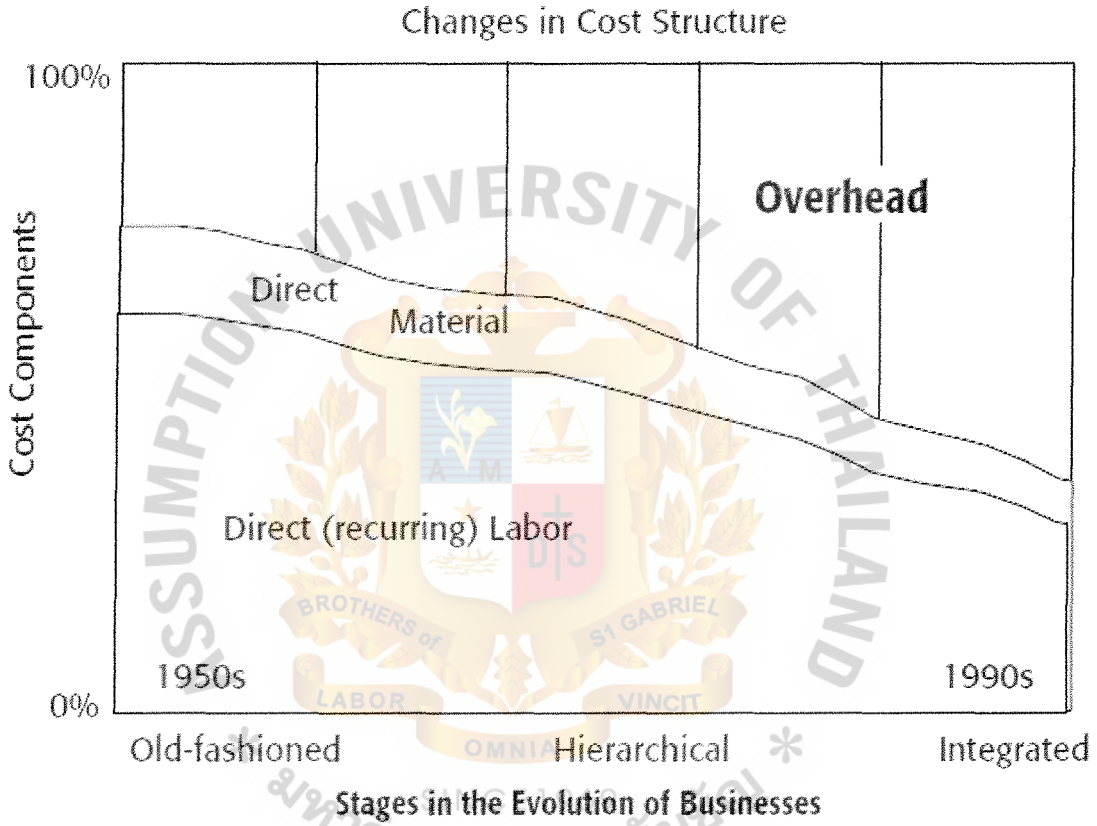
Kaplan and Cooper developed Activity-Based Costing or ABC system in 1988, which is a new technique to provide the accurate costs of activities, products and processes together with solving the problem of increasing overhead cost in modern manufacturing organization (Ozbayrak, Akgun, & Turker, 2004; Hofmann & Bosshard, 2017). ABC system is a method that identifies the activities used, then assigning activities costs for producing products or services to manage the organizational expenses (Stapleton, Pati, Beach, & Julmanichiti, 2004; Rothberg, 2011). By using this method, the organization will be able to understand the cause of activity's cost that helps to manage the demand of resources and processes to be performed efficiently (Banker, Bardhan, & Chen 2008).

Kellermanns and Islam (2004) noted that currently, the change in customer behavior leads the organization to develop by itself in coming up with robotic technology and new automation rather than human labor which increases overhead costs and reduce direct labor costs. Consequently, traditional costing method cannot explain the actual high overhead consumption cost of resource of the factory.

Cokin (2001) also mentioned that the traditional costing approach does not take into account the fact that more complex products need to consume more resources. The

reason is that manufacturing in small volume especially in complex product often requires more complex manufacturing processes and more support department. Thus, those products would be under-allocated factory overhead costs.

Figure 2.2: Overhead Costs Displacing Direct Labor Costs



Source: Cokin (2001)

Figure 2.2 shows the evolution of business and cost structure. Kellermanns and Islam (2004) stated that the proportion of direct labor cost is replaced by factory overhead cost because many manual jobs in the organization are displaced by computers, equipment, and automatic system. It also develops a modern production method, quality and variety of raw materials which make the trend of direct labor cost decrease significantly. In addition, increasing in the variety of products, distribution and sale channels create the complexity of the cost structure (Cokin, 2001).

Stapleton et al., (2004) stated that cost drivers are used to allocate indirect costs and convert the quantity of the production activities to each product. The traditional cost system weighted overhead equally in the physical volume of the units produced which could not represent the support department and indirect resources. Therefore, ABC concept comes up with an idea of multiple cost drivers to link the overhead cost from different activities to the products.

Even though the cost drivers are used to determine the overhead costs for individual unit works, but it may not be suitable for certain activities because some activities are incurred in a specific cost for a particular batch of products, particularly the process level and product line, or support the operation in general. Blocher et al. (2005), Khataie and Bulhak (2013) stated that because those resources and activities support different level in the organization, thus Cooper and Kaplan (1998) presented a cost hierarchy for the overhead cost in a manufacturing process.

The purpose of cost hierarchy concept in ABC is to realize when to use the term variable cost and understand the variable with regard to what the cost driver is. In traditional costing method, the variable cost is used only with regard to the number of units produced. However, some activities the operation needs to perform only once per batch which regard to the number of batches produced rather than units produced (Hilton et al., 2003).

The cost drivers can be classified into four types as presented below.

1) Unit-level activity

   The cost occurs every time a product is made and varies directly with the quantity of the product that performs on each individual unit same as volume-based (e.g. using direct material, direct labor hour, machine hour).

2) Batch-level activity

The cost occurs when a batch or a group of units of products and schedules to be processed together (e.g. setting up machines, inspecting products by batch, scheduling production).

3) Product-level activity

The cost occurs to support an entire product line or support the production of particular products to be produced which the special equipment or personnel would not be required for normal use except for the particular product (e.g. administering parts required for product, engineering change to modify products, designing product).

4) Facility-level activity

It is the cost of the organization in general to produce goods that cannot be traced to individual unit, batch, or product (e.g. incurring taxes and insurance, performing general machine maintenance, providing security and safety).

Ben-Arieh and Qian (2003) studied the cost of the design and development activity for machined parts. By applying ABC method to clarify the overall process costs, it gave clearer picture of capacity planning and more accurate product cost. The analysis showed the main resource spent about half of the total machining cost in manufacturing coordinator section. The main activity which used most of the resources was spent by run test part, machine prototype and discuss a product. After comparing ABC with traditional costs, the result showed that traditional systems tend to underestimate on prototype production and adjust the production parameters. The growth of the complexity of the machined parts needed more development and experimentation expense, thus led to the product cost estimation of ABC and traditional method differently.

Ozbayrak, Akgun, and Turker (2004) studied push and pull strategies in advanced manufacturing system which discussed the implementation of the ABC and simulation model to estimate the manufacturing and product cost. Their simulation provided the

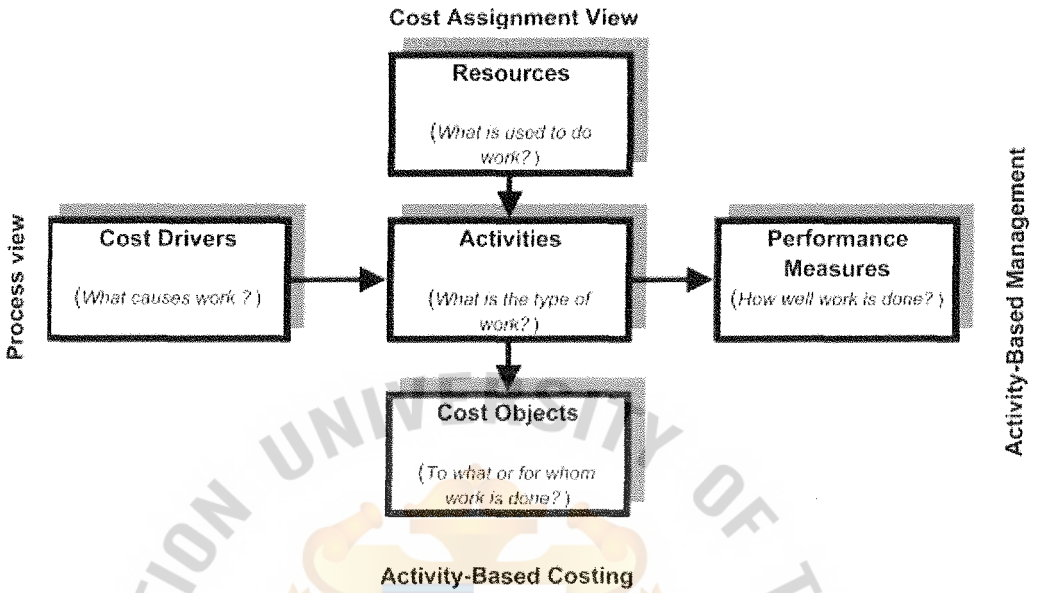
understanding of the relationship among costs, activities, and products which point out to the greatest cost item within the system. They found that ABC could provide the insight information of the working and help to understand the major effect on product value chain in terms of work-in-process and throughput in both push and pull production environment. Their important cost drivers which increased in manufacturing cost were randomness, buffer capacity and lead time. Therefore, they decreased the waiting time in the production process resulting in lower production cycle and production costs.

However, Lin, Collins, and Su (2001) mentioned that ABC technique does not replace and change the recording method of traditional costing system. But, it allows the organization to leverage the cost calculation and limitation of traditional cost calculation. It does not only attempt to enhance an aggregate level information of traditional method but also benefits the manager in making a decision by tracing the consumption of resources and activities. The cost driver is assigned to measure the activity consumption which represents the quantity of resource usage in each activity to produce the products.

2.3 Activity-Based Management (ABM)

Activity-based management is the management of activities that gives attention to increase both the value of products to customers and profits to the company by improving the way activities are performed (Hansen & Mowen, 2006).

Figure 2.3: Activity-Based Costing and Activity-Based Management Framework



Source: Gupta and Galloway (2003)

Some researchers such as Trussel and Bitner (1998), Cooper and Kaplan (1999), Cokins (2001), Gupta and Galloway (2003), Hansen and Mowen (2006), Greasley and Smith (2017) described that ABC system can be divided into two different views as presented in Figure 2.3.

1) Cost assessment view (Activity-Based Costing)

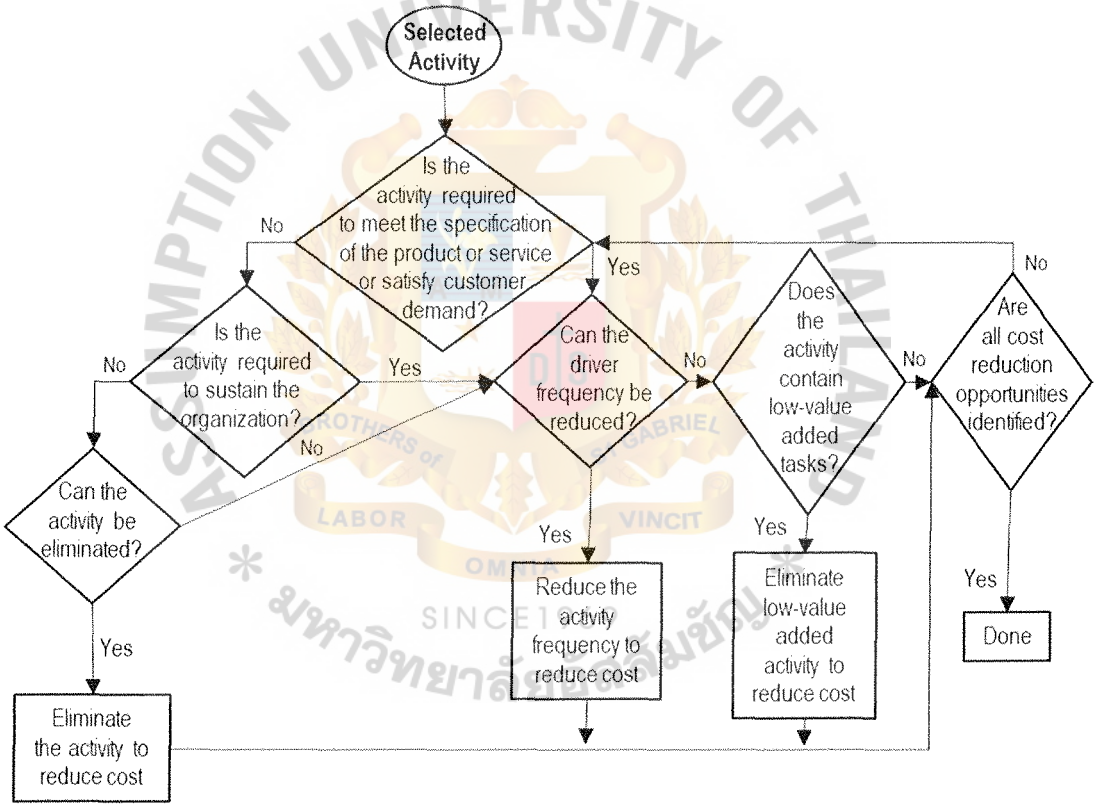
   The vertical axis is a cost-consumption chain that traces the expenses of resource usage (i.e. salary and supply) into the work activities (i.e. employee and machine equipment) based on the proportion of resource drivers and activity drivers to the cost objects. It will help to track, collect, and estimate the resource consumption in each activity. This will provide useful insight about cost information to support the decision of the management.

2) Process view (Activity-Based Management)

   The horizontal axis is an operating measure that provides the internal linkages of performance activities, causes of incurred activities and cost drivers in order to measure and manage business processes.

Hilton et al. (2003) explained that ABM links the activity-based costing analysis and value-added analysis together to identify the opportunities for process improvement. ABM takes a further step from ABC information related to value added and non-value added activities to reduce wasted resource. Organizations could create more value either saving those wasteful spending on non-value added activities or rotating wasted resources to value-added activities instead.

Figure 2.4: Questions to Identify Value of Activity



Source: Blocher et al. (2005)

Figure 2.4 displays the sample of asking questions for identifying the value of activities. Eliminating the activities that have little or no value would not lower the value of the product to the customer or affect the accuracy and efficiency of the organization. For example, a process might include waiting time, rework, or moving parts between processes that waste time, resource and space.

Blocher et al., (2005) referred to Cooper and Kaplan (1998) that ABM could be classified into two categories which are Operational ABM and Strategic ABM. The management techniques for Operational ABM are performance measurement, total quality management, business process re-engineering and activity management. On the other hand, the management techniques for Strategic ABM are market segmentation, distribution channels, customer relationships, supplier relationships, product-line and customer mix, and process design.

Gupta and Galloway (2003) studied the benefits of ABC and ABM in terms of support strategic decision-making processes for operational managers which have not seen by the traditional costing data. They referred to Western Zirconium Inc. that after they had applied ABC and ABM, which focused on cost drivers and value-added process, Western Zirconium reduced work in process inventory by $8.1 million, reduced elapsed production time by 35 days, and increased first-time product acceptance by 58%.

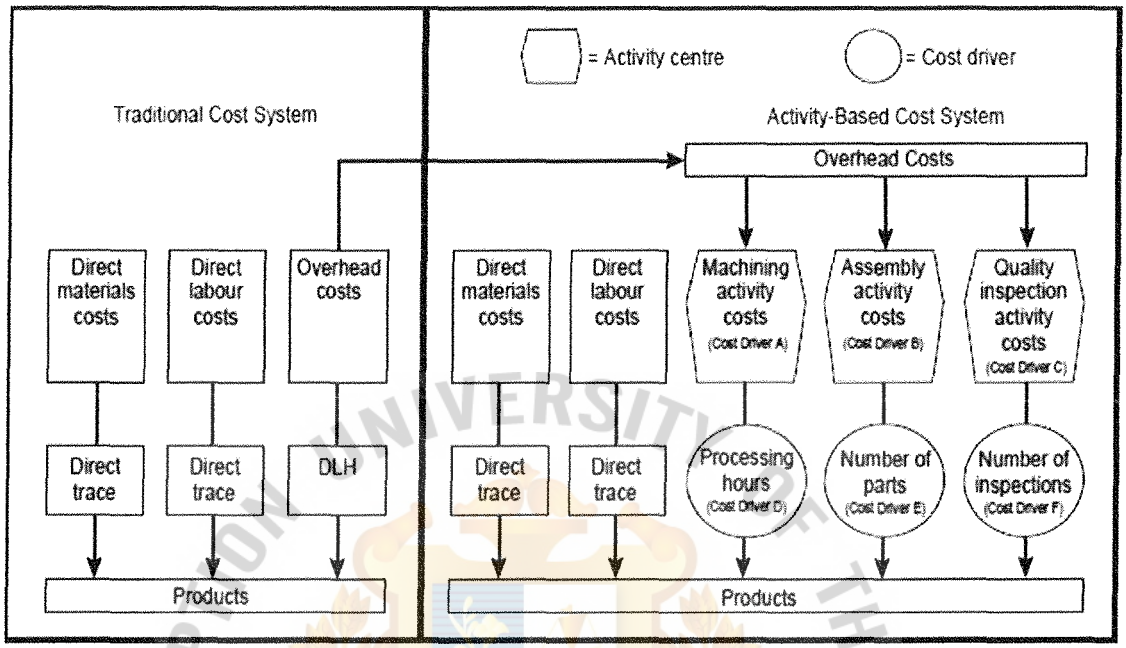
2.4 Traditional Costing versus Activity-Based Costing

The difference between traditional costing and activity-based costing are the following.

2.4.1 Overhead Assignment

The product in traditional costing system is allocated overhead by using volume-based cost driver or single cost driver which relies on the units produced. It means that each product item is charged an equal amount of overhead. However, the higher overhead cost of modern production makes distortion in the expense and cost report. As ABC model uses multiple cost driver, it does not only rely on volume-based but also non-volume based by considering cause and effect of resource consumption among activities. (Hilton et al., 2003; Blocher et al., 2005; Hansen & Mowen, 2006)

Figure 2.5: The Difference Between Traditional Cost System and ABC System

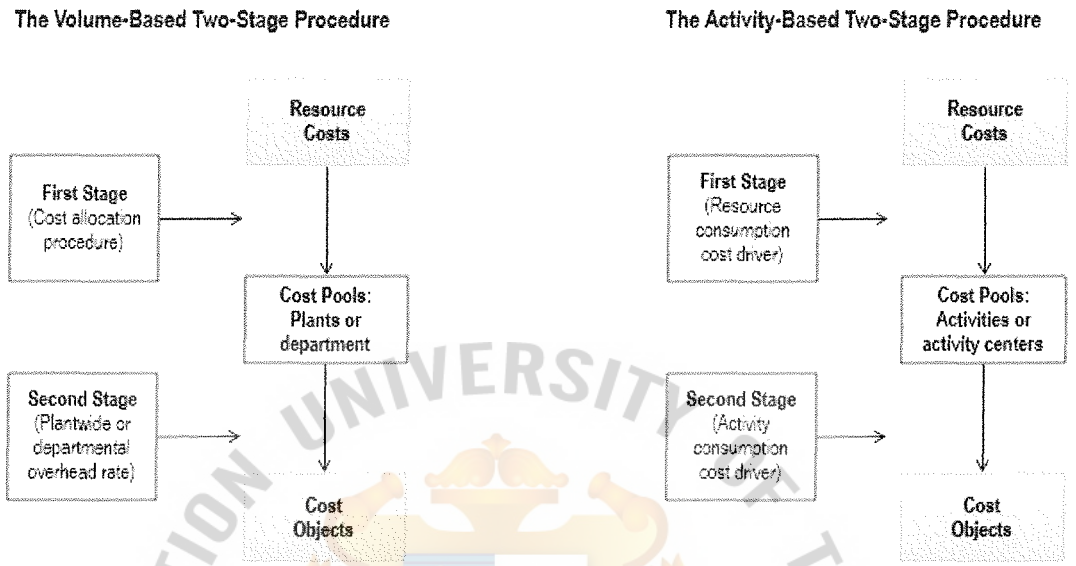


Source: Cokins (2001)

2.4.2 Volume-Based Cost Drivers and Activity-Based Cost Drivers

Tracing the resource costs from manufacturing to products, in a volume-based costing system, it determines the product cost relying on volume-related allocation base. The overhead costs differ only when the different numbers of units are produced. On the other hand, activity-based costing uses several factors to determine product cost from different aspects of the production process (Blocher et al., 2005). An allocation of resource costs into cost objects consists of a 2-stage cost assignment procedure.

Figure 2.6: The Difference of 2-Stage Cost Assignment Between Volume-Based Cost and Activity-Based Cost

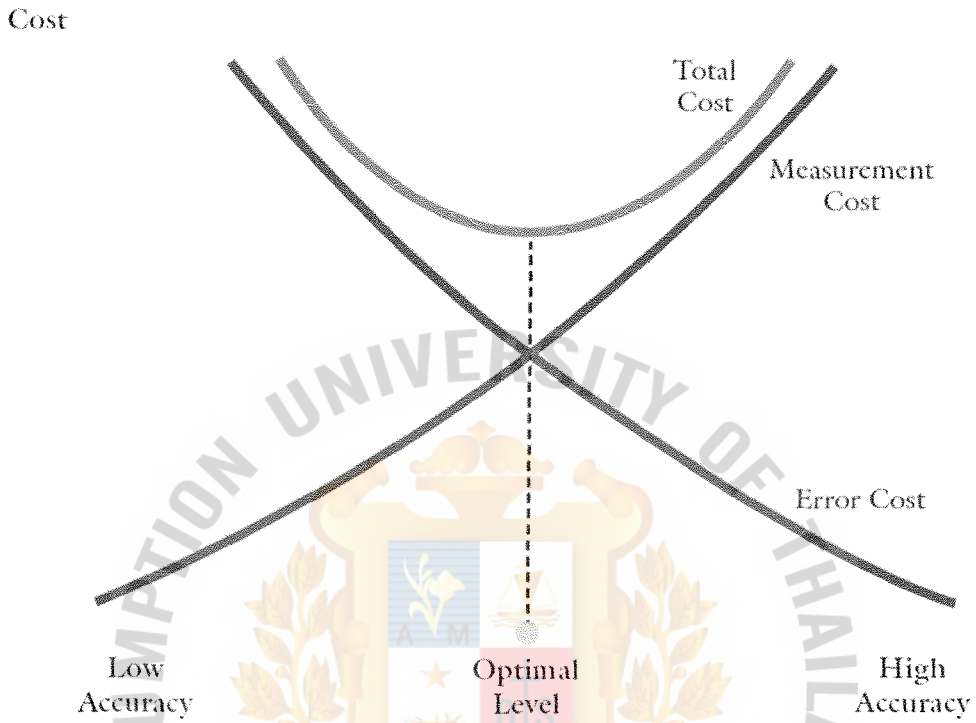


Source: Blocher et al. (2005)

Figure 2.6 explains that the direct materials and direct labor costs are traced to the cost objects directly. The first stage in traditional costing approach assigns the overhead cost of resources used in production to cost pool by volume-base. Then the second stage, the cumulative production costs in the cost pool are allocated to the related product relying on the production volume which relatively distorts product costs because all products do not use the same resources in the same proportion. In contrast, ABC will trace the cost of resources used to various activities by analyzing cost drivers that have a causal relationship with cost consumption. Then assigns the activity cost pools to the related product by using activity consumption cost drivers. It means more or less production cost depends on activity performed (Kaplan & Atkinson, 1998; Cokins, 2001; Blocher et al., 2005).

In addition, Kaplan and Atkinson (1998), Hansen and Mowen (2006) pointed that implementing the ABC system should consider the optimal level between measurement cost and error cost which would be further explained.

Figure 2.7: Trade-Off between Measurement and Error Costs



Source: Hansen and Mowen (2006)

Figure 2.7 illustrates the trade-off between measurement cost and error cost in order to determine the optimization of the cost driver in the individual activity. The measurement cost is associated with the measuring information of the actual resource cost performed in numerous activities for each product. It could incur expensive measurement cost but has more accurate cost information. The error cost is inaccurate cost assessment information that could lead to making wrong decisions (e.g. inappropriate costed products) but inexpensive operation. Therefore, the ABC system does not need to detect every single production to obtain the most accurate cost of the resource used because it will require very expensive system and collect numerous activity. A properly designed ABC system should represent approximately 90 percent accurate cost system which will have more benefits than the traditional cost system (Kaplan & Atkinson, 1998).

The study of Zhu, Lin and Wang (2012) was related to HZ Pharmaceutical Company that tested the cost driver optimization after implementing the ABC system for three years by applying the simple linear regression model. The purpose of their study was to verify the accuracy of the selected cost drivers in ABC system. They found that the data of the cost driver from the original design passed the compliance test and substantive test which was essential to reassure that the collected data entered into the system were still appropriate for ABC and ABM system.

2.5 Chapter Summary

In this chapter, the review of the literature has dealt with understanding the different concepts of traditional cost and ABC in relation to the manufacturing cost. Leading to the conclusion that using ABC in manufacturing company would analyze in great detail rather than using traditional costing method. The changing business environment makes traditional way become distorted compared to the use of ABC that can help the company improve this issue.

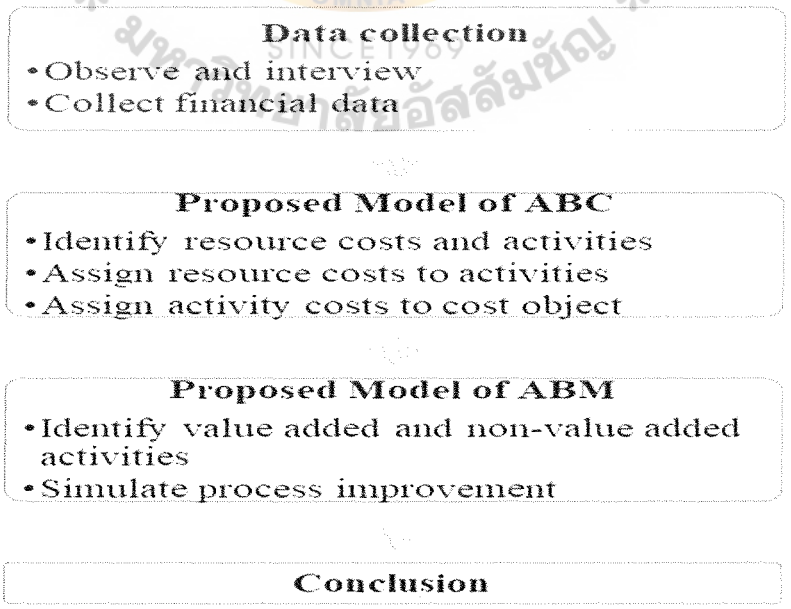
CHAPTER III

RESEARCH METHODOLOGY

This chapter presents the research methodology for implementing ABC and ABM technique in a case study of AAA company. The methodology reveals the estimated cost of an activity which mainly concerns about the activities of production processes and supports production processes to understand the company's spending on activities and achieve cost reductions.

In this research, the researcher employed a four-step methodology. The first step was to observe and to interview about the manufacturing process and collect the company's historical financial data. The second step was using the proposed model by applying ABC approach to appraise the cost of the organization activity. The third step was using ABM approach to find the non-value added activities and the improvement solutions. The final step was the conclusion of all findings.

Figure 3.1: Research Procedure



Source: Author

3.1 Data Collection

The researcher collected relevant information by interviewing key persons involved in the work process and gathering relevant financial documents from the company's database for analysis in an appropriate format. The researcher used two types of data collection methods: the primary data and the secondary data collections.

3.1.1 Primary data collection method

Data were collected using interview and observation methods in the production department to find the details of production activities and support production activities. The company's information was acquired by observing the production process and interviewing five officers to understand the current operations, including production manager, maintenance engineer, quality control officer, purchasing officer, and warehouse officer. The results from interview and observation helped to understand the relationship of activities in each process. Moreover, the researcher listed down the activities to determine a logical cost driver for each activity. The list of interview questions and the summary of interview results are shown in Appendix A.

3.1.2 Secondary data collection method

The researcher reviewed historical documents of accounting information from the company's ERP system and reviewed the documents relevant to the production process. The collected data were the financial transactions and expenses from January to December 2017. They were used in calculating costs based on ABC concept. The expenses of the company are summarized as follows.

Table 3.1: AAA Company's Expenses in 2017 Only the Model 405, 406 and 407 of Branch A

Expenses	Amount (THB)
Raw Materials	165,332,412
Direct labor	19,162,313
Indirect labor	20,698,777
Production Expenses	9,175,967
Repair and Maintenance Expenses	2,977,683
Packaging	5,216,145
Printing and Stationery Expenses	269,012
Vehicle Fuel Costs	4,554,436
Electric Expense	15,122,783
Water Expense	193,444
Gas Expense	747,959
Telephone, Internet, Cellphones	172,945
Fees	461,344
Other expenses	317,809
Total Expenses	244,403,029

Source: Company's data

Table 3.2: Proportion of Manufacturing Costs by Product

Product	Model 405	Model 406	Model 407
Direct materials (฿)	118,958,682	33,576,570	12,797,160
Direct labor (฿)	10,094,770	7,014,190	2,053,353
Factory overhead (฿)	46,792,397	10,750,028	2,365,879
Total cost	175,845,849	51,340,788	17,216,392
Production volume (unit)	8,958,000	2,058,000	452,927

Source: Company's Data

Table 3.2 indicates a manufacturing cost proportion of selected products classified into three categories: direct materials cost, direct labor cost, and factory overhead cost. AAA company's overhead cost calculation was varied depending on the direct materials used and the number of units produced. The product model 405 with a large number of product units had a factory overhead cost more than the product model 406 and model 407 respectively.

3.2 Proposed Model of ABC

After reviewing the collected data, the next step was the implementation of ABC concept consisting of three steps. The first step is to identify and classify the activities related to the company's selected products. Next, assign resource costs to activities by estimating the resource and activity consumption cost driver. The final step is to assign activity costs to products.

3.2.1 Identify and classify the activities related to the company's products

In the first step of applying an ABC system, the researcher made a list of all activities that the company performs to produce the product. Then, the researcher assigned the department cost center to determine the main activity and sub-activity to specify the activity cost driver and calculate the activity cost concerning expenses and costs incurred from individual activities.

The activity cost drivers are any factors that influence the change of the activity's cost to go up or down. The activity costs in ABC approach are categorized based on the different types of cost drivers utilized. The number of packaging of finished goods at the end of the production lines; the number of setting up machines in production lines; and the number of moves of finished goods to a warehouse are activities that impact the costs that the company incurs. The explanation of the activities in Table 3.3 is shown in Appendix B.

Table 3.3: List of Activities and Cost Driver

Operation Sector	Activity Type	Department Cost Center	Activity	Activity Cost Pools	Activities Cost Drivers	Activity Level
Plant operation	Production activities	Production dept.	Manufacture	Mixing materials	Machine hours	Unit
				Molding materials	Machine hours	Unit
				Curing products	Machine hours	Unit
				Ejecting product from the mold	Labor hours	Unit
				Packing finished goods	Number of packages received	Batch
	Support production activities	Maintenance dept.	Repair and maintenance	Setting up machine	Number of setups	Batch
				Reviewing and preparing the equipment at scheduled	Number of prepared parts	Unit
				Repairing machine during production hour	Repair hours	Unit
				Developing the capabilities of production	Developing hours	Unit

Source: Author

Table 3.3: List of Activities and Cost Driver (Cont.)

Operation Sector	Activity Type	Department Cost Center	Activity	Activity Cost Pools	Activities Cost Drivers	Activity Level
Plant operation	Support production activities	Quality control dept.	Measure and control the product quality	Inspecting and testing quality of raw materials	Number of tests	Batch
				Inspecting and testing quality manufactured products	Number of tests	Batch
				Report and follow the problem	Number of reports	Batch
Office operation	Support production activities	Transportation dept.	Manage delivery of finished goods	Check and issue picking list	Number of picking lists	Batch
				Load up finished goods to transport truck	Number of truckloads	Batch
				Deliver goods to customers	Number of deliveries	Batch

Source: Author

Table 3.3: List of Activities and Cost Driver (Cont.)

Operation Sector	Activity Type	Department Cost Center	Activity	Activity Cost Pools	Activities Cost Drivers	Activity Level
Office operation	Support production activities	Warehouse dept.	Control inventory	Receive finished goods from production dept.	Number of pallet moves	Batch
				Keep and store finished goods by forklift	Number of pallet moves	Batch
				Prepare and send finished goods according to picking list	Number of pallet moves	Batch
		Purchasing dept.	Manage purchasing as required	Issue purchase requisition	Number of purchase requisition	Batch
				Record and follow the purchased goods	Number of withdraw/ requisition slips	Batch
		Production planning dept.	Planning demand for materials, labor and machinery	Scheduling and controlling production process	Number of analysis reports	Batch

Source: Author

Table 3.3 demonstrates the list of activities which are based on the company's working information. The researcher classified the operation sector into two parts as plant and office operations. The plant operation involves the production department, maintenance department, and quality control department. The office operation involves the transportation department, warehouse department, purchasing department, and production plan department.

In addition, the purpose of the activity for manufacturing company was classified into two categories as production activity and support production activity. The production activities are related to the production department which includes works that they create or produce the products. The other work activities are considered as support production activity.

3.2.2 Assign resource costs to activities

In the second step, the researcher allocated the resource cost for each activity, which provides the activity consumption cost driver in each activity for assigning the activity cost to the products.

1) Estimate the cost of activities

The assignment of the resource costs to activities can be done by direct tracing and estimation. The costs that use direct tracing measure the activities by the actual usage of resources. However, if the direct measurement is not available, the researcher needs to estimate by applying the percentage of people and time that workers spend on each activity.

Table 3.4: The Costs of Production Activities

Department Costs for Production Activities	Total Cost (THB)	Mixing materials	Molding materials	Curing product	Ejecting product from the mold	Packing finished goods
Model 405						
Direct labor	10,094,770	2,202,953	4,405,906	-	2,937,271	548,640
Production exp.	8,392,216	165,949	5,412,955	-	205,240	2,608,073
Utilities	7,672,547	2,167,391	4,912,752	14,433	433,478	144,493
Total	16,064,763					
Model 406						
Direct labor	7,014,190	1,530,033	3,060,066	-	2,040,044	384,048
Production exp.	4,394,207	98,182	2,373,159	-	97,214	1,825,651
Utilities	6,020,834	1,517,173	3,438,926	660,155	303,435	101,145
Total	10,415,041					
Model 407						
Direct labor	2,053,353	435,868	871,736	-	581,157	164,592
Production exp.	1,605,689	43,201	742,204	-	37,862	782,422
Utilities	2,370,805	650,217	1,473,826	73,371	130,043	43,348
Total	3,976,494					

Source: Company's data

Table 3.4 shows the activity costs of production department. The rows in the table identify the expenses of selected product model, while the columns identify the five principal activities related to the production. The total cost of this table came from the direct labor, production expense, and utilities (electricity, water and gas consumption) from table 3.1. Then, the researcher collected the direct labor cost from the payroll record to specify the direct labor in each production activity. Direct tracing can be used to measure the activities cost because the production activities determine the employee's responsibility fixed in each workstation. The production expenses can be tracked by the actual usage from the materials and spare parts withdrawal records which are taken from the storage or warehouse. The records have been separated by the workstation. For the utilities expense, the researcher gathered the consumption of the electricity, water and gas from the records of the utility usage.

Table 3.5: The Matrix of Costs by Departments and Support Production Activities

Department Costs for Support Production Activities	Total cost (THB)	Setting up machine		Reviewing and preparing the equipment at scheduled		Repairing machine during production hour		Developing the capabilities of production	
Maintenance dept.									
Wage-Salary	7,252,075	7%	507,645	38%	2,755,789	34%	2,465,706	21%	1,522,936
Parts and equipment expense	2,977,683	2%	59,554	69%	2,054,602	13%	387,099	16%	476,429
Transportation dept.									
Wage-Salary	5,098,412	0%	-	0%	-	0%	-	0%	-
Supplies expense	3,568,342	0%	-	0%	-	0%	-	0%	-
Warehouse dept.									
Wage-Salary	3,991,356	0%	-	0%	-	0%	-	0%	-
Supplies expense	2,124,703	0%	-	0%	-	0%	-	0%	-
Purchasing dept.									
Wage-Salary	3,696,466	0%	-	0%	-	0%	-	0%	-
Supplies expense	22,910	0%	-	0%	-	0%	-	0%	-
Production plan dept.									
Wage-Salary	344,818	0%	-	0%	-	0%	-	0%	-
Supplies expense	32,398	0%	-	0%	-	0%	-	0%	-
Quality control dept.									
Wage-Salary	315,650	0%	-	0%	-	0%	-	0%	-
Supplies expense	27,193	0%	-	0%	-	0%	-	0%	-
Total	29,452,006		567,199		4,810,391		2,852,805		1,999,365

Source: Author

Table 3.5: Matrix of Costs by Departments and Support Production Activities (Cont.)

Department Costs for Support Production Activities	Total cost (THB)	Inspecting and testing quality of raw materials		Inspecting and testing quality manufactured products		Report and follow the problem		Check and issue picking list	
Maintenance dept.									
Wage-Salary	7,252,075	0%	-	0%	-	0%	-	0%	-
Parts and equipment expense	2,977,683	0%	-	0%	-	0%	-	0%	-
Transportation dept.									
Wage-Salary	5,098,412	0%	-	0%	-	0%	-	23%	1,172,635
Supplies expense	3,568,342	0%	-	0%	-	0%	-	3%	107,050
Warehouse dept.									
Wage-Salary	3,991,356	0%	-	0%	-	0%	-	0%	-
Supplies expense	2,124,703	0%	-	0%	-	0%	-	0%	-
Purchasing dept.									
Wage-Salary	3,696,466	0%	-	0%	-	0%	-	0%	-
Supplies expense	22,910	0%	-	0%	-	0%	-	0%	-
Production plan dept.									
Wage-Salary	344,818	0%	-	0%	-	0%	-	0%	-
Supplies expense	32,398	0%	-	0%	-	0%	-	0%	-
Quality control dept.									
Wage-Salary	315,650	9%	28,409	74%	233,581	17%	53,661	0%	-
Supplies expense	27,193	4%	1,088	93%	25,290	3%	816	0%	-
Total	29,452,006		29,496		258,871		54,476		1,279,685

Source: Author

Table 3.5: Matrix of Costs by Departments and Support Production Activities (Cont.)

Department Costs for Support Production Activities	Total cost (THB)	Load up finished goods to transport truck		Deliver goods to customers		Receive finished goods from production dept.		Keep and store finished goods by forklift	
Maintenance dept.									
Wage-Salary	7,252,075	0%	-	0%	-	0%	-	0%	-
Parts and equipment expense	2,977,683	0%	-	0%	-	0%	-	0%	-
Transportation dept.									
Wage-Salary	5,098,412	48%	2,447,238	29%	1,478,539	0%	-	0%	-
Supplies expense	3,568,342	6%	214,101	91%	3,247,191	0%	-	0%	-
Warehouse dept.									
Wage-Salary	3,991,356	0%	-	0%	-	45%	1,796,110	31%	1,237,320
Supplies expense	2,124,703	0%	-	0%	-	34%	722,399	47%	998,611
Purchasing dept.									
Wage-Salary	3,696,466	0%	-	0%	-	0%	-	0%	-
Supplies expense	22,910	0%	-	0%	-	0%	-	0%	-
Production plan dept.									
Wage-Salary	344,818	0%	-	0%	-	0%	-	0%	-
Supplies expense	32,398	0%	-	0%	-	0%	-	0%	-
Quality control dept.									
Wage-Salary	315,650	0%	-	0%	-	0%	-	0%	-
Supplies expense	27,193	0%	-	0%	-	0%	-	0%	-
Total	29,452,006		2,661,339		4,725,730		2,518,509		2,235,931

Source: Author

Table 3.5: Matrix of Costs by Departments and Support Production Activities (Cont.)

Department Costs for Support Production Activities	Total cost (THB)	Prepare and send finished goods according to picking list		Issue purchase requisition		Record and follow the purchased goods		Scheduling and controlling production process	
Maintenance dept.									
Wage-Salary	7,252,075	0%	-	0%	-	0%	-	0%	-
Parts and equipment expense	2,977,683	0%	-	0%	-	0%	-	0%	-
Transportation dept.									
Wage-Salary	5,098,412	0%	-	0%	-	0%	-	0%	-
Supplies expense	3,568,342	0%	-	0%	-	0%	-	0%	-
Warehouse dept.									
Wage-Salary	3,991,356	24%	957,926	0%	-	0%	-	0%	-
Supplies expense	2,124,703	19%	403,694	0%	-	0%	-	0%	-
Purchasing dept.									
Wage-Salary	3,696,466	0%	-	22%	813,223	78%	2,883,243	0%	-
Supplies expense	22,910	0%	-	14%	3,207	86%	19,703	0%	-
Production plan dept.									
Wage-Salary	344,818	0%	-	0%	-	0%	-	100%	344,818
Supplies expense	32,398	0%	-	0%	-	0%	-	100%	32,398
Quality control dept.									
Wage-Salary	315,650	0%	-	0%	-	0%	-	0%	-
Supplies expense	27,193	0%	-	0%	-	0%	-	0%	-
Total	29,452,006		1,361,620		816,430		2,902,946		377,216

Source: Author

Table 3.5 shows the department costs to support the production activities. The rows in the table identify the department expenses and the columns in the table identify the eighteen principal activities related to support the production. The costs of each department came from indirect labor cost, printing and stationery expenses, vehicle fuel costs, telephone, internet, cellphones, fees, other expenses in Table 3.1 and then allocated them properly into each activity by using the usage report, position of worker in each department, and daily working report of some departments. Because the support production activities were difficult to measure or trace, the workers' salaries and supply expenses to the activities cost directly. The employees may need to be responsible for various activities in their department. Therefore, the researcher needed to gather the department expenses, usage report and working report, then interviewed the one who works in the related area to estimate the percentage of the cost of the support production activities. The percentage was estimated according their opinion, knowledge, and experiences related to a job description and time spent on each work activity.

For example, the activity cost for setting up a machine in the Maintenance department was calculated by interviewing the maintenance engineer. The Maintenance department has 34 technicians, 13 of them (38.23%) work in preparing equipment for production line; 7 of them (20.59%) focus on developing performance of the production line; the rest of them (41.18%) have two jobs which are setting up the machine for one day and repairing machine for another five days. Therefore, the labor cost in the activity is allocated as:

Setting up machine	=	14/34 workers = 41.18 %
		41.18% × 1/6 workday = 6.86% or 7%
		7% × 7,252,075 = 507,645 THB
Repairing machine	=	41.18% × 5/6 workday =34.32% or 34%
		34% × 7,252,075 = 2,465,706 THB

In addition, the part and equipment expense of Maintenance department was assigned to the activity cost based on the records of user requisition. The researcher sorted the position of user to estimate the percentage of resources used and expenses to calculate each activity cost. Therefore, the estimation of the expenses in the activity is allocated as:

Setting up machine	=	2% (small parts for adjusting and tuning the machine e.g. bearings) 2% × 2,977,683 = 59,554 THB
Reviewing and preparing the equipment as scheduled	=	69% (major parts for repairing equipment) 69% × 2,977,683 = 2,054,602 THB

2) Calculate a cost driver rate for the activity

To calculate the activity cost driver rate of ABC system: the total cost of each activity cost pool is divided by the number of units of the activity cost drivers to determine the cost per unit of an activity.

$$\text{Activity cost driver rate} = \frac{\text{Total cost in each activity cost pool}}{\text{Driver quantity}}$$

The total cost of the maintenance department divided by the number of setup machine; the total cost of the quality control department divided by the number of tests; the total cost of the purchasing department divided by the number of purchase requisition are the examples to calculate the activity cost driver rate. The driver quantities of this project were collected from many reports, such as production downtime, maintenance schedule, delivery order, total purchasing request, qc report, sale orders, etc. The driver quantity and activity cost driver rate of each activity are shown in Chapter 4.

Table 3.6: Example for the Calculations of Activity Cost Driver Rate

	RECEIVE PARTS	RECEIVE MATERIALS	DISBURSE PARTS AND MATERIALS
Activity cost driver	No. of parts receipts	No. of materials receipts	No. of production runs
Activity cost	$25,000	$12,500	$12,000
Driver quantity	2,500 receipts	1,000 receipts	500 runs
Activity cost driver rate	$10/receipt	$12.50/receipt	$25/run

Source: Kaplan and Atkinson (1998)

3.2.3 Assign activity costs to products

Once the activity cost driver rates are all calculated, the next phase is to assign activity costs to products.

Activity cost = Quantity of activity cost driver × Activity cost driver rate

The researcher calculated the activity cost by specifying the quantity of the activity cost driver used for product model 405, 406 and 407. Then, the researcher multiplied by the number of activity cost driver rate to assign the activity-based cost to the products.

Table 3.7: The Calculations of Activity Cost

ACTIVITY	QUANTITY OF ACTIVITY COST DRIVER	ACTIVITY COST DRIVER RATE	ACTIVITY COST
Receive parts	20	$10/receipt	$200
Receive materials	4	$12.50/receipt	50
Disburse materials	1	$25/run	25
Total			$275

Source: Kaplan and Atkinson (1998)

3.3 Proposed Model of ABM

After completing the ABC calculation, the following steps are the combination between the ABC information and the value analysis in order to resolve the wasted activity in the processes. The researcher analyzed the information by sorting from the highest to the lowest activity cost driver. Then, the researcher selected the highest activity cost driver rate to analyze in detail the resources and activities performed in the processes to determine the probability of solving the problem in the next step.

3.3.1 Identify value added and non-value added activities

The value analysis is a systematic method to identify the way of working in a company's operation by looking at the value from the customer's viewpoint. The researcher considered the activity within the process in order to evaluate the value added and non-value added activities, then applied value matrix in this study. The assessment value of the activity can be classified as the value-added activity, necessary value-added activity, and non-value added activity.

Figure 3.2: Value Matrix

	Necessary	Unnecessary
Value added	Activities that add value and necessary to make the product. It will affect the process if remove.	
Non-Value added	Even though activities do not add value to a product but necessary for the current business processes.	Activities that unnecessary and non-value added to a product should be eliminated or redesign.

Source: Author

3.3.2 Simulate process improvement

The purpose of this step is to offer a more effective process to improve the current production activities or support production activities which focus on the most likely cause of creating non-value added activities in the processes. After analyzing the results of ABC information and identifying non-value added activities, the researcher attempted to recommend the possible improvement and the appropriate solutions to reduce costs by applying "what if analysis" in order to analyze in detail the resources and activities performed in that section. Then, the researcher considered the main factors that caused the cost of the unnecessary activity to find the solutions of cost saving in different scenarios.

3.4 Chapter Summary

This chapter has provided an explanation of the research methodology used in this study. The researcher interviewed, observed, gathered the historical data to identify the list of activities, and estimated the cost of activities in an appropriate format to apply ABC and ABM techniques in the next chapter. The researcher expected that the ABC and ABM models would help to have the full knowledge of the activity cost and understand the factor of the cost of activities in order to find out the most appropriate path to propose solutions.

CHAPTER IV

PRESENTATION AND CRITICAL DISCUSSION OF RESULTS

This chapter expresses the procedure for calculating the manufacturing cost based on ABC method with the information taken from the previous chapter to calculate the results. There are four main sections in this chapter. The first section presents the calculation of activity cost driver rate. The second section concerns with the allocation of overhead costs of the selected products. The third section discusses about the calculation results of ABC compared to the traditional costing system. The last section shows the application of ABM to find out cost saving solutions.

4.1 Calculate Activity Cost Driver Rate for Activities

The activity cost driver rate is a calculation which figures out a per unit activity cost for further calculation of the product cost. After the researcher has chosen an appropriate cost driver, estimated an activity cost, and collected the driver quantity, the researcher calculated the rate for each activity, which demonstrates sixteen activities from the amount of indirect cost in support production activities. The data being calculated and analyzed the results were retrieved from the company system in the year 2017 as below.

Table 4.1: The Calculation of Activity Cost Driver Rate

Activity	Activity Cost Driver	Activity Cost (THB)	Driver Quantity	Activity Cost Driver Rate
Setting up machine	Number of setups	567,199	786.50 setups	฿721.1685/setup
Reviewing and preparing the equipment at scheduled	Number of prepared parts	4,810,390	2,704 parts	฿1,778.9904/part
Repairing machine during production hour	Repair hours	2,852,804	1,416 hours	฿2,014.6921/hour
Developing the capabilities of production	Developing hours	1,999,365	1,248 hours	฿1,602.0553/hour
Inspecting and testing quality of raw materials	Number of tests	29,496	399 tests	฿73.9248/test
Inspecting and testing quality manufactured products	Number of tests	258,871	2,944 tests	฿87.9317/test
Reporting and following-up the problem	Number of reports	54,476	4,800 reports	฿11.3492/report
Checking and issuing picking list	Number of picking lists	1,279,685	10,689 picking lists	฿119.7198/picking list
Loading up finished goods to transport truck	Number of truckloads	2,661,338	5,453 truckloads	฿488.0502/truckload
Delivering goods to customers	Number of deliveries	4,725,731	3,576 deliveries	฿1,321.5131/delivery
Receiving finished goods from production dept.	Number of pallet moves	2,518,509	2,693 moves	฿935.2057/move
Keeping and storing finished goods by forklift	Number of pallet moves	2,235,931	8,628 moves	฿259.1482/move
Preparing and sending finished goods according to picking list	Number of pallet moves	1,361,619	12,833 moves	฿106.1029/pick
Issuing purchase requisition	Number of purchase requisition	816,430	806 pr	฿1012.9404/pr
Recording and following-up the purchased goods	Number of withdraw/requisition slips	2,902,946	16,803 slips	฿172.7636/slip
Scheduling and controlling production process	Number of analysis reports	377,216	3,204 reports	฿117.7328/reports

Source: Author

Table 4.1 shows the calculation of the activity cost driver rate which computes by the activity expense and the quantity of the activity cost driver. The researcher chose the duration drivers which represent the amount of time required to perform an activity. For example, repair hours for the activity of repairing machine during production hour and developing hours for the activity of developing the capabilities of production. While the other cost drivers apply transaction drivers which represent the amount of resources required to perform the activity in order to assign the cost to individual products for the model 405, 406 and 407 in the next section.

4.2 Assign Activity-Based Costing to Products

The final step is to allocate support production activity costs to the products which trace overhead costs to products through activities. The activity costs are assigned to selected products by multiplying the activity cost driver rate by the amount of the activity consumption cost driver required to complete the model 405, 406 and 407 as the following.

Table 4.2: The Estimation of Activity-Based Costing for Product Model 405

Activity	Quantity of Activity Cost Driver (A)	Activity Cost Driver Rate (B)	Activity Cost (THB) (A×B)
Setting up machine	445	฿721.1685/setup	320,919.97
Reviewing and preparing the equipment at scheduled	1458	฿1,778.9904/part	2,593,767.98
Repairing machine during production hour	862	฿2,014.6921/hour	1,736,664.58
Developing the capabilities of production	382	฿1,602.0553/hour	611,985.12
Inspecting and testing quality of raw materials	210	฿73.9248/test	15,524.21
Inspecting and testing quality manufactured products	1390	฿87.9317/test	122,225.10
Reporting and following-up the problem	2529	฿11.3492/report	28,702.04
Checking and issuing picking list	9034	฿119.7198/picking list	1,081,548.72
Loading up finished goods to transport truck	4836	฿488.0502/truckload	2,360,211.00
Delivering goods to customers	3200	฿1,321.5131/delivery	4,227,520.55
Receiving finished goods from production dept.	1818	฿935.2057/move	1,700,204.00
Keeping and storing finished goods by forklift	6188	฿259.1482/move	1,603,609.30
Preparing and sending finished goods according to picking list	8555	฿106.1029/pick	907,710.63
Issuing purchase requisition	448	฿1012.9404/pr	453,797.32
Recording and following-up the purchased goods	9391	฿172.7636/slip	1,622,422.54
Scheduling and controlling production process	1185	฿117.7328/reports	139,513.41
Total			19,526,326.46

Source: Author

Table 4.3: The Estimation of Activity-Based Costing for Product Model 406

Activity	Quantity of Activity Cost Driver (A)	Activity Cost Driver Rate (B)	Activity Cost (THB) (A×B)
Setting up machine	239	฿721.1685/setup	172,359.26
Reviewing and preparing the equipment at scheduled	749	฿1,778.9904/part	1,332,463.80
Repairing machine during production hour	369	฿2,014.6921/hour	743,421.38
Developing the capabilities of production	742	฿1,602.0553/hour	1,188,725.02
Inspecting and testing quality of raw materials	147	฿73.9248/test	10,866.95
Inspecting and testing quality manufactured products	1054	฿87.9317/test	92,680.04
Reporting and following-up the problem	1768	฿11.3492/report	20,065.33
Checking and issuing picking list	1180	฿119.7198/picking list	141,269.37
Loading up finished goods to transport truck	510	฿488.0502/truckload	248,905.63
Delivering goods to customers	298	฿1,321.5131/delivery	393,810.92
Receiving finished goods from production dept.	717	฿935.2057/move	670,542.50
Keeping and storing finished goods by forklift	2025	฿259.1482/move	524,775.18
Preparing and sending finished goods according to picking list	2415	฿106.1029/pick	256,238.59
Issuing purchase requisition	269	฿1012.9404/pr	272,480.98
Recording and following-up the purchased goods	5182	฿172.7636/slip	895,260.74
Scheduling and controlling production process	828	฿117.7328/reports	97,482.79
Total			7,061,348.47

Source: Author

Table 4.4: The Estimation of Activity-Based Costing for Product Model 407

Activity	Quantity of Activity Cost Driver (A)	Activity Cost Driver Rate (B)	Activity Cost (THB) (A×B)
Setting up machine	102.5	฿721.1685/setup	73,919.77
Reviewing and preparing the equipment at scheduled	497	฿1,778.9904/part	884,158.22
Repairing machine during production hour	185	฿2,014.6921/hour	372,718.04
Developing the capabilities of production	124	฿1,602.0553/hour	198,654.86
Inspecting and testing quality of raw materials	42	฿73.9248/test	3,104.84
Inspecting and testing quality manufactured products	500	฿87.9317/test	43,965.86
Reporting and following-up the problem	503	฿11.3492/report	5,708.63
Checking and issuing picking list	475	฿119.7198/picking list	56,866.91
Loading up finished goods to transport truck	107	฿488.0502/truckload	52,221.38
Delivering goods to customers	79	฿1,321.5131/delivery	104,399.54
Receiving finished goods from production dept.	158	฿935.2057/move	147,762.50
Keeping and storing finished goods by forklift	415	฿259.1482/move	107,546.52
Preparing and sending finished goods according to picking list	1863	฿106.1029/pick	197,669.77
Issuing purchase requisition	89	฿1012.9404/pr	90,151.70
Recording and following the purchased goods	2230	฿172.7636/slip	385,262.73
Scheduling and controlling production process	1191	฿117.7328/reports	140,219.81
Total			2,864,331.07

Source: Author

With the updated information according to the ABC method, the researcher was able to calculate the new cost of the selected products for AAA company as below.

Table 4.5: The Calculation Results of ABC Model

Product model	Direct material (THB)	Direct labor (THB)	Factory overhead		Total (THB)
			Production activity cost (see Table 3.4)	Support production activity cost (see Table 4.2 - 4.4)	
405	118,958,682	10,094,770	16,064,763	19,525,225.9	164,643,440
406	33,576,570	7,014,190	10,415,041	7,061,107.5	58,066,908
407	12,797,160	2,053,353	3,976,494	2,864,570.3	21,691,577

Source: Author

4.3 ABC Versus Traditional Costing Results Compared

After evaluating the cost of products according to the ABC method, the researcher compared the results of the calculation to highlight the difference between two types of production costs and consider the actual factory overhead consumptions of the three products as presented below.

Table 4.6: The Comparison Between the Proportion of Production Cost between Traditional Costing and Activity-Based Costing

Product	Direct materials (THB)	Direct labor (THB)	Factory overhead (THB)		
			Traditional	ABC	Different
Model 405	118,958,682	10,094,770	46,792,397	35,591,089	(11,201,307)
Model 406	33,576,570	7,014,190	10,750,028	17,476,389	6,726,361
Model 407	12,797,160	2,053,353	2,365,879	6,840,825	4,474,946
Total	165,332,412	19,162,313	59,908,304	59,908,304	0

Source: Author

Table 4.6 compares the results of the calculation for the costs of the product models 405, 406 and 407 between the factory overhead cost of traditional costing system and ABC system. It was found that the factory overhead of the product model 405 decreased by 11,201,307 baht. On the other hand, the factory overhead of the product models 406 and 407 increased by 6,726,361 baht and 4,474,946 baht respectively. As a result, this would imply that the model 405 which was a high-volume product was overcharged factory overhead costs. While a low-volume product models 406 and 407 were significantly undercharged factory overhead costs.

4.4 Using ABM to Find Out Cost Saving Solution

After calculating the product cost by using ABC model, the researcher sorted out the calculation results from the largest number of activity cost driver rate to the smallest number of activity cost driver rate. The sorting out was done in order to capture and identify the resources and the activities performed in the processes to propose solution to the problem.

Table 4.7: The Sorting of the Activity Cost Driver Rate

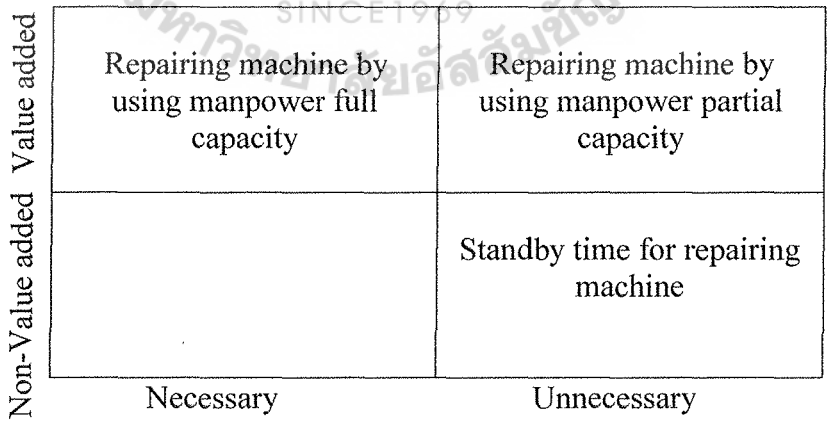
Number	Activity	Activity Cost Driver	Cost Driver Rate (THB)
1	Repairing machine during production hour	Repair hours	2,014.69/hour
2	Reviewing and preparing the equipment at scheduled	Number of prepared units	1,778.99/part
3	Developing the capabilities of production	Developing hours	1,602.06/hour
4	Delivering goods to customers	Number of deliveries	1,321.51/delivery
5	Issuing purchase requisition	Number of purchase requisition	1,012.94/pr
6	Receiving finished goods from production dept.	Number of moves	935.21/move
7	Setting up machine	Number of setups	721.17/setup
8	Loading up finished goods to transport truck	Number of truckloads	488.05/truckload
9	Keeping and storing finished goods by forklift	Number of moves	259.15/move
10	Recording and following-up the purchased goods	Number of withdraw/requisition slips	172.76/slip
11	Checking and issuing picking list	Number of picking lists	119.72/picking list
12	Scheduling and controlling production process	Number of reports	117.73/reports
13	Preparing and sending finished goods according to picking list	Number of picks for an order	106.1/pick
14	Inspecting and testing quality manufactured products	Number of tests	87.93/test
15	Inspecting and testing quality of raw materials	Number of tests	73.92/test
16	Reporting and following-up the problem	Number of reports	11.35/report

Source: Author

Table 4.7 shows the top three activities cost drivers in the Maintenance department which are repairing machine during production hour; reviewing and preparing the equipment as scheduled; and developing the capabilities of production. However, the second and the third items are the external and uncontrollable factors which are dependent on the engine parts and machine components pricing in the market. Therefore, the researcher focused only on the greatest activity cost driver which is repairing machine during production hour to analyze the value of the resources performed within this activity in order to find ways to reduce the cost on working process.

To conduct the repair or maintenance work at running machines, the maintenance manager has to assign the maintenance technicians to task by setting up two shifts employee work schedule and assigning seven people for each shift. However, the operation varies depending on the type of machine damage that occurs on each downtime. Thus, the researcher classified the value of the resource utilization into three types which are repairing machine that requires all technicians; repairing machine that requires only partial number of technicians; and standby for repairing the machine.

Figure 4.1: Value Matrix of Value Added and Non-Value Added Activities



Source: Author

Figure 4.1 points out the excessive manpower costs for not using a full workforce and having a standby time which provides the area of improvement in an existing process to reduce unnecessary positions because some working situations in repairing a machine would not require all manpower. It can be helpful to find a suitable working hour and eliminate unnecessary work to have the appropriate staffing levels. Therefore, the researcher attempted to manage the resources optimally for the current operation by minimizing the unnecessary spending on the wasted resources in the repairing activity.

Analyzing the frequency of occurrences in repairing machine activity, the researcher has identified the categories of maintenance level in order to investigate the degree of task difficulty in the stages of machine maintenance against the number of technician requirements. The descriptions of maintenance level are as follows.

Table 4.8: Identifying Categories of Maintenance Levels

Category	Degree of difficulty	Description
Maintenance level 1	Easiest	A common problem that requires 2 technicians
Maintenance level 2	Difficult	A problem affecting the working condition and requires 3 technicians to repair
Maintenance level 3	More difficult	A problem that disrupts some parts of production line and requires 4 technicians to solve
Maintenance level 4	Most difficult	A significant machine breakdown that requires 5 technicians to handle the problem

Source: Author

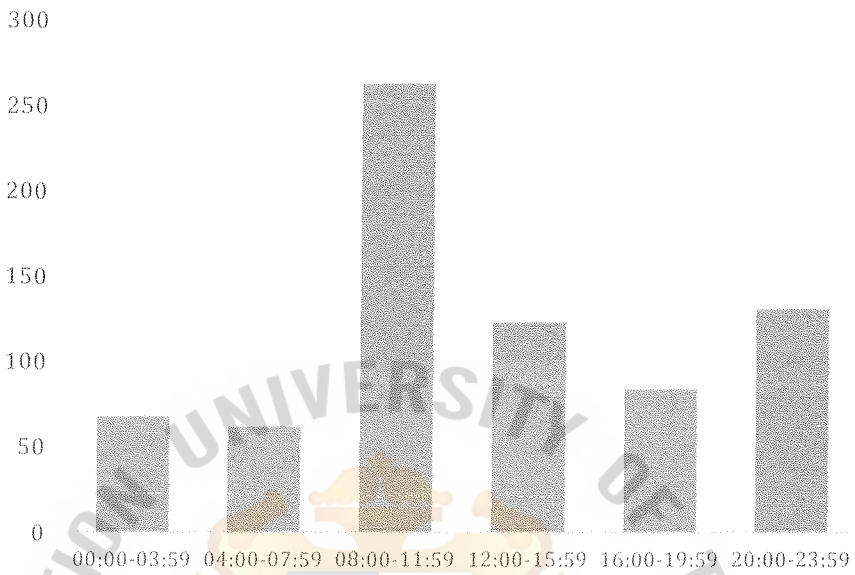
Table 4.9: The Occurrence of Maintenance Levels in Each Duration

Durations	Maintenance				Total
	Level 1	Level 2	Level 3	Level 4	
00:00 - 00:59	13	1	1	1	16
01:00 - 01:59	10	1	1	1	13
02:00 - 02:59	16	2	1	1	20
03:00 - 03:59	18	-	-	1	19
04:00 - 04:59	9	2	-	-	11
05:00 - 05:59	20	1	1	-	22
06:00 - 06:59	18	-	1	-	19
07:00 - 07:59	8	1	1	-	10
08:00 - 08:59	69	20	11	17	117
09:00 - 09.59	45	14	1	7	67
10:00 - 10:59	33	6	-	2	41
11:00 - 11:59	26	9	1	2	38
12:00 - 12:59	26	2	1	7	36
13:00 - 13:59	17	3	-	-	20
14:00 - 14:59	26	7	-	2	35
15:00 - 15:59	23	6	1	2	32
16:00 - 16:59	20	7	2	1	30
17:00 - 17:59	17	3	2	3	25
18:00 - 18:59	15	5	-	-	20
19:00 - 19:59	9	-	-	-	9
20:00 - 20:59	31	11	1	6	49
21:00 - 21:59	23	7	1	-	31
22:00 - 22:59	15	2	4	3	24
23:00 - 23:59	20	3	3	1	27
Total	527	113	34	57	731
Percentage	72.09%	15.46%	4.65%	7.80%	100%

Source: Company's data

Table 4.9 illustrates the details of maintenance levels and time. The number of repairs comes from the company system in the Maintenance department, which provides the data for analyzing the duration of performing maintenance. It indicates that the majority of the maintenance tasks in level one is 72 % which requires only two technicians to handle the problem. However, there is still a chance of machine breakdown that requires a certain number of technicians to deal with it.

Figure 4.2: Histogram of the Frequency in Repairing Machine Hours

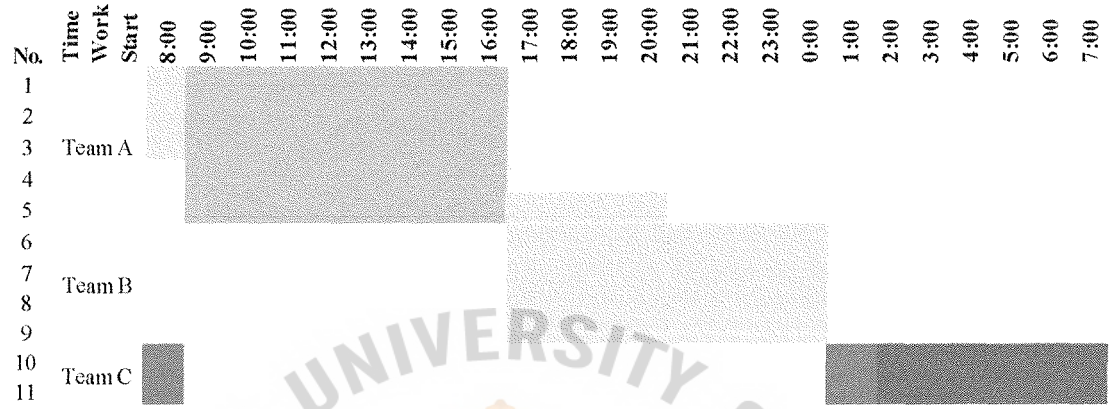


Source: Author

Figure 4.2 reveals the result of the statistical data analysis. A histogram displays the statistical information with the computation of the frequency of repairing the machine last year as shown in Table 4.8. The dataset shows that the occurrence of the repairing event is quite predictable. The peak period that often occurs during the repairing activity is in the morning from eight o'clock until noon. Therefore, what if, the company can adjust the working hour and labor force to match with the frequency of occurrence of downtime. The company will be able to mitigate the non-productive time.

Regarding maintenance level 4, it frequently requires five technicians to deal with the machine problems at 08:00 – 21:00, which means that the company can reduce the technician's amount to less than five people after 21:00 – 08:00. In the maintenance level 3, four technicians need to work at 08:00 – 01:00. This means that the company can assign four technicians after 21:00 – 01:00 to handle the problems. For maintenance level 2, the problem requires three technicians which usually happen at the same time as maintenance level 3. Thus, the author focused on the maintenance level 3, which requires four technicians to cover the maintenance level 2 and 3. Eventually, for the rest of the time, it requires only two technicians to take care of the maintenance level 1.

Figure 4.3: New Work Scheduling for Machine Repair Activity



Source: Author

Figure 4.3 displays the suggestion that the maintenance manager should rearrange a schedule of technicians to suit with the repair activities by assigning three work shifts which are team A, B, and C. The technicians of team A (5 persons) work from 09:00 – 17:00. Then, assigning three technicians of the team A to work overtime from 08:00 – 09:00 and assigning another one technician to work overtime from 17:00 – 21:00. For team B, all technicians of team B (4 persons) work from 17:00 – 01:00. The last team C (2 persons), will have working time from 01:00 – 09:00. In summary, 08:00 – 21:00 will have five technicians to take care of most of the level 4's problem; 21:00 – 01:00 working time will have four technicians to serve the level 3's and level 2's problem. Then, from 01:00 – 08:00, the machine will need only two technicians to take care of level 1 problem.

However, it still has a chance of occurrence for an urgent situation that needs more than two technicians to deal with a problem at night. Therefore, the researcher recommends to set up a standby duty at the staff house by setting a technician on standby to be called just in case unable to solve the problem. The company has provided housing facilities to employees close to the plant and takes only few minutes to reach the plant.

The labor cost in the machine repairing activity is allocated as:

Current man-hour per day	=	7 technicians × 24 working hours
	=	168 hours
New man-hour per day	=	(5 technicians × 13 working hours) +
		(4 technicians × 4 working hours) +
		(2 technicians × 7 working hours)
	=	99 hours
Labor cost will decrease	=	1- (99 ÷ 168)
	=	41.07 % or 1,012,666 baht
New labor cost	=	2,465,706 – 1,012,666 = 1,453,040 baht

Under this recommendation, the researcher is able to help the company reduce the labor cost in the Maintenance department. The present working schedule of repairing activity has assigned two work shifts and each shift assigning seven people having a total of 14 technicians and 168 work hours. In contrast, the recommended number of working hours is only 99 hours with eleven technicians. It can help the company save the labor costs of an excess workforce which the labor cost in the Maintenance department of machine repairing activity will decrease from 2,465,706 baht to 1,453,040 baht per year.

4.5 Chapter Summary

In conclusion of this chapter, the researcher realized that applying ABC method reveals the actual consumption of activity cost for each product based on the historical data from January – December 2017. In addition, the ABM technique exposes the major contribution of the activity cost driver rate in order to provide the solution of cost saving in the organization.

CHAPTER V

SUMMARY FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

In this final chapter, the author concludes all the study from the previous chapters of this research paper. The summary of the findings, conclusions, theoretical implications, managerial implications, limitations and recommendations for future research are presented in this chapter.

5.1 Summary of the Findings

This study aimed to answer the research question **"How can ABC and ABM methods help find the cost drivers of the manufacturing costs and reduce the operation cost?"** The purposes of this study were to identify and analyze the main activity in the company departments and recommend alternative solution to eliminate non-value added activity. The resource costs were assigned to individual activities after identifying the main activity in the organization which the researcher has identified main activity into 21 activities. The research results of ABC method demonstrated the cost driver of individual activity to figure out the cost consumption of resource and activity utilization. The cost calculation of selected products based on the ABC model has reflected the true indirect cost of product models 405, 406 and 407 in the year 2017. The calculation of factory overhead cost for product model 405 showed the traditional costing system at 46,792,398 baht while ABC method at 35,591,089.46 baht. Moreover, traditional cost for product model 406 is 10,750,028 baht but ABC method is 17,476,389.47 baht. Finally, old cost calculation for product model 407 is 2,365,879 baht, and ABC cost calculation is 6,840,825.07 baht. These results can imply that the traditional costing method is overcost to the model 405 but undercost to the models 406 and 407.

In addition, this research has found that the machine repairing activity consumed the highest cost driver rate after analyzing the calculation result of ABC information. Thus, the researcher has recommended the solution for reducing non-cost effective of repairing the machine activity in order to decrease excessive manpower cost by rearranging the work schedule of the maintenance activity during production hour in the Maintenance department because the histogram indicates the record of the repair activity which frequently occurs from 08:00 to 12:00. It means that it is possible to reduce the number of technicians for the rest of the day. Therefore, the researcher has considered the working hour, the labor force and the repairing activity. Then, applying ABM approach to find a solution for reducing unnecessary activity which helps the company cut the excess labor costs of repairing activity by 1,012,666 baht per year.

5.2 Conclusions

An upward pressure on price in the market makes the company more difficult to generate revenue. Thus, it is necessary to understand the cost of production for the consumption of activities and resources in the manufacturing company.

The study focused on the production activities and support production activities in AAA company by setting four objectives in order to find the cost drivers and the solution to reduce cost. The first objective was to study the costs and expenses that impact to company activities by applying ABC technique. The second was to identify the activity that was not cost-effective. The third was to suggest the solution which could help the company mitigate non-value added activity. The forth was to simulate the result of cost saving.

The researcher had identified and analyzed the company's expenses and activities by collecting the historical documents of accounting information during January – December 2017 together with interviewing the five key officers to make a list of activities. The traditional costing and ABC methods were reviewed to understand two different techniques for computing the production cost. The traditional costing method

relies on the units produced and allocate the overhead cost to a product equally (Hilton et al., 2003; Blocher et al., 2005; Hansen & Mowen, 2006). While ABC method relies on the resource and activity being performed by analyzing the cost driver and the relationship of cost consumption (Kaplan & Atkinson, 1998; Cokins, 2001; Bocher et al., 2005).

The ABC method was used to estimate the cost of individual activity in production activities and support production activities. Starting from identifying and classifying the activities related to the selected products to listing the activities and cost drivers. Then, estimate the cost of activities by using direct tracing in production activity to measure the actual usage of resources and estimating the percentages of activity cost in support production activity. After that, the calculation of cost driver rate for the activity and the calculation of activity cost to the products were present. By using ABC method, the two different ways of the calculation in the production costs between traditional cost and ABC were found and further analyzed the highest activity cost driver in detail to determine the probability of cost saving in ABM model.

The ABM method was applied to determine the value and non-value added assessment of the activity and analyze the main factor that causes the cost of the unnecessary activity to find the solutions of cost saving. After analyzing, the machine repairing activity during production hour in the Maintenance department was found to have generated the largest activity cost driver. Therefore, the researcher has recommended to rearrange the work schedule to reduce the wasted resources spent on standby to repair a machine.

5.3 Theoretical Implications

This research studied the manufacturing cost in relation to production activity and support production activity to understand the cause and effect relationship of costs, activities, and products. The main theory in this research paper comprised of ABC and ABM methods. The ABC model provides an in-depth study of overheads cost (Cooper

& Kaplan, 1999; Cokins, 2001; Gupta & Galloway, 2003; Hansen & Mowen, 2006). It is one of the accounting methods to calculate production cost which helps to see the corporate expenses incurred from indirect activities. The cost drivers which represent the relationship between the costs incurred and the activities have to correlate mainly with the cost object. However, the selection of cost drivers should be traded off between the accuracy and the complexity of the ABC system. A high accuracy in allocating overhead costs can incur an expensive measurement cost information. Thus, the optimal level between measurement cost and error cost must be considered to ensure that the cost drivers are acceptable and appropriate to ABC system (Kaplan & Atkinson, 1998; Hansen & Mowen, 2006). The ABM model provides the visibility on wasted resources spent on non-value added activity to provide the improvement solution. It does not only help the company increase the accuracy of the cost information rather than the production cost calculation under traditional costing method but also helps manage the activity to decrease the unnecessary cost of working activities in the company.

5.4 Managerial Implications

This research is mainly for AAA company to implement the proposed model to calculate the true product cost based on the actual performance and managing activity to reduce cost. The cost calculation results based on ABC and ABM methods can be a guideline for corporate executives to make a decision on business management and administration better than the traditional costing system which combines all indirect expenses and charges an equal amount of overhead. It is a useful method for the company to plan in advance for product costs and pricing strategy in the market that the management team wants to achieve as well as to provide insight information about the costs to increase the opportunity to improve an internal process. The ABC and ABM methods also provide the priority ranking of the most unoptimized activities which could help to see the most significant problems, find the cause of unnecessary activity and contribute proper working processes in the organization. The recommendation and possible solution of reorganizing the work schedule can eliminate excess workforce

which helps to save the extra wage costs spending on machine repairing activity in the Maintenance department.

5.5 Limitations and Recommendations for Future Research

This research was conducted to calculate production cost according to ABC and ABM methods limited to AAA company only due to the different activities in production processes, operation processes, product type, and business scale. The calculation results from ABC model in this case study were shown in a simple model using Microsoft Excel program. To implement ABC and ABM methods in the whole organization, the company should use the software for ABC and ABM system to reduce the difficulty and error in designing the system. The ABC and ABM models also need to be checked and updated on a regular basis to ensure that the information cost in the system relates to the present situation because the changes in operations or processes can impact on the cost calculation results and the cost analysis of the organization. In addition, the author recommends for the future researcher to apply Time-Driven Activity-Based Costing (TDABC) method which focuses on the time factor to reveal the costs of a business activities by recording the employees' time spent in the activity. TDABC method will help to analyze the amount of time in performing the activity which could provide the calculation result of the activity cost against the time used in each activity. The result will be able to present the different views of cost reduction to the company.

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APPENDICES

APPENDIX A

Interview Questions and Results

Interviewees	Information for department	Q1. How many people work in your department?	Q2. What are the major activities that your department perform on regular basis?	Q3. How many people or how long it takes to performing these activities?
Production manager	Production department	- 64 employees	- Mixing materials	- 12 employees
			- Molding materials	- 24 employees
			- Curing products	- Machine only
			- Ejecting product from the mold	- 24 employees
			- Packing finished goods	- 4 employees
Maintenance engineer	Maintenance department	- 34 employees	- Setting up machine	- 14 employees, 1 day per week
			- Reviewing and preparing the equipment at scheduled	- 13 employees
			- Repairing machine during production hour	- 14 employees, 5 day per week
			- Developing the capabilities of production	- 7 employees
QC officer	QC department	- 2 employees	- Inspecting and testing quality of raw materials	- Average 45 mins per day
			- Inspecting and testing quality manufactured products	- Average 355 mins per day
			- Report and follow the problem	- Average 80 mins per day
Purchasing officer	Purchasing department	- 2 employees	- Issue purchase requisition	- Average 105 mins per day
			- Record and follow the purchased goods	- Average 375 mins per day
Warehousing officer	Warehousing department	- 25 employees	- Receive finished goods from production dept.	- 11 employees
			- Keep and store finished goods by forklift	- 8 employees
			- Prepare and send finished goods according to picking list	- 6 employees
	Transportation department	- 35 employees	- Check and issue picking list	- 8 employees
			- Load up finished goods to transport truck	- 17 employees
			- Deliver goods to customers	- 10 employees

APPENDIX B

Activity Description

Main Activity	Description
Manufacture	
Mixing materials	Mixing the raw material in the defined proportions including cement powder, reinforcing fiber and water to form a thick slurry in the mixing machine
Molding materials	Forming and shaping the cement sheets
Curing products	Curing to harden the sheets
Ejecting product from the mold	Removing mold from the products
Packing finished goods	Packing finished products by plastic film wraps
Repair and maintenance	
Setting up machine	Adjusting and tuning the machine for the next new batch of a production line
Reviewing and preparing the equipment at scheduled	Planning the scheduled maintenance and managing stocks of repairing equipment
Repairing machine during production hour	Making repairs or fixing the machines that have broken down during the production hour or machine downtime
Developing the capabilities of production	Investigating and testing new equipment to modify current processes or form the new production processes
Measure and control the product quality	
Inspecting and testing quality of raw materials	Checking on the quality of the raw materials to meet the required quality
Inspecting and testing quality manufactured products	Checking on the quality of the manufactured products to meet the quality control standards
Report and follow the problem	Recording and analyzing the results of the quality problems in the report to find prevention measures
Manage delivery of finished goods	
Check and issue picking list	Checking the merchandise and issuing the picking list according to the order
Load up finished goods to transport truck	Arranging and loading finished products to trucks prepared for delivery to customers.
Deliver goods to customers	Planning routes and scheduling for deliveries.
Control inventory	
Receive finished goods from production dept.	Receiving the finished products from production area to warehouse inventory
Keep and store finished goods by forklift	Moving and keeping warehouse stock products according to the prepared space
Prepare and send finished goods according to picking list	Completing orders for delivery or pickup according to the picking list
Manage purchasing as required	
Issue purchase requisition	Processing the purchase requisition document
Record and follow the purchased goods	Updating records of purchased products and withdraw items from store
Planning demand for materials, labor and machinery	
Scheduling and controlling production process	Organizing production schedules and managing the stock of raw materials to ensure that it has enough for the machines