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

Kanokporn Kleosakul* and Srobol Smutkupt**
Assumption University of Thailand

ABSTRACT

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

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, appropriate improvement solutions were proposed 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 are expended on non-value added activity. This solution can save over 1 million Thai Baht per annum in the labor cost of the maintenance department. The findings indicate the important implications for Alexa, the focus company, to understand the cause and effect relationship between cost, activity, and product, which provides a perspective of the cost driver of the manufacturing costs and the solutions for saving costs in the organization.

Keywords: *Activity-based costing (ABC), Activity-based management (ABM), Cost driver*

บทคัดย่อ

ในปัจจุบันนี้การแข่งขันที่รุนแรงในหลายอุตสาหกรรมทำให้หลายบริษัทตระหนักถึงค่าใช้จ่าย และการใช้ทรัพยากรภายในองค์กรมากขึ้น ประเด็นสำคัญที่ทุกบริษัทคำนึงถึงคือการลดต้นทุน แต่ในขณะเดียวกันก็ต้องรักษาและปรับปรุงกระบวนการทางธุรกิจเพื่อตอบสนองความต้องการของลูกค้า

---

*This is a much condensed version of Ms. Kanokporn Kleosakul's research report in part fulfillment of the requirements for the MSc degree in Supply Chain Management at Assumption University. Email: kanokporn.wo@gmail.com

**Dr. Srobol was her advisor. Email: srobol.smutkupt@gmail.com

การวิจัยครั้งนี้มีวัตถุประสงค์เพื่อศึกษารูปแบบระบบต้นทุนฐานกิจกรรม (ABC) และการบริหารกิจกรรม (ABM) เพื่อเป็นทางเลือกหนึ่งในการคำนวณต้นทุนผลิตภัณฑ์ของระบบต้นทุนรูปแบบเดิม ซึ่งให้การประมาณต้นทุนที่เหมาะสมกว่า อีกทั้งยังช่วยเพิ่มการจัดการทรัพยากรและกิจกรรม ข้อมูลสามผลิตภัณฑ์ที่เลือกมาใช้ในการศึกษานั้น ถูกเก็บรวบรวมจากกิจกรรมการผลิตและกิจกรรมสนับสนุนการผลิตในปัจจุบัน เพื่อคำนวณต้นทุนผลิตภัณฑ์ตามวิธี ABC จากนั้นจึงเสนอวิธีการปรับปรุงเพื่อจัดการทรัพยากรและกิจกรรมที่เหมาะสม ผลการวิจัยพบว่าการปรับปรุงที่เสนอจะช่วยให้บริษัทสามารถลดการใช้ทรัพยากรที่สิ้นเปลืองในกิจกรรมที่ไม่เพิ่มมูลค่า ซึ่งวิธีแก้ปัญหาที่เสนอสามารถประหยัดค่าแรงในแผนกซ่อมบำรุงมากกว่า 1 ล้านบาทต่อปี

ผลการวิจัยนี้ชี้ให้เห็นถึงผลกระทบที่สำคัญสำหรับ บริษัท Alexa เพื่อความเข้าใจในความสัมพันธ์ของสาเหตุและผลลัพธ์ระหว่าง ต้นทุน กิจกรรม และผลิตภัณฑ์ ซึ่งให้มุมมองเกี่ยวกับตัวผลักดันต้นทุนในต้นทุนการผลิตและแนวทางสำหรับการประหยัดค่าใช้จ่ายในองค์กร

INTRODUCTION

The Alexa Company Ltd was established in the 1960s. 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 and is one of the major players in the cement industry in Thailand.

Statement of the Problems

For its production costs, the company currently used only the traditional costing method which allocated factory overhead costs by using a volume-based method which gave equal weight to all the units produced. However, it is uncertain that all products consume overhead cost equally. Therefore, the researcher considers another calculation method that can provide insightful information of the workings in the organization and understand the cause and effect relationship of costs, activities and products. This would increase the accuracy of the cost information and decrease the unnecessary cost of some working activities. This research attempts to answer the question, “How can ABC and ABM methods help to find the cost drivers of the manufacturing costs and reduce the operation costs?” The research has mainly focused on the current operation of production activities, and calculates the manufacturing costs of Alexa Company with an emphasis on Factory A and product models 405, 406 and 407, by using annual historical data from January-December 2017.

REVIEW OF RELATED LITERATURE

Traditional Costing System

The traditional costing system is an accounting method that is easy to calculate product cost, and is widely used in many companies rather than the ABC system which provides simplicity and a convenient way to allocate costs by assuming all cost related to the number of units produced, and assumes that each product item consumes an equal amount of overhead cost (Hansen & Mowen, 2006).

Activity-Based Costing (ABC)
Kaplan and Cooper developed the ABC system in 1988. It was a new technique to provides more reasonable cost estimation based on actual performance and activities, together with solving the problem of increasing overhead cost in modern manufacturing organizations (Ozbayrak, Akgun, & Turker, 2004; Hofmann & Bosshard, 2017). The ABC system was a method that identified activities used, then assigning activities costs for producing products or services to manage the organizational expenses (Stapleton, Pati, Beach, & Julmanichiti, 2004; Rothberg, 2011).

Activity-Based Management (ABM)
ABM linked 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 by relating to value added and non-value added activities to reduce wasted resource. Organizations could create more value either by savings from that wasteful spending on non-value added activities or by rotating wasted resources to value-added activities instead (Hilton, Maher, & Selto, 2003).

RESEARCH METHODOLOGY

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

Data Collection
The researcher collected all relevant financial documents from the company's database and interviewed key people involved in the work processes to understand and identify in detail the current operations of work activities.

The ABC Model
There are three steps involved in this case study.

Step 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 centers to determine the main activities and sub-activities 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 increase or decrease. The activity costs in the ABC approach are categorized based on the different types of cost drivers utilized (Table 1).

Table 1: List of Activities and Cost Driver

Operation Sector	Activity Type	Department Cost Center	Main Activity	Sub-Activity or 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
		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

Table 1: List of Activities and Cost Driver (Cont.)

Operation Sector	Activity Type	Department Cost Center	Main Activity	Sub-Activity or Activity Cost Pools	Activities Cost Drivers	Activity Level
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
		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

Step 2: Assign resource costs to 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 this by applying the percentage of people and time that workers spend on each activity.

1) Estimate the cost of activities

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 (Table 2).

Table 2: The Costs of Production Activities

Department Costs for Production Activities	Total Cost (THB)	Mixing materials	Molding materials	Curing products	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 Data

However, for the support production activities it was 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 interview those who work in the related area to estimate the percentage of the cost of the support production activities (Table 3).

Table 3: 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

Table 3: Matrix of Costs by Department 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

Table 3: 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

Table 3: 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		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

2) Calculate a cost driver rate for the activity

The activity cost driver rate is a calculation which reveals the per unit activity cost for further calculation of the product cost. To calculate the activity cost driver rate of the 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 (Table 4).

Table 4: 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
Report and follow the problem	Number of reports	54,476	4,800 reports	฿11.3492/report
Check and issue picking list	Number of picking lists	1,279,685	10,689 picking lists	฿119.7198/ picking list
Load up finished goods to transport truck	Number of truckloads	2,661,338	5,453 truckloads	฿488.0502/ truckload
Deliver goods to customers	Number of deliveries	4,725,731	3,576 deliveries	฿1,321.5131/ delivery
Receive finished goods from production dept.	Number of pallet moves	2,518,509	2,693 moves	฿935.2057/move
Keep and store finished goods by forklift	Number of pallet moves	2,235,931	8,628 moves	฿259.1482/move
Prepare and send finished goods according to picking list	Number of pallet moves	1,361,619	12,833 moves	฿106.1029/pick
Issue purchase requisition	Number of purchase requisition	816,430	806 pr	฿1012.9404/pr
Record and follow 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

Step 3: Assign activity costs 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 models 405, 406 and 407, as in the following Table 5.

Table 5: The Estimation of Activity-Based Cost to Product

Activity	Activity Cost Driver Rate (A)	Model 405		Model 406		Model 407	
		Quantity of Activity Cost Driver (B)	Activity Cost (THB) (A×B)	Quantity of Activity Cost Driver (C)	Activity Cost (THB) (A×C)	Quantity of Activity Cost Driver (D)	Activity Cost (THB) (A×D)
Setting up machine	฿721.1685/setup	445	320,919.97	239	172,359.26	102.5	73,919.77
Reviewing and preparing the equipment at scheduled	฿1,778.9904/part	1458	2,593,767.98	749	1,332,463.80	497	884,158.22
Repairing machine during production hour	฿2,014.6921/hour	862	1,736,664.58	369	743,421.38	185	372,718.04
Developing the capabilities of production	฿1,602.0553/hour	382	611,985.12	742	1,188,725.02	124	198,654.86
Inspecting and testing quality of raw materials	฿73.9248/test	210	15,524.21	147	10,866.95	42	3,104.84
Inspecting and testing quality manufactured products	฿87.9317/test	1390	122,225.10	1054	92,680.04	500	43,965.86
Report and follow the problem	฿11.3492/report	2529	28,702.04	1768	20,065.33	503	5,708.63
Check and issue picking list	฿119.7198/ picking list	9034	1,081,548.72	1180	141,269.37	475	56,866.91
Load up finished goods to transport truck	฿488.0502/truckload	4836	2,360,211.00	510	248,905.63	107	52,221.38
Deliver goods to customers	฿1,321.5131/ delivery	3200	4,227,520.55	298	393,810.92	79	104,399.54
Receive finished goods from production dept.	฿935.2057/move	1818	1,700,204.00	717	670,542.50	158	147,762.50
Keep and store finished goods by forklift	฿259.1482/move	6188	1,603,609.30	2025	524,775.18	415	107,546.52
Prepare and send finished goods according to picking list	฿106.1029/pick	8555	907,710.63	2415	256,238.59	1863	197,669.77
Issue purchase requisition	฿1012.9404/pr	448	453,797.32	269	272,480.98	89	90,151.70
Record and follow the purchased goods	฿172.7636/slip	9391	1,622,422.54	5182	895,260.74	2230	385,262.73
Scheduling and controlling production process	฿117.7328/reports	1185	139,513.41	828	97,482.79	1191	140,219.81
Total			19,526,326.46		7,061,348.47		2,864,331.07

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 considered the actual factory overhead consumptions of the three products.

Table 6: The Comparison Between the Proportion of Production Cost between Traditional Cost and Activity-Based Cost

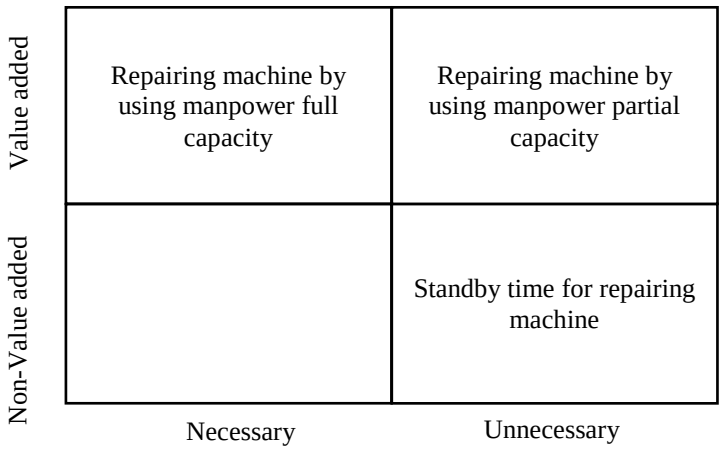
Product	Direct materials (THB)	Direct labor (THB)	Factory overhead (THB)		
			Traditional (THB)	ABC (THB)	Different
Model 405	118,958,682	10,094,770	46,792,397	35,591,089.46	(11,201,307.54)
Model 406	33,576,570	7,014,190	10,750,028	17,476,389.47	6,726,361.47
Model 407	12,797,160	2,053,353	2,365,879	6,840,825.07	4,474,946.07
Total	165,332,412	19,162,313	59,908,304	59,908,304	0

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 model 405 (which was a high-volume product) was overcharged for factory overhead costs. Conversely, low-volume product models 406 and 407 were significantly undercharged for factory overhead costs.

FINDINGS AND DISCUSSION

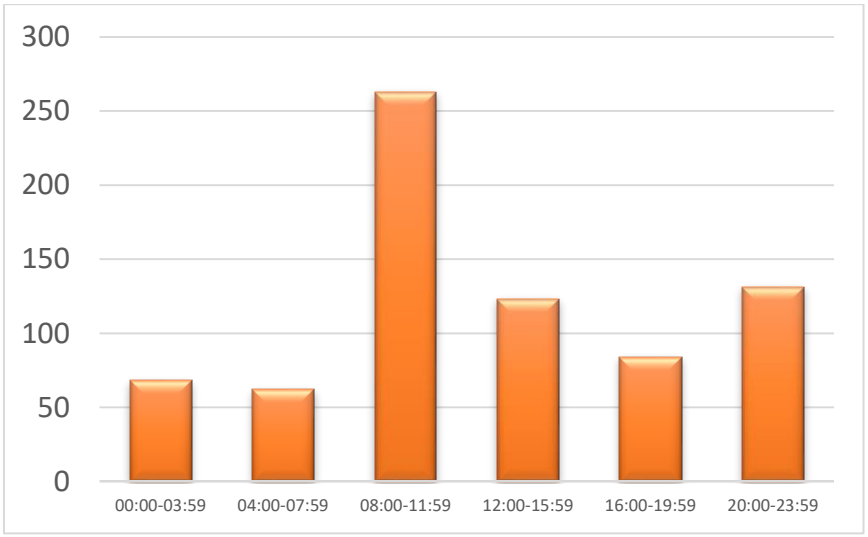
The findings show that the highest number of the activity cost driver rate is repairing machines during production hours in the maintenance department which is 2,014.69 baht per hour, as in Table 4. After analyzing the value of the resources performed within this activity, it found that there were some 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, as shown on Figure 1.

Figure 1: Value Matrix of Value Added and Non-Value Added Activities



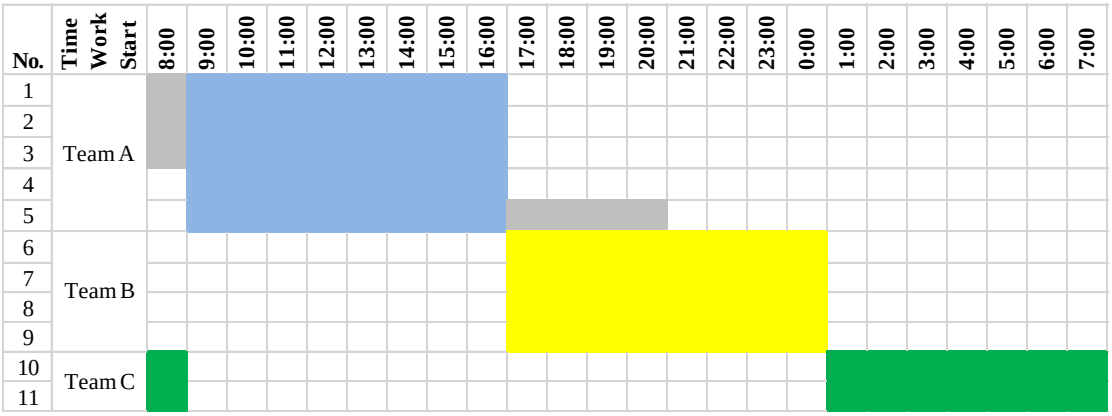
The data set shows that the occurrence of the repairing event is quite predictable. The peak period that often occurs during the repairing activity is in the morning from eight o'clock until noon (Figure 2). Therefore, what if, the company can adjust the working hour and labor force to match with the frequency of occurrence of downtime? The company would be able to mitigate the non-productive time.

Figure 2: Histogram of the Frequency in Repairing Machine Hours



Under this recommendation, the maintenance manager should rearrange a schedule of technicians to suit the repair activities by assigning three work shifts, team A, B, and C as shown on Figure 3. The present working schedule of repairing activity was assigned two work shifts and each shift was assigned seven people which had total fourteen technicians and 168 work hours. Basing on the recommended working hours, only 99 hours with eleven technicians will be required. The researcher will be able to help the company save the labor costs of an excess workforce, which means that the labor cost in the maintenance department of repairing machine activity will decrease from 2,465,706 baht to 1,453,040 baht per year.

Figure 3: Recommendation to Rearrange Work Scheduling for Repair Machine Activity



CONCLUSION

The research results of using the ABC method demonstrated the effectiveness of using the cost driver of each individual activity to figure out the cost consumption of resource and activity utilization. It not only demonstrated an in-depth study of overhead cost according to actual performance and activity but also provided the true cost of the products. Moreover, the findings of this research identified that the repairing machine activity consumed the highest cost driver rate. Thus, the researcher will recommend the solution for minimizing non-cost effectiveness of repairing the machine activity in order to reduce standby time by rearranging the work schedule. This will help the company save the excess labor costs of approximately one million baht per year.

REFERENCES

Hansen, D., & Mowen, M. (2006). *Cost Management: Accounting and Control.* Mason, Ohio: Thomson South-Western. 5th edition.

Hilton, R., Maher., & Selto, F. (2003). *Cost Management: Strategies for Business Decisions.* New York: McGraw-Hill. 2nd edition.

Hofmann, E., & Bosshard, J. (2017). Supply chain management and activity-based costing: Current status and directions for the future. *International Journal of Physical Distribution & Logistics Management, 47*(8), 712-735.

Ozbayrak, M., Akgun, M., & Turker A. (2004). Activity-based cost estimation in a push/pull advanced manufacturing system. *International Journal of Production Economics, 87*(1), 49-65.

Rothberg, A. (2011, October 11). *Activity-Based Costing: Improving Cost and Expense Analyses.* Retrieved February 3, 2018, from CFO Edge website: https://www.cfoedge.com/blog/strategy-and-planning/profitability-strategy/activity-based-costing-improving-cost-and-expense-analyses/

Stapleton, D., Pati, S., Beach, E. & Julmanichoti, P. (2004). Activity-based costing for logistics and marketing. *Business Process Management Journal, 10*(5), 584-597.