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APPLICATION AND BENEFITS OF ACTIVITY BASED COSTING OVER TRADITIONAL COSTING APPROACH: A CASE STUDY ON AN EXPORT ORIENTED CERAMIC (TILES) MANUFACTURING INDUSTRY

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ABSTRACT

Activity Based Costing (ABC) system is a technique that is designed to accurately reflect the costs (indirect) to which it incurred. Unlike traditional method, instead of using the single predetermined overhead rate to absorb the overhead cost to product, ABC system uses actual incurred cost to determine the product cost. Although its main advantage is its ability to provide more realistic product cost information, use of ABC can help managers to make better decisions about product design, pricing, marketing, and product-mix and encourage for continual improvement. Based upon this ABC fundamental principle, present work develops a precise and detailed costing model to calculate the indirect product costs of an export oriented tiles manufacturing industry. It gives a clear view of cost assignment through resource to activity; activity to cost objects for similar type of industry. A comparative analysis of product costs using ABC and traditional costing system is carried out to show significance of the model as well as ABC approach. This paper also suggests the way how the decision makers can get the benefit by using this model**.** The paper reports on the application of ABC method for tiles manufacturing industry and concludes that it is an effective method in product costing as well as in decision making.

KEYWORDS: Activity Based Costing System, Traditional Costing System

INTRODUCTION

There are approximately 40 ceramic manufacturers operating in this industry in Bangladesh producing tableware, sanitary ware and tiles [7].Ceramic industry of Bangladesh is considered to expand rapidly in this global market with its high quality products [11]. Bangladeshi ceramic wares are being exported to 48 countries [17].The present investment in the country's ceramic industry is roughly BDT 50 billion and total annual capacity of ceramic tableware manufacturing companies is 222 million pieces, tiles 68.7 million square meter and sanitary ware 0.114 million metric tons. Export earnings from ceramics products stood over US$36million,in first nine months of 2013-14 fiscal year, which is an almost 30% rise, comparing to previous year [17].

Like other manufacturing firms, ceramic industries face continually increasing competition in today's global marketplace. Companies must react quickly and manufacture high quality, low cost products to be successful in this new environment. One marketing strategy that often used to attract customer attention is to reduce the price of an item to a level lower than the competitors. However this could result in the company receiving lower or no profit. Using incorrect pricing strategies and poor control over increasing overhead cost could eventually force the company out of business, or into economic failure. Thus, the existence of a manufacturing industry is largely depending on the ability to keep the operation cost at marginal level which requires the application of an effective and efficient accounting system.

The traditional cost accounting methods were designed for overhead cost allocation between 1870 and 1920 when industry was labor intensive with no automation and small product variety. The consequent overhead costs in companies were generally very low compared to today. However, from 1980s, this scenario changed rapidly. Traditional cost accounting is, therefore, mentioned as 'number one enemy of production' [9]. In recent decades, such conventional concepts have become obsolete due to ever increasing competition in the marketplace, the necessity to reduce costs and the effect of having more detailed information on company costs. Moreover, in terms of the majority of overhead costs, traditional allocation concepts can often provide incorrect information on product costs as they are on overhead absorption rate base [12]. Kim and Ballard (2002) define the problems resulted from traditional costing methods as: cost distortion hindrance to profitability analysis, and little management attention to activities or processes of employees [10].

The correct information about the true overall cost of a product is the critical factor in effective cost administration and assists management to compete effectively against their rivals, and accordingly ensures the company's success and survival [5]. The Activity Based Costing (ABC) concept was designed as a method which eliminates the shortages of the traditional costing methods. This concept is developed based on the facts that activities cause the costs and the cost objects e.g. products and services create the demand for those activities. It forces management to focus on what creates the demand for the resources and estimation of those resources consumed by products resulting in redeployment or elimination of excess resources [2].

LITERATURE REVIEW

Considering the benefits it offers, many researchers have been motivated to apply the ABC technique in both the industrial and the service sectors. Waters et al. [19] applied the ABC in a Peruvian NGO Healthcare System with a view to calculate real unit costs by including support and administrative costs in the unit-cost information. It also revealed the hidden costs associated with some non-value-added activities. Vazakidis et al. (2010) examined whether the implementation of ABC technique is possible in a Public Sector Organization or not [18]. They mainly focused on using ABC as an informative tool regarding the cost estimation so as to identify the bottlenecks to be resolved for providing better service. Abu-Tapanjeh (2008) in his study on 'Activity-Based Costing Approach to Handle the Uncertainty Costing of Higher Educational Institutions: Perspective from an Academic College' found that the implications of ABC system would help in assessing an accurate and better budgetary and programmatic issues of financial devolution in universities [1]. Reich and Abraham (2006) also focused on the use of ABC as a management tool in the higher education sector with particular emphasis on the process of staff activity data-collection. The impacts were found to be positive, particularly in the area of resource allocation decision-support [13]. Turney [17] adorned ABC technique as a promising foundation for performance management. It was indicated that a single ABC model could support historical and predictive costing, resource and capacity planning, performance measurement and other analysis. Dwivedi and Chakraborty (2014) developed an ABC model in a simple and cost effective manner for food processing industries [3]. Their model was found to be appropriate in precisely measuring various cost information of the mill which could assist in various managerial decision making like fixing of selling price, ascertaining profitability of products, taking make or buy decision etc. Ríos-Manríquez et al., (2014) performed a quantitative research to determine what extent of ABC is implanted in firms and the proportion of its use compared to traditional one [14]. The study was conducted on small and medium sized enterprises (SMEs) of Mexico including industrial, service and commercial sector with sample size of one hundred and eighty. Though the survey result shows ABC tool user is only 12%, all of them are beneficiary of it in regard to the company's management. Elhamma (2015) carried out a survey based study attempting to show the impact of the perceived environmental uncertainty (PEU) on ABC implementation and its performance according to the PEU [4]. He collected data from sixty-two Moroccan firms of different sectors. After performing different statistical analysis, he found a positive and significant relationship between PEU and ABC implementation. Moreover, the result was also satisfactory of using ABC as it shows increase competitiveness and profitability under uncertain and dynamic environment.

In Bangladesh, Hasan and Akter (2010) conducted a survey among forty randomly selected manufacturing companies to identify the problems of ABC utilization [6]. The ABC method itself was found to be mostly utilized by the biggest Bangladeshi companies operating in the field of manufacturing, energy, and telecommunications etc. However, medium sized companies with heterogeneous production, where the application of ABC system could be very effective, did not use ABC system in a wider range. This was because of their inability to perform effective implementation process and to effectively utilize information outputs of the system. Sharkar et al., (2006) also carried out a survey with a view to obtain an overview of the management accounting practices in different manufacturing companies of Bangladesh [15]. Their analysis revealed that though there was difference in extent of practices among the sectors, all sectors failed to practice some newly developed techniques. Moreover, none of the ceramic industries was particularly found to use activity based costing as their product costing method.

OBJECTIVES

From the aforested literature reviews, it is clear that traditional approach tends to distort product costs leading to poor strategic decision-making. ABC approach, on the other hand, can be effectively used in manufacturing and service sectors for cost estimation so as to increase company's competitiveness and profitability. As this approach provides detailed information of the resources, activities, and cost objects, it can be a useful tool for performance management and taking accurate and better managerial decisions. Besides, there is huge potential of using ABC technique in

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Bangladeshi companies as almost all of them are currently using traditional approach as their product or service costing method. This paper, hence, tries to use ABC approach in an export oriented ceramic industry as a method of its product costing and to assess its associated benefits over the traditional method, which is being commonly used in this sector. In this context, a precise ABC model suitable for calculating cost of ceramic products is also developed showing the relevant cost assignment structures. This study, therefore, focuses on:

- developing a precise product costing model by Activity Based Costing System for production department of studied organization
- determining the cost of selected product using ABC method
- analyzing traditional cost of the selected production department for particular products
- highlighting the decision making issues using ABC concept

RESEARCH METHODOLOGY

The research methodology adopted for this study is **case study**. Product costing based on activity wise is the main issue of the study. The analysis was carried out to costing the product in ABC system and then the result was compared to traditional system. At last some decision making issues was highlighted through the results of ABC system.

Data Collection

At first the tiles manufacturing process was observed directly and carefully with a view to understand what is really going on; that is for which cost is incurred. After observation, the production manager was interviewed for identification of activity, resource and cost objects and for collecting various quantitative data related to resource and activity cost driver. The data which were not available at interview were collected by documenting and taking note on review of records.

Followed system of ABC system

It is necessary to focus on the stages of application in the production department of the studied industry. At first stage, primary activities were identified from the activity center of production department. The selected primary activities are: Clay collection, Wet cake formation, Dry cake formation, Powder formation, Hand Pressing, Automatic pressing, Firing, Coating, Packaging and Strapping.

The primary activities were decomposed into secondary activities. Identified indirect resources associating to the secondary activities were electricity, gas lubricants, packaging paper and P.P.Belt. After selecting the resources; a Resource-Activity-Dependence (RAD) matrix is created where the resources represent the columns and the identified secondary activities represent the rows. A checkmark is placed in the cell *i*,*j*, if the activity *i* contributes to the resource *j*. The cost objects were chosen for their significant production quantity and the considerable distinction of production procedure and consumed resources from one to another. The studied products were: **TAYLOR** (roof tiles) and **D.T. 5** (wall tiles). The production processes of these products are different at powdering, pressing and firing section. Cost of packaging paper and consumption of this paper and P.P.Belt used for these two products are different. The activities consumed by each product were identified and the Activity-Product-Dependence (APD) matrix is created where the activities represent the columns and the products stand for the rows. If the product *i* consumes the activity *j*, a check-mark is placed on the cell *i*,*j*.

In the second stage resource cost drivers were selected and then activity costs were calculated. The selected resource cost drivers are given in table 1. The costs of secondary activities were calculated taking into account of the resource cost of respective activity and then put in the RAD matrix. Then these costs were assigned to the primary activities. The resource costs were calculated for a particular period (one month) with respect to the existing capacity of the resources.

Table 1. Selected Resource Cost Drivers

Resource Cost		Resource cost driver
Utility Cost	Electricity	Use of Kilo-Watt-Hour (KWH)
	Gas	Use of m^3
Indirect Material Cost	Lubricants	Quantity of using (liter or kg)
	Packaging Paper	Piece of packaging paper
	P.P. Belt	Length of using (foot)

Collected data for calculating the resource cost were related to:

- Actual raw material consumption per month of the filter presses
- Monthly consumption quantity of lubricants (ltr. or kg.) and unit cost of lubricants
- Gas consumption (m^3/hr) of dryers and kilns & Operation hr/cycle
- Unit Electricity Cost from PDB and Diesel Generator
- Power of the Motors
- Operating hr/day and Working day/month of machines and No. of cycle & Operating hr/cycle
- Monthly Consumption length of P. P. Belt (ft) and cost/ft

At third stage, to trace the cost to cost object, activity cost driver were selected based on following criterions:

- ➢ There had to be a reasonable assumption of a cause-effect relationship between the driver unit and the consumption of resources
- ➢ There had to be a reasonable relationship between cost driver unit and the level of activity
- ➢ Data of the cost driver unit had to be available

The selected cost drivers are shown in the table 2. Activity cost driver rate for respective activity was calculated. According to the product's consumed unit, the costs of respective product's activity cost were calculated. The product costs at each activity were calculated and then put in the APD matrix. The product costs were calculated based on the monthly average production quantity of selected products. Resource of an activity performs at low cost per piece was selected for product costing.

Table 2. Selected Activity Cost Driver

Activity Level	Activities	Activity Cost Drivers
Unit Level Activity	Powdering	No. of Machine Hr
	Hand Pressing(Tiles Press)	No. of Machine Hr
Batch Level Activity	Clay supplying	No. of Trips
	Wet Cake Forming	No. of Cycle
	Dry cake forming	No. of Cycle
	Pressing in HP-1100	No. of Cycle
	Firing	No. of Cycle
	Packaging the product	No. of Packet
	Strapping the packed product	No. of strapped packet

Description of the Developed Model

According to the concept of ABC, a product costing model is developed in this paper. The developed costing model consists the six blocks of: Total Overhead costs, Resource Costs, Activity Costs, Activity Cost Driver, Activity Cost Driver Rate, and Cost Objects.

First three blocks represent the first stage allocation of costs. All overhead costs of selected resources to the selected activities are shown by the first three blocks. Rests three blocks represent the second stage allocation of costs where activity costs are assigned to the selected cost objects based on the activity cost driver rate and the consumed amount of cost drivers by cost objects. A schematic view of the developed product costing model is shown in the figure 1. All associated values will be found by performing the ABC method step by step.

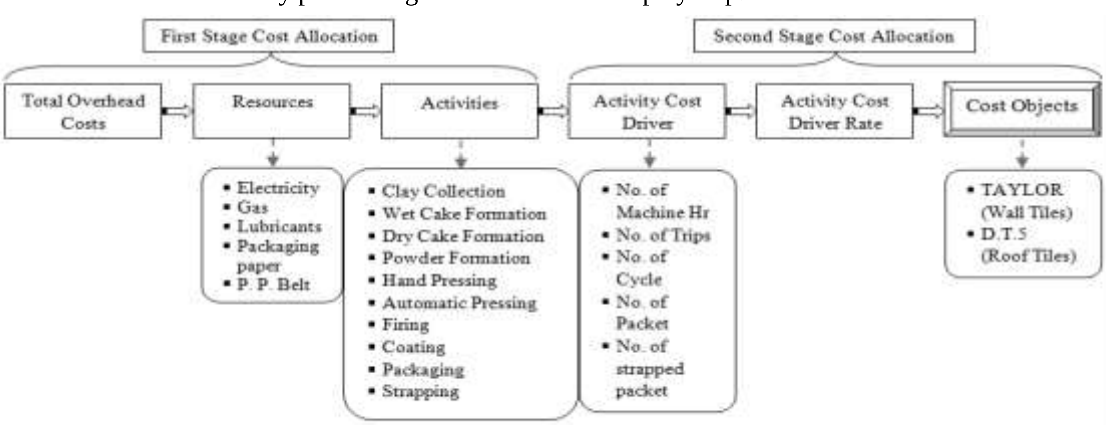

Figure 1: A schematic view of the developed product costing model

Traditional Costing System

For traditional cost analysis total indirect costs were first figured out from the ABC system where the costs were as resource costs. It acts as manufacturing overheads for the selected resources. Machine hour has chosen as cost driver for cost calculation. The total amount of consumed machine hour for whole manufacturing and respective product was calculated for one month. The required machine hours of each activity were calculated and then summed up which results the total manufacturing machine hour. This process was also carried out for the selected products, which results the product direct machine hours. Then predetermined overhead rate was computed. Product volume was set based on one year average production quantity. The product volume, product direct machine hour and the predetermined overhead rate were put in the equation of total indirect product cost of per piece of product and then computed.

Equations Used

Formulas used for different types of resource cost calculation are:

- Gas cost = Total gas consumption per hour (m^3/hr) × rate / m^3
- Electricity cost = Power of motor (KW) × Total working hour (hr) × rate/KWH
- Lubricant cost = Consumption quantity of lubricants (ltr or kg) × rate/ltr or kg
- Packaging paper cost = Consumption of no. piece of packet × rate/packet
- P.P. Belt cost = Consumption length of belt (ft) × rate / ft

Following equations were used for product costing in ABC method:

Activity cost driver rate

$$= \frac{\text{Monthly Resource Cost}}{\text{Monthly actual consumption of cost drivers}} \ldots\ldots\ldots (1)$$

Machining cost per unit

$$= \frac{\text{Monthly Resource Cost of machine}}{\text{Monthly produced unit by the machine}} \ldots\ldots\ldots (2)$$

Monthly produced unit by the machine

$$= \text{Actual capacity per activity cost driver} \times \text{Monthly actual capacities of cost drivers} \ldots\ldots\ldots (3)$$

Consumption of activity cost driver unit

$$= \frac{\text{Input amount to each activity}}{\text{Actual Capacity per activity cost driver}} \ldots\ldots\ldots (4)$$

Total Monthly Product Cost of an Activity

$$= \text{Consumption of Activity Cost Driver Unit} \times \text{Activity Cost Driver Rate} \ldots\ldots\ldots (5)$$

Following equations were applied for product costing according the traditional costing system:

Predetermined Overhead Rate

$$= \frac{\sum \text{Manufacturing Overheads}}{\sum \text{Manufacturing Machine Hours}} \ldots\ldots\ldots (6)$$

Toatal Indirect Cost of per piece of Product

$$= \frac{\text{Predetermined Overhead Rate} \times \text{Product Direct Machine Hours}}{\text{Product Volume}} \ldots\ldots\ldots (7)$$

Followed Assumptions of the Study

The following assumptions were made to perform the study:

- All existing machines and labors operate at their full capacity.
- Production is assumed to be continuous, without any maintenance or failure.
- Production process at all stage is carried out without losses and defects. A perfect quality and quantity conformance is assumed along the system.

The major emphasis of this paper has given at the development process of ABC system in selected production department and as well as rationally selection of the cost drivers, whereas the main concern was to develop a model which gives the clear scenario of how cost assigns through resource to activity, activity to cost object. Therefore, according to the above assumptions, there will be difference in mathematical figure against the actual production system which includes: defects, loss time, value added and non-value added activities etc. But the whole process or structures of model will remain same. That is, the above assumptions do not affect the settled objectives; only results the change in mathematical figures.

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STUDY of the TILES MANUFACTURING SYSTEM

For this case study the selected industry was Khadim Ceramics Ltd. (KCL), situated at Sylhet, Bangladesh. KCL is a sister concern of Mirpur Ceramics Works Ltd. (MCWL). MCWL is one of the largest local brick and tiles manufacturing companies of Bangladesh in ceramics arena; contributing construction sector for last 56 years. Currently this company produces 30 million pcs of different products per year. It has been exporting the building materials to Singapore for over a decade, and is getting ready to inscribe its footprint on Middle East markets [8]. The products of KCL are bricks and tiles (wall tiles, roof tiles, floor tiles). The produced tiles differ from each other with their distinct color, design, size and shape. Two Production units are running in KCL. One is for brick production (unit-01) and another (unit-02) is for tiles production. The study was conducted through the **production of tiles.** The major machineries, sections, process name carried out by these machineries and output of unit-02 are listed in following table 3.

A brief overview of the sequential steps of tiles manufacturing process is given below:

i. **Raw material Collection:** The main raw material of the industry is clay. As filler and fluxing material Silica is used for red color and Soda Feldspar is used for beige color product.

ii. **Preparation of raw material:** In order to reduce size and homogenization of clay, at first manually large grains are broken down into small grains. Then it is put on rotary dryer for pre-drying as further preparation. Rollers roll on the grains and grains become powder. At last, the clay becomes ready to further production process and is reserved into the clay sheds.

iii. **Prepared clay collection from clay shed:** The granular clay is then brought to the blanger. The amount of transferred clay depends on the filtering capacity.

iv. **Blending & Filtering:** The clay is put on blanger. The major points in the blending process are, blend the clay uniformly with water and mix silica or soda feldspar. By this time waste materials are removed by vibrator and stirrers continuously work. From the mud tank or reserved tank the mixed clay is then come to the disc through pumps (Mud pump/Hydraulic Pump/Diaphragm pump) and filtered here. An air compressor is used at mud tank. After filtering water from clay, it is called wet cake. The wet cakes are unloaded from the disc after the wet cake formation process. The three section of filter presses is slightly differ from each other according to the raw material flow path.

v. **Cake Drying:** At this stage, the wet cakes are taken to the dryer. The dryer temperature is raised up to 150°-160° C. After drying the wet cake, it is called dry cake.

vi. **Powdering:** The dry cake is then taken to the crushing machine (dry pan or surki machine) for powdering. This powder is used at next process- pressing.

Table 3. Machineries, process and output of unit-02 of KCL

Name of Machine	No. or sections and tag names of Machineries	Process	Output
Blanger & Filter Press	3 sections: Filter Press section A Filter Press section B Filter Press section C	Blending and Filtering	Wet Cake
Cake Dryer	2 dryers: Dryer A & Dryer B	Cake Drying	Dry Cake
Granular M/C	1 Small Dry Pan and 2 Surki machines: Surki machine 1 & Surki machine 2	Powdering	Powder
Press Machine	8 Tiles or Hand Press (Tiles press 1-8) and 1 Hydraulic press (HP-1100)	Pressing	Green Products
Kiln	3 Shuttle kiln and 1 Roller kiln	Firing	Finished Products

vii. **Pressing:** Pressing operation is done by either Hand Press or automated Hydraulic Press (HP-1100). The type of press machine selection depends on quantity produced, shape complexity, quality etc. For the pressing operation by HP-1100, the powder produced from Big Dry Pan is used. This dry pan is the powdering machine of Unit-01. Die boxes are charged with a pre-set volume of powder, and pressure is usually applied from the top. Then the product is formed and taken out from lower die. This pressed product is called green product**.**

viii. **Firing the Green Product:** For firing the green products, at first, temperature is raised from room temperature to 800°C (drying), then raised 800°C to 1000°C (preheating) and at last raised 1000°C to 1120°C (heating). This process is carried out in two types of kiln: Shuttle kiln and Roller kiln. Shuttle kilns are mainly used for smaller scale manufacture of products and special shaped tiles. The produced green products from hand press are fired in shuttle kiln and from HP-1100 are fired in roller kiln. The conveying system of HP-1100 to roller kiln is automatic. On the single-deck roller kiln the heat required for firing is provided by natural gas-air burners located at the sides of the kiln.

ix. **Coating:** After firing the green product, grade of the product is selected; this is called sorting. The products are coated by silicon which gives the water resistance qualities to the products.

x. **Packaging and Strapping:** Followed by coating, the finished products are packed and strapped. Afterward the products are ready to sell.

This study covers the activities of production department which includes the steps starting from Prepared Clay Collection from clay shed to Packaging and Strapping the Finished Product.

RESULTS and ANALYSIS

Primary and secondary activities of the tiles production department are identified showed in table 4. In this study, eight activity centers were chosen based on requirement of KCL management. A primary activity is identified as the output of one activity center is input to another. Secondary activities were identified as they support its corresponding primary activity and each secondary activity contains only one cost driver. The resource; gas is used at dryer, shuttle kiln and roller kiln for dry cake formation and firing purpose. The rate of per unit of gas consumption is 5.86 BDT. Electricity is used for filtering, drying, powdering, firing and strapping activity to run the respective machineries. KCL uses electricity from PDB and Diesel generator. 80% of required electricity comes from PDB (rate 5.89 BDT/KWH) and rest 20% is provided by diesel generator (rate 17.06 BDT/KWH). Different types of lubricants are used at tractor. Clay supplying activity is done by these tractors. Lubricants are also used at surki machine, hand press and roller kiln. Packaging paper is only used to pack the final product and P.P. Belt is used only for strapping the packet of products.

Table 4. Primary and Secondary Activities

Activity Center	Primary Activities	Outcome	Secondary Activities
1. Clay Collection Section	Clay Supplying (CSU)	Supplied Clay	a) Clay supplying
2. Filter Press Section	Wet Cake Formation (WCF)	Pieces of wet Cakes	b) Clay Feeding c) Wet Cake Forming d) Wet Cake Unloading
3. Dryer Section	Dry Cake Formation (DCF)	Pieces of dry Cakes	e) Dry Cake Forming f) Cake Loading & Unloading
4. Powdering Section	Powdering (POW)	Powder	g) Dry Cake feeding h) Powder forming
5. Press Section	Hand Pressing (HPR)	Green Product	i) Loading powder & pressing
	Automatic Pressing (APR)		j) Powder Feeding k) Pressing
6. Firing Section	Firing (FIR) at Shuttle Kiln	Dried Green Product	l) Firing the Green Product m) Loading & Unloading
	at Roller Kiln		n) Firing
7. Coating Section	Coating	Finished product	o) Coating the product
8. Packaging Section	Packaging (PAC) & Strapping (STR)	Packed final product	p) Packaging the product q) Strapping the packed product

The resource costs were calculated for one month with respect to the existing actual capacity of the resources. All of these calculations were performed by the equations stated before. Like this all other resource cost calculations were done. At this point, the calculated resource costs of respective activities are put in the RAD matrix shown in table 5. As shown in the table, total monthly cost of selected resources is **54,70,374 BDT.**

To show the relation of responsible activity for production of selected cost objects, APD matrix is created. In table 6 this constructed matrix is shown. From the table it is clear that the activity of clay supplying, wet cake and dry cake forming, all are done for product TAYLOR and D.T. 5. Powdering activity for product TAYLOR is done by surki machine and small dry pan whereas big dry pan is used for product D.T. 5. Hand press and Automatic press is used at product TAYLOR and D.T. 5 respectively to carry out the pressing activity. The green product of TAYLOR and D. T. 5 is fired at shuttle kiln and roller kiln respectively. For both of the product packaging and strapping activity is performed.

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Table 5. Monthly resource cost of activity

RESOURCES / ACTIVITIES	Indirect material Cost (BDT)			Utility Cost (BDT)		TC of Primary Activity(BDT)
	Lubricant	Packing Paper	P.P.Belt	Gas	Electricity	
Clay Collection						
Clay supply	(√) 6945					**6945**
Wet Cake Formation						
Cake formation	(√) 4837				(√) 723458	**728295**
Dry Cake Formation						
Drying				(√) 795085	(√) 1046007	**1841093**
Powdering						
By surki machine & small dry pan						
Powder formation	(√) 3340				(√) 64576	**67916**
In big dry pan						
Powder formation					(√) 40044	**40044**
Hand Pressing						
Pressing	(√) 38720				(√) 61768	**100488**
Automatic Pressing						
Pressing	(√) 1390				(√) 39030	**391420**
Firing at DIS Kiln						
Firing				(√) 404164	(√) 211122	**615286**
Firing at Roller Kiln						
Firing	(√) 27520			(√) 337536	(√) 773275	**1138331**
Packaging & Strapping						
Packaging		(√) 429748				**540556**
Strapping			(√)59638		(√) 51170	
Total Indirect Cost	**82752**	**429748**	**59638**	**1536785**	**3361450**	**5470374**

Table 6. Activity Product Dependence Matrix

Activity / Product	CSU	WCF	DCF	POW by small dry pan & Surki Machine	POW by big dry pan	HPR	APR	FIR at DIS or shuttle kiln	FIR at roller kiln	PAC	STR
TAYLOR	√	√	√	√		√		√		√	√
D.T. 5	√	√	√		√		√		√	√	√

The calculation of activity cost driver rate and the machining cost per unit is given in table 7. The paper used for TAYLOR packaging is 10 BDT/packet and 2.25 BDT/packet for D.T.5. Cost of P.P.Belt depends on length of belt used for strapping. 6 ft belt is used for strapping the TAYLOR packet and 4 ft. belt is used for D.T. 5 packet. Cost of per foot of P.P. Belt is 0.17 BDT. To calculate per unit machining cost for product costing; the machine operating at low cost per unit for one activity was selected among similar machines. Since, the cost per ton of surki Machine is lower than other machines used for powdering activity; it is selected for calculating the product cost TAYLOR and small dry pan. For the same reason, Filter Press C, Dryer B, and Shuttle Kiln-2 were selected for Wet Cake Forming, Dry Cake Forming and Firing activity respectively.

Table 7. Calculation of Activity Cost Driver Rate and Machining Cost per Unit

Activities	Resource Cost (BDT)	Actual capacity of activity cost driver	Monthly Actual Consumption of Cost Drivers	Activity Cost Driver Rates (BDT/Cost Driver)	Monthly produced unit by machine	Machining Cost/ unit (BDT)
CSU	6945		844 trip	8.23		
POW						
Surki Machine (each)	14655	0.5	432 hr	33.92	216	67.85
Small Dry pan	38,605	1	432 hr	89.36	432	89.36
Big Dry pan	40,044	3.125	216 hr	185.39	675	59.32
WCF						
Filter Press A	194362	240	46 cycle	4225.26	11040	17.61
Filter Press B	230894	310	51 cycle	4527.33	15810	14.60
Filter Press C	303,039	480	64 cycle	4734.98	30720	9.86
DCF						
Dryer A	957147	968	160 cycle	5982.17	154880	6.18
Dryer B	883946	1660	152 cycle	5815.43	252320	3.50
Pressing						
Hand Press (each)	12561		432 hr	29.08		
HP-1100	391,420		171428 cycle	2.28		
FIR						
Shuttle Kiln 1	98,612	2000	15 cycle	7681.80	30000	3.29
Shuttle Kiln 2	258,337	9000	12 cycle	26638.66	108000	2.39
Shuttle Kiln 3	258,337	9000	12 cycle	26638.66	108000	2.39
Roller Kiln	1,138,331	3750	360 cycle	3162.03	1450000	0.84
PAC	429748		70163 pack			
STR	51170+59683(electricity+Belt)		70163 strapped pack	0.73(electricity)		

Product cost calculation for TAYLOR and D.T. 5 is shown in table 8. Calculation is done for monthly average production of TAYLOR (98311pcs) and D.T. 5 (340772 pcs). Weights of per piece of wet cake and dry cake is 25.66 kg and 21.814 kg respectively; one pc TAYLOR green product is 600 gm and final product is 450 gm; one pc D.T. 5 green product is 400 gm and final product is 350 gm. Monthly average actual raw material consumption by filter presses: 2531.23 ton. Raw material required for 98311 pcs TAYLOR is 69387.91kg and for 340772 pcs D.T. 5 is 160363.29 kg. All of these weight and quantity are used for calculating the input amount of material to its respective each activity. By using eq. (4) the amount of consumed activity cost driver unit is calculated for each activity. Then this amount is multiplied with the activity cost driver rate (table 7) to compute the total cost of product.

Now, each cell of APD matrix (table 6) is replaced by the product cost of respective activity. The replacement of checkmarks at APD matrix is shown in following table 9. From this table we can conclude that, per unit resource cost of the studied product TAYLOR is 1.681 BDT and D.T.5 is 1.478 BDT.

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Table 8. Calculation of Product Cost by ABC system (TAYLOR and D.T.5)

Activity	TAYLOR			D.T.5		
	Input amount to each activity	**Consumption of activity cost driver unit**	**TC (BDT)**	**Input amount to each activity**	**Consumption of activity cost driver unit**	**TC (BDT)**
CSU	69387.91 kg clay	24 trip	197.52	160363.29 kg clay	54 trip	444.42
WCF at Filter Press C	2704 pcs wet cake	6 cycle	28409.90	6249 pcs wet cake	14 cycle	66289.72
DCF at Dryer B	2704 pcs wet cake	2 cycle	11630.90	6249 pcs wet cake	4 cycle	23261.72
POW at Surki Machine	58986.95 kg powder	117.973 hr	4001.64			
POW by Big Dry Pan				136309 kg powder	43.6188 hr	8086.49
HPR	98311 pcs Green Product	344.95 hr	10031.10			
APR at HP-1100				340772 pcs Green Product	28397 cycle	64838.61
FIR at Shuttle Kiln 2	98311pcs Green Product	2 cycle	53277.30			
FIR at Roller Kiln				340772 pcs Green Product	91 cycle	287744.78
PAC	98311 pcs final product	4916 packet	49160	340772 pcs final product	14199 packet	31947.38
STR	4916 packet	4916 packet	8504.68	14199 packet	14199 packet	21014.52

Table 9: TC of per piece product (Product name: TAYLOR and D.T.5)

Activity / Product	CSU	WCF	DCF	POW by small dry pan & Surki Machine	POW by big dry pan	HPR	APR	FIR at DIS or shuttle kiln	FIR at roller kiln	PAC	STR	Unit Cost of the Product (BDT)
TAYLOR	0.002	0.289	0.118	0.041		0.102		0.542		0.500	0.086	**1.681**
D.T. 5	0.001	0.195	0.068		0.024		0.190		0.844	0.094	0.062	**1.478**

Developed Model of ABC System

After data processing and analysis, an ABC model of tiles production department of KCL was developed. The total amount of overhead cost is included at the Total Overhead Cost Block, from table 5. Total resource cost of every resource and every activity costs are taken also from table 5 and inserted at respective Resource Cost Block and Activity Blocks respectively. From table 7 Activity cost driver consumption amount and activity cost driver rates are placed at Activity Cost Driver Block and Activity Cost Driver Rate Block respectively. The total amount of consumed cost driver quantity and the cost for producing the selected product at every activity are put on Cost Object Block. These amounts are taken from table 8 for TAYLOR (column 4) and for D.T.5. (column 7). Developed model for product costing using ABC system is shown in figure 4.2.

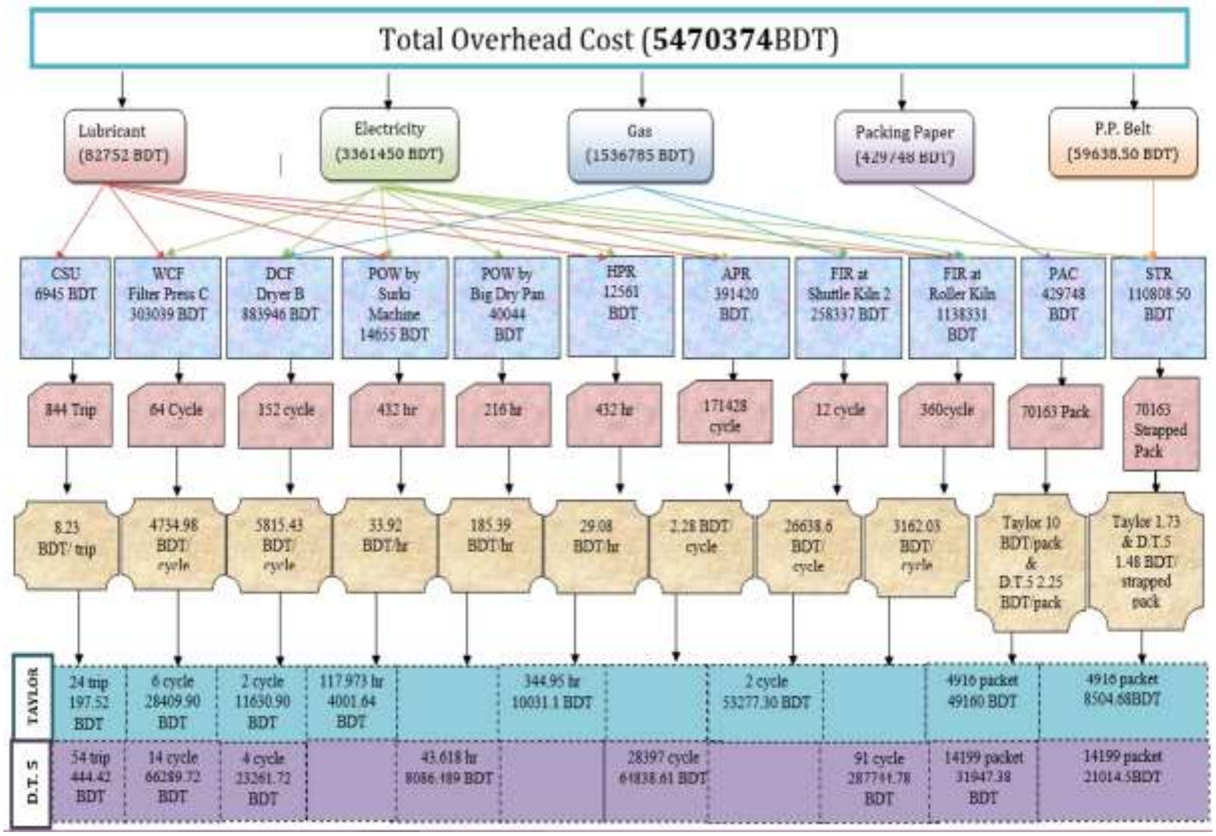

Figure 2: Developed Model for Product Costing Using ABC System

Analysis of Product Cost Using ABC System and Traditional System

Traditional system assumes all overhead is volume-related. That is, if the production quantity is high and incur so many machine hours, then the total production cost will be high than the low volume product which incurs lower machine hour. The rates here are related to single activity measure- machine hour and focuses on costs incurred, not cause of costs. Total Indirect Cost is 5470374 BDT (table 5). It is found total 18212 hr was associated to all types of manufacturing process. Predetermined overhead rate is then calculated by using eq. (6) and the resulted rate is 300.372 BDT/machine hour. Machine hour and total cost of producing 98311 pcs TAYLOR and 340772 pcs D.T.5 is calculated. Cost of per piece of TAYLOR and D.T.5 are found to be 3.52688 BDT and 0.46085 BDT respectively. As shown in Table 10, product unit cost calculated by traditional approach 3.066 BDT higher for TAYLOR than the product D.T.5. This difference is found to be only 0.203 BDT/pc while applying ABC system. The gap between these two unit costs is due to the machine hour, which is allocated arbitrarily in traditional system.

Table 10. Difference of product cost in ABC and Traditional system

	PRODUCTS		
Costing System	**TAYLOR**	**D.T.5**	**Difference** (BDT/pc)
Traditional Costing (BDT/pc)	3.527	0.461	**3.066**
ABC (BDT/pc)	1.681	1.478	**0.203**
Difference (BDT/pc)	**1.846**	**-1.017**	**2.863**

Difference is also observed if the product margin of two products is determined for a specific activity by this two costing system. For an example, product margin of pressing activity done for TAYLOR (hand pressing) and D.T.5 (automatic Pressing) computed using traditional and ABC system is given in table 11. Differences marked are of two reasons: **First,** for both products the traditional costing system absorbs all manufacturing indirect costs regardless of whether they actually consumed the costs. The ABC system does not assign all of the manufacturing indirect costs to both products. For an example: the activity **"Firing at roller kiln"** consumed by the product **D.T 5** not by **TAYLOR** and so the indirect cost of this activity is only assigned to the product **D.T.5** in ABC system. But traditional system assigns it for both products. From ABC point of view, allocating the cost as traditional costing system is inherently arbitrary and counterproductive. **Second,** in the traditional system, it shows the product margin of **D.T.5 (99.60%)** is higher than **TAYLOR (96.17%)**. But the scenario is different at ABC system, which shows the higher revenue, is at **TAYLOR (99.63%)** compared to **D.T.5 (98.91%)**. The reason behind this is, the traditional system works with the predetermined overhead rate which includes all of the cost and if the consumed machine hour is high the product cost will be high. It does not differ whether the activity is unit level or batch level.

Table 11. Product margin for pressing activity

		TAYLOR	**D.T.5**	**Total**
	Revenue (BDT)	28 BDT/pcs× 98311 pcs = 2702708	17.50BDT/pcs×340772 pcs = 5963510	8666218
Data from **Traditional System**	No. of machine hour	1154.338	522.8338	431.8895
	Predetermined overhead rate (BDT/hr)	300.372	300.372	300.372
	Pressing cost (BDT)	103614.223	23883.62	127497.84
	Net Revenue (BDT) (Revenue- Pressing cost)	2599093.77	5939626.38	8538720.15
	Product Margin (Net Revenue/ Revenue**)**×100%	**96.17%**	**99.60%**	**98.53%**
Data from **ABC System**	No. of Cost driver	344.95 hr	28397 cycle	
	Cost per cost driver	29.08	2.28329094	
	Pressing Cost (BDT)	10031.146	64838.6128	74869.758
	Net Revenue (BDT) (Revenue- Pressing cost)	2692676.85	5898671.387	8591348.237
	Product Margin (Net Revenue/Revenue**)**×100%	**99.63%**	**98.91%**	**99.14%**

Findings from the Study

The developed ABC model gives a clear view of cost allocation to activity and cost objects. By calculating the product cost through ABC system, some information have come to know along with the cost of cost object, which can play a role in decision making. The emerging information are: list of activities carried out in the production department, list of resources associated with the selected activities, total monthly cost of selected resources, machining cost per production unit, reasonable cost driver at each activity, monthly actual consumption of activity cost drivers, activity cost driver rates, consumption of activity cost driver to the selected cost objects and the cost of selected cost objects caused for the selected resources etc.

Decision Making Issues

The central benefit from ABC approach is that, the answer of which triggers the cost and how the costs can be managed have come to know. Compared to the traditional costing systems, ABC not only answers how much product cost is but also tells executives the factors triggering costs. For an example, from the developed model (figure 1), this is found that, the overhead costs are caused for lubricants for clay supplying activity. The cost driver for this resource and for the clay supply activity is identified and showed in the model. From these the factors of triggering cost are visible. Here the no. of trip is the main fact which caused cost. If the no. of trips increases, the lubricants costs also increase. Again by tracing the absorption process (no. of trips) of lubricant cost management can find better ways to manage it and to reduce the costs. Consequently, control of the costing and any action will be on what and where is realized. The real power of activity-based costing arises from its ability to support managerial decisions. Specifically, ABC just not acts as a product-costing tool. It generates the data necessary to make the decision effective. Some decision can be taken by KCL management based on the facts, feature and mathematical figures which results from the calculation. Since the costs of every activity found from the ABC are all in detail, it makes the pricing decision more realistic. This wider and practical view of costs will allow the manager to construct pricing decision on more accurate information. ABC system also plays a crucial role here in generating exact and clear sourcing information. If it seems to managers that the packaging paper cost for TAYLOR (10 BDT/packet) is so high for per piece of product (0.5 BDT/piece), they can decide to find another market for buying the packaging paper at lower price. By giving insight to table 7 of cost per unit of all machines, manager can decide to re-engineer the wet cake forming activity at filter press A and B. Since, the same activity is done by filter press C at much lower cost (9.86 BDT/cycle) than filter press A (17.61 BDT/cycle) and B (14.60 BDT/cycle); they can give useful insight to design or re-engineer the filter press

A and B like press C. Efficiency and time, these two dimensions for activity performance measurement can be analyzed through the information provided by ABC in this study. The efficiency of all activity considering the input output relationship, the time required for activity, all are here documented for developing the ABC. Again, concerning this dimensions benchmarking is also possible in activity center to center. If a particular center of the production department performs far below the world-class standard, managers can be likely to target that area for improvement. Furthermore, by practicing this ABC knowledge, the organization can also acquire a more profitable mix of products, identify those activities that are prime candidates for improvement, better use their limited capital funds, and overall can make better business decisions.

CONCLUSION

The preliminary target of our research was to develop an ABC model for a ceramic industry. Production department was chosen for this study because the production system of tiles is mostly dependent on gas and electricity and costs of these indirect resources are rising gradually. Management need to know how much they bear cost for these and how they manage it in a rational way. It is also needed to know which products are really winners, which are losers among many types of produced products. Without the realistic costing information it will be difficult to survive in long run where the overhead cost increasing day by day. Devoid of ABC system, it is not possible to identify where and how the cost incurs. Unlike traditional method, instead of using the single predetermined rate to absorb the indirect cost to products, ABC uses actual incurred cost to determine the product cost. In this study the product cost calculated by the ABC system comprises the cost of electricity, gas and indirect material used in the selected activity. All information and data for this study was systematically processed to give a framework of costing system of a renowned tiles manufacturing industry. As the cost drivers are the main concerning point of ABC, these were selected carefully and rationally for every selected resource and activity. The developed RAD and APD matrices assist in the understanding of how overhead costs are generated by activity and the cost object. The product cost is not only the outcome of the model, monthly resource cost (table 5), the consumption amount of this cost by the selected activities and machining cost of per unit cost driver (table 7) was also calculated for giving the full structure of ABC. As KCL produce multiple products, it is necessary to find the most profitable product and the percentage of contribution in profit of other products. The developed model gives the realistic view of the cost assignment on product. This model gives a scenario of how the cost is assigned through resource to activity and activity to product. This generated ABC model gives managers a true picture of selected resource costs and now they will get the way to do something about the costs. And for the similar type of tiles manufacturing industry this model will be beneficiary to construct their costing technique in ABC a more advanced approach of product costing. So it is recommended to the company to start their costing technique in ABC system.

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