



The Integration of Reverse Engineering and Characteristics Based Costing Approaches and its Applying in a Manufacturing Company

Husam Muhammed Ali Alawaed

Department of Accounting, College of Administration and Economics, University of Kerbala, Iraq.
E-mail: husam.m@uokerbala.edu.iq

Lara Qasim Khanjar Almagsoosi

Department of Business Management, Kut University College, Al kut ,wasit, 52001, Iraq. E-mail:
lara.almagsoosi@alkutcollege.edu.iq

Salah Mahdi Jawad Al-Kawaz

Department of Accounting, College of Administration and Economics, University of Kerbala, Iraq.
E-mail: Salah.m@uokerbala.edu.iq

Ali Saad Alwan

Department of Business Management, Kut University College, Al kut, wasit, 52001, Iraq. E-mail:
ali.s.al-musawi@alkutcollege.edu.iq

Abstract

This research deals with integrating RE and CBC in the product design process. RE improves the product value based on evaluate the competition products, whereas CBC aims to use a process approach to define activities and prelates those activities to products or customers using the product's Characteristics. Integrating RE and CBC together leads to the improvement of product value, an increase of customer satisfaction, and support of competitive advantage. In this study first, a conceptual model of integration of these two approaches is provided and then the implementation procedures in product design cycle are explained, and finally, the results got from implementing it in an Electronic Industries company are discussed.

Keywords: Characteristics Based Costing, Reverse Engineering, Integration of RE, CBC.



Introduction

Changes in the business environment, triggered by global competition and technological innovation, have led to innovations in using financial and nonfinancial information in organizations. The new environment demands relevant information and data about costs and performance within the organization's activities, processes, products, services and customers. Usually, leading companies are using their cost systems (Kaplan & Cooper, 1998:5):

- Design products and services that both meet customers' expectations, and can be produced and delivered at a profit;
- Signal where either continuous or discontinuous improvements in quality, efficiency and speed are needed;
- Assist employees in their learning and continuous improvement activities;
- Guide product mix and investment decisions;
- Negotiate about price, product features, quality, delivery and service with customers;
- Efficient and effective distribution and service processes to targeted market and customer segments.

Still, many companies are not gaining competitive advantages from these enhanced cost systems because they rely on information from a cost system designed for a simpler technological age when the competition was only local instead of global, and companies were producing standardized products and services and when speed, quality, and performance were less critical for success. Using these systems managers doesn't have timely and relevant information to guide their improvement activities and they don't have accurate and valid information to shape their strategic decisions about processes, products, services, and customers. Nowadays companies and managers need cost systems to perform three primary functions (Kaplan & Cooper, 1998):

- Valuation of inventory and measurement of the cost of goods sold for financial reporting – because of the external circumstances with investors, creditors, regulators, and authorities;
- Estimation of the costs of activities, products, services and customers –because of the internal managers needs to understand, and improve the economics of their operations;
- Provide accurate and timely cost information and economic feedback to managers and operators about process efficiency to make both strategic decisions and operational improvements.

Under these conditions managers need to rethink their managerial practices and in close relation to this, they need to reshape their existing accounting systems, especially the managerial accounting systems. As a response to these changes, researchers turned into the study of changes and innovations in managerial accounting, and nowadays we are witnesses of a re-evaluation of managerial accounting to develop new techniques and systems (Yazdifar

& Tsameny, 2005). Traditional managerial accounting techniques such as absorption costing, budgeting, and profit-based performance measures were replaced with such things as a strategic management accounting, activity-based costing (ABC), strategic cost management, non-financial measures, balanced scorecard (BSC) and target costing. Some of them, for example, of Reverse Engineering and Characteristics Based Costing Approaches, have also could gain popularity in practice. Reverse Engineering and Characteristics Based Costing are two important approaches in the product design cycle. Reverse Engineering is a systematic evaluation of all aspects of competitors to reduce costs and achieving a quality level that satisfies customers. Characteristics Based Costing uses a process approach to define activities and prelates those activities to products or customers using the product's Characteristics.

Research problem

The research problem is the inability of many of the companies in the modern production environment to improve the product value, an increase of customer satisfaction and support of competition advantage, and therefore the research problem can be formulated in the following question: Does the application of reverse engineering and characteristics based costing approaches help to improve the product value, an increase of customer satisfaction, and support of competition advantage?

Importance of Research

The importance of research comes from the following aspects:

1. Focus on the characteristics of the product and try it engineering and planning at an early stage of the design of the product and to suit the requirements for achieving the company's objectives through improving product value, increase customer satisfaction, and support competitive advantage through provide a Model for integrating both Engineering inverse and characteristics based coating to achieve the above objectives.
2. Newness of this subject covered by this research, which did not receive sufficient attention by the concerned thought accounting yet, as it is not addressed in the accounting literature concern with approach identifies the cost based on the product characteristics and this feature the current study, which singled out, and in this case this research will take precedence in this aspect that is the first study that deals with this approach, and it's also the first study that addresses the integration between this approach and the approach of reverse engineering

Research Objective

The research aims to study and illustrate the importance of the approaches of reverse engineering and characteristics based coating as elements of success in any company if it was their integration for their role in shaping the image characteristic of the product at an early stage of its design and how leads to the improvement of its value, increase customer satisfaction, and as a result achieve a competitive advantage for the company.

Research Hypothesis

Research is based on the fundamental Hypotheses that "The integration between the two approaches of reverse engineering and characteristics based costing contribute to the improvement of product value, increase customer satisfaction, and as a result achieve the company's competitive advantage".

Methodology

The researcher, in the importance's light of the aim and the hypotheses, depends on the descriptive analytical methods in the research's preparation:

1. The first approach, which depends on the presentation and analysis of the literature relevant to the subject through the use of different sources, periodicals and references and the use of an international information network.
2. The second approach, which depends on the practical application of research and relying on a variety of means to get the required data and information is the most important of cohabitation, field visits and interviews with engineers and workers in the electronics industry company and the accounting records and reports of cost and time cards for the characteristics of a product.

Research Limits

Search limits include a range of temporal and spatial limits:

- Temporal limits: the field study was conducted during 2015.
- Spatial limits: the field study was conducted on State Company for Electricity Industries in Iraq.

The Theatrical Framework for Research Approach

Reverse Engineering

Reverse engineering is assessing competitors' products to identify opportunities for the development of the company's products and reduce costs (Drury, 2000). Reverse engineering focuses the attention on analyze competitor product to determine its characteristics (its components) and designed under the clear vision of the processes used in their production (Horngren, et., Al., 2015). A reverse engineering helps in reaching results about the method or the process that was applied in the design and production of competitive products, and work to change any attributes of the company's product characteristics specification in the form in which it is consistent with the attributes enjoyed by characteristics of those products (Stevenson, 2005), (Kaplan & Atkinson,1998).

How to Conduct Reserve Engineering

Determine the Product Characteristic

In step 1 they determine the characteristics of each product according to customer requirements and market research. The characteristic is a major element of a product that stimulate customer behavior to gain the product. The characteristics of a product are then divided into sub- characteristics, for example, the main characteristic of a car would be the engine. The engine could then be classified into sub- characteristics such as the gas or diesel and several cylinders (Mundy, 2003: 1). Another literature looks at characteristics from the point of view of the other may be tight, as it in the car's example, characteristics represent in number the doors of the car and the color of the car (Brimson, 1998).

Trace the production characteristics of the product

In step B we trace the production characteristics of the product after its identification and analysis across departments that pass by and knowledge the number of materials used in production and kinds prelude to compare it with the competitor product characteristics.

Analysis of the competitor Product

In this step, the competitor Product is analysis according to its characteristics for the purpose of comparing designs product competitor with the designs of the company's product characteristics to identify the attributes that are supposed to be prevalent in the market for this product, and stand on the secondary characteristics within the product competitor and quantity of materials used, and then compare them with the secondary characteristics of the company product to identify the differences between them.

Modify the attributes of the company product characteristics

In step D, we change the attributes of the company product characteristics accordance with the attributes of the competitor product characteristics. as it is expected that the modification process results in a reduction in the company's product characteristics cost (Characteristics - Based Costing Approach Is applied).

Characteristics - Based Costing (CBC) Approach

Reasons for applying a (CBC) Approach

The approach ABC was presented for manufacturing corporations in the half of 80's of the twentieth century in the USA (Cardos, 2015). In fact, it was the reply to inaccurate American accounting standards. (Kuchta and Troska, 2007) maintained that ABC is a proper approach for the shaping of the customer's profitability. ABC also contributes to identifying activities which produce the value and which do not. Although, some argued the information from ABC could boost up strategic and operational decisions. In order, (Kaplan and Anderson,2007) claim it still exists an empirical reason the acceptance of this approach has a big influence on

the enterprise's performance. In addition, (Bogdanoiu,2009) claims ABC approaches the causal relationships between products and the resources used in their production and traces the cost of products according to the activities through the use of cost drivers.

ABC is proceeding in the two phases. First, the costs of sources are assigned to activities by using cost factors. Then the costs of activities are divided to cost objects by measuring quantity and related cost drivers, which means that costs of activities are allocated to costs objects, which are based on the relevant cost factors (for instance the number of settings, the number of customers visits) (Dejnega,2011). The approach ABC uses the causal relationship between costs objects and activities and between activities and sources. According to (Macurová 2009) the approach ABC works with real costs and real occurrence of factors. The understanding of a hierarchal level of costs enables a manager to recognize the costs reasons and then make better decisions and design better supply chain networks. Approach ABC assigns in a good way the costs to particular activities, but on the other hand the application of approach is linked with some problems. Particularly the upgrade of the system is time consuming, because for every variation of process separated activity is needed. ABC also used only one cost driver, worked with an average rate of costs to one occurrence of cost driver and high sophistication. Therefore, since its early stages, several specific Applications based on the ABC approach have been suggested. Table 1 shows a synthesis of these applications.

Table 1. Synthesis of the ABC Applications

Approach	Main Features
First Group	
Customer-driven ABC Market-driven Benchmarking-driven ABC Environmental-driven ABC Interorganizational Cost Management	Spatial widening of the costs perimeter .Customers, markets, consumers, society, etc.
Second Group	
ABB ABC and Life Cycle Costing Target ABC Feature Costing	Temporal widening of the costs perimeter: Analysis of future costs (one or several years, a life cycle, etc.)
Third Group	
RCA: Resource Consumption Accounting Process Costing and Lean Accounting Time-driven ABC and other equivalence Methods	Determination of the relevant level of details to analyze the costs Relevant Level: The resource pool Relevant Level: The processes Simplification of the resource allocation Process. The level of analysis depends on the cases (department, activities or tasks).

Source: Adapted from (Wegmann, 2009:10)

In Table 1, distinguish the three groups of approaches (Wegmann, 2009). The first group gathers those which enable spatial widening of the costs perimeter. Some of them suggest broadening the cost analysis to the customers (customer- driven ABC), others to the

competitors (benchmarking-driven ABC), to the environment (environmental-driven ABC), or to the suppliers and partners (inter-organizational cost management and open-book accounting). This list of solutions is not exhaustive.

The second group brings together those which allow analysis of future costs (Activity - Based Budgeting (ABB), Antos and Brimson, 1999) and a temporal widening of the costs perimeter. These solutions comprise combining the ABC approach to the life cycle costing or to the target costing (Horvath et al., 1998). we can also associate the target costing to a specific version of ABC called feature costing approach (Cokins, 2002). The feature costing (Brimson, 1998) introduces another level of analysis in the(ABC) approach—the product's features.

The third group, puts together approaches which proposal to determine the relevant levels to analyze the costs, depending on the features (strategic and organizational) of a firm. Sometimes, the processes and strategy complexities are great. The (ABC) approach is insufficient, so we need another approach to allocate the resources. The Resource Consumption Accounting (RCA) approach (Keys and van der Merwe, 2002) complete the (ABC) with a deeper analysis of resources. In other situations, the complexity of the process is low and the ABC approach is too detailed. So we can bring together several activities to set a meta-activity or a process with a single cost driver. This is the assumption of the process costing approach (Horngren et al., 2015) and the lean accounting approaches.

Time-driven ABC (Kaplan and Anderson, 2007) represents the last stages of the development of the (ABC), which depends on its application to provide two parameters, namely the cost of the unit time to set various resources calculated based on Practical capacity and time of performance of the activities of each group of resource groups. Although this approach is characterized by the effective exploitation of resources, ease and speed of application and update according to the variables of the processes and the nature of the resources, and the possibility of estimating the practical capacity time each group of resource groups, but it's faced several criticisms, notably the internal focus on operational processes that are carried out to get product and ignore external aspects such as price and quality with the neglect of its characteristics and the extent of compliance with the customer's requirements. The researcher believes that this underlines the need for the adoption of product characteristics when determining and measuring the cost and this lead to introduce the concept of characteristics based costing approach that could be an expansion in the system (TD-ABC) and not cancel it, and the adoption of this approach will complement the success of the application of the reverse engineering approach (handled later) regarding that there is so far in the literature of cost and managerial accounting applications represent a framework intellectually or applied reflects the integration between the reverse engineering and the characteristics based costing.

Concept OF Characteristics - Based Costing

Characteristics based costing (CBC) is a strategic approach which specializes in the display the costs behavior on a level of the product characteristics which is represented the components of the product or parts that are directly linked to the aim of the final cost of the product (Brimson, 1980). This is the approach of an expansion in the system (ABC) through its dependent on allocating the cost to activities related to the production characteristics of the product and, as a result, represent the characteristics cost the total cost of the product (Dondero, 2003). Researcher knows the characteristics based costing approach that one approach of strategic cost management, which is an expansion in the system (TD-ABC) in terms of its dependence on time in the allocation of costs on activities related to the characteristics of the product that fit the customer's requirements and be the basis of product design.

Characteristics Based Costing Objectives

The process of applying the Characteristics Based Costing approach can to achieve the following objectives if it has been applied:

1. Measuring cost on the basis of the product in relation to the activities that contributed to the production (Sormaz, et., al, 2013).
2. Provide information that will help in estimating the cost of the product at an early stage of its life cycle (Debusk & Chuck, 2014).
3. Provide appropriate information about cost of the activities and characteristics that help make strategic and operational analysis of (Gangurde, 2015).
4. Providing the important information about product characteristics and that will help determine the competitive position of the company (Rush & Roy, 2016).
5. Reducing the company's costs and improve performance due to the lack of data that you need to calculate the cost of the product (Mundy, 2003).
6. Determining the time needed to produce the product characteristics and work within the scope of capacity supplied (Debusk & Chuck, 2014).
7. Comparing the characteristics of the product with the characteristics of similar products and discuss the areas of improving their performance (Rush & Roy, 2016).

How to Conduct Characteristics Costing

Application of method TD-ABC has the following steps according:

Assessment the costs by particular spent resources on the one available capacity.

- Identification the group of resources, which have performed the activities.
- Estimation of costs on every group of resources.
- Estimation of practical time capacity of each group of resources.
- Calculation costs the group of resources by dividing total costs group of resource by their available capacity.

Assessment of time, which is needed for required variation of running activity.

- Identification of factors, which had influence on the time period of appropriate activity (time driver), when we determine the factors for every real variation of activity.
- Creation time equation, which express the dependence the time running of activity on all factors with next recognizing the values of factors and calculation total consumption of time for every concrete variation of activity.

C. Multiply the unit costs of particular resources by total consumption time of concrete variation of running process and summarizing the operation costs for every resources groups.

D. Identification the cost of Characteristics based on consumption time by every Characteristic.

CBC) an approach has many advantages in comparison with the traditional accounting approaches. The approach assigns the operation costs only into the onetime equations, which encompass all special aspects of choosing an activity in the firm's database of activities. (CBC) allocates in a better and fair way the costs to the activity, customer, region, product, or Characteristic. (CBC) discovers the possibility of unused capacity, enables operational improvements, respects interaction between time drivers, detects the process without value in the way of a trace of costs and changes in production, loading, delivering, storing etc. (CBC) is the good tool for design of new competitive strategy of supply chain not only with other members of the chain but also between the particular company's divisions and as the instrument to identify the profitability of the company's customers and new market opportunities. (CBC) information improved the communication system of the company, increased the quality of the product, and increased its value and effectiveness and better planning of Characteristics of the product.

Integration of VE and CBC

To develop a model for integration between the approaches of (RE) and (CBC) proposed by the researcher depends on how the certain approach advantage of other approach outputs. As it is shown in the above steps apply approach (RE), is clear that the process modify the attributes of a particular product characteristics under the attributes of the competitor product characteristics accompanied by calculation of the costs of product characteristics to the extent of impact which is expected to result from the modified process by reducing the cost of the characteristics of product and this process is verified by applying steps approach (CBC). Figure 1 illustrates a model of integration between the approaches of (RE) and (CBC) and relying on the steps of each application that has been addressed

The Field of Study

In this part is to clarify the steps of the integration process between the two approaches of reverse engineering and the characteristics based costing of the Electronic Industries Company in Iraq to improve the value of one of their products, increase customer satisfaction, and to help achieve competitive advantage and this product is the mobile device, and the reasons for choosing this product back to its importance, increase the intensity of competition

around this product, the higher selling price compared to other competing products, and fit on several characteristics that meet basic customer requirements.

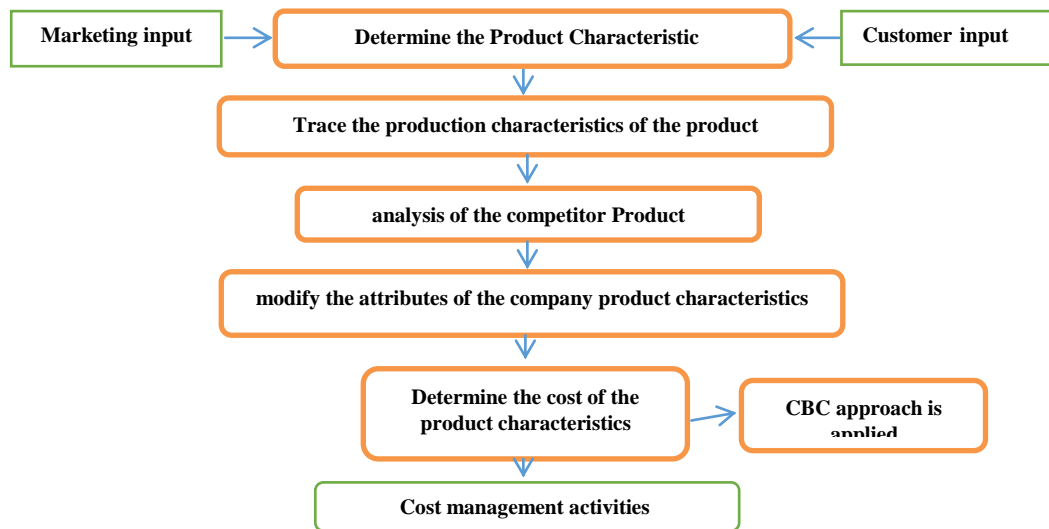


Figure 1. The Integrated model of RE & CBC

Determine the Product Characteristics: Table 2 shows the main characteristics of the smart phone model (EIC 85-01T).

Trace the production characteristics of the product: Table 2 shows Trace the production characteristics of the characteristics of the smart phone model (EIC 85-01T).

Table 2. Characteristics of the smart phone model (EIC 85-01T)

Major characteristics	Material	Issued Average
Panel	Plastic 9.7 Inch	1 Piece
Touch screen	Plastic(1280 * 720 pixels)	1 Piece
PCB Board Assy	Plastic	1 Piece
Plastic case	Plastic	1 Piece
Battery	Dry	1 Piece
Charger	Plastic	1 Piece
USB Cable	Cable	1 Piece
Earphone with microphone	Plastic	1 Piece
User manual	Plastic	1 Piece
Home Buttons	Plastic	1 Piece
Home Paper for Battery (Black)	Paper	1 Piece
Adhesive Tape Black (Past on the Buttons silver)	Tape	1 Piece
Inner Card Cover Upper	Plastic	1 Piece
Inner Card Cover Lower	Plastic	1 Piece
PO Bag	Plastic	1 Piece
PO Bag Charger	Plastic	1 Piece
Silicon Rubber for Knob (White)	Rubber	1 Piece
Screw Black	Plastic	8 Piece
Screw Silver	Plastic	5 Piece
Sticker Pass	Paper	1 Piece
Barcode Sticker(IMEI)	Plastic	1 Piece
EIC Sticker Specification	Plastic	1 Piece
Metal Logo EIC	Metal	1 Piece
Label EIC	Metal	1 Piece
Carton Box	Carton	1 Piece

Source; Prepared by the researcher based on information Of design department.

Analysis of the Competitor Product

Table 3 shows analysis the smart phone competitor (Nokia) to its characteristics for the purpose of knowledge of materials quantities used in production and kinds, and then compare it with the materials used by the company.

Table 3. Comparing between characteristics the Smart phone for com& Competitor

Major characteristics	Company Mobile		Competitor Mobile	
	Material	Issued Average	Material	Issued Average
Panel	Plastic 9.75Inch	1 Piece	Plastic 5.5 Inch	1Piece
Touch screen	Plastic(1280 * 720 pixels)	1 Piece	Plastic(540*960 pixels)	1 Piece
PCB Board Assy	Plastic	1 Piece	Plastic	1 Piece
Plastic case	Plastic	1 Piece	Plastic	1Piece
Battery	Dry	1 Piece	Dry	1Piece
Charger	Plastic	1 Piece	Plastic	1Piece
USB Cable	Cable	1 Piece	Cable	1Piece
Earphone with microphone	Plastic	1 Piece	Plastic	1Piece
User manual	Plastic	1 Piece	-	-
Home Buttons	Plastic	1 Piece	Plastic	1Piece
Home Paper for Battery (Black)	Paper	1 Piece	-	-
Adhesive Tape Black (Past on the Buttons silver)	Tape	1 Piece	Tape	1 Piece
Inner Card Cover Upper	Plastic	1 Piece	Plastic	1Piece
Inner Card Cover Lower	Plastic	1 Piece	Plastic	1Piece
PO Bag	Plastic	1 Piece	-	-
PO Bag Charger	Plastic	1 Piece	-	-
Silicon Rubber for Knob (White)	Rubber	1 Piece	-	-
Screw Black	Plastic	8 Piece	Plastic	6 Pieces
Screw Silver	Plastic	5 Piece	Plastic	3Pieces
Sticker Pass	Paper	1 Piece	-	-
Barcode Sticker(IMEI)	Plastic	1 Piece	-	-
EIC Sticker Specification	Plastic	1 Piece	Plastic	1Piece
Metal Logo EIC	Metal	1 Piece	Metal	1Piece
Label EIC	Metal	1 Piece	Metal	1Piece
Carton Box	Carton	1 Piece	Carton	1Piece

Source; Prepared by the researcher based on information Of design department.

Modifying the company's product characteristics attributes

Table 4 shows the modification of the attributes characteristics for the company's smart phone according to the attributes of the competitor phone.

Table 4. Modifying the company's smart phone characteristics attributes according to the attributes of the competitor phone

Major Characteristics	Phone of the Company before the modification			Phone of the company after the modification		
	Price	Issued Average	Cost	Price	Issued Average	Cost
Panel	55,000	1 Piece	55,000	50000	1Piece	50000
Touch screen	15,000	1 Piece	15,000	13500	1 Piece	13500
PCB Board Assy	55,000	1 Piece	55,000	55000	1 Piece	55000
Plastic case	3,000	1 Piece	3,000	3000	1Piece	3000
Battery	7,000	1 Piece	7,000	7000	1Piece	7000
Charger	5,000	1 Piece	5,000	5,000	1Piece	5,000
USB Cable	1,000	1 Piece	1,000	1,000	1Piece	1,000
Earphone with microphone	2,000	1 Piece	2,000	2,000	1Piece	2,000
User manual	1,000	1 Piece	1,000	-	-	-
Home Buttons	1,000	1 Piece	1,000	1,000	1Piece	1,000
Home Paper for Battery (Black)	50	1 Piece	50	-	-	-
Adhesive Tape Black (Past on the Buttons silver)	250	1 Piece	250	250	1 Piece	250
Inner Card Cover Upper	1,000	1 Piece	1,000	1000	1Piece	1000
Inner Card Cover Lower	1,000	1 Piece	1,000	1000	1Piece	1000
PO Bag	1,000	1 Piece	1,000	-	-	-
PO Bag Charger	1,000	1 Piece	1,000	-	-	-
Silicon Rubber for Knob (White)	1,000	1 Piece	1,000	-	-	-
Screw Black	100	8 Piece	800	100	6 Pieces	600
Screw Silver	100	5 Piece	500	100	3Pieces	300
Sticker Pass	50	1 Piece	50	-	-	-
Barcode Sticker(IMEI)	1,000	1 Piece	1,000	-	-	-
EIC Sticker Specification	1,000	1 Piece	1,000	1000	1Piece	1000
Metal Logo EIC	1,000	1 Piece	1,000	1000	1Piece	1000
Label EIC	100	1 Piece	100	100	1Piece	100
Carton Box	3,500	1 Piece	3,500	3,500	1Piece	3,500
			158,250			146250

Source; Prepared by the researcher based on table 4.

Determine the Cost of the Product Characteristics

In this step, the cost of each characteristic in step 4 is determined. For the cost of direct materials, it can be determined according to the previous step (4) As shown in Table 5, as to the elements of both direct labor and manufacturing overhead cost (Operation cost) are applied on the smart phone characteristics in accordance with the following steps:

Assessment the costs by particular spent resources on the one available capacity

In this step, the cost and time unit for departments that contribute to the phone production in the company are determined by dividing the operating cost related to the performance of the activities of these departments (direct and indirect) by their available capacity that represent hours needed for production work, which has been certified as 80% of the theoretical capacity as It explained in the theoretical Framework , for example, Cost of resource per unit of practical time for the production department is D.101.46 calculated as follows:

Cost of resource per unit of practical time= $D.750000 \div 7392 \text{ minutes} = D.101.46 \text{ per minute}$

Of course, To compute the Cost of resource per unit of practical time for the other departments, we use the same steps described above.

Assessment of time, which is needed for required variation of running activity

In this step, the time that takes to perform the events activities in each of the departments and reflected in the equations of time are determined, the time equation for the production department as follows:

Production department time in minutes = 14 (productive work) +1 (planning and design) +1.2 (receipt of materials) +2 (maintenance of the machines) +3 (check the work done) +1 (conversion work done)

Multiply the unit costs of particular resources by total consumption time of concrete variation of running process and summarizing the operation costs for every resources groups.

In this step, the calculating the operating cost by multiplying the cost of time unit for each department with the performance time, for example, the cost of operation of the production department is D.2032.18 calculated as follows:

Operation cost $(101.46 \times 14) = +(52.73 \times 1) + (1.2 \times 79.1) + (2 \times 99.8) + (3 \times 70.63) + (1 \times 52.6) = D.2032.18$

Identification the cost of Characteristics based on consumption time by every Characteristic.

After operating cost is calculated for each of the department related to the production of the smart phone are allocated to the characteristics of the product based on the time it takes the output it is then added the cost of materials for each Characteristic to be obtained at the cost of the smart phone. Table 5 shows the calculation of the cost of manufacturing a smart phone Characteristics.

Table 5. Compute of Characteristics Cost

Major Characteristics	Direct Material	Operating Costs	Manufacturing Costs
Panel	50000	30	50030
Touch screen	13500	224	13724
PCB Board Assy	55000	227	55227
Plastic case	3000	210	3210
Battery	7000	57	7057
Charger	5,000	63	5063
USB Cable	1,000	120	1120
Earphone with microphone	2,000	80	2080
User manual	-	-	-
Home Buttons	1,000	50	1050
Home Paper for Battery (Black)	-	-	-
Adhesive Tape Black (Past on the Buttons silver)	250	20	270

Inner Card Cover Upper	1000	75	1075
Inner Card Cover Lower	1000	76.18	1076.18
PO Bag	-	-	-
PO Bag Charger	-	-	-
Silicon Rubber for Knob (White)	-	-	-
Screw Black	600	95	695
Screw Silver	300	125	425
Sticker Pass	-	-	-
Barcode Sticker(IMEI)	-	-	-
EIC Sticker Specification	1000	200	1200
Metal Logo EIC	1000	125	1125
Label EIC	100	10	110
Carton Box	3,500	245	3745
TOTAL	146250	2032.18	148282.18

Source; Prepared by the researcher based on table 5.

When comparing the cost of derived characteristics under the traditional system of cost that the amount of D.177,220 with a cost that has been reached under the model integration between the (RE) and (CBC) ,notice a reduce in the cost of characteristics by D.28937.82 and this confirms the effectiveness of the integration between the two approaches above in improving the value of smart phone product and as a result, it supports research to accept the hypothesis that says "The integration between the two approaches of reverse engineering and characteristics based costing contribute to the improvement of product value, increase customer satisfaction, and as a result achieve the company's competitive advantage".

Conclusion

With the globalization, the conditions of competition have changed and customer awareness has risen. Now the business is competitive as much as their ability to cope with providing new consumer demands and needs at their quality, price and time the consumer desires. These changes have led to the development of new strategic approaches in cost and management accounting. reverse engineering(RE) integrated with characteristics based costing(CBC)is an effective management tool aims to improve the existing product design, improve product value, an increase of customer satisfaction, and support of competition advantage. Reverse engineering deals with an analysis of the competitor Product characteristics attributes and modifying the company's product characteristics attributes according to the attributes of the competitor product. Characteristics based costing is a cost management approach used to define activities and relates those activities to products or customers using the product's Characteristics. Managing product costs during product design is not enough, continuous cost management activities could continue in the production stage. Further scope of the study is to implementing (RE)- (CBC) process in different industries, especially service industry.

If all the suggestions given in the study are carried out by an Electronic Industries company, there is no doubt about Electronic Industries improving of product value, increase of customer satisfaction, and support of competition advantage and reaching new heights in the near future.

Conflict of interest

The authors declare no potential conflict of interest regarding the publication of this work. In addition, the ethical issues including plagiarism, informed consent, misconduct, data fabrication and, or falsification, double publication and, or submission, and redundancy have been completely witnessed by the authors.

Funding

The author(s) received no financial support for the research, authorship, and/or publication of this article

References

- Bazala, J. (2003). *Logistika v praxi: praktická příručka manažera logistiky*.verlag Dashöfer praha. ISBN 80-86229-71-8.
- Bogdănoiu, C. (2009). Activity based cost from the perspective of competitive advantage. *Journal of Applied Economic Sciences*, 4(7).
- Brimson, J. A. (1998). Feature costing: beyond ABC. *Journal of cost management*, 12, 6-13.
- Brimson, J. A., Antos, J., & Collins, J. (1999). *Driving value using activity-based budgeting* (Vol. 1). Wiley.
- Cardos, I. R., & Pete, S. (2011). Activity-based Costing (ABC) and Activity-based Management (ABM) Implementation–Is This the Solution for Organizations to Gain Profitability?. *Romanian Journal of Economics*, 32(1), 151-168.
- Cokins, G. (2002). Integrating target costing and ABC. *Journal of Cost Management*, 16(4), 13-22.
- Debusk, G.& Chuck,D., (2014),"Features and characteristics costing", *Journal of Cost Management ,USA*.
- Dejnega, O. (2011). Method Time Driven Activity Based Costing–Literature Review. *Journal of Applied Economic Sciences*, (1), 7-15.
- Gangurde, S. R., & Akarte, M. M. (2015). Segmentation based product design using preferred features. *Benchmarking: An International Journal*, 22(6), 1096-1114.
- Horngren, C. T., Foster, G., Datar, S. M., Rajan, M., Ittner, C., & Baldwin, A. A. (2005). *Cost accounting: a managerial emphasis*,15th Edition, Pearson Education, Upper Saddle River, New Jersey.
- Horvath, P., Gleich, R., & Schmidt, S. (1998). Linking target costing to ABC at a US automotive supplier. *Journal of Cost Management*, 12(2), 16-24.
- Kaplan, R. S. (1998). *Cost & effect: using integrated cost systems to drive profitability and performance*. Harvard Business Press.
- Kaplan, R. S., & Anderson, S. R. (2007). *Time-driven activity-based costing: a simpler and more powerful path to higher profits*. Harvard business press.
- Kuchta, D., & Troska, M. (2007). Activity-based costing and customer profitability. *Journal of cost management*, 21(3), 18-25.
- Mundy,K.,(2003),"Feature Costing : Beyond ABC", Master of Accountancy Program, University of South Florida ,USA.
- Rush, C., & Roy, R. (2000, July). Analysis of cost estimating processes used within a concurrent engineering environment throughout a product life cycle. In 7th ISPE International Conference

- on Concurrent Engineering: Research and Applications, Lyon, France, July 17th-20th, Technomic Inc., Pennsylvania USA (pp. 58-67).
- Sormaz, D., Gannon, P., & Pulugurta, S. (2013). Methodology for feature modeling and cost estimation of large cast parts. In IIE Annual Conference. Proceedings (p. 2349). Institute of Industrial and Systems Engineers (IISE).
- Stevenson, W. J., Hojati, M., & Cao, J. (2005). Operations management (Vol. 8). Boston: McGraw-Hill/Irwin.
- Van der Merwe, A., & Keys, D. E. (2001). The case for RCA: understanding resource interrelationships. *Journal of Cost Management*, 15(5), 27-36.
- Wegmann, G. (2008). The activity-based costing method: development and applications. *The IUP Journal and Audie Practices*, 8(1), 7-22.
- Yazdifar, H., & Tsamenyi, M. (2005). Management accounting change and the changing roles of management accountants: a comparative analysis between dependent and independent organizations. *Journal of Accounting & Organizational Change*, 1(2), 180-198.

Bibliographic information of this paper for citing:

Alawaed, Husam Muhammed Ali; Khanjar Almagsoosi, Lara Qasim; Al-Kawaz, Salah Mahdi Jawad & Alwan, Ali Saad (2022). The Integration of Reverse Engineering and Characteristics Based Costing Approaches and its Applying in a Manufacturing Company. *Journal of Information Technology Management*, 14 (2), 90-105. <https://doi.org/10.22059/jitm.2022.86930>

Copyright © 2022, Husam Muhammed Ali Alawaed, Lara Qasim Khanjar Almagsoosi, Salah Mahdi Jawad Al-Kawaz and Ali Saad Alwan