Integrating Target Costing and Resource Consumption Accounting

Mostafa Al-Qady*
Said El-Helbawy*

Abstract

Target costing is a system of profit planning and cost management that ensures the new competitive product produced by the firm meets customer desires for price, features and functionality, and other subjective factors, while maintaining the firm's required financial return. Accordingly, target costing requires cost information that has ability to assist in managing costs for future products. While target costing provides an effective tool for generating plans and managing resources, it requires an improved method for determining and controlling costs.

This paper proposes integrating resource consumption accounting (RCA) with target costing to improve the target costing process. Target costing has the ability to work in a feedforward mode in the design stage, while RCA can be run in reverse to assess the future demand on resource pools' output. The integration of target costing and RCA would help determine estimated costs more accurately, provide cost structures of design alternatives, and thus achieve the target cost.

Keywords

Resource Consumption Accounting (RCA)
Target Costing, QFD
Value Engineering
Kaizen Costing
Activity-Based Costing (ABC)

Introduction

Increased global competition creates pressures on firms to offer their products at competitive prices. Accordingly, firms respond to these pressures by focusing on customer value, so that they can maintain their presence in the market. A firm should not just match or surpass what competitors can do, but also discover what customers want to buy and then satisfy their expectations while maintaining profitability. Target costing plays the role of balancing product's profitability and customer value. Target costing is primarily a technique for profit management whose objective is to ensure that new products, or new models of existing products, generate sufficient profits to enable the firm achieve its long-term profit plans. This objective can only be achieved if products are designed to satisfy the demands of the firm's customers and to be manufactured at a sufficiently low cost. Target costing first identifies the cost at which the product must be manufactured so that the profit objective can be achieved, and then creates the environment that helps ensure the target cost is achieved.

Target costing requires cost information that has feedforward ability to assist in managing and controlling costs for future products. A lot of studies, i.e., IMA, 1998; Cokins, 2002; Sani & Allahverdizadeh, 2012; Pazarceviren & Celayir, 2013, suggested the integration of target costing with activity-based costing (ABC) which was believed that it assists accurate estimation of drifting costs, provides cost structures of design alternatives, and is used as a tool for achieving target cost.

Unfortunately, ABC inherently suffers from a number of problems concerning resource consumption and cost behaviour which would make the integration of ABC and target costing counterproductive. First, ABC strictly adopts the work principle which emphasises that costs are incurred only through firm's activities. Accordingly, ABC does not recognise the interrelationships among resources and the fact that cost behaviour should be addressed through the pattern of consuming resources either by other resources or directly by the final output (Balakrishnan, et al., 2012). Second, ABC only defines resource consumption by costs, based on selected cost

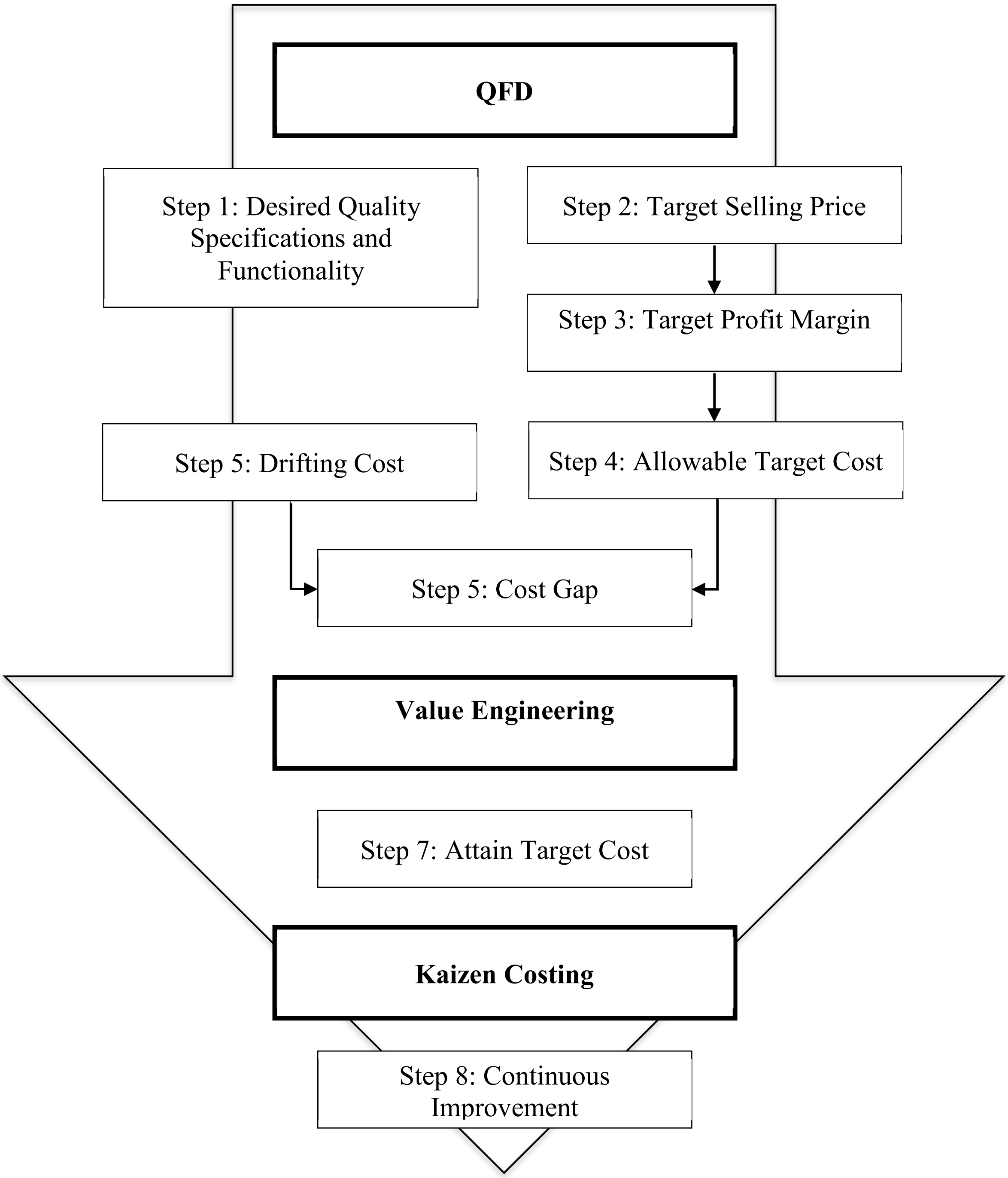
---

* Tanta University, Egypt

drivers. This ignores the fact that the nature of cost could change at the time of consuming resource by the final output or another resource (Clinton and van der Merwe, 2008).

This paper suggests shifting the focus from following costs to following resource quantities through a quantitative model based on RCA approach. RCA focuses attention on resources, their interrelationships, and how resource outputs are consumed. RCA overcomes the problems of ABC concerned with resource consumption and cost behaviour, as the resource consumption should be defined by resource quantities, and the cost behaviour should be defined according to the resource consumption pattern by the consuming object at the time of consumption.

Figure 1: Target Costing Process



(Source: Zengin and Ada, 2010)

Target Costing

The Meaning of Target Costing

Target costing is a cost management tool that aims at managing all product costs throughout the design stage, as well as a profit management technique that ensures a new product is sufficiently profitable to justify its production (Kee and Matherly, 2013). According to the CAM-I definition, target costing is much more than a costing system; it is a comprehensive profit planning and cost management system that is price-led, focuses on customer, focuses on product and process design, involves cross-functional teams to manage product from conception to production, is extended along the value chain, and aims to minimise life cycle costs (Ansari et al., 2006).

Target costing is not limited to new product development; it can be also applied to current products which management seeks to reduce their production costs (Yu-Lee, 2002). In addition, target costing is not a unique tool that is used separately. Rather, a number of tools support the process of target costing at the design and manufacturing stages, including value engineering, kaizen costing and quality function deployment (QFD) (Ratnatunga and Waldmann, 2003).

Figure 1 demonstrates the three key stages of target costing process. The first stage is the determination of the target cost, the second is the achievement of the target cost, and the final stage is continuous improvement to further reduce cost to attain the target cost.

Determination of Target Cost

Customer specifications for a product represent the trigger of target costing process. Since customers often make fairly subjective statements when evaluating a product, their preferences should be translated into a number of objective design requirements that can be then communicated to design and production teams. QFD is one of the main tools used in translating customer subjective preferences into technical attributes that can be quantified and measured in product design (Jariri and Zegordi, 2008). QFD takes the voice of customer data and displays the relationships among competitive offerings, customer requirements, and technical attributes together through a matrix summarising information about product functions and their associated customer rankings (IMA, 1998). Correctly rating the importance of customer requirements is essential to the QFD process, since it will largely affect the final target value of a product's technical attributes (Lai et al., 2008).

After identifying specifications and functionality of the product, the target selling price is established. The main factor to be considered is customer value; the value embedded in a product in the customer's eye. Customers can be expected to pay more for a new product than its predecessor or counterpart only if the new one’s perceived value is greater. Thus, the relative value of a product in the customer's eye can be defined based on the customer’s willing-to-pay for that product (Cannon and Morgan, 1991). This approach to pricing, known as value-based pricing, is a customer-oriented approach which requires that product selling price reflects the customer's willingness to pay for that product in relation to the customer perceived value (Sarokolaee et al., 2012).

After setting the target selling price, the target profit margin is set relative to the financial rate of return the firm requires to continue its existence in the market. Target profit should be set based on the return on sales which can be linked most closely to the product's profitability. Then, based on the target selling price and the target profit margin of the product, allowable product cost can be calculated as the difference between both. The allowable cost represents the cost at which the firm must manufacture the product to achieve the target profit margin when it sells the product at its target price.

Achievement of Target Cost

The first step in achieving the target cost is to examine the firm’s cost information so that the product's drifting cost, which considers product’s current design and firm's current and new manufacturing capabilities, can be estimated (IMA, 1998). One of the core tools typically used in this effort is cost tables which are detailed databases that contain detailed estimates of the costs of various parts or activities, depending on the materials and manufacturing methods and functions involved. Cost tables work as a measurement tool to decide and evaluate the cost of both existing and future products at the early design stages (Yoshikawa et al., 1990) and support the what-if analysis for alternative product designs by including comprehensive information about the product's alternative designs cost drivers; i.e., the size of the product, the materials used in its manufacture, and the number of features (Blocher et al., 2010).

After determining allowable and drifting costs, the firm has to decide whether and how the allowable cost level can be achieved. The cost gap, which is targeted for cost reduction, is identified between the drifting and allowable costs. The firm must identify the portion of the target cost reduction objective that can be achieved. Attainable cost reduction reflects the internal capabilities of the firm to design and produce the internally-manufactured components at a lower cost as well as suppliers' capabilities to provide externally-sourced components at a lower cost. The other portion of target cost reduction not yet achieved is considered a strategic cost reduction challenge whose size must be managed so that it reflects the firm's actual inability to match its competitor's efficiency (Cooper and Slagmulder, 2005).

The target cost can only be attained at the component level since customer and market forces place pressure on product design which places pressure on components. The component-level target costs identify how much the producer is willing to pay for the components purchased (Cokins, 2002).

Accordingly, target costing employs a diverse set of techniques which support the process of attaining the target cost by revealing cost reduction potentials at the component level and showing ways to transform those potentials into design alternatives. Value engineering is used to study the relationship between the product's functions and the costs incurred; searching for the appropriate mix that enhances the value provided by the product and maintains similar, or even better, quality. The design team should first identify the product's functions and establishes a worth for each function. Then, the design team applies value engineering to reduce the cost of each function and component whose cost exceeds its allowable cost (Kee, 2010).

Value engineering begins with performing functional analysis, and ends with generating cost reduction. Functional analysis involves determining what components should be targeted for cost reduction and, then, assigning a cost target to each of these components. Engineers analyse the functions of the components and the cost of each major function, and attempt to improve products' design to reduce the overall cost without reductions in the required quality and performance (Atkinson et al., 2012). The analysis of a major function identifies whether unnecessary features exist and could be eliminated, whether the function's components can be reduced, whether components can be shared with other existing products, and the ways to substitute components that perform similar functions (Bragg, 2010). If nothing could be made with the selected major function, the focus should be shifted to another major function and the analysis begins again.

The core point is to keep the cost of each function and the total cost of all functions below the target cost.

Based on the results of functional analysis, engineers may change the product's or component's design, use fewer parts, substitute new less expensive materials, or modify and improve the manufacturing process. For instance, a product redesign may enable the same functionality to be achieved but with fewer parts or with more common rather than unique parts (Atkinson et al., 2012). In this way, value engineering results in a series of improvement plans that raise the value of the product by emphasising functionality and meeting customer requirements within the target cost.

Continuous Improvement

Target costing is a continuous process; once a product enters production, further attempts to improve its quality and reduce its cost are performed through continuous improvement efforts such as kaizen costing (Kee and Matherly, 2013). Kaizen is the Japanese term of making improvements in the manufacturing process in small incremental amounts rather than through large innovations (Atkinson et al., 2012). Kaizen costing reduces the cost of production by finding ways to increase the efficiency of the production process (Kaplan and Cooper, 1998).

Target costing and kaizen costing are used as complementary methods to continually reduce cost and improve value. While target costing applies to product design stage, incremental approach of kaizen is appropriate in manufacturing stage where the effects of value engineering and improved design are already in place (Hilton, 2008). Typically, a firm responds to competitive pressure by periodically redesigning products using target costing so that it can simultaneously reduce the selling price and improve value. The role of kaizen costing comes next, after target costing is in effect. In the time period between product redesigns, the firm uses kaizen to reduce product cost in the manufacturing process by improving both manufacturing methods and productivity programmes.

A product whose price is declining, however, will reach a point where costs can no longer be reduced through kaizen costing. In addition, a current failure to achieve the allowable cost becomes a challenge for the future. This is a trigger for new-generation product with significantly different characteristics which can result in a significantly lower allowable cost and, accordingly, new profit opportunities. As that new-generation product enters production, kaizen costing techniques are subsequently applied.

Resource Consumption Accounting

The Meaning of RCA

Resource consumption accounting (RCA) was introduced as an emerging cost management system that combines advantages of the resource-focus provided by German managerial accounting with the activity/process view provided by ABC. RCA focuses on the analysis of resource flow from and among groups of resources to the final consumer of these resources. Webber and Clinton (2004) stated that RCA digs down to the resource level to provide superior information that helps accurate determination of costs. In their study, Clinton and Keys (2002) refer to RCA as a dynamic, integrated, and comprehensive system. RCA is *dynamic* since the model is able to adjust to changes in the consumption relations. RCA is *integrated* since it is typically applied as part of an ERP system's effort to achieve the best combination of cost management principles implemented in an integrated fashion, to provide superior information that is fully integrated throughout the firm across the various reporting and planning systems (Webber and Clinton, 2004). RCA is *comprehensive* since it can include product costing as well as resource planning (Clinton and Keys, 2002).

RCA focuses on following resource flow, then costs can be followed. Since costs are important for management decisions, and resources are the cause of costs, it is vital to understand the nature of resources to model them effectively. White (2009) provided a basis to understand the nature of resources through their fundamental characteristics: capability, capacity, and cost. First, *capability* refers to the qualitative characteristics of resources that each resource has ability to perform a particular work. Based on this characteristic, resources that could be integrated to perform a particular work are grouped in one resource pool. For instance, machine maintenance, technicians, and materials are grouped in one resource pool. Similarly, materials and their handling are combined in one resource pool. Second, since *capacity* resides in resources, RCA employs theoretical capacity of resources which breaks down capacity into three categories: productive, idle/excess, and waste. Thus, each resource pool should combine resources whose theoretical capacity can be measured, so that the level of unused capacity can be better managed. Third, resource *costs* reflect resource characteristics. Since costs are fundamentally tied to the flow of resources and resource pools' outputs through the firm, each resource pool should combine the characteristics of its resources and produces a fairly homogenous output that transfers those costs to other resource pools or the final outputs.

RCA Modelling

The first step in RCA modelling is establishing resource pools. The fundamental characteristics of resources (capability, capacity, and cost) play an important role in this step. In addition, Cooper and Kaplan (1988) introduced three rules that guide the process of designing an ABC system to examine the demands made by particular products on resources, which will be also beneficial to the grouping of resources into resource pools. When combined together, the following rules have to guide the process of establishing resource pools and grouping resources into those resource pools (Cooper and Kaplan, 1988; Tse and Gong, 2009; Balakrishnan et al., 2011; White, 2011; El-Helbawy and El-Nashar, 2013):

- *Focus on expensive resources*. The most expensive resources should be handled as separate resource pools. Erroneous attribution of these resource outputs and, then, costs to intermediate and/or final cost objects would significantly distort product costs;
- *Emphasise resources whose consumption varies significantly by products*. Products are diverse in consuming resource pools' outputs. Thus, information on resource consumption patterns should be available;
- *Focus on resources whose demand patterns are not correlated with the volume-based measures* that do not represent adequate measures of resource consumption; and
- *Combine the "like" resources in a single resource pool*. It is reasonable to combine various small-value resources together in one resource pool rather than larger pools. Also components obtained from a single vendor can be grouped into one resource pool.

After establishing resource pools and identifying their outputs, operational resource flows among resource pools are modelled. Costs are fundamentally tied to the flow of resources and outputs of resource pools through the organisation. If the operational resource flows are accurately modelled, the costs can be accurately modelled.

Accordingly, RCA provides three modelling principles that help model resource flow which accurately reflects cost flow and allows managers to make correct decisions.

Causality: This is the first modelling principle. Causality requires resource flows and their associated costs to be modelled from resources to consumers on a cause-and-effect basis, meaning that arbitrary allocations between resource pools are eliminated. If a causal relationship cannot be established, resource flow and its associated cost must be allocated to a higher level in the organisation (White, 2009).

Responsiveness: The second modelling principle is responsiveness which ensures compliance with causality through describing the relationship between a particular resource pool's output and the input quantities from other resource pools required to produce it. In this way, RCA governs the fixed and proportional relationships between resource pools and recognises that the nature of costs could change as outputs are consumed (Clinton and van der Merwe, 2008).

Work: Finally, RCA applies the *work* principle, but in a much more limited and highly disciplined manner than ABC. Activities are included in RCA model only when they add critical and ongoing information that managers need. In this case, however, activities must have quantity-based drivers that provide capacity information and must consume inputs in a quantitative manner (White, 2009). Examples include aggregating such resources as labour, strapping machine, and packaging carton in a packaging resource pool (previously known as packaging activity in ABC) whose output can be measured in quantitative terms such as hours of packaging consumed.

Resource Consumption and Cost Behaviour

RCA is able to provide a consistent view on resource consumption and cost behaviour through the causality principle. RCA focuses on resources and their consumption, and stresses the building of a quantitative model that avoids allocations based on percentages or monetary values. In this way, RCA seeks to model the causal relation between the driver that is measured quantitatively and the underlying cost. By correlating required inputs with outputs, RCA is able to provide a consistent view on resource consumption and cost behaviour (van der Merwe, 2011).

Cost behaviour is accurately modelled in resource pools through the responsiveness principle. RCA recognises two facts about cost behaviour. First, resource pools' costs may be inherently fixed, proportional, or a portion of both. Resource costs are classified as fixed or proportional based on the correlation between the input quantities to a resource pool and that pool's output quantities. The cost would be fixed if the input is incurred regardless of changes in the level of the consumption output, and it would be proportional when the demand for input changes, as the case of variable costs.

Second, the potential nature of proportional costs may change at the point of resource consumption. A resource that is normally acquired proportionately can be used in a fixed manner, i.e., consumption is constant regardless of output. Electricity used for lights that are always on would be an example (Clinton and van der Merwe, 2008). Therefore, RCA model treats proportional costs as either proportional or fixed based on the consumption pattern at the time of consumption. In contrast, the inherent nature of a fixed cost does not change with consumption patterns (Clinton and Keys, 2002).

Capacity Management

The resource-focus dimension of RCA stems from two facts about resources: first, resource is the main cause of cost; second, capacity resides in resources which are the store of capacity. Managing capacity and usage of resources is the basis for effectively managing costs. Through employing theoretical capacity, RCA emphasises making the unused capacity visible so that capacity can be managed. Theoretical capacity provides management with a complete disclosure of the resources available so that the whole capacity can be managed. The degree to which capacity has actually been used when compared to the available amount presents a readily visible accounting for unused resources (Clinton and Keys, 2002).

RCA recognises that costs follow output quantities consumed and, thus, are not involved in defining the consumption relationships (Clinton and Keys, 2002). The interrelationships among resource pools are actual consumption relationships, and the consumption rates represent these relationships (Xiao-yan, 2007). Costs of a resource pool are assigned based on its output consumed by the intermediate and/or final consumers. Resource quantities are monetarised based on the fixed/proportional consumption relationships.

According to the *responsiveness* principle, RCA employs a separate cost assignment rate for each of the fixed and proportional buckets. For each resource pool, both theoretical capacity and planned output quantity should be identified to set the resource pool's fixed and proportional rates used for cost assignments.

The fixed rate is equal to the total fixed cost for a resource pool divided by that pool's theoretical capacity. The proportional cost rate is obtained by dividing the resource pool's total proportional cost by its planned output quantity.

The logic behind employing theoretical capacity and planned output is that theoretical capacity represents the supply or availability of resources, while planned output quantity represents the projected demand on resource pools' output which is placed by demand on the product. In this way, the unused capacity, whether idle/excess or waste, can be accurately monetarised.

Integrating Target Costing and RCA

The main objective beyond target costing is to plan product cost reduction to the level that both satisfies customer requirements and meets the firm's target profit. This objective is accomplished through identifying the allowable and drifting costs and, accordingly, the cost gap. Then, all subsequent efforts are focused on achieving the allowable cost. RCA, on the other hand, is a consumption-based approach that focuses on how each resource pool's output is consumed by other resource pools and final products. In order to determine resource requirements, product demand is first established in quantitative terms, and then transformed into resource requirements.

As stated before, the target costing process includes three main stages; determination and achievement of target cost and continuous improvement. The integration of RCA with target costing helps improve the last two stages; achieving target cost and continuous improvement. Specifically, RCA improves the estimation of product's drifting cost as to current product design and firm's current and new manufacturing capabilities, which results in accurately determining the cost gap. In addition, RCA can be converted into feedforward mode to determine the effect of alternative product and process designs on resource consumptions (White, 2009) and thus can improve the procedures of attaining the target cost. Finally, RCA can enhance continuous improvement through identifying the resource quantities that should be reduced for continuous improvement.

Establishment of Drifting Cost

The power of target costing is its ability to apply pressure in a feedforward mode in the design stage (Cokins, 2002). Given product's projected demand, target costing provides information about the projected requirements of resources and components used to produce the product, considering firm's current production capabilities. On the other hand, RCA is highly divisible in terms of resource flows and costs and, thus, it can be easily run in reverse to assess the future demand on output of each resource pool (White, 2009). As a resource-focus and quantity-structure model, RCA translates projected requirements into projected outputs of resource pools, and maps the resource quantities projected to be consumed among resource pools, due to resource interrelationships, and by the final product. In addition, RCA provides information about the inherent and changing resource consumption patterns at the point of consumption, whether fixed or proportional. Accordingly, the cost gap is identified in a more accurate manner by establishing the drifting cost based on resource quantities and consumption patterns identified.

As to RCA model, resources are grouped into homogenous resource pools which are classified as either primary or secondary. Primary resource pools are the pools whose outputs are directly consumed by the cost object, even if they are also consumed by other resource pools. However, if a resource pool's outputs are only consumed by other resource pools, it is a secondary resource pool. The costs of the secondary resource pools are first traced to the primary resource pools as proportional or fixed, and then the total proportional and fixed costs of each primary resource pool are traced to final products.

Based on the three pillars of RCA (resource-focus, quantity-structure, and inherent/changing resource consumption patterns), equation 1 can be used to identify the projected product's demand on the outputs of a primary resource pools.

Equation 1:

$$\sum_{i=1}^{m} F_i X_i + \sum_{i=1}^{m} P_i Q_i + \sum_{i=1}^{m} P_i Y_i$$

where:

X_i is the quantity of primary resource pool (i) output consumed in a fixed pattern.

Q_i is the quantity of primary resource pool (i) output consumed proportionately.

Y_i is the quantity of primary resource pool (i) output that is inherently consumed proportionately, but consumed by the cost object in a fixed pattern.

F_i is the fixed consumption rate of primary resource pool (i) output.

P_i is the proportional consumption rate of primary resource pool (i) output.

RCA considers the fact that some resources exist to serve other resources, and that interrelationships exist between resource pools.

Once the projected demand on the outputs of primary resource pools is determined, the demand of such resource pools on the outputs of other primary and secondary resource pools should be determined, as equation 2 demonstrates.

Equation 2:

$$\sum_{i=1}^{m} F_i X_i + \sum_{i=1}^{m} P_i Q_i + \sum_{i=1}^{m} P_i Y_i + \sum_{j=1}^{n} F_j X_j + \sum_{j=1}^{n} P_j Q_j + \sum_{j=1}^{n} P_j Y_j$$
$$i = 1, 2, \ldots m$$

where:

X_i is the quantity of other primary resource pool (i) output consumed in a fixed pattern.

X_j is the quantity of secondary resource pool (j) output consumed in a fixed pattern.

Q_i is the quantity of other primary resource pool (i) output consumed proportionately.

Q_j is the quantity of secondary resource pool (j) output consumed proportionately.

Y_i is the quantity of other primary resource pool (i) output that is inherently consumed proportionately, but consumed by the cost object in a fixed pattern.

Y_j is the quantity of secondary resource pool (j) output that is inherently consumed proportionately, but consumed by the cost object in a fixed pattern.

F_i is the fixed consumption rate of other primary resource pool (i) output.

F_j is the fixed consumption rate of secondary resource pool (j) output.

P_i is the proportional consumption rate of primary resource pool (i) output.

P_j is the proportional consumption rate of secondary resource pool (j) output.

The preceding equations reflect how RCA model can capture complexity. When interrelationships between resource pools are identified, they are demonstrated through those equations. When such interrelationships do not exist, they could be eliminated from the equations. This provides an effective measure for controlling and monitoring process effectiveness.

Attaining Target Cost

After determining the cost gap, the next step is to focus efforts on narrowing or even closing the gap and determining where and how to achieve the target cost. It is the role of value engineering to study the relationship between the product's functions and the costs incurred, and evaluate alternative product designs. RCA, on the other hand, has a feedforward mode to determine the effect of alternative product and process designs on resource consumption.

The integration of value engineering and RCA provides a map of resources for each alternative product design. Value engineering should focus on the possibility of reducing the product's consumption of the outputs of resource pools that contain expensive resources or the resources whose consumption vary significantly by products, while maintaining product performance and functionality. Based on the information provided by QFD regarding customer preferences and rankings of features, and the resource-based information provided by RCA, value engineering provides information about the alternative product designs that accomplish the same product functionality while reducing product cost, so that the cost gap can be narrowed.

Based on the information provided by the work of QFD, target costing would impose the use of specific resources to achieve the target cost while still satisfying customer. For each alternative product design, value engineering highlights possible reductions in the consumption of outputs of the resource pools containing expensive resources or the resources whose consumption varies significantly by products.

In addition, a change in the demand on resources may reflect a changing nature of their consumption by the product. In this regard, the outputs of resource pools that are consumed proportionately would indicate resource consumption that is targeted for the work of value engineering and functional analysis.

In order to determine product cost according to each product design, the equation previously used to establish the product's drifting can be applied again, but for each design alternative as shown in equation 3.

Equation 3:

$$\sum_{i=1}^{m} F_i\, X_{id} + \sum_{i=1}^{m} P_i\, Q_{id} + \sum_{i=1}^{m} P_i\, Y_{id}$$

$$d = 1, 2, \ldots, D$$

where:

X_{id} is the output of primary resource pool (i) consumed in a fixed pattern by the alternative product design (d).

Q_{id} is the output of primary resource pool (i) consumed proportionately by the alternative product design (d).

Y_{id} is the output of primary resource pool (i) that is inherently consumed proportionately, but consumed by the alternative product design (d) in a fixed pattern.

F_i is the fixed consumption rate of primary resource pool (i) output.

P_i is the proportional consumption rate of primary resource pool (i) output.

Continuous Improvement

The preceding discussion about the role of target costing in narrowing the cost gap is concerned with product design stage. In manufacturing stage, RCA supports continuous improvement efforts where the effects of value engineering and improved design are already in place. RCA enhances the role of kaizen costing through identifying where resource consumption can be reduced for continuous improvement. The cost of the non-value-added resource consumption is a non-value-added cost that should be targeted for reduction or even elimination.

Benchmarking complements kaizen costing in identifying opportunities for improvement in internal processes, which will lead to superior performance. Comparing the results of an internal process with the best practice and identifying the process is not good, the benchmark may not be achieved a result of the existence of non-value-added resource consumption in the process. Benchmarking, therefore, supports kaizen costing through identifying the value-added and non-value-added costs so that the non-value-added resource consumption could be eliminated and its cost could be saved.

Case Study

Unit of Analysis

In this study, Elaraby half automatic washing machine factory, one of Elaraby Group factories located in Egypt, is chosen to be the unit of analysis. Elaraby Group has two washing machine factories, one for manufacturing half automatic washing machines and the other for manufacturing full automatic washing machines. Services provided by planning, engineering, and maintenance departments are shared by the two factories. The planning department is responsible for determining the needs of each component required to meet the projected product demand, while the engineering department is responsible for the work of value engineering.

The half automatic washing machine factory produces three models of twin tub half automatic washing machines; twin tub 7 Kg washing machines (VH-720); twin tub 10 Kg washing machines (VH-1000); and twin tub 12 Kg washing machines (VH-1210). The main inputs are metal sheets and washing and spin motors from outside local and foreign suppliers, in addition to other plastic components produced by the Plastic factory which is one of the group's factories. The production of the three washing machine models includes four main processes:

- *Metal Cabinet Forming*. The metal sheets pass through four hydraulic pistons to shape the metal cabinet of washing machine. The time required to process each metal sheet is about 30 seconds. Producing different models of washing machine requires 20 minutes set up to respond to change.

- *Assembly Processes*. The assembly process is performed through the main assembly line, starting with riveting the formed cabinets, then assembling the base, twin tub, and control panel respectively with the cabinet. The main assembly line is fed from three subassembly lines; base line, twin tub line, and control panel line. After assembling the main components, quality control tests are made at the main assembly line to ensure that washing machines meet the criteria of quality.

- *Quality Assurance*. A complete test is performed on washing machines to ensure the product meets the criteria of quality and performance. If any defect is detected, the production line will be stopped till identifying and solving the cause of such defect.

- *Packaging*. This process includes cleaning the outside surface, fixing the bottom carton base, putting accessories, and packaging and strapping the product.

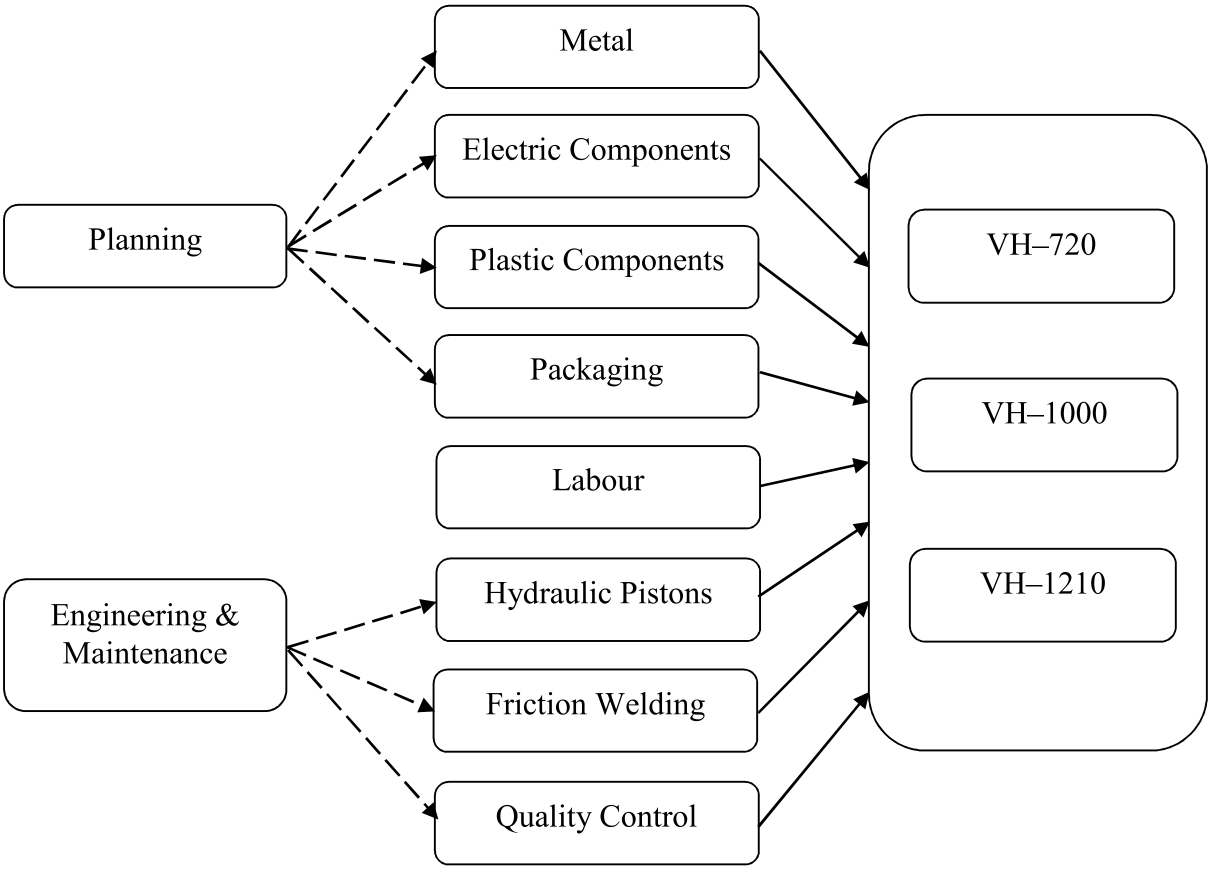
RCA in Action

Resources of the unit of analysis can be grouped into ten resource pools categorised in five major categories: materials resource pools, labour resource pool, machine resource pools, hybrid resource pools, and facilities resource pools. Materials, labour, machine, and hybrid resource pools are considered primary resource pools since their outputs are directly consumed by the cost objects. In contrast, facilities resource pools are considered secondary resource pools since their outputs are only consumed by primary resource pools; they have no direct relation with final cost objects. Figure 2 demonstrates resource flow among and from resource pools to cost objects in the unit of analysis.

Materials Resource Pools

Materials used in manufacturing washing machines include metal sheets, electric components, and plastic components. Resources acquired from one supplier can be considered 'like' resources and thus can be grouped in a single resource pool. Therefore, metal sheets, back lids, and metal rivets can be combined in metal resource pool. Electric components are grouped in as single resource pool combining wires, plugs, fuses, capacitors, knobs, and spin and wash timers. Each electric component, individually, represents a small value, while such components are capable to perform unique functions, their capacity could be determined by their available quantities, and their associated costs can be easily determined. Similarly, plastic components are grouped in a single resource pool combining twin tubs, dumbs, drain hoses, drain links, water flow cases, spin cams, and décor panel. Costs associated with material resource pools are proportional in relation to those pools' outputs.

Figure 2: RCA Model in Elaraby Washing Machine Factory



Labour Resource Pool

Supervisors, technicians, and workers in factory shop floor perform different functions. Each group of them is working on a particular assembly line, whether the main assembly line or a subassembly line, and is capable and qualified to perform such work. Labour capacity is measured in terms of their working hours (theoretical capacity of 8 hours per shift, 2 shifts per day). Labour cost is determined on the basis of hours worked, so the costs associated with labour resource pool are considered proportional in relation to the pool's output.

Machines Resource Pools

Hydraulic pistons and friction welding machine are considered expensive resources and thus should be paid special attention while establishing resource pools. Each type of machine provides a unique service to the product that cannot be performed by another type. Thus, each type of machine represents a resource pool. We group depreciation and supplies together, where supplies represent such items as the power of operating the machines as well as the coolants and lubricants used. Accordingly, costs associated with machines resource pools include both fixed and proportional buckets in relation to their output.

Hybrid Resource Pools

As to their operational capability and the work principle, some machines and labour would be combined in a single resource pool. The costs of resources grouped in a hybrid resource pool are traced to cost objects based on the relevant output measure of that pool. In this study, hybrid resource pools include quality control and packaging. Quality control resource pool combines labour and the testing operators used, while packaging resource pool combines labour, strapping machines, and packaging carton. Accordingly, costs associated with these resource pools include both fixed and proportional buckets in relation to the resource pools' outputs. The fixed bucket includes salaries and depreciation of machines involved, while the proportional bucket includes labour wages and supplies.

Facilities Resource Pools

As stated earlier, the outputs of planning, engineering, and maintenance departments are equally consumed by the half and full automatic washing machine factories. Accordingly, we considered each of these departments as a resource pool whose outputs are consumed in portion by the unit of analysis. Such resource pools are considered secondary since they do not have a direct relationship to cost objects. Costs associated with such resource pools include both fixed and proportional buckets in relation to the resource pools' outputs.

Table 1 demonstrates defining the output measure and theoretical capacity for each resource pool. In addition, the planned output quantity from each resource pool is identified based on the projected demands of each model of washing machine. Once this step is completed, fixed and proportional rates are developed. Fixed rate is calculated by dividing total resource pool’s fixed cost by the pool’s theoretical capacity. Similarly, proportional rate is calculated by dividing total resource pool’s proportional cost by the pool’s planned output quantity. Table 2 demonstrates how fixed and proportional rates are developed.

Table 1: Define output measure and Theoretical Capacity

Resource Pool	**Output Measure**	**Theoretical Capacity**	**Planned Output**
Metal	Feet of metal sheet	N/A	240,000
Electric Components	# of components	N/A	210,000
Plastic Components	# of components	N/A	210,000
Hydraulic Pistons	Machine hours	40,000	36,000
Friction Welding Machine	Machine hours	32,000	30,000
Labour	Labour hours	51,000	45,000
Quality Control	Labour hours	15,000	15,000
Packaging	Packaging hours	18,000	17,000
Planning	Labour hours	32,400	31,500
Engineering & Maintenance	Labour hours	42,000	36,000

Table 2: Develop Fixed and Proportional Rates

Resource Pool	Fixed Cost	Fixed Rate	Proportional Cost	Proportional Rate
Metal	N/A	N/A	$6,600,000	$27.50
Electric Components	N/A	N/A	4,900,000	35.00
Plastic Components	N/A	N/A	7,700,000	55.00
Hydraulic Pistons	$900,000	$22.50	540,000	15.00
Friction Welding Machine	200,000	6.25	144,000	4.80
Labour	244,800	4.80	270,000	6.00
Quality Control	75,000	5.00	75,000	5.00
Packaging	63,000	3.50	51,000	3.00
Planning	243,000	7.50	189,000	6.00
Engineering & Maintenance	285,600	6.80	288,000	8.00

RCA and Target Costing

The integration of target costing and RCA provides improved information regarding estimation of drifting cost, cost structures of design alternatives, and achieving the target cost. Equation 1 is concerned with determining product's drifting cost in light of firm's current technology and production capability. Table 3 demonstrates how drifting cost is determined for VH-1210 as to the RCA. After determining market demand for the product to be 20,000 units, it is converted into demand on output of each primary resource pool since those resource pools have direct relationship to the product. For materials resource pools, each one's output is proportionately consumed by the VH-1210. For machine resource pools, each one has both fixed and proportional buckets, where fixed labour and machine depreciation are considered fixed costs in relation to the pool's output. Assuming products equally consume the outputs of depreciation and fixed labour, Table 3 demonstrates how fixed and proportional costs are calculated.

Table 3: Drifting Cost of Product VH-1210

Resource Pools	Projected Fixed Consumption	Projected Proportional Consumption	Fixed Cost	Proportional Cost
Primary Resource Pools				
Metal	---	60,000	---	$1,650,000
Electric Components	---	70,000	---	2,450,000
Plastic Components	---	70,000	---	3,850,000
Hydraulic Pistons	N/A	12,000	$300,000	180,000
Friction Welding	N/A	10,000	70,000	48,000
Labour	17,000	15,000	81,600	90,000
Quality Control	5,000	5,000	25,000	25,000
Packaging	6,000	5,600	21,000	16,800
Total primary costs			$497,600	$8,309,800
Secondary Resource Pools				
Planning	10,800	10,500	$81,000	$63,000
Engineering & Maintenance	14,000	12,000	95,200	96,000
Total secondary costs			$176,200	$159,000
Total Product Drifting Cost			$673,800	$8,468,800
Unit Drifting Cost			33.69	423.44

Table 4: Cost of Alternative Designs of Product VH-1210

Panel A: Design A of VH-1210		
Resource Pools	**Proportional Consumption**	**Proportional Cost**
Metal	59,000	$1,620,000
Electric Components	70,000	2,450,000
Plastic Components	60,000	3,300,000
Total Cost of Components		$7,370,000
Component Unit Cost		$368.50
Panel B: Design B of VH-1210		
Resource Pools	**Proportional Consumption**	**Proportional Cost**
Metal	57,500	$1,581,250
Electric Components	66,400	2,324,000
Plastic Components	70,000	3,850,000
Total Cost of Components		$7,755,250
Component Unit Cost		$387.76

After identifying the direct relationships from primary resource pools to products, the interrelationships between resource pools are considered, and the demand of each primary resource pool on the outputs of other primary and/or secondary resource pools is placed. For simplicity, the fixed consumption of secondary resource pools' outputs is determined by assuming all the three products equally consume outputs. That is, VH-1210 bears one-third of what materials and packaging resource pools consume from planning resource pool's outputs. Similarly, the product bears one-third of what machine and quality control resource pools consume from the outputs of engineering and maintenance resource pool.

Once the firm has established product's target cost, it begins to disaggregate it to identify the target costs of the components included. Value engineering is used to support attaining the target cost by revealing cost reduction potentials at the component level through transforming those potentials into design alternatives. As previously stated, the outputs of resource pools consumed proportionately may indicate resource consumption that is targeted for the work of value engineering. Since target costing focuses on product components, the focus of cost reduction is oriented to the materials resource pools.

Table 4 demonstrates how equation 3 works. Panel A shows an alternative design of VH-1210 while panel B shows another alternative design. Both designs reflect changes in consumption of materials resource pools' outputs based on the work of value engineering. Only materials resource pools are included in the analysis since they represent the area for value engineering.

Conclusion

Target costing focuses its efforts on the design stage where there is greater potential for managing product costs therein. Target costing begins with research into the attributes and quality required by customers in a prospective product, and the price they are willing to pay for product's features. QFD is used to identify the critical customer preferences that define the desired product functionality and provide a structured approach to ensure that customer requirements are not compromised during the design process. Then, product's allowable cost is determined by subtracting the profitability required by the firm to provide the product from the set target price.

All subsequent efforts of target costing focus on achieving the allowable cost. Value engineering is used to study the relationship between product functions and costs incurred; searching for the appropriate mix that enhances customer value. Although most of cost saving are planned at the design stage, there is still a potential for cost saving at the manufacturing stage. Kaizen costing is appropriate in the manufacturing stage where the effects of value engineering and improved design are already in place.

Target costing requires cost information that has feedforward ability to assist in managing costs for future products. Such information would be relevant when provided by a costing system that has a feedforward ability to provide, in advance, more accurate information about product costs including resource consumption and cost behaviour. Thus, the focus has to be shifted from following costs to following resource quantities through a quantitative model.

RCA focuses attention on resources, their interrelationships, and how resource outputs are consumed. Therefore, integrating target costing and RCA provides cost structures of design alternatives based on a map of the resource quantities and components to be used at different product designs. Such integration also provides information about the initial and changing consumption patterns of resources, in order to accurately determine the drifting cost and how to achieve the target cost. In this way, the integration can improve the target costing process through providing improved information regarding the estimation of drifting cost, cost structures of design alternatives, closing the cost gap and achieving the target cost, and further cost reduction as part of continuous improvement.

References

Ansari, S., Bell, J., and Swenson, D. (2006). A template for implementing target costing, *Cost Management*, 20(5):20-27.

Atkinson, A. A., Kaplan, R. S., Matsumura, E. M., and Young, S. M. (2012). *Management Accounting: Information for Decision-Making and Strategy Execution*, Pearson Education Inc., Boston. USA.

Balakrishnan, R., Hansen, S., and Labro, E. (2011). Designing an effective cost system, *Statements on Management Accounting* (online), Institute of Management Accounting, www.imanet.org. (Accessed on August 5, 2015)

Balakrishnan, R., Labro, E., and Sivaramakrishnan, K. (2012). Product costs as decision aids: An analysis of alternative approaches (Part I), *Accounting Horizons,* 26(1):1-20.

Blocher, E. J., Stout, D. E., Cokins, G., and Chen, K. H. (2010*). Cost Management: Strategic Emphasis*, McGraw-Hill Irwin, New York, USA.

Bragg, S. (2010). *Cost Reduction Analysis: Tools and Strategies*, John Wiley & Sons, Inc., New Jersey, USA.

Cannon, H. and Morgan, F. (1991). A strategic pricing framework, *Journal of Business & Industrial Marketing*, 6(3-4):59-70.

Clinton, B. D. and Keys, D. E. (2002). Resource consumption accounting: The next generation of cost management systems, *Focus Magazine for the Performance Management Professional*, 5: 35-42.

Clinton, B. D and van der Merwe, A. (2008). understanding resource consumption and cost behavior—Part II, *Cost Management*, 22(4):14-20.

Cokins, G. (2002). Integrating target costing and ABC, *Journal of Cost Management*, 16(4):13-22.

Cooper, R. and Kaplan, R. S. (1988). Measure costs right: Make the right decisions, *Harvard Business Review*, Western Academic Press, May, 66(5): 96- 103.

Cooper, R. and Slagmulder, R. (2005). Target costing for new-product development, in R. L. Weil and M. W. Maher (Ed.) *Handbook of Cost Management*, John Wiley & Sons Inc., New Jersey, USA: 243-270.

El-Helbawy, S. and El-Nashar, T. (2013*). Advanced Management Accounting: Cost Management Approach* (in Arabic), Ghobashy Press, Tanta, Egypt.

Hilton, R. W. (2008). *Managerial Accounting: Creating Value in a Dynamic Business Environment*, McGraw-Hill Irwin, Boston, USA.

IMA (1998). Implementing target costing, *Statements on Management Accounting* (online), Institute of Management Accountants, www.imanet.org. (Accessed on August 5, 2015)

Jariri, F. and Zegordi, S.H. (2008). Quality function deployment, value engineering and target costing, an integrated framework in design cost Management: A mathematical programming approach, *Scientia Iranica*, 15 (3): 405-411.

Kaplan, R. S. and Cooper, R. (1998). *Cost & Effect: Using Integrated Cost Systems to Drive Profitability and Performance,* Harvard Business School Press, Boston, Massachusetts, USA.

Kee, R. (2010). The sufficiency of target costing for evaluating production-related decisions, *International Journal of Production Economics*, 126(2):204-211.

Kee, R. and Matherly, M. (2013). Target costing in the presence of product and production interdependencies, in M. J. Epstein and J. Y. Lee (Ed.) *Advances in Management Accounting*, 22: 135-158.

Lai, Z., Xie, M., Tan, K.C., and Yang, B. (2008). Ranking of customer requirements in a competitive environment, *Computers and Industrial Engineering*, 54 (2): 202-214.

Pazarceviren, S. Y. and Celayir, D. (2013). Target costing based on the activity-based costing method and a model proposal, *European Scientific Journal*, special edition, 4:1-21.

Ratnatunga, J. and Waldmann, E. (2003). A marketing approach to service quality in accounting: A case study, *Journal of Business and Economics Research,* Western Academic Press, May, 2(5):29-43.

Sani, A. A. and Allahverdizadeh, M. (2012). Target and kaizen costing, *World Academy of Science, Engineering and Technology*, 6(2):40-46.

Sarokolaee, M. A., Taghizadeh, V., and Ebrati, M. (2012). the relationship between target costing and value-based pricing and presenting an aggregate model based on customers' expectations, *Procedia - Social and Behavioral Sciences*, 41:74-83

Tse, M.C.S and Gong M.Z. (2009), Recognition of idle resources in time-driven activity-based costing and resource consumption accounting models*, Journal of Applied Management Accounting Research,* 7(2):41-54.

Webber, S. and Clinton, B. D. (2004). Resource consumption accounting applied: The Clopay case, *Management Accounting Quarterly*, 6(1):1-14.

White, L. (2009). Resource consumption accounting: Manager-focused management accounting, *The Journal of Corporate Accounting and Finance*, 20(4):63-77.

White, L. (2011). RCA recognized as highest level approach, *Alta Via Consulting, LLC (online),* www.altavia.com.

Xiao-yan, Z. (2007). Authorized variance analysis with consumption rate, *Journal of Modern Accounting and Auditing*, 3(4):42-46.

Yoshikawa, T., Innes, J., and Mitchell, F. (1990). Cost tables: A foundation of Japanese cost management, *Journal of Cost Management*, Fall: 4(3): 30-36.

Yu-Lee, R. T. (2002). Target costing: What you see is not what you get, *Journal of Cost Management*, 3(4):23-28.

Zengin, Y. and Ada, E. (2010). Cost management through product design: Target costing approach, *International Journal of Production Research*, 48(19):5593-5611.