DOKUZ EYLÜL UNIVERSITY

GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES

TARGET COSTING AND NEW PRODUCT DESIGN IN A MANUFACTURING COMPANY

by

Güntaç KOCATÜRK

February, 2006

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AND NEW PRODUCT DESIGN
IN A
MANUFACTURING COMPANY

A Thesis Submitted to the
Graduate School of Natural and Applied Sciences of Dokuz Eylül University
In Partial Fulfillment of the Requirements for the Degree of Master of Science
in Industrial Engineering, Industrial Engineering Program

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M.Sc THESIS EXAMINATION RESULT FORM

We have read the thesis entitled **"THESIS TITLE"** completed by **STUDENT NAME** under supervision of **TITLE AND NAME OF THE SUPERVISOR** and we certify that in our opinion it is fully adequate, in scope and in quality, as a thesis for the degree of Master of Science.

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Prof. Dr. Edip TEKER

Supervisor

(Jury Member) (Jury Member)

Prof.Dr. Cahit HELVACI
Director
Graduate School of Natural and Applied Sciences

ACKNOWLEDGEMENTS

This thesis is by far the most significant accomplishment in my self-life and in my business-life. It would be impossible without people who supported me.

Most of all I would like to thank my research advisor, Prof. Dr. Edip TEKER for his valuable advice, encouragement and guidance of this thesis. His trust inspired me in the most important moments of making right decisions and I am glad to work with him. I would also like to express my special thanks again to him for giving me the opportunity to share her experience and insights during this process that inspired creativity and motivation.

I am grateful to all of the personnel of the manufacturing company DEKORPAN who helped me to gather the data of the study.

I also want to express my special gratitude to Cengiz and Reyhan Baltacı for their encouragement. Without their help, I would not have finished the degree.

Special thanks to Gamze Öztuzcu and Sezgi Özen for their continuous support and friendship.

Special thanks to Gül Yılmaz and Mehmet Kılıç for their professional supports.

Finally, I wish to express thanks to all my family. Therefore, I dedicate this thesis to my family; Metin, Emine, Berna and Belma Kocatürk, who have provided me constant support, endless love, patience and encouragement throughout my whole life. I am particularly grateful to them.

Güntaç KOCATÜRK

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ABSTRACT

Increased competition and increased costs of designing made it important for the firms to identify the right products and the right methods for manufacturing the products. Firms should focus on customers and identify customer demands directly to design the right products. Several management methods and techniques that are currently available improve one or more functions or processes in an industry and do not take the complete product life cycle into consideration.

On the other hand target costing is a method / philosophy that takes financial, manufacturing and customer aspects into consideration during designing phase and helps firms in making product design decisions to increase the profit / value of the company. It uses various techniques to identify customer demands, to decrease costs of manufacturing and finally to achieve strategic goals. Target Costing forms an integral part of total product design / redesign based on strategic plans. The current report details the process of target costing along with some associated techniques and applies the process to the designing of the DEKORPAN Towel Radiators.

Keywords: Target Costing, Target Cost Management, Cost Management, Activity Based Costing, New product design.

BİR İMALAT İŞLETMESİNDE HEDEF MALİYETLENDİRME VE YENİ ÜRÜN TASARIMI

ÖZ

Yükselen rekabet ortamı ve artan tasarım maliyetleri, ürünün üretilmesi için doğru malzemelerin ve doğru metodların kullanılmasını önemli hala getirdi. Firmaların müşterilere odaklanmaları ve “doğru ürün” için müşteri taleplerini direct olarak ürün dizaynına yansıtılması önem kazmaktadır. Çoğu yönetim metodları ve teknikleri bir endüstrideki birkaç fonksiyon ya da süreci geliştirmeye yöneliktir ve bunlar tüm bir ürün oluşum sürecini göz önüne almazlar.

Diğer bir taraftan da; hedef maliyetlendirme; ürünün tasarım aşamasına, finansal, imalat ve müşteri taleplerini yansıtan bir method/felsefedir ve firmalara, firma kar/değer oranlarının artması için ürün tasarım geliştirmesinde yardımcıdır. Hedef Maliyetlendirme; müşteri taleplerini teşhis etmek, maliyetleri azaltmak ve sonuç olarak da stratejik hedefleri oluşturmak için birçok teknik kullanır. Hedef Maliyetlendirme tasarımların önemli bir parçası olarak, stratejik planlara ait, tüm ürün tasarımlarını ve/veya revize tasarımlarını şekillendirir. Bu tez; hedef maliyetlendirmenin aşamalarını, birçok birleştirilmiş teknikle birlikte incelemiş ve DEKORPAN Havlu Radyatörleri Ltd Şti ‘de yeni bir tasarım üzerinde uygulanmıştır.

Anahtar Sözcükler: Hedef Maliyetlendirme, Hedef maliyet Yönetimi, Maliyet Yönetimi, Süreç Tabanlı Maliyetlendirme, Yeni Ürün Tasarımı.

ABBREVIATIONS

Activity Based Budgeting……………………………………………………..ABB

Activity Based Costing……………………………………………………..ABC

Activity Based Management ……………………………………………....ABM

Analytic Hierarchy Process………………………………………...….AHP

Balanced Scorecards …...……………………………………………………BC

Component cost analysis ……………………………………………….…..CCA

Computer Aided Design ……………………………………………….. CAD

Computer Aided Manufacturing …. …………………………………………CAM

Computer Integrated Manufacturing ………………………………………… CIM

Cost Management …………………………………………………………….. CM

Cost of Quality …………………………………………………………………COQ

Customer voice analysis ……………………………….………………..CVA

Design for Manufacture and Assembly ………………………………... DFMA

European Economic Commitee ……………………………………….…EEC

Equipment Manufacturers Institute …………………………………….…. EMI

Functional Cost Analysis ……………………………………………………..FCA

Functional Costing …………………………………………………………… FC

Kaizen Costing ……………………………………………………………...KC

Life Cycle Budgeting …………………………………………………………LCB

Quality Function Deployment …………………………………………...……QFD

Process Costing ……………………………………..………………….PC

Relationship Matrix ………………………………………………………...RM

Return on Investment …………………………………………………………ROI

Return on Sales …………………………………………………………….…ROS

Standard Costing ………………………………………………………………SC

Strategic Investment Decisions ………………………………………………..SID

Strategic Management Accounting …………………………………………SMA

Target Costing ……………………………………………………………………TC

Target Pricing ……………………………………………………………………...YP

Target Cost Management ………………………………………………………TCM

Theory Of Constraints …………………………………………………………...TOC

Throughput Accounting ……………………………………………………………..TA

Total Quality Manegement …………………………………………………...TQM

Value Engineering …………………………………………………………………...VE

Variable Costing ……………………………………………………………………..VC

Variance Analysis …………………………………………………………...…….VA

Work In Process ……………………………………………………………….WIP

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CHAPTER ONE
INTRODUCTION

1.1 Objectives

Increased competition and vocal customers have made it imperative that every company should upgrade its processes constantly to stay ahead of the competition. This is achieved mainly through design and process designs and cost reductions. The process of actual designing is product-dependent and it is more important to identify the aspects of products that require designing than the process of designing. Target costing is a strategic tool for planning that takes a holistic view of products and their sub-assemblies and identifies the opportunities for cost reduction and product improvement. Target costing also uses various techniques to set and achieve the goals based on the strategic plans of a company.

The objective of the current report is to describe the process of target costing for total product re-designing. This is achieved through the following steps.

- The concept of target costing is explained along with the various tools that are used. The managerial aspects that need to be considered are mentioned. The concepts of designing and cost reduction are also considered in the process.

- The introduction of the **DEKORPAN TOWEL FARMER** is analyzed retroactively with the help of target costing.

1.2 Thesis Outline

This report shows the implementation of target costing and analyzes the managerial aspects of target costing from the perspective of a manufacturing firm. The cost management and cost management tools have been presented in Chapter 2. Target costing concept and literature review is presented in Chapter 3. Chapter 4 deals with the role of target costing in product re-designing to be competitive, and studies the aspects of implementation from the practitioner's view. Chapter 4 illustrates the re-designing process stages. Also, target costing process steps and factors influencing Target costing process are presented in Chapter 5. A case study about implementing target costing and new product design in a manufacturing company, DEKORPAN, presented in Chapter 6. And finally, a conclusion ,regarding target costing and new product design based on the case study, is described in Chapter 7.

CHAPTER TWO
COST MANAGEMENT

2.1 Cost management

Cost management is currently one of the main topics of interest in the area of project management. This is particularly true as high technology companies, which until recently were mainly concerned with time-based competition, are being increasingly subjected, especially under the highly competitive conditions that are prevalent today, to cost-based competition. The need to improve project cost control has been emphasized by Nixon (1998), Jorgensen and Stein (2000) and Kinsella (2002), among others.

This chapter examines; project managers' perceptions of the contribution of various cost management tools to improvement of the organization's cost management system.

Project cost management is concerned with ensuring that the project is completed within the approved budget, and includes the processes of resource planning, cost estimation, cost budgeting and cost control. The management accounting discipline has developed various planning and control tools and concepts for these processes, including: costing systems (such as Job Order Costing and Process Costing) to track the flow of costs related to the project; overhead allocation methods, such as the traditional method that allocates overhead costs to projects on the basis of hours or months used, and Activity Based Costing (ABC) method that derives the cost of a project as the sum of the costs of the activities undertaken to produce the project while accounting for various levels of overhead; budgeting, as a central mean for cost planning and cost control throughout the entire life cycle of projects; Target Costing and Target Pricing aimed at ensuring the project's profitability; Value Engineering which seeks to reduce non-value-added activities and hence non-value-added costs, as well as Standard Costing and Variance Analysis as important managerial control tools.

Some of these cost management tools and techniques have been acknowledged in the traditional industry sectors as highly successful in improving firms' operating results and performance (Horngren et al., 2003).

2.2 Cost Management Tools

Cost Management is the area in accounting that deals with methods of costing products and services, and provides managers with information relevant to planning and control of costs in the short run and in the long run (Horngren et al., 2003). Six major cost management tools have been selected for inclusion in this study and will be briefly introduced next.

2.2.1 Costing systems that follow the flow of costs.

There are two main costing systems that are being used by organizations - Job Order Costing system and Process Costing system. In a Job Order Costing system the cost object is a unit or multiple units of a distinct product or service called a job. Costs are collected for each job separately, and the individual jobs are identified as separate work units. The jobs have clear start and finish times, and include units that are uniquely identifiable. In the context of projects, the Job Order Costing system can be applied to activities or segments between milestones, to specific work packages, or even to an entire project. Most organizations in the high-technology sector use Job Order Costing systems due to the nature of their projects. Conversely, in a Process Costing system the cost object consists of masses of identical or similar units of a product or a service. In typical Process Costing systems, conversion costs (labor and overhead costs) are accumulated uniformly throughout the process, whereas material costs are added at discrete points of completion in the process. Cooper and Kaplan 1999) claim that over the long run projects with few milestones adopt the characteristics of Process Costing. Typically, bothsystems are applied within Standard Costing, which establishes predetermined standards for the cost of the inputs.

2.2.2 Overhead cost allocation methods

Overhead allocation is required whenever the manufacturing of a product or the delivery of a service involve costs that cannot be directly traced to these cost objects. Traditional overhead allocation methods use a simplified approach, which amounts to assignment of overhead to cost objects on the basis of a single allocation rate, say on the basis of man/months that were used in a project. A relatively modern pproach, called Activity Based Costing (ABC), has been attributed with success and with providing insights to managers regarding their resource consumption. The basic premise behind ABC is that overhead costs are incurred with relationship to more than a single, volume-based, cost driver. The ABC method recognizes a hierarchy of cost-drivers and overhead costs, and accumulates the costs at the product or service level according to the amount of specific activities that were consumed by the product or service. The original ABC hierarchy was developed in the manufacturing environment, as described in Cooper and Kaplan (1999). Raz and Elnathan (1999) adapt the ABC hierarchy and apply it to projects. They include cost drivers at the work unit level, deliverable level, project-support level, and organizational-support level. Kinsella (2002) offers an analysis of ABC, points out to its usefulness for project cost management and concludes that its use may result in cost figures that in many cases are significantly different from those obtained under traditional accounting.

2.2.3 Budgeting

Horngren et al., (2003) define the budget as a quantitative expression of a proposed plan of action by management for a specified period, and an aid to coordinating what needs to be done to implement the plan. The budget describes in financial terms the future activities of the organization during the period for which it is prepared, and serves as a basis for comparison between plans and actual activities. More specifically, in this context a distinction is made between a static budget, which is based on the level of planned activities and a flexible budget, which takes into account the actual level of activity for the period, and is thus more useful. In particular, in a dynamic environment, the flexible budget provides more informative data and allows for a better Variance Analysis (see below). Frank (1998) notes that many organizations use the flexible budget, which allows for budget changes when economic conditions change. Jorgensen and Stein (2000) write about improvement in project cost estimation when managerial flexibility is taken into account during the planning of the budget.

Of particular interest for project managers is Life Cycle Budgeting, which span the entire planned life cycle of the project and therefore extend beyond the short term, operational budget. Life Cycle Budgeting is the process of estimating and accumulating costs over a product's entire life (Kaplan and Atkinson, 1998). It is particularly important in environments in which there are larger planning and development costs or large product abandonment costs. Kaplan and Atkinson (1998) mention the three broad purposes of Life Cycle Budgeting: develop a sense of the total costs associated with the product or project; identify the product's environmental cost consequences and spur action to reduce or eliminate these costs; and identify the planning and decommissioning costs during the product and process design phase in order to control and manage costs in this phase.

2.2.4 Target Costing / Target Pricing.

Target Costing is a cost management tool that planners use during product and process design to drive improvement efforts aimed at reducing the product's future manufacturing costs (Kaplan and Atkinson, 1998). Target Costing is price-led and customer oriented - it begins with price, quality, and functionality requirements as defined by the customers. This is in contrast to cost-plus pricing methods, which are cost-led (Horngren et al., 2003). Cooper and Kaplan (1999) write: "in the Target Costing approach, the cost of a new product is no longer an outcome from the product design process; it becomes an input into the process". Ansari and Bell (1996) argue that Target Costing is better suited to meet the needs of organizations in today's competitive environment.

2.2.5 Value Engineering.

Value Engineering is the systematic evaluation of all aspects of the value-chain business functions, with the objective of reducing costs while satisfying customers' needs (Horngren et al., 2003). Laszlo (1997) writes that the purpose of Value Engineering is to improve quality, and reduce inefficiency and waste for the end user - the customer. Value Engineering seeks to reduce non-value-added activities and hence non-valueadded costs, on the one hand, and enhance greater efficiency in value-added activities in order to reduce value-added costs, on the other. Value-added costs are those that, when removed, reduce the value or the perceived benefits that customers obtain from a particular product or service (Horngren et al., 2003). Epstein and Young (1999) claim that using such management tools improves the capital investment decisions.

2.2.6 Standard Costing and Variance Analysis.

Standard Costing is a method that relies on pre-established rates (standards) of consumption for inputs. It traces direct costs to the produced output by multiplying the standard prices or rates of direct cost items, such as materials and labor, by the standard quantities of those inputs that were allowed for actual outputs produced. As for the indirect costs (overhead) - those are allocated on the basis of the standard indirect rates and the standard quantities of the allocation bases allowed, for the actual output produced (Horngren et al., 2003).

Variance Analysis is a longstanding and widely used managerial control tool. Variance is the difference between a target level of revenues or costs and the realized level of that item. The variance is a signal that the assumptions underlying the financial plans were not realized (Kaplan and Atkinson, 1998). Managers use Variance Analysis in their planning and control decisions. In the planning process they focus on areas where the variances are large - and thus where actual results deviate most significantly from plans. By doing so, they use limited managerial resources more efficiently, directing them to areas of operations where they are needed most and where they are more likely to yield the higher return. Variances are then used in performance evaluation, a central control procedure. Managers are expected to meet their targets (standards) and when they do, as indicated by low variances, their evaluation and rewards reflect it favorably (Horngren et al., 2003). Frank (1998) notes that in the project planning process, the costs are estimated for each of the tasks that make up the entire project. The estimated costs then become the project's standard costs. After each task has been completed, the standard costs are compared with the actual costs to arrive at the variances.

2.3 Modern Cost Management Techniques

After decades relative stability in cost accounting, the increasingly competitive environment through the 1980s and 1990s has been the prime stimulus for a range of new developments in cost identification, cost management and, possibly to a lesser extent, in broader aspects of financial control concerned with responsibility accounting. These developments were mainly initiated in companies related to the motor industry and high-tech companies in industries like computing and electronics where the competitive threat from Japan in particular was severe, although changes in cost accounting practice were by no means observable only within such industries.

These developments have not, however, spread widely to the civil engineering industry. This section examines, outline the current state of the art in cost accounting and cost management theory and practice in manufacturing industry.

2.3.1 Activity Based Costing (ABC) And Activity Based Management (ABM)

There are two traditional forms of product costing: full Absorption costing and Variable (sometimes called marginal) costing. Under absorption costing the cost of products is estimated to include all direct and indirect manufacturing costs irrespective of whether they are variable or fixed in relation to changes in the level of output produced. Direct product cost is defined as those costs which can be easily traced direct to the product. Hence, the cost of the material content of a finished product and the cost of labour working directly on the production line are, traditionally, the prime elements of direct product cost. Indirect manufacturing costs are all other costs incurred in the manufacturing process.

The manufacturing costs of products under absorption costing are used to specify inventory amounts in the balance sheet and trading account where the valuation rule is to show stocks at the lower of their manufacturing cost or market value. For internal management purposes, businesses may also wish to attribute a share of non manufacturing costs to individual products or product groups in order to compare the full cost with selling price and thereby determine the profitability of each product or product group.

Variable costing differs from full absorption costing in only one key respect. Only variable costs (i.e. those assumed to change in strict proportion to changes in the level of output) are considered to be the costs of products. This will include both direct and indirect variable costs. For balance sheet and trading account purposes this will mean that the cost of stocks is based on only variable manufacturing costs. But, for management purposes, businesses may attribute both manufacturing and non manufacturing variable costs to products in order to estimate each product's (or product group's) contribution towards profits and fixed period costs. (The contribution for a product is simply its selling price minus the variable cost per unit). Under variable costing, fixed costs are simply treated as a cost of doing business in the period and not a product cost.

It is important to recognise that under both absorption costing and variable costing, product cost will be the sum of direct costs plus a share of indirect costs. Under absorption costing both fixed and variable indirect costs are assigned to products; under variable costing only variable indirect costs are assigned to products. It is important to stress this because debates about cost accounting are often conducted as though the overhead cost allocation problem arises only in absorption when it also arises in variable costing although to less extent.

Unless otherwise stated, the following description in this section of the paper applies to absorption costing. In addition, the cost allocation in a manufacturing firm will be described because that is where Activity Based Costing (ABC) originated.

Activity Based Costing concerns itself with the way in which indirect costs (all indirect costs including both manufacturing and non-manufacturing indirect costs) are best associated with the production of different products and product groups. It is , therefore, necessary to consider the traditional method for doing this, before considering what changes supporters of ABC propose. Of course, systems of cost allocation will vary from firm to firm, but one can describe the traditional nature of general practice.

Conventionally, the cost of products for balance sheet purposes was constructed as follows:

Direct product cost (direct materials plus direct labour costs)

plus

Indirect manufacturing costs

equals

Total manufacturing cost

To obtain a full cost estimate, including non-manufacturing overheads, for management purposes, it was often convention simply to add a percentage of Total manufacturing cost to cover non-manufacturing costs.

Indirect manufacturing costs for each product (product group) were usually assigned to products through a two stage process. First, one would separate out the indirect costs incurred directly in the manufacturing processes (e.g. plant depreciation, supervisors’ wages, factory cleaning, costs of utilities) from the costs incurred in service operations (e.g. personnel, buildings and grounds, machine maintenance) which supported manufacturing. More sophisticated systems would trace costs of support services to different production departments using factors which seemed most appropriate. For example, one might use number of employees in each production department to allocate personnel costs, square footage to allocate buildings and ground costs or actual work tickets to charge out machine maintenance. The support services costs would then be added to the indirect product costs incurred in each production department and the sum of the two would be allocated to products which used the processes in each production department. The allocation of the indirect product costs to products was traditionally, and still is widely, performed on a direct labour basis. That is the total indirect manufacturing cost in each department forecast for the year would divided by the budgeted number of products to be produced times the estimated labour hours required to produce each one - this would yield an indirect cost per labour hour which would be multiplied by the actual hours taken in that department by each product in order to work out its share of indirect manufacturing costs. Figure 2.1 outlines the whole system.

Figure 2.1 shows costs of four Service Departments assigned and added to the indirect product costs incurred in two Production Departments (PD1 and PD2) which are then allocated to products at rates appropriate for each product as it passes through each Production Department. Some systems also re-allocate costs between Service Departments before assigning them to Production Departments. Some systems do not differentiate between separate production departments, but use one blanket rate for allocating overheads to products related to total labour hours used by products in all stages of production.

Traditional systems do not necessarily use labour hour bases for overhead allocation. Other bases used include a direct labour cost basis, a direct materials cost basis or machine hours basis with a tendency towards a growth in the latter as production becomes more dominated by technology in many industries. ABC advocates usually claim, however, that the labour hour or labour cost basis is still the most widely used basis.

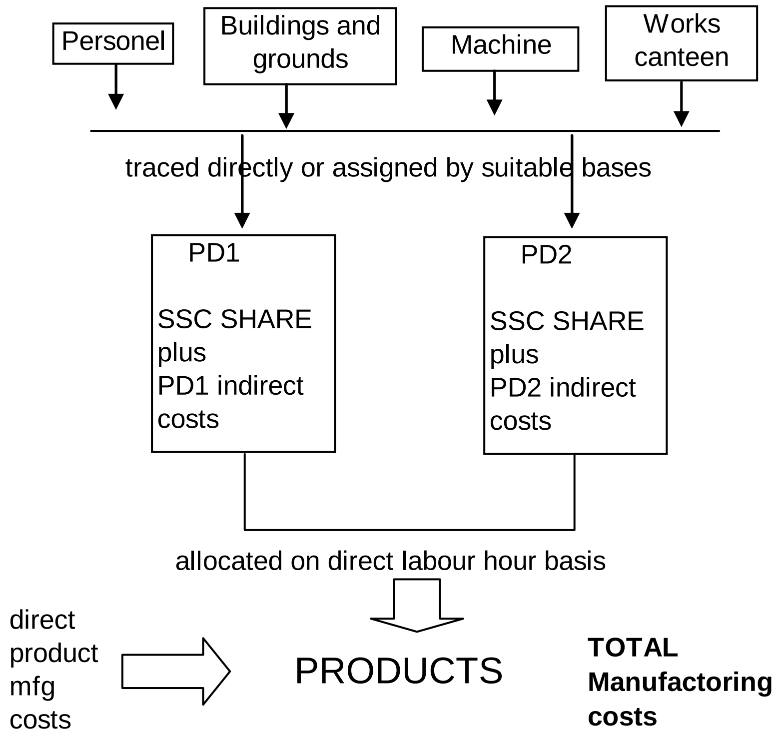

Figure 2.1 Allocation of manufacturing indirect costs to add to direct product costs to determine total manufacturing costs. (Carr. C. and C. Tomkins 1997)

Having described a traditional cost allocation system, it will now be possible to demonstrate the essential difference of that system from ABC.

ABC supporters argue primarily that costs in modern manufacturing firms, with their reliance on CAD / CAM and CIM are less and less driven by the employment of direct labour. Moreover, a large proportion of costs do not vary with other measures of production volume either (e.g machine hours). The ABC position is that if one wants to understand fully how costs change, one needs to establish exactly what the determinants of costs are. This applies both to manufacturing and non-manufacturing costs. One needs, in other words, to discover what drives costs. While ABC supporters would agree that many costs may still vary according to the number of direct labour hours or machine hours worked, a growing element of total costs have different cost drivers. These might, for example, be the number of set-ups required for production or the number of orders placed to procure materials or the number of deliveries to be made to customers. If different products, production batches or product groups have a different call for numbers of production set-ups, etc., then it will only be possible to estimate an accurate product (product batch, product group) cost by reference to these cost drivers.

The difference between ABC and conventional absorption cost accounting is, fundamentally, no more than that. In fact some have argued that it was always possible for a variety of cost drivers to be made in traditional systems and so ABC systems are not really significantly different. The principal advocates of ABC respond that even if this is so, companies have not, in general, been operating that way and they are concerned more with changing practice than debating the appropriate terminology. Moreover, ABC eschews allocating costs first to Production Departments if it is not necessary and it also applies the cost-driver logic to all costs and not just manufacturing costs.

Many companies in many industries have now experimented with or applied ABC. Notable case studies exist which indicate that, where companies have introduced ABC, it has radically changed their perception of the profitability of different products compared to that held under previous costing systems dominated more by labour cost / hour bases of overhead allocation. Some found that many products that they were producing were, in fact, loss making and that they had simply not realised this. Several notable companies have significantly changed their long run product mix strategies as a consequence. It is also noticeable that the spur for change for some of these companies was a realisation that past profitability was disappearing in the face of increased competition and that a better understanding of their product costs was vital to meet this threat. For such companies, ABC was a vehicle for product pruning and “downsizing” which enabled them to refocus on their profitable core business. Initially, therefore, one might have conceived of ABC as a “corporate turnaround tool”. Something required when a company is in need of a radical re-think of where it will operate in future if it is to remain profitable. The implication is that, once profitability, returns, ABC does not become so critical. In addition, it may not be necessary to use a full-blown ABC system for regular cost control at ,say ,monthly intervals where product mixes are not changed frequently and total product costs do not change radically. Hence, ABC analyses, which can be rather detailed, may only be needed when strategic reviews of product mix takes place.

Other accountants have, however, stressed that is fundamental to know exactly how costs are generated if one wants to try continually to manage costs down. A vital part of continuing improvement is, therefore, up-to-date ABC based estimates of costs. Only then can one see the cost consequences of changing the batch size (number of set-ups) or numbers of orders placed or delivery times and frequencies or other key cost drivers. Even a company not under threat may, therefore, need ABC estimates in order to keep free from threats by remaining, for example, a cost leader in the industry.

Activity Based Costing then becomes the basis of Activity Based Management. Budgets can also be drawn up on such a basis integrating activity based cost savings with budget targets (Activity Based Budgeting).

Once one moves in that direction, however, it is important to note that the type of cost drivers discussed by advocates of ABC are usually only first level cost drivers. While the number of set-ups may well determine the level of a significant part of manufacturing overheads given the existing plant layout, the number of set-ups themselves may be determined in part by the plant layout. The plant layout may in turn be partly a function of the type of plant used or the factory space available of the particular location of the plant. Hence, there is really a complete hierarchy of cost drivers above the first level cost drivers used in ABC product costing which stretches up, in theory, to the existence of the whole entity itself. Consequently, cost reduction programmes should not just be confined to the use of “conventional” ABC data, but should also consider “re-engineering” processes in more radical form. The advantages of operating at this higher level of cost driver may swamp the benefits to be derived from modifications to production and non-production processes derived from insights gained by ABC. But then they may not - and radical re-engineering is not always feasible or necessary. The specific context in which cost reduction is being sought will be important in determining the cost reduction approach to be adopted.

2.3.2 Cost of Quality Calculations in Support Of TQM

Quite a different, and rather earlier, accounting development introduced the idea of calculating the cost of not getting things right first time. This has been termed the Cost of Quality (COQ) but should perhaps have been called the cost of poor quality or the cost of non-compliance. This development grew out of TQM developments and the Japanese pressures to reduce parts per million defects. It is sometimes stated that the Japanese did not extend their development of TQM to link with accounting in the form of COQ procedures and that these were a product of more Western thinking. One argument for this is that, initially, the Japanese realised that they had to get defect rates down in terms of delivered products to customers as a key plank of their marketing strategy and that this then fed back through the total production process and led to a focus on moving to zero defects as a physical process rather than wanting to know the costs that could be saved. In the West, it is sometimes argued that many senior company executives had to be convinced first that this was an appropriate policy to adopt and COQ estimates were developed as a means of convincing such executives that a move to radical defect reduction could have a major impact on the bottom line.

It is important to realise what "quality" means in this context. Quality means producing something or giving a service which complies with a pre-determined specification and achieving that first time without the need for alterations or amendment. The COQ is, however, more than just re-work costs, although that may constitute a significant element of COQ.

Most applications of this concept have attempted to estimate costs in four categories:

- Prevention costs
- Inspection costs
- Costs of errors discovered on the firm's premises
- Costs of errors only discovered once the goods have left the firm

Prevention costs are incurred by all those activities which are undertaken because the firm cannot trust everything to be done right first time without those activities. This might include training, planning, supplier assurance, analysis of data to prevent future failure and, indeed the cost of COQ programmes themselves. Inspection costs include the costs of all those activities that are undertaken to ensure that errors have not occurred. These will include testing equipment, inspecting work-in-progress and finished goods, inspecting goods received, inspecting stock levels and condition. Costs of errors are usually divided, as above, into internal failures and external failures. Internal failures might include the cost of scrap materials and scrapped items, the cost of re-work, the cost of defect analysis, re-inspection and testing, sub-contractor failures, etc. External failures will include penalties and warranty claims, the costs of handling, examining and reworking returned goods, and, where possible, should also include the cost of lost goodwill or future business.

By undertaking a COQ analysis, it is possible to see the total estimated costs of not getting things right first time. Such costs are not visible in conventional accounting statements and usually need some effort to obtain.

Studies in various industries have suggested that companies that have not undertaken such exercises before often discover that something of the order of 20% of total costs are incurred through failures. This does not mean that those companies can immediately get rid of those costs. Management methods have to be found to ensure that errors do not occur. Practices and organisational culture has to change. Operatives have to accept responsibility for ensuring that errors are not made and given the necessary support and training to do that. Often this leads to increases in Prevention costs in the short run - especially relating to improved planning. However, internal and external failure costs are usually heavier than prevention and inspection costs, especially if any errors still remaining are discovered earlier in the production process, and so there will be net gains even in the short run. As the error rate improves, it should then be possible to work on reducing prevention and inspection costs.

There has been much debate over the value of COQ estimates. Some managers, like the Japanese apparently, argue that there is no need to estimate COQ costs, companies should just focus upon avoiding errors. Others see the value of having COQ estimates to convince senior managers that quality control has huge potential for increasing profits. Even a 10% savings in total costs will do wonders for the "bottom line". Some have argued that they agree with this, but feel that once the improved quality consciousness is instilled into the organisation, one can dispense with the COQ estimates. Others, especially in industries where products are regularly redesigned and new ones, with relatively short life cycles, introduced, have linked up the notion of COQ improvement with notions of the "learning curve" and monitor production cell achievement against standard time-cost reduction curves (sometimes referred to as half-life functions).

2.3.3 Target Costing

Target costing has been given much more attention in Japan, but is increasingly being taken up in the West. It is linked with both Functional Cost Analysis and Value Engineering in order to design products and services which have the attributes that the market requires at the price that it is prepared to pay.

The initial step is to study the market place to identify the attributes that the next generation of products must have and the maximum selling price. This does not mean that the company simply provides what the market says it wants. The company may have superior knowledge of what can be provided. Depending on the type of market, there may well need to be considerable interaction between supplier and customer at this stage to decide on the bundle of attributes that will best meet the customer's needs (this may extend to trying to understand the customer's customers needs too). This will usually also involve a marketing analysis to identify market segments and how product attributes fit with each segment. It will also involve understanding the capacities of rival companies to deliver such attributes at the relevant costs.

The next stage of the target costing process is to identify what activities the company must embark upon in order to deliver those product attributes. These activities are then costed and the total cost compared to the cost level likely to be consistent with selling at the acceptable market price after deducting a desired profit. In the event that the allowable cost exceeds the predicted cost, the company then embarks upon Functional Costing and Value Engineering routines to identify where costs can be reduced without destroying the required product attributes. This process continues until the predicted cost has been reduced to a level which, with a profit margin added, is consistent with the required market price. When this stage has been achieved, the company is ready to go ahead with its plans for investment in order to produce the product in question.

Functional Cost Analysis and Value Engineering both contribute to the search for viable cost reductions within this process. In outline, Value Engineering employs multidisciplinary or multi-functional teams to examine the specification of the product and, through intensive and creative study, reconsider how that specification can be delivered with alternate product designs or through different production processes. This Value Engineering process usually has at least two main stages: the first, early in the concept development stage, considers more radical design alternatives in terms of changing major components provided that the service required from the product can still be delivered. The second stage, coming after the concept has been largely set, usually uses separate teams to address different parts of the product design to see whether the functionality of those specific parts can be increased at no extra cost or whether the part can be reduced in cost with no loss of functionality.

Functional Cost Analysis may be used at both levels to help to focus this search by comparing the actual cost of incorporating different attributes into the product with its value as perceived by the customer / market place. The value attached by customers to particular and specific product features is not obvious from market data. Customers buy products as bundles of attributes for an all-encompassing price. There may be evidence of product variations and different market prices, but this is unlikely to be sufficient to identify the separate values of all major attributes. One approach to resolving this question is to ask customers (or company staff acting as if they were customers) to give weights indicating the relative importance attached to each of the main product attributes. The total product price is then allocated over the components according to those weights and the “product price allocation” for each attribute compared to its costs. Clearly one may question how rigorous such a process is for arriving at the precise market value of each attribute, but that would be to miss the point. The aim is to get an approximate idea of the monetary value of each attribute. If such an estimate is far below the cost of incorporating it into the product, this is taken as a signal that here is an area that should be subjected to cost reduction.

The distinguishing feature of target costing is its ex ante nature. Traditional Western costing is usually described as a process of identifying costs of products as they are being produced with prices fixed by adding a profit element to cost. Target costing says more of the detailed costing should take place at the design stage, after all most major cost elements of many manufactured products are committed at that stage and there is limited scope for reduction thereafter. Target costing does not start with product cost, but with market price; it then deducts the profit element to leave allowable product cost as the residual. As used in Japan, this approach also seems to have the advantage of enabling the enterprise to operate with less detailed costing systems for ongoing operations. Where more detailed cost planning is taken in advance in conjunction with marketing and engineering functions, it is more likely that the products will be acceptable to the market and that they can be produced at the appropriate cost. Hence, cost accounts can be kept in more aggregated form and focus more upon whether more aggregated budgeted goals are being met, rather than very detailed product costing of goods as they are produced.

2.3.4 Kaizen Costing

Kaizen costing also has a Japanese heritage. Kaizen refers to the process of seeking continuous improvement. Some Japanese companies link a target costing planning process with a kaizen process once the products are in production. Other companies, for example those with short to medium product life cycles, place more focus upon target costing. Their approach to continuing improvement is to have several generations of products at different stages of design and development (i.e. different stages of target costing). Other companies, in more mature markets with longer product life cycles, place more emphasis on kaizen during operations.

Kaizen essentially tries to ensure that everyone in the company continually reconsiders how the task is undertaken and whether there is a better way of doing it. It is not so much a costing routine as the outcome of developing an organisational culture of collaborative learning at all levels of the company. There were precedents in the West in terms of learning curves (which projected the extent to which direct labour costs could be reduced through learning undertaken in a repetitive activity) and experience curves (which traced how all costs could be reduced as a task was undertaken more and more times). There is certainly some element of this in kaizen, but the latter is even more encompassing than experience curves in so far as it does not just depend upon experience to identify improvements, but encourages the use of intelligent and shared thought and action through work-teams to search for improvements.

It is clear that one approach to seeking continuous improvement would be through following up Cost of Quality analyses as described earlier in order to trace root causes of not getting things right first time and removing them. As indicated earlier, some companies have borrowed from the learning/experience curve notions and established cost curves which indicate the rate at which kaizen learning ought to take place.

Sometimes these are expressed in terms of half-lives, that is the time it takes forcosts, or machine failures, etc. to fall to half of what they were at the beginning of each period. Progress in continuing improvement is then monitored against these half-life functions.

2.3.5 The Theory Of Constraints (TOC)

The Theory of Constraints is not a cost accounting method, but it has far reaching implications for cost management. The theory was developed by Eli Goldratt who subsequently established the Goldratt Institute to extend the practice of the theory. The initial motivation for developing the theory was to seek an improved way of production. It was designed to identify the most efficient way of increasing production throughput. Goldratt and Cox argued that the pace of the slowest process in the production run determined the pace at which production could function. Hence, everything had to be geared to ensuring that there were no delays in that slowest part of the process. Unlike JIT which has the goal of eliminating all inventories, TOC allows for a minimum buffer of stock to be held immediately before the process with the slowest pace so that unexpected interruptions in delivery from the other processes will not delay this critical process.

It also follows from Goldratt's analysis that, in order to improve throughput, which is not the same as reducing cost, attention will be best focused on increasing the rate at which that one constrained factor operates. TOC supports the notion of continuing improvement and after some point by improving the rate of production on the critical process, that process will itself cease to be the constraining resource. Then attention should be shifted to the new critical process. In this way Goldratt provides a logical path for more efficient continuing improvement of throughput rates. This must not be confused with the most logical way of cost reduction, because this could well be achieved by paying more attention to non-critical processes. However, Goldratt argues that TOC would prefer to focus on improving throughput first, then cutting out inventories in excess of the minimum buffer stocks and lastly in cost reduction.

Later developments of TOC have moved far beyond improving production. TOC is now directed to "improving everything". In the Goldratt Institute's view all problems can be resolved by a process of identifying constraints and removing them. In pursuing this goal, Goldratt also developed what he called his "Thinking Process" which is essentially a set of logic trees for identifying what factors are causing the constraints and how to remove them. A particularly interesting observation that he makes is that after tracing back to root causes it is valuable to ask why these causes have not been removed before. The answer he says often lies in different assumptions held by different people about what they and others have to do to optimise the system. Change these assumptions (mind sets) and removing constraints can often become much easier.

Goldratt also suggested that his TOC should be supported with some new and specific measures of performance. These are (I) Throughput Dollar Days and (II) Inventory Dollar Days. These may be explained quite simply.

Throughput Dollar Days is a new measure of due date performance. If an order is late, it is given a value equal to its throughput (sales less direct materials costs) times the number of days that it is late. The department in which the work is currently situated bears this charge as a cost. The objective is to make departments very aware of the need to maintain throughput and deliver on time. It may be unfair to charge a department with such a cost when the delay was caused by some earlier process in another department, but Goldratt argues that this practice will create a "hot potato" and induce all departments to pass it on quickly.

Inventory Dollar Days has a similar philosophy. A calculation will be made to indicate how long it will take to reduce any excess inventories beyond the agreed buffer level to that buffer level at the normal rate of usage. If, for example, there was an excess above the buffer level of 40 units in stock and the normal rate of usage was 20 units per day, this would imply that it will take two days to remove the excess inventory - an excess of 20 units will he held for one day and an excess of 20 for two days. The inventory day measure will then be 20 x 1 plus 20 x 2 = 50 inventory days. The number of 50 will then be multiplied by the value of each unit of stock in order to derive a measure of Inventory Dollar Days and departments will be held accountable for any such dollar days. (This measure would not normally be used to value stock in accounting reports). The intention once more is to have a measure of undesirable performance which escalates rapidly as stock is held for an excessive time, thereby highlighting the matter.

Even though a number of companies have adopted a Theory of Constraints approach to managing their operations, very few seem to have adopted the Inventory Dollar Days measure mainly because the implied cost of holding excess stock was seen itself to be unrealistic. The cost of holding stock does not normally double between day 1 and day 2.

2.3.6 Throughput Accounting

Throughput accounting arose from Goldratt's thinking in developing his Theory of Constraints. In developing his theory, Goldratt was initially trying to maximise the profitability of the firm by maximising the amount that could be produced given existing production configurations and constraints. He argued that plans will be drawn up to maximise production (throughput) and that once these plans have been established no section of the firm should depart from them or the co-ordinated plan would be upset. It follows that each department could be seen as having a fixed budget to spend to meet its target.

Under this form of operation, Goldratt argued that no benefit, and perhaps a lot of harm, came from existing cost accounting practices which allocated indirect costs, variable and fixed, over products and / or product groups. Given a clear co-ordinated plan, all the firm needs to do is maximise throughput measured in aggregate financial terms as sales less direct materials costs and see that the throughput measured in financial terms exceeded the fixed operating expenses by as much as possible. In other words, he defined all costs as fixed except direct materials costs. Subsequently, he has softened his stance, to allow that other costs may also be variable, but still stresses that direct materials costs are the main variable costs.

Throughput accounting, as defined by Goldratt, is not really a new form of accounting. It is merely an extreme form of variable costing. If the only costs which are truly variable are direct materials costs, there will be no difference between throughput accounting and variable costing. Moreover, if the focus of decision-making is on maximising throughput in the short-term, given existing resources, throughput accounting may well approximate the true variable costs. As one lengthens the period of decision-making, however, such that excess labour may be laid off or other indirect cost services varied, it is clear that throughput accounting would not support appropriate decision-making. At the limit, if the firm is contemplating severe product line pruning, ABC with its sophisticated approach to cost allocation will provide the best guide to relevant costs. There ought not, therefore, to be a controversy over whether TA or Variable Costing or ABC (full costing basis) is best - they each serve different purposes. Of course, companies will not run their routine costing systems in all three forms. As data base methods become more widely available and applied to accounting, it should be possible to generate accounting data with the appropriate form of cost variation assumption for the decision at hand and use the concept most appropriate for measuring managers at different levels according to their personal responsibilities and functions. The accounting skill should be to provide relevant costs for the purpose for which they are required - this has always been the case and TA offers nothing new to that basic concept.

2.3.7 Integrated Strategic Management Accounting

Strategic Management Accounting is not a new costing system. It is a generic term which covers the use of cost and management accounting to help inform an organisation in making major strategic decisions. In this sense, all the methods described above have a role to play. More recently, however, the term has been used more precisely (see Carr and Tomkins, 1996) to describe how accounting needs to be integrated with strategic thinking in order to provide a comprehensive control system. Essentially, Carr and Tomkins, draw up a framework for system design which integrates all, or most, of the new developments described above and it does so through a general target costing approach to strategic investment decisions - i.e. those decisions concerning new markets, new products or the acquisition of new attributes by the company in order to give it a better market standing.

The process will first involve a consideration of what customers need and what rival companies can deliver in order to arrive at a project description in terms of product / service attributes and a target price at which that “bundle of attributes” which constitute the product or service will sell.

The firm must next test out whether it is capable of delivering that product at the target price. In order to do that it must specify the exact value chain for providing each of the product characteristics. This will involve specifying how the firm’s inbound logistics, operating production procedures, outbound logistics, distribution system and aftersales service all impact upon the proposed product attributes. If current elements of the value chain cannot deliver the product attributes, the firm has to decide whether it was being too ambitious and settle for a more easily attainable set of product attributes (provided that it can still be sold) or set about improving the relevant aspects of its value chain. If it takes the latter route, it will be necessary to establish exactly what the value chain modification will cost and whether that it still feasible within the target price. Of course, as explained above the target price itself is a product attribute and the firm may discover that it can produce the non-price attributes with its current practices and resources, but not within that price. Either way attention will need to be focused upon cost reduction in order to achieve the non-price attributes within the target price (cost) or a functional cost analysis in order to establish which attributes can best be downgraded to produce the minimum reduction in market attractiveness of the product for the maximum reduction in cost.

It is likely that several iterations around this process using Functional Cost Analysis and Value Engineering will be needed before a desirable mix of product attributes and target price can be delivered, namely a mix which is attractive to the buying market and the producer/seller. Once this desirable mix has been established as a feasible proposition, the producer can ahead and invest or accept the contract. The whole system is mapped out in Figure 2.2.

It should be clear how all the new developments described above could fit into such an overall process. Careful cost behaviour analysis and cost driver identification will be needed to cost out proposed changes in the value chain and the product attributes derived from the Functional cost analysis and Value Engineering - this suggests a role for world class finance functions using ABC principles. Cost reduction may be pursued by trying to squeeze out waste using a COQ approach. The TOC method might be used to identify constraints which prevent cost reduction attribute improvement. The important point to note is that whatever mix of tools is used in such a process, all the cost calculations will be made prior to the acceptance of the project or investment decision. This implies that such an approach is best employed where a firm is planning a succession of product developments. The next generation of products to be launched should be nearing the end of this process, the generation planned after that will still be in the earlier stages of this process.

Where this approach can be implemented successfully, it should be possible to simplify the accounting processes required to monitor performance. The cost analysis will have been conducted rigorously beforehand and operating control should be attainable by reference to broader aggregates provided that managers keep to their agreed planned way of operating. This has some similarity with the philosophy behind Goldratt’s TOC although it is not identical to it.

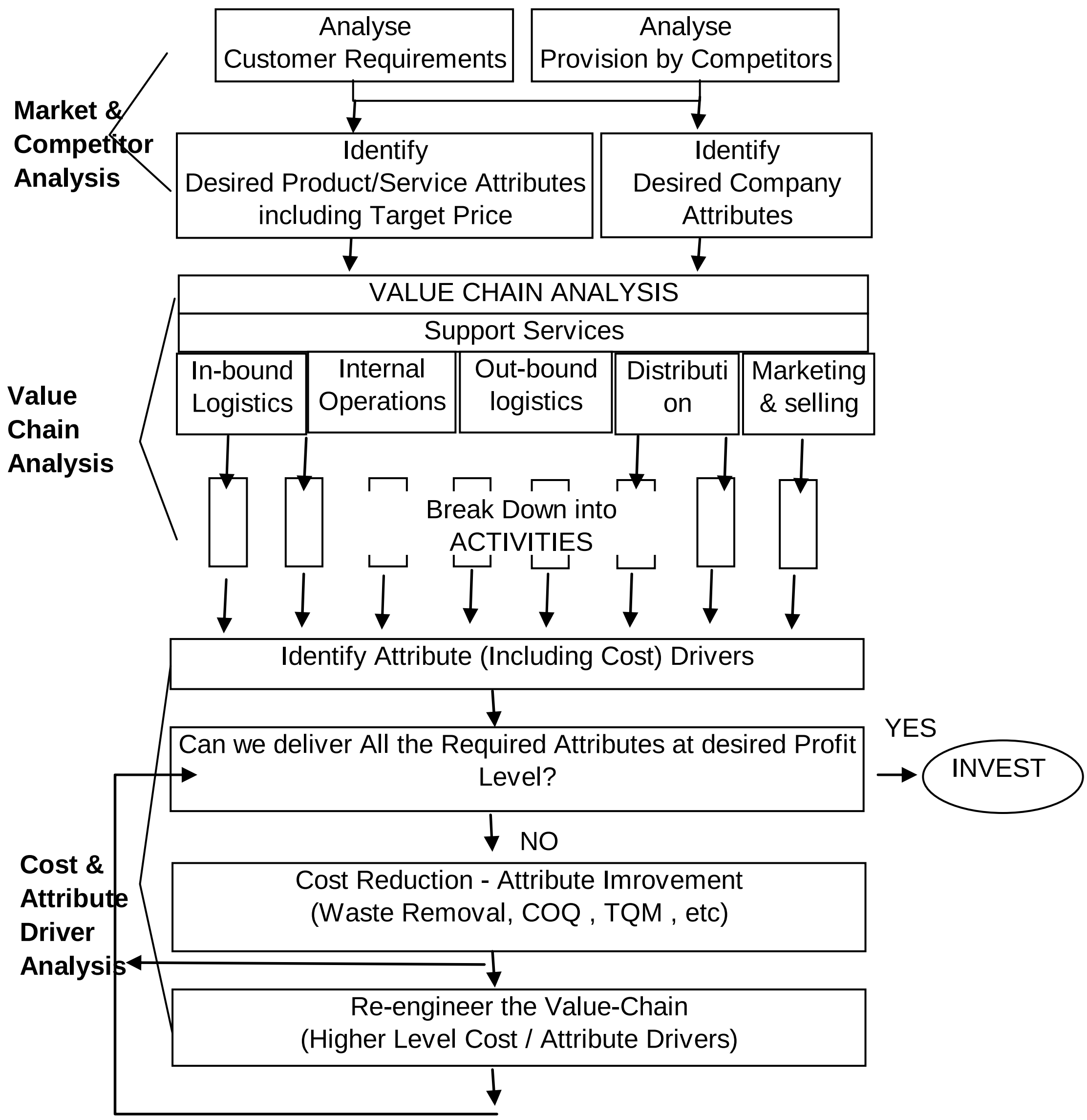

Figure 2.2 A schematic formal Analysis for Strategic Investment Decisions (Carr. C. and C. Tomkins 1997)

2.3.8 Balanced Scorecards

Another recent development has been balanced scorecards (see particularly Kaplan and Norton, 1996). The thrust behind this development came from a dissatisfaction with reliance on just financial statements, especially the Income Statement and Balance Sheet, as the dominant means of checking a corporate group or division's position. Initially, in 1992, Kaplan and Norton proposed that was a need for ‘balanced scorecards’ which reported performance along four different dimensions: a financial perspective, a customer perspective, an internal business perspective and an innovation and learning perspective.

This was a step forward in moving the focus of attention in performance monitoring beyond financial analysis, but it could still be criticised in that it did not offer a clear way to decide what was important to measure and what not. There seemed to be no serious attempt to develop a clear theory of success for each company or division which would serve as the basis for choosing between many possible indicators and dimensions which could be measured. Without such a theory, how could the performance monitoring be balanced - i.e how would one know what weight to put on some factors compared to others? Perhaps it was always implicit that these factors would be based on the key result areas and key success factors appropriate to each corporate unit being monitored. It certainly has now been set out very clearly in Kaplan and Norton (1996) where a whole book is devoted to linking up these ‘scorecards’ to the firm’s specific strategy and key success factors. In fact Kaplan and Norton (1996) now say, up front:

“A properly constructed Balanced Scorecard articulates the theory of the business.”

This scorecard will set out clearly the cause and effect relationships assumed to underlay the firm’s strategy and be used in more innovative companies as the basis for a complete management system and not just a measurement system.

CHAPTER THREE

TARGET COSTING

3.1 Introduction To Target Costing

The most important feature of any company is its ability to stay ahead of the competition. In the midst of a plethora of products and choices for the customer, it becomes increasingly important for any company to make its products better, faster, cheaper and more innovatively. Increasing the efficiency of products has the two aspects of cost and functionality attached to it. An efficient designing technique takes the cost and functionality aspects into consideration during the early stages of product design. Such an approach provides us with the chance to concentrate our design efforts on important features and at the same time reduce the costs incurred on less important features. Target costing is like a planning tool that helps us to identify the features to be improved and helps us in setting targets for designing and cost reduction. It is generally known that challenging goals lead to better performance than the general goal of doing ones best .Cooper R. and Slagmulder R. ,(1997).

Frequent innovations characteristic of today's market have decreased the life of new or re-designed products and increased the costs of design. This made it essential for every company to analyze its product's feasibility and profit-making ability before launching expensive design and manufacturing teams. Costs through the life cycle of a product require more attention as the costs of recycling, distribution, etc., keep increasing. The following important features can be considered to summarize the market condition for the last two decades.

- Increased competition
- Increased costs of design
- Decreased product life
- Increased non-manufacturing costs
- Increased importance of customer needs and demands

- Less-forgiving customers

3.2 Core Concept of Target Costing

3.2.1 Definition

The core concept of target costing is very straightforward. It is based on the logic that a company should manufacture the products that yield the desired profit. If the product is not yielding the desired amount of profit, the design of the product should be changed to obtain the desired profit or the product should be abandoned. A comprehensive definition of target costing as given in ,Ansari S., and J. Bell, (1996),is mentioned below:

"The target costing process is a system of profit planning and cost management that is price led, customer focused, design centered, and cross functional. Target costing initiates cost management at the earliest stages of product development and applies it through out the product life cycle by actively involving the entire value chain."

3.2.2 Process

Target costing process consists of two phases known as establishment phase and implementation phase. The establishment phase defines goals for product concepts based on strategic plans and the implementation phase achieves the set goals. The relation between target costing and product design is illustrated in Figure 3.1.

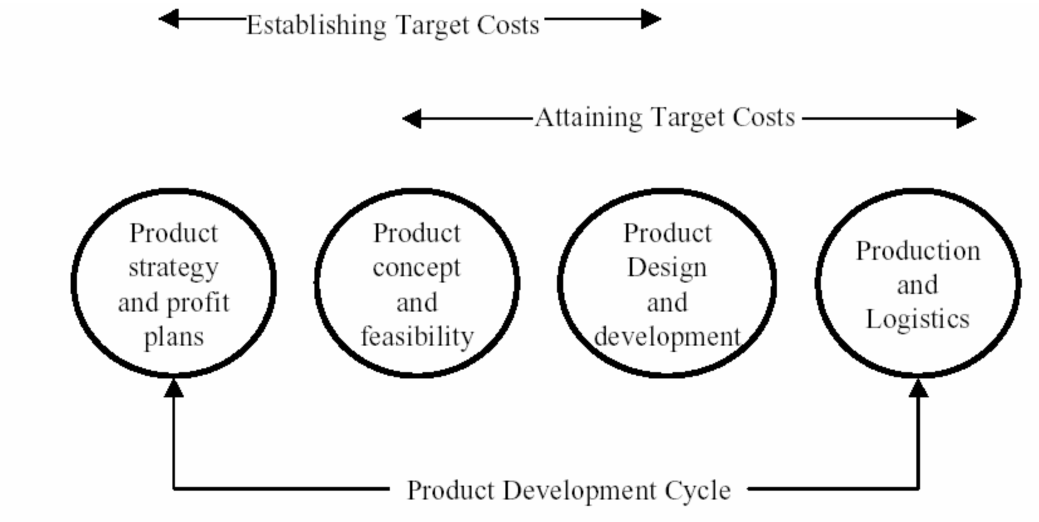

Figure 3.1: Target costing and product development cycle.
Ansari S., and J. Bell, (1996)

The process of target costing is illustrated in Figure 3.2 and is based on the cardinal rule, “If we cannot make the desired profit we should not launch the product.”

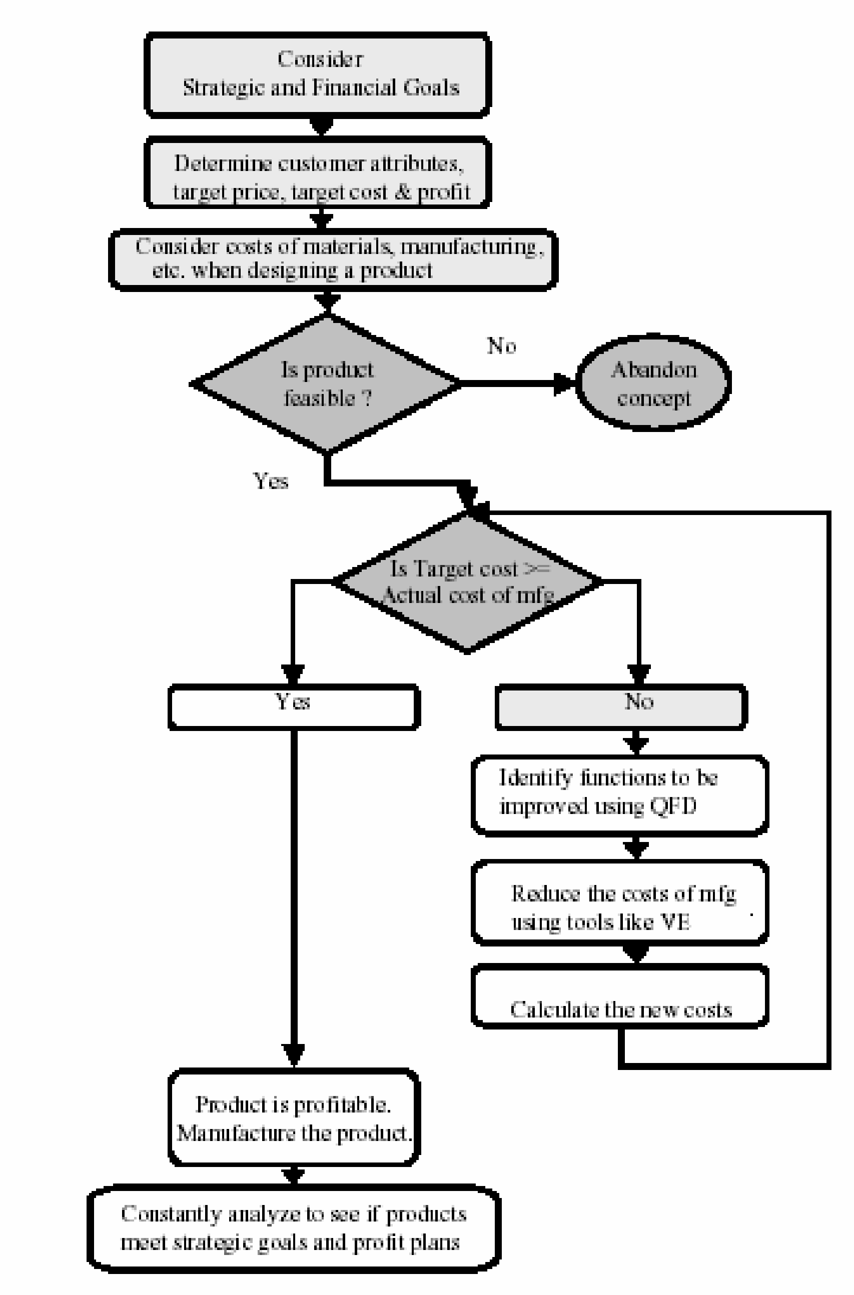

Figure 3.2: Target Costing Process (V. Amara 1998)

The illustrated process of target costing for product design (see Figure 3.2) can be described in the following steps:

1. Consider strategic and financial goals: Top management sets long-term goals for the complete corporation and every product should be designed to help the company to achieve these goals.
2. Determine the customer attributes or demands: This process involves conducting thorough market analysis and customer surveys to determine what the customer's needs and demands are for a given product.
3. Consider costs and processes while designing: This step must result in the design specification of the product. The major tools used to obtain the design specification of a product are (a) Pugh Method and (b) QFD.
4. Determine the target price: Target price is the price a customer is willing to pay for the new product. Thorough market analysis must be conducted to determine the target price.
5. Determine the target cost: Target cost, also known as the allowable manufacturing cost, is calculated by subtracting the profit required (ROS can be used to determine the profit required from the new product) from the target price.

   Target Cost = Target Price - Desired Profit
6. Determine the drifting cost and product feasibility: fitting cost, also known as the actual cost of manufacturing, is the present cost of manufacturing the new product and this is calculated with the help of the engineering department. It is also analyzed to see if all the desired functions can be provided in the new product. A good costing system like ABC (Activity Based Costing) will assist in determining accurate costs.
7. Process Improvements:f the designed product yields the required profit, the new product can be manufactured. If the new product does not yield the required profit, the product needs to be re-designed or the process of manufacturing should be improved to yield the required profit. Some tools like value engineering can be used to associate costs to components or functions in order to determine their cost efficiency. The components or functions that are cost inefficient should be re designed to reduce costs. If the products are found not to meet the financial profit requirements, they should be abandoned.

8. Implementing / Evaluating long term effects:s essential to make sure that the new product will yield the required profits through its complete life and the product mix must be regularly adjusted to meet the strategic goals of the company.

3.3 Literature Review

The literature about target costing deals more with the concepts of target costing than with its practical application. Several companies where target costing is used are mentioned, but specific details about product designing and cost reduction are not available. Literature describing the concept of target costing and various techniques used in target costing, along with some important definitions of target costing are mentioned here.

The definitions of target costing are many, but they all focus on the same point of cost reduction. However, definitions vary in the scope of cost reduction. Some definitions take the overall product life cycle into consideration while some consider particular functions or just product development. P. Horvath, (1994) take the product life into consideration and define target costing as follows .

“Target costing is a set of management methods and tools used to drive the cost and activity goals in design and planning for new products, to supply a basis for control in the subsequent operations phase, and to ensure that those products reach given life cycle profitability targets.”

Target costing has been defined in ,S. L. Ansari , M.D. Ferguson and P.A. Zampino, (1997), by listing all stages of product life cycle, while Cooper R. and Slagmulder R. ,(1997), defined target costing in “Target Costing and Value Engineering” by placing emphasis on the aspects of cost, quality and functionality as follows:

"Target costing is a structured approach to determine the life cycle cost at which a proposed product with specified functionality and quality must be produced to generate the desired level of profitability over its life cycle when sold at its anticipated selling price."

Different aspects of target costing including those of interest to management are detailed in S. L. Ansari , M.D. Ferguson and P.A. Zampino, (1997), The following are the key messages sent by target costing according to there.

1. Target costing takes place within the strategic planning and product development cycles of a firm. Product design goes through this development cycle in a recursive, rather than in a linear fashion.
2. The first phase of target costing is the establishment phase. The focus here is on defining a product concept and setting allowable cost targets for a product or a family of products.
3. The second phase of target costing is the attainment phase. This phase transforms the allowable target costs into achievable target costs.
4. The establishment and attainment phases of target costing occur at different points in the product development cycle. Different organizational processes play primary and secondary roles in these two phases.
5. Many other business processes support target costing, and the success of target costing depends on these other processes being performed effectively within an organization.

The process of target costing is explained in detail in "Advanced Target Costing: State of the Art Review" [1] and "Target costing: The next frontier in Strategic Cost Management" ,S. L. Ansari , M.D. Ferguson and P.A. Zampino, (1997), The different steps of target costing and a guide for management have been laid out in S. L. Ansari , M.D. Ferguson and P.A. Zampino, (1997), .These steps are detailed and used in the current report.

The Consortium for Advanced Manufacturing-International (CAM-I) made concerted efforts to promote target costing. Horvath and CAM-I, P. Horvath, (1994)produced a comprehensive report detailing the basic technical concepts of target costing. CAM-I later worked with its core group to generate L. Ansari ,(1997), to include all the aspects to be considered during the implementation of target costing.

The contribution of various techniques to target costing is different. Some techniques like the Pugh Method, Quality Function Deployment (QFD) and Value Engineering (VE) should be studied in more detail as these tools help in designing the products and processes. The Pugh Method helps in identifying customer requirements and is explained by Stuart Pugh in Pugh S. ,(1991), .This technique is used in the current report to identify customer attributes. QFD relates product functions to customer requirements in order to establish goals for product design. Bob King explains this method in Kıng B. ,(1989), .QFD is used in the current report to correlate the customer attributes to components or product attributes to establish their relative importance. The candidates for improvement are the product attributes with high relative importance. Value engineering helps us in reducing costs incurred by a product and is detailed by Cooper and Slagmulder in Cooper R. and Slagmulder R. ,(1997), .This process is used to identify product attributes that are not cost efficient.

P. Horvath, (1994) ,describes target costing and relates it with Activity-Based Costing (ABC), product life cycle management costs, and Value Engineering. Target costing along with supporting tools, techniques and means of deployment is detailed in Ansari S., and J. Bell, (1996). Cooper R. and Slagmulder R. ,(1997), explain how value engineering can be used along with target costing to increase the value of a firm’s products. Kaizen costing, the process of continuous cost reduction after a product is launched, is explained along with its relationship to target costing by Monden Y. and Hamada K., (1991) .Effects of Return on Investment (ROI) and Return on Sales (ROS) on target costing are analyzed by Sakurai in “Measures of Organizational Improvement” Sakurai M. ,(1995).

Effect of target costing in many large companies like Nissan, Toyota, and NEC, are discussed in some papers. Sakurai M. ,(1992), mentions the reasons for the use of target costing in Japan. He mentions that increased consumer demand for product variety and shortening of life cycle prompted Japanese industries to adopt target costing. Worthy F. S. ,(1991), shows how target costing helped several industries in Japan. He mentions the way Japanese industries take calculated risks after using management techniques like target costing. Schmelze G. Geier R. and Buttross T. E. ,(1996), show how target costing is applied at ITT Automotive and how it created cost savings before the product reached the production stage. Cooper R. and Chew W.B., (1996) , illustrate that target costing lets the customer and not the product set the price with reference to Olympus and Komatsu. Brausch J.M. (1994) demonstrates the implementation of target costing in the textile industry to reduce the costs before they are incurred.

The literature review of target costing shows us that the concept of target costing and the tools used for its implementation are described in detail. The companies that have implemented target costing are multi-billion international companies, and the literature illustrating the use of it in small-scale industries is sparse. The current report explains target costing and discusses the issues of implementation from the perspective of a company by conducting a retroactive analysis of a real life decision taken by the **DEKORPAN** Company .

3.4 Facts / Advantages of Target Costing

The major characteristics or advantages of target costing as mentioned in ,P. Horvath, (1994) ,are listed below.

- Target costing will provide management methods and analytical techniques for developing products and services whose costs support strategic objectives for market position and profit.
- Product costs will be defined from the customer’s viewpoint; they will include functionality, cost of ownership and manner of delivery.

- Target costing is a critical component of product development teams and concurrent engineering.
- Target costing will incorporate as wide a range of costs and life cycle phases for the product or service as can be logically assigned and organizationally managed.
- Target costing will provide analytical techniques to indicate where cost reduction efforts on parts and processes will have most impact, and where commonality and simplification can be increased.
- The quality of cost data will be consistent with the responsiveness and level of detail required at various development phases: The system will use the logic and benefits of activity-based costing.
- The achievement of market-driven product attributes will be protected from cost reduction ambitions.
- Targets for product cost will be set for various life cycle phases in development and production.
- Target costing will aim for appropriate simplicity, relevance and ease of use by product development teams; it avoids unnecessary complexity of language and time consumption in cost assessments.

The process of target costing creates a team based, proactive atmosphere, where representatives from different departments get together to make decisions. This leads to a reduction in the information gap between different departments and makes the departments more responsive as they realize the importance of their activities . Ansari S., and J. Bell, (1996),

Another significant advantage of target costing is its inherent flexibility as mentioned by Sakurai M. ,(1989). He mentions that target costing was used by Atsugi to reduce the current level of standard costs by autonomous efforts, while Daihatsu Motor used target costing to establish a new plant to maximize profits through controlling costs by the use of automation and flexible manufacturing systems. These factors are some of the many reasons that establish target costing as a good technique.

CHAPTER FOUR

TARGET COSTING IN NEW PRODUCT DEVELOPMENT

4.1 Establishing Target Costing

The first and the most important step of target costing is the critical decision of management to implement target costing. The importance of this step cannot be overstated, as target costing is a dynamic process based on management's strategic plans. Some major reasons for implementing target costing can be increased competition, expansion of business, or introduction of new products.

Once the decision to implement target costing is taken, the target costing team needs to be established. Small manufacturing firms do not have the luxury of having multiple target costing teams for different phases or for different functions of a product.

The effectiveness of target costing is usually expected to increase with an increase in the number of involved personnel. A target costing team has the advantages listed below:

- Association with the complete cycle of product development facilitates future revisions.
- No information gap occurs between different stages of product design or target costing.

The target costing team should consist of personnel from different functions and departments. It is very important to note that the members of the target costing team should not be completely dedicated to target costing. The personnel must still have significant functional responsibility, as this keeps them updated in their functional areas. The target costing team should consist of personnel from marketing, information systems, cost planning, operations, research and development and all functional areas. A top management executive, who has a good knowledge of the company's strategic plans, must lead the target costing team. However, costing, production and designing are more important and the product designing process can be carried by frequent inputs from the remaining departments in a firm.

The members of a target costing team should be trained in target costing implementation. A complete proper working knowledge of target costing is necessary for its success. However, the most important factor is practice. Every firm is different from another and it is very important to start implementing target costing and it should be refined to meet the requirements.

For the successful implementation of target costing, the team should be provided with the information required for conducting the analysis. The type and the amount of data required vary depending on the type of the product, but typical categories of data required are mentioned below.

- Customer needs and demands
- Pricing data
- Costing data
- Information system to track and evaluate the target costs and manufacturing costs

For a firm without a big marketing department, there are several ways to collect the required data. Customer surveys can be used to gather information about what the customer currently needs. Operations personnel taking customer orders can collect valuable information about customer demands. It is very important to store customer demands historically as they can indicate trends in the market. The Internet and organizations like Equipment Manufacturers Institute (EMI), Engineering Information Inc., etc. can provide valuable historical information. Pricing data consists of the customer's willingness to pay, which can be determined from customer surveys.

The most efficient way to collect this pricing data is by function. Let us consider an eraser; the basic function of an eraser is to erase. But additional functions and features include softness, shape, scent, pen and pencil eraser in one, longevity, and color. Pricing data must indicate how much a customer is willing to pay for each function or feature.

An efficient method is to start from a current product and conduct surveys to identify the price paid for features based on customer surveys. Costing data should be obtained from the current costing system and cost bases for distributing administrative, design and marketing costs must be established. Last but not the least, systems and databases must be established so as to collect this information and the data must be very accessible to the target costing team.

The duration of the target costing project depends on the type of the product being studied. But, the preliminary analysis to reject or accept a product is suggested not to take more than a couple of months for a manufacturing firm. The total time for launching a product should be proportional to the product life.

4.2 Product Design Stages

Implementation of target costing in a firm is achieved through the establishment phase and the implementation phase as mentioned before. These two phases happen within the four major phases of product design, which are :

1. Product Strategy and Profit Planning
2. Product Concept and Feasibility
3. Product design and Development
4. Production and Logistics

The phases are classified based on critical decision points in product designing / redesigning rather than being based on time or function. The process and the decisions to be taken at the end of each step are explained in the Section 4.2.1.

Each phase corresponds to one or more steps illustrated in Figure 2. Product strategy and profit planning obviously includes the first step of setting strategic and financial goals. The second phase includes the next four steps of considering customer attributes and costs for designing the new product. It also includes determining target price, target cost and drifting cost for new concepts. This phase will validate the feasibility of various product concepts. The third phase involves process improvements based on the results of phase two and finalizes the design and manufacturing methods for the selected concept in phase two. Phase four involves implementing the manufacturing processes and evaluating long term effects to make sure that the product helps in achieving the corporate goals. The association between the various phases and the steps in Figure 3.2 is illustrated in Figure 4.1.

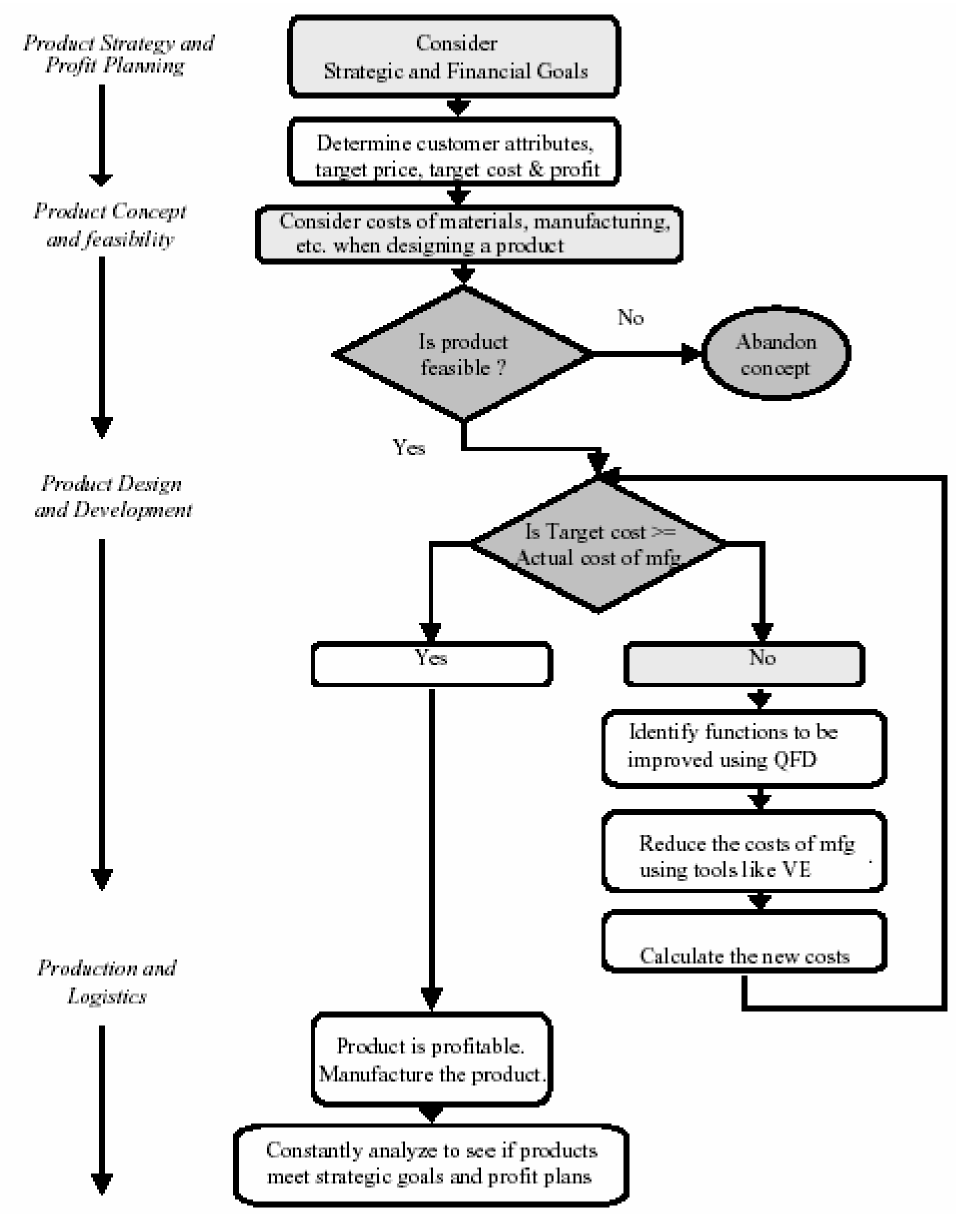

Figure 4.1 Target Costing Process along with Product Design phases (V. Amara 1998)

The various phases and the main tools used in each phase are illustrated in Table4.1.

Table 4.1: Product design phases and tools used . (V. Amara 1998)

Various Phases	Tools Used
Product Strategy and Profit Plan	*National Growth Indicators, Marketing Plans, etc.*
Product Concept and Feasibility	*Pugh Method, QFD, Preliminary cost analysis, etc.*
Product Design and Development	*QFD, Value Engineering, ABC, Process engineering, etc.*
Production and Implementation	*Value Engineering, ABC, Kaizen costing, etc.*

4.2.1 Product Strategy and Profit Planning

The objective of this step is to define long term strategies and goals of a firm. The strategic plan of a company must include the planned rate of return and market expansion plans. There is no fixed method for determining the desired rate of return. But it is indirectly determined by the expectations of stockholders and the price set by competitors.

Marketing information about the trends in customer demands must help us in establishing market expansion plans. Market expansion plans can include particular product definitions or a general description of the market to be reached. For example, an encapsulation firm for a pharmaceutical client can have market expansion for solid tablet manufacturing, packaging and distribution or to enter paint-ball manufacturing.

The type of marketing information required depends mainly on the position of the industry in a supply chain. Industries in the lower levels of the supply chain can obtain most of the information from their direct upper level customers. The interaction with suppliers is very important in large assembly industries and the supplier's strategic goals and profit margin calculations should coincide with ones own firm's strategic plans. For the previously cited example, the marketing information and strategic plans should consider the pharmaceutical clients supplying the material to be encapsulated along with the end user.

Established costing systems should provide the top management with the information required for setting strategic goals for profit margins. Long term planning needs to consider many factors and a few important ones are listed below:

- Financial
- Establishing new customers
- Increasing market reach
- Establishment of brand name

4.2.2 Product Concept and Feasibility

The objective of this step is to determine feasible product concepts. It is not essential to determine precisely the manufacturing process at this stage. But, this is the phase where several concepts are analyzed to determine the best concept.

The process of establishing product concept feasibility consists of the following steps:

1. Determining if the product meets customer demands
2. Establishing the method of manufacturing
3. Verifying that the product generates the desired profit margin

The product concepts are analyzed to determine if they at least satisfy the customer needs. A product concept is considered to meet the requirement if it satisfies the customer needs. The costs and manufacturability of concepts is later considered to determine the best concept. But, at this preliminary stage all concepts that satisfy the customer needs are considered.

The Pugh Method , Pugh S. ,(1991), focuses on the total life cycle of the product to determine the complete list of customer needs and wants for total design. The Pugh Method defines total design as "a systematic activity, from the identification of the market/user, to the selling of the successful product to satisfy that need." The customer needs can be defined by analyzing the complete product life cycle, and the customer demands must be classified into needs and demands. It is important to apply the Pugh Method in the early phases to make sure that all customer requirements are considered. It is also important at this stage to determine the price a customer is willing to pay for each requirement/function (also known as target price of the requirement/function). The different aspects that need to be considered during designing according to the Pugh Method are listed in Table 4.2.

Table 4.2: Different aspects to be considered during product design

a. Performance	b. Environment	c. Life in service(Performance)
d. Maintenance	e. Target Product Cost	f. Competition
g. Shipping	h. Quantity	i. Manufacturing facility
j. Size	k. Weight	l. Aesthetics
m. Materials	n. Product life span	o. Standards and Specs
p. Ergonomics	q. Customer preferences and prejudices	
r. Quality and Reliability	s. Shelf life	t. Processes
u. Time scale of Project	v. Testing	w. Safety
x. Company constraints and market constraints		
y. Patents, literature and product data		
z. Political, legal and social implications		

After establishing that a product concept meets customer requirements, its functions must be analyzed to verify their manufacturability. Personnel from all positions and departments should apply their functional knowledge to determine the manufacturability of products.

Once the manufacturability of a product concept is established, the target price should be established by adding the target prices of all functions. The financial feasibility of a product can be verified by using the equation mentioned in the Section 3.2.2.

Target Cost = Target Price – Desired Profit

The profit desired from a product is determined based on the strategic goals set by the top management. If the actual cost of manufacturing is less than the target cost, the product concept can be considered economically feasible. If the actual cost of manufacturing is greater than the target cost, the target costing team needs to decide if the manufacturing process can be improved to reduce the cost. The last step is to compare different product concepts to determine the best concept for further analysis.

A few other factors that need consideration for cost-effective design and decision making are listed below:

1. Actual cost of manufacturing must include total life cycle costs, i.e. it must include costs of designing, marketing, recycling, distribution, etc.
2. Product concepts must be analyzed along with suppliers in order to ascertain their feasibility.
3. Trends in customer demands should be identified and considered during designing.

4.2.3 Product Design and Development

An established product concept is refined to include more functions and to reduce costs of manufacturing to achieve target costs. The final output of this step is a complete and comprehensive definition of the product along with the process of manufacturing.

Quality Function Deployment (QFD) uses various charts and helps the designer by establishing relative weights for various quality characteristics and customer demands. A QFD chart compares the left section of the chart with the top section and identifies strong, moderate and possible correlations. Processes are analyzed to see if additional customer wants can be provided without adding significant costs. It is very important to consider the features provided by competitors at this stage.

QFD (Quality Function Deployment), a process that originated in Japan, helps us in designing products efficiently. Bob King defined QFD in Kıng B. ,(1989), as:

“Narrowly defined, QFD refers to the organization that makes the design improvement effort possible. Broadly defined, QFD also includes the charts that document the design process.”

QFD is explained in detail in Kıng B. ,(1989), and the major QFD charts (or tables) taken into consideration are:

1. Quality-table relates customer’s demands to quality characteristics and compares our current performance to competitor’s performance. This helps the designer to come up with the initial plan of design ,Kıng B. ,(1989),
2. Functions / Quality Characteristics table is used to identify functions of the product that might not be known to the customer Kıng B. ,(1989), by establishing correlations between quality characteristics and the functions of a product.

Quality characteristics not correlated to any customer function should be replaced by appropriate functions to capture customer demands.

The next step after establishing designing goals is to achieve them. The actual process of designing depends on the product and is not considered in the current report. But, the process of cost reduction using value engineering is described in this report. The basic concept of value engineering is to determine candidates for cost reduction by primarily focusing on product functions and only secondarily on cost Cooper R. and Slagmulder R. ,(1997), .Value engineering compares the relative degree of importance of each component or function to the percentage of total cost the component or function takes. Dividing the percentage degree of importance by the percentage of cost for that component gives the value index for that component. A component/function with a value index of 1 or more is cost inefficient and needs to be made cost efficient. The method of cost reduction depends on the type of the product and the process of manufacturing. Some common cost reduction methods include conducting staffing analysis to reduce staffing levels, compromising the quality of a function in a product if it is not very important, decreasing the inventory level, improving yield, etc. This process must be continued so as to add value to important components and to reduce the costs of less important components until the target cost is reached.

If the actual cost of manufacturing exceeds target cost, the product concept should be discarded. This should not happen at this stage, as the second stage of product concept testing must determine if the target costs are achievable or not. But, if it ever happens, the target costing’s cardinal rule must be followed and the product should not be launched except for marketing reasons.

Cost reduction can be achieved by identifying when and where the costs occur. Reference ,Ansari S., and J. Bell, (1996), allocates the total costs based on:

1. Value chain perspective
2. Life cycle perspective
3. Customer perspective
4. Engineering perspective
5. Accounting perspective

Each perspective provides a unique way of looking at the product and helps us to identify where excess costs occur and to reduce them. Cost reduction should start as soon as possible and should concentrate on functions that are easy to improve and further cost reduction must be achieved.

4.2.4 Production and Logistics

Actual production should not be started until the target cost is considered achievable. This is just the beginning of cost reduction and constant endeavors must be made to reduce costs as much as possible. Frequent customer surveys should be conducted to determine the changes in customer wants, and the products must be modified accordingly.

Kaizen Costing is the process of continuous cost reduction. Economies of scale, setup improvements, work methods, etc. must be analyzed to increase the productivity of the bottleneck operation. This will help us in increasing the throughput of the line without adding costs, thereby increasing the profit margin. Root cause analysis must be conducted to identify the reasons for downtime and idle time and process improvements must be made. A simple method of conducting root cause analysis is to conduct time studies identifying the amount of non-productive time. The total non-productive time can be classified into various categories like waiting time for operator, waiting time for work in process (WIP), waiting time for maintenance, setups, etc. The major causes can be further investigated for improvement. For further details about Kaizen Costing refer to Monden Y. and Hamada K., (1991), and Sakurai M. ,(1996).

CHAPTER FIVE

TARGET COSTING PROCESS

5.1 Target Costing Process Steps

The target costing process has six key steps. These steps, along with the pre-project preparation, represent a standard work plan, a framework for training, and implementation. While each target costing initiative is unique, an organization's actual implementation will likely include most or all six steps outlined in Figure 5.1, although not necessarily in the order presented.

Keeping this in mind, the six basic steps involved in implementing target costing are:

- establishing the target market price;
- establishing the target profit margin and cost to achieve;
- calculating the probable cost of current and new products and processes;
- establishing the target cost;
- attaining the target cost; and
- pursuing cost reductions once production has started.

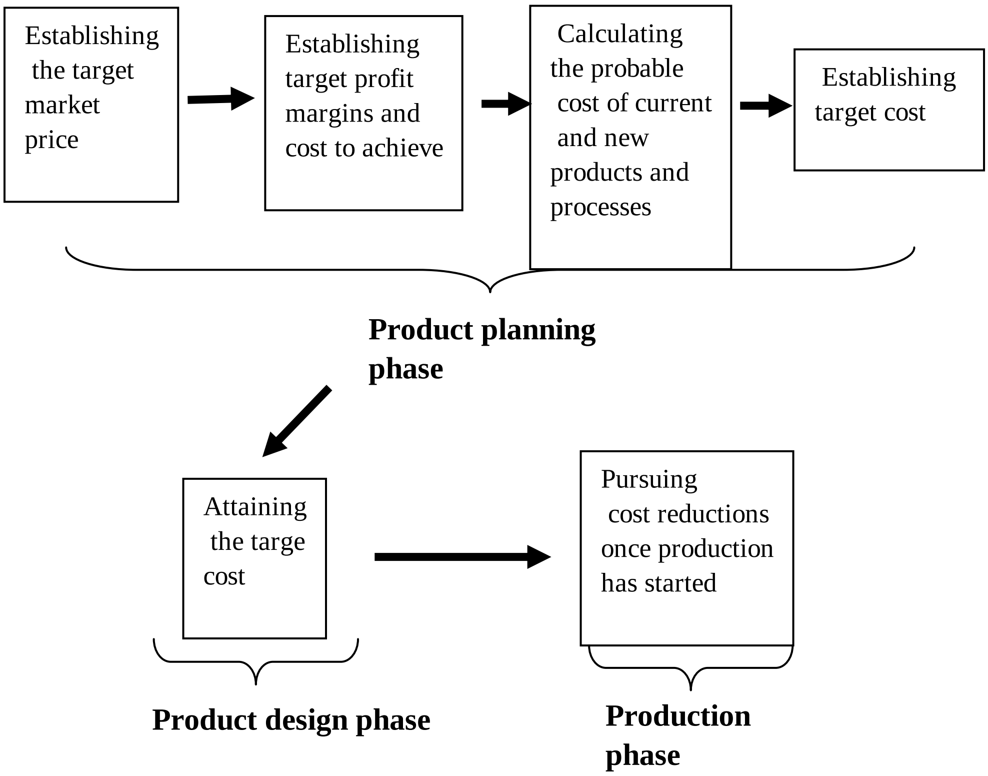

Figure 5.1. Target Costing Process Steps , (Andersen A. ,1998)

While organizations can modify these core activities to meet a particular situation, they are recommended as a guide for structuring the implementation of target costing initiatives.

5.1.1 Product Planing Phase

5.1.1.1 Establishing the Target Market Price

Cost considerations play a minor role, at best, in determining the target price under target costing. Instead, target costing uses product or service features1 to identify a target market price. Driven by the market, and by expected relationships between supply, demand, and price sensitivity for the product, the determination of the target market price incorporates several objectives, including:

• identifying market and customer wants and needs;

• determining how much customers are willing to pay for alternative features;

• transforming the desires of the customer/user into the language required to implement a product; and

• assessing what the competitive offerings are.

At the heart of the target-price-setting process is the concept of perceived value. Customers can be expected to pay more for a new product than its predecessor, but only if its perceived value is greater. Understanding what attributes lead to specific value, and therefore price, is an essential part of setting a market price that yields optimal return for the organization's efforts. These objectives can be achieved by applying several tools and techniques including:

• quality function deployment;

• analytic hierarchy process;

• customer voice analysis; and

• relationship matrix.

5.1.1.1.1 Quality Function Deployment. Since customers often make fairly subjective statements when evaluating a product, quality function deployment (QFD) is a methodology useful for translating customer preferences systematically into a number of objective design requirements.These requirements can then be communicated to the design and production teams to ensure that everyone is working toward the same objectives and outcomes.

QFD brings together the relationships between competitive offerings, customer requirements, and design parameters, through a set of matrices. These matrices are used iteratively throughout the target costing process. In the product planning phase, these matrices help determine exactly what the customer desires, how well competitors are satisfying the customer, and where unfulfilled niches exist in the marketplace. A QFD matrix developed for the product planning phase of a fax machine is shown in Table 5.1.

Table 5.1. QFD Matrix in Product Planning of a Fax Machine , (Andersen A. ,1998)

Design Parameters	Display	Print	Modem	Paper	Memory	Interface	Competitor Ranking					Customer
Customer Requirements	Panel	Engine	Speed	Tray	Board	Card	1	2	3	4	5	Ranking
Ease of setup	S					M		O	C			5
Memory			S		M	S		C			O	3
Receive/send speed			S		S		C			O		4
Printing speed		S				W	C				O	4
Copy settings	M				S				C	O		3
Handset	S					W		C		O		2
Paper supply		M		S			O			C		3
PC interface			W		M	S			O	C		2

Correlation of design parameters and rankings
S : Strong Correlation
M : Moderate Correlation
W : Weak Correlation

Comparative competitive rankings
C : Competitor Ranking
O : Our Ranking

This matrix summarizes information about product functions and their associated customer rankings. It also shows the correlation between competitor design parameters and customer requirements. Additionally, information is provided about how customers evaluate competitor offerings on these same features. The QFD matrix shows that the customer requirement of receive/send speed has a high correlation with the design of modem speed and memory. Similarly, printing speed is correlated to the print engine design parameters.

QFD is used successfully by both product- and service-based organizations. For example, it has been used in the manufacture of automobiles, electronics, home appliances, clothing, integrated circuits, synthetic rubber, construction equipment, and agricultural engines. QFD has also been used to design retail outlets, schools, and plant layouts.

Figure 5.2 provides a summary of the critical processes, tasks, responsibilities, and stages involved in QFD. *Columns* represent the organization's functional units, while *rectangles* in the flow chart identify activities and required interdepartmental participation. *Arrows* indicate the flow of documents or decisions.

The chart defines QFD team structure as well as the core documents and information the team will require to complete tasks. Serving as a road map for managing a QFD project, the chart helps an organization identify and answer several core questions in the planning and design process, including which customers are being emphasized, what their demands are, how much one customer segment's requirements should drive the design process, and what criteria should be used to make these decisions.

Using the QFD methodology, a model is developed that consists of the following:

• An *Objective Statement,* a description of the goal, problem, or objective of the team effort;

• The *Whats,* a list of characteristics of a product, process, or service, as defined by customers;

• *Importance Ratings*, or weighted values assigned the *Whats* , indicating relative importance;

• A *Correlation Matrix,* which shows the relationship between the *Hows;*

• The *Hows*, ways of achieving the *Whats;*

• *Target Goals*, indicators of whether the team wants to increase or decrease a *How* or set a target value for it;

• A *Relationship Matrix*, a systematic means for identifying the level of relationship between a product/service characteristic *What* and a way to achieve it, the *How*;

• *Customer Competitive Assessment*, a review of competitive products/service characteristics in comparison with the team's product or service;

• *Technical Competitive As sessment*, the organization's engineering specifications for each *How* and the competitor's technical specifications;

• *Probability Factors*, values indicating the ease with which the organization could achieve each *How;*

• *Absolute Score*, the sum of the calculated values for each *How* or column in the *Relationship Matrix*; and

• *Relative Score*, a sequential numbering of each *How* according to its *Absolute Score*. Number one is entered for the *How* with the highest score, two for the next highest, and so on.

QFD methodology provides a framework for clarifying and meeting goals. For decision makers, it helps them identify what is important by providing a fact-based system to replace emotion-based decision making. The uniqueness of the methodology is that this data can be captured and strategically evaluated in the initial days of decision making. This is when decisions are made on whether to proceed with production or service development. QFD helps organizations identify what will work, what will not work, and what things should be avoided. Since as much as 80 percent of the project's cost is locked in during this early phase, this assessment can greatly reduce program costs and development time.

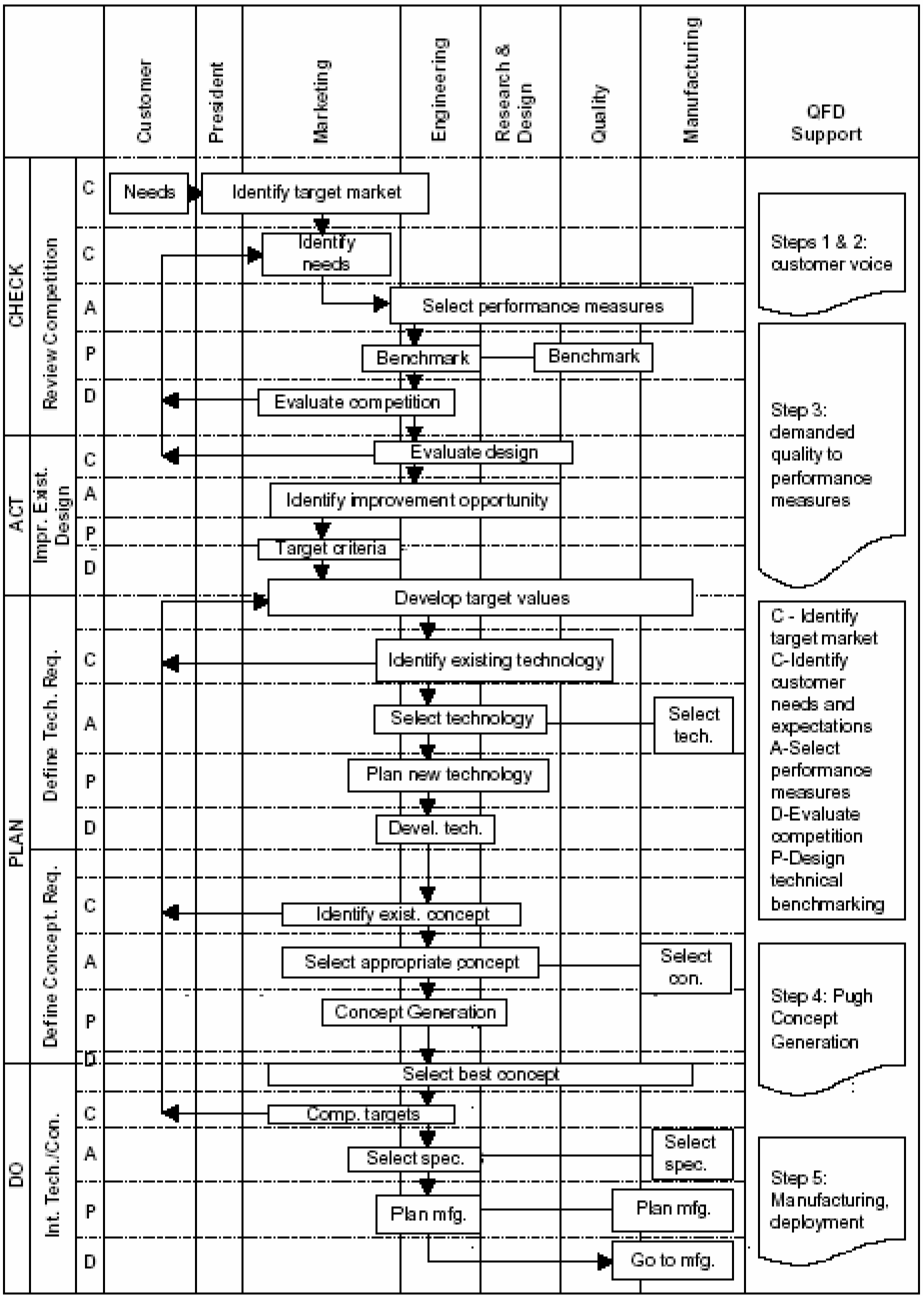

Figure 5.2 Product Design Process Chart , (Andersen A. ,1998)

For example, Toyota has used QFD since 1977. The results have been impressive. Between 1977 and 1994, Toyota Autobody introduced four new van-type vehicles. Using 1977 as the base year, Toyota reported a 20 percent reduction in start-up costs on the launch of the new van in October 1979, a 38 percent reduction in November 1982, and a cumulative 61 percent reduction in April 1984. During this period, the product development cycle (time to market) was reduced by one-third with a corresponding improvement in quality due to a reduction in the number of engineering changes.

5.1.1.1.2 Analytic Hierarchy Process. The analytic hierarchy process (AHP) is a multi-criteria, decisionmaking technique that combines qualitative and quantitative factors in the overall evaluation of alternatives. AHP is an excellent tool for considering different characteristic combinations of customer segments. By examining these characteristics, an organization can uncover new market segments and determine the relative importance of each.

The AHP methodology comprises four steps:

• building a decision hierarchy by breaking the general problem into individual criteria;

• gathering relational data for decision criteria and encoding them using the AHP relational scale;

• estimating the relative priorities (weights) of decision criteria and alternatives; and

• performing a composition of priorities for the criteria that gives the rank of alternatives relative to the top-most objective.

AHP begins with subject matter experts building a hierarchical representation of the decision problem. At the top of this hierarchy is the overall objective, and the decision alternatives are at the bottom. Between the top and bottom levels are the relevant attributes of the decision problem that provide significant input to the decision process. The hierarchy can be quite detailed, though most applications need no more than three levels, as shown in Figure 5.3.

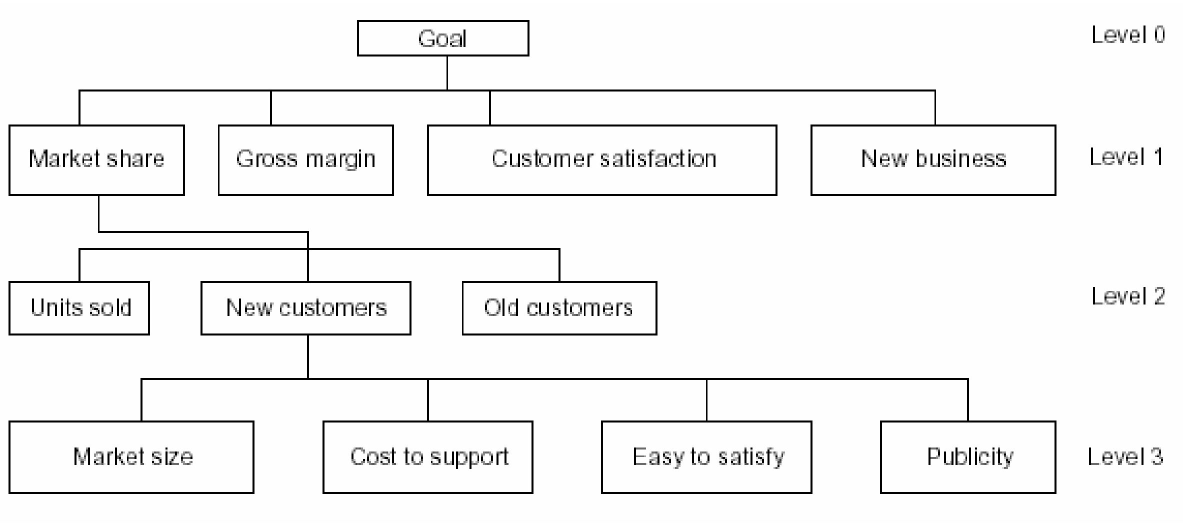

Figure 5.3 Hierarchy of Defined Criteria , (Andersen A. ,1998)

Once the levels and elements have been determined, the subject matter experts assign relative weights to each defined characteristic using a consensus method based on the following nine-point scale of importance.

1. Equal importance–the row and column have the same impact upon the higher order need.

2. Between 1 and 3.

3. Moderate importance–experience and judgment slightly favor the row over the column.

4. Between 3 and 5.

5. Strong importance–experience and judgment strongly favor the row over the column.

6. Between 5 and 7.

7. Very strong importance–the row is strongly favored and its dominance is demonstrated in practice.

8. Between 7 and 9.

9. Extreme importance–the evidence favoring the row is of the highest possible order of affirmation.

Using a series of calculations, a resulting two-way comparison table is normalized (the fraction of the characteristic as a percentage of the total for each column). The average of the normalized scores in the rows ranks the importance of the criteria. As shown in Table 5.2, market size, cost to support, ease to satisfy, and publicity are 0.604, 0.119, 0.066, and 0.211, respectively. Market size is nearly three times more important than publicity.

Table 5.2 Determining the Priority of Criteria , (Andersen A. ,1998)

	Market Size	Cost to Support	Easy to Satisfy	Publicity	Total	Normalized Average
Market Size	0.608	0.588	0.600	0.621	2.417	0.604
Cost to support	0.122	0.118	0.133	0.103	0.476	0.1198
Easy to satisfy	0.067	0.059	0.067	0.069	0.262	0.066
Publicity	0.203	0.235	0.200	0.207	0.845	0.211
Total	1.000	1.000	1.000	1.000	4.000	1.000

Once key criteria are identified, potential customers can be ranked, as illustrated in Table 5.3. The left two columns show the criteria and their calculated weights. The importance of each customer for each criterion is recorded in the next three columns. The weighted importance of each customer for each criterion is the product of the importance of the criterion and the importance of each customer for that criterion. The column totals are the weighted importance for each of the customers. The table illustrates that the market size criterion is the most important and the consultant is the most desirable customer for this criterion. By helping organizations determine the relative importance of customer segments, AHP allows firms to better determine whom to talk to and how much weight to assign to their opinions.

Table 5.3. Ranking Customers by Criteria , (Andersen A. ,1998)

Criteria	Priority	Teacher	Student	Consul tant		Teacher	Student	Consultant
Market size	0.604	0.090	0.010	0.900		0.05	0.01	0.54
Cost to support	0.119	0.609	0.304	0.087		0.07	0.04	0.01
Easy to satisfy	0.066	0.267	0.667	0.067		0.02	0.04	0.00
Publicity	0.211	0.177	0.085	0.737		0.04	0.02	0.16
Total	1.000			Importance		0.18	0.10	0.71

5.1.1.1.3 Customer Voice Analysis . Customer voice analysis helps an organization to better understand customers' expectations, voiced desires, and as yet unperceived needs. These qualities, or attributes, become the "whats" of QFD—the individual characteristics of the product or service that drive customer satisfaction and value perceptions. If an inaccurate representation of customer desires is obtained, the QFD process will fine-tune the system to bring forth the wrong product or service. Therefore, obtaining the voice of the customer accurately is critical.

Customer voice analysis aids the development of an accurate list of product or service characteristics. As illustrated in Table 5.4, customer voice analysis makes the list of *"whats"* more manageable, focuses the QFD process, and helps clarify meanings.

Table 5.4. Voice of customer Analysis Table, (Andersen A. ,1998)

Info about person	Voice of customer	I = inferred E = explicit	CONTEXT OF APPLICATION											INTEGRATED DATA
			WHO		WHAT		WHERE		WHEN		WHY		HOW	
53 years	I can move it	E	Instructor	E	Work-shop	E	Bldg. 255		For 5 days		Historic record			Stays up long time
Consultant	Works on my walls		Trainers		Lecture				Moved several times	E	Limited work space			Sticks to coated walls
1.9m tall		I	Tall				Easy to clean walls							Many moves possible
12345A		I	Short											Stays on wall 48 hours
														Repositionable 4 times no change in properties

Once the primary list of *"whats"* is identified, attention turns to rating these qualities systematically. The resulting rankings play a key role in the QFD process, serving as weighting factors that are used downstream as multipliers for other analysis. It is critical that these rankings accurately reflect the customers' opinions. Table 5.5 provides an illustration of the delivery qualities and their rankings for a large aerospace company.

Table 5.5 Ratings within a Customer Voice Analysis, (Andersen A. ,1998)

What Are The Important elements of a delivery?	**Importance Rating (1 to 5)**
On-time	**3**
Quantity	**3**
Received condition marking	**2**
Marking	**1**
No inspection	**5**
Paperwork	**2**
Cost and logistics	**4**

Puritan-Bennett used customer voice analysis to develop a new spirometer. Information about customer demands came from physicians and nurses, supplemented by dealer and distributor input. During the design process, there were many lively discussions over which engineering solution a product feature should use. Customer voice analysis ensured that decisions always favored the customer. With a better design and reduced selling price, Puritan- Bennett took away the competitor's price edge and fulfilled a need that neither company had previously satisfied.

5.1.1.1.4 Relationship Matrix. A relationship matrix focuses attention on how the various customer requirements will be met using tangible and intangible product or process characteristics. Since many customer requirements are too unclear or poorly defined to provide guidance to the organization, they must be changed into the language of engineering. Performance or technical measurements evaluating the product's performance, based on demanded quality, are used for this purpose.

At least one quantifiable performance measure is typically identified for each demanded quality. For instance, if the demanded quality for an easel pad includes “stay on wall,” two performance measures can be envisioned: “time on walls” and “number of walls.” Test procedures can then be developed to understand how long the product remains on a variety of different wall surfaces.

Defining how well performance measures that detail the technical features of the product will relate to the demanded qualities is key to transforming customer information into specific, objective design language. Without this transformation, product characteristics and potential “price-creating” value cannot be used to drive internal efforts.

A relationship matrix details the strength of each performance measure in terms of its predictive ability for each customerdemanded quality. For each row *demanded quality* and column *performance measure* intersection, the following question should be asked: If I know the value for performance measure X, how well will it predict the customer’s satisfaction with the product’s ability to satisfy demanded quality Y?

Four options are offered in the example illustrated in Table 5.6: a strong relationship, a medium relationship, a weak relationship, and no relationship. The use of symbols for these weightings, similar to a *Consumer Reports* evaluation model, facilitates the identification of patterns of relationships in the matrix.

Table 5.6 Relationship Matrix , (Andersen A. ,1998)

Demanded quality / Performance measurement	Write on with 12 pens		Sheet removal	Shear various surfaces	Peel energy		Blackboard stability	Packaging test
Smear-free	◎	■	■	■		■		■
Common markers	●	■	■	■	■	■	■	
Freestanding	■	■	■	■	■	■		■
Stays on wall	■	■	◎	●	●	■	■	
Easily removed from wall	■	■	●	■		■	■	■
Opens easily	■	■		■	■	■		●
Protects	■	■	■	■	■	■	■	○

Predictive quality of performance measure

● = strong
◎ = medium
○ = weak
■ = none

Important demanded qualities should have a performance measure with at least a medium relationship. Relatedly, more than 50 percent of the cells should represent no relationship, in keeping with the Pareto principle that most of the value will come from the critical few qualities and measures. If a row is blank in the relationship matrix, it means that the demanded quality will not influence the design. This could be a critical omission. A blank column, on the other hand, indicates that resources would be wasted measuring something that does not directly satisfy customer needs.

Narrowing the total list of potential measures to the critical few is important in order to focus design efforts and ensure that the needs of target customers are met. If multiple customer segments are to be addressed, the answers to these questions can be expected to differ by segment. The final choice of performance criteria will then need to be adjusted to accommodate the optimal level of satisfaction for the largest number of potential customers, incorporating the least amount of variety and complexity in the final product design.

5.1.1.2 Establishing the Target Profit Margin and Cost to Achieve

After the target price is set, the focus shifts to establishing the target profit margin and specification of the achievable cost objective. The overall goal is to ensure that the profitability and return on investment goals of the organization are met by the new product or service. Specific objectives of this phase include:

- determining return on sales objectives; and
- linking capital investment planning to profitability and the costs associated with product development and delivery.

The long-term general profit plan of the organization is the backdrop for the development of product-line-specific objectives. Specifically, target profit margins for product line models and the various strategic project plans that together make up the organization's basic management structure must be determined. Strategic project plans include new product development plans for each product or service, plant investment plans, and capital procurement plans. New product development plans are required for each year of the projected product life.

For example, at Nissan, the corporate development plan coordinates the new-product life-cycle plans for each vehicle model with long-term profit plans as part of the long-term profit planning process. Corporate new-product development plans are required for each year in the projected product life and cover all full model changes or minor changes that are planned for all target models. Thus, all production and sales plans for the company's vehicle models are coordinated under one plan that takes the perspective of the company's overall business strategy.

Coordinating all of an organization's production and sales plans ensures that these efforts reflect the strategic business perspective. Figure 5.4 details the role of the target profit management process within a target costing system of a major automobile manufacturer.

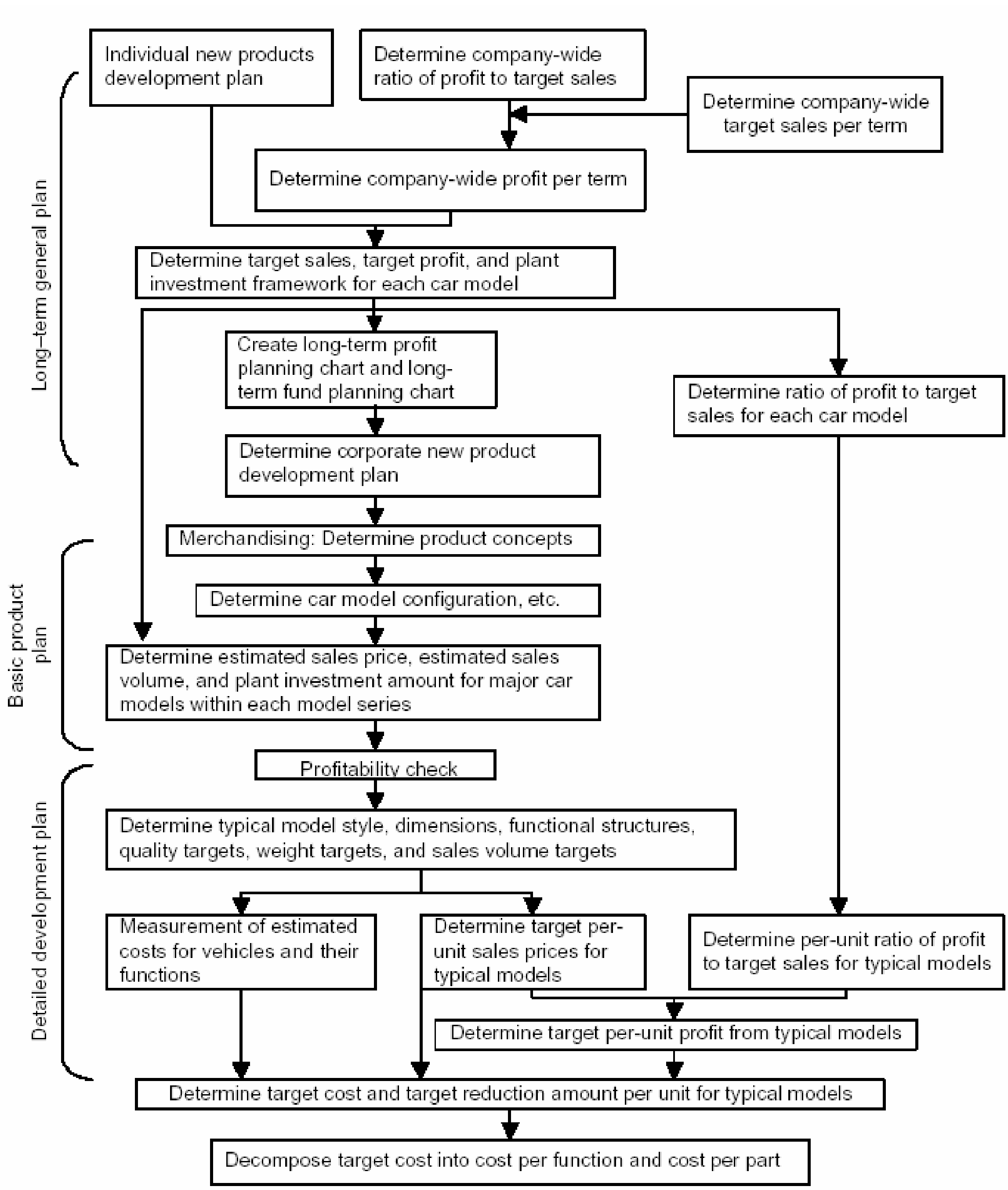

Figure 5.4 Target Costing and Profit Management Process, (Andersen A. ,1998)

Target profit margins must be realistic and sufficient to offset the life-cycle costs of the product. A useful tool used for establishing target profit margins is a multi-year product/profit plan.

5.1.1.2.1 Multi-Year Product/Profit Plan. A multi-year product/profit plan integrates the various product plans, establishes baseline targets for each product over its useful life, and ensures that the timing of new product releases are staggered to prevent bunching, while supporting the effective use of company resources. The plan has a series of inputs and outputs, specifically:

Inputs:

- life-cycle plans for the proposed new products;
- current position of existing products on cash flow/product portfolio charts; and
- estimated values for the company's overall personnel capacity (for design, prototype development, and production setup work), manufacturing plant capacity, and new plant investment capacity (including capital procurement ability).

Outputs:

- multi-year general profit plan (exact timeframe varies by the nature of the planning cycle in a given industry);
- products/services to be developed and introduced over a certain time period;
- target profit for each product or product series;
- target return-on-sales ratio for each product;
- plant investment plan for each product;
- personnel plan; and
- overall new product introduction plan.

Figure 5.5 illustrates a multi-year product/profit plan structure. It is an annual product mix that shows aggregate target profits by year for each product. The sum of all products in a given year is the annual profit plan, while the total of annual profits by products is the product life-cycle profit. The product level profit includes all directly traceable recurring costs (such as materials) and conversion, and nonrecurring traceable costs (such as special tooling and dedicated machinery and other costs.)

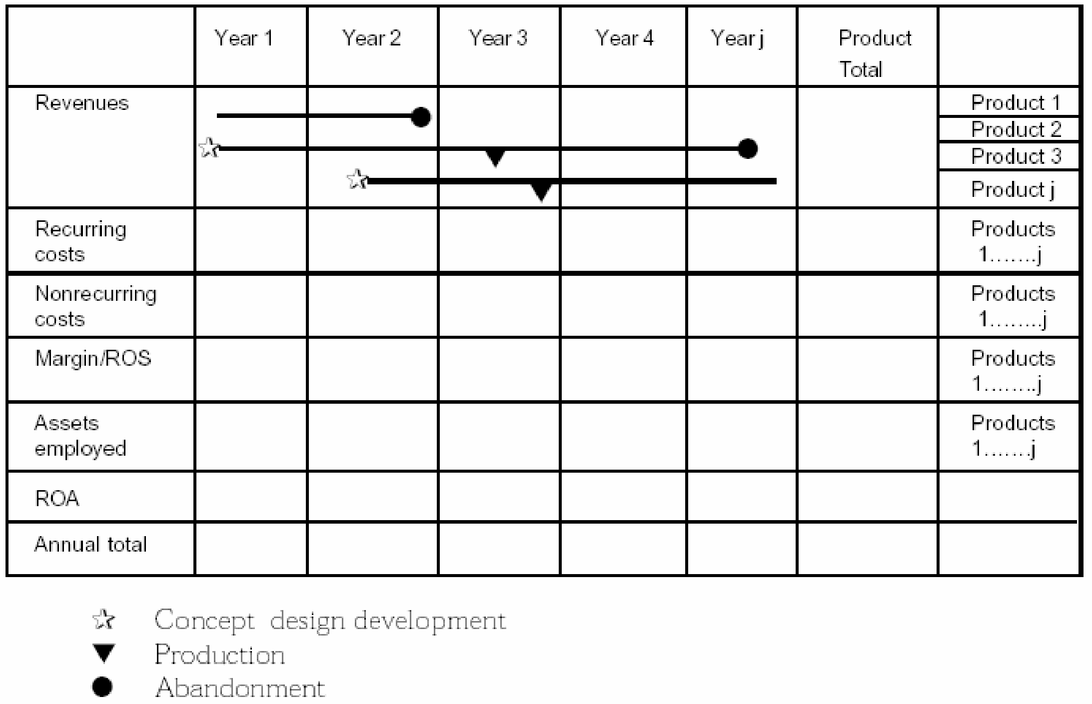

Figure 5.5. Multi-Year Product/Profit Plan, (Andersen A. ,1998)

Having laid out the parameters for an individual product within the context of the overall company strategic profit and product plans, attention can turn to calculating the probable cost of current and new products and processes.

5.1.1.3 Calculating the Probable Cost of Current and New Products and Processes

A key step in the product planning phase involves the examination of the organization's cost information in order to generate reliable cost estimates for the probable costs of current and new products and processes. These estimates may include production costs, R&D costs, physical distribution costs, and end-user costs. The underlying objectives during this phase include the following:

• determining what a new product's costs would be using existing product specifications and manufacturing processes;

• cost modeling; and

• analyzing internal costs.

Several core tools and techniques typically used in this effort include:

• process (operational) costing;

• component cost analysis; and

• cost tables.

5.1.1.3.1 Process (Operational) Costing. Process (operational) costing can be used to identify the cost drivers for each step of the manufacturing process. Process costing makes no attempt to account for the costs of individual units or specific groups of products. Instead, all costs are accumulated by operations or processes. These costs are subsequently allocated from processes to products on a systematic basis.

Process costing directly considers the effects of customer requirements and differentiates the value-added costs likely to be incurred by serving one group of customers versus another. The technique includes the impact of requirements on process characteristics such as capacity. The result of this effort is an economic model of the organization that clearly defines customer needs and the processes required to satisfy those needs. The model integrates marketing, operational, and financial data to better understand the total cost caused by a potential change to the product matrix.

An advantage of placing the costing emphasis on processes is that the trade-offs between competing products can be better identified. As the flow of a new product is tracked through an existing facility, the target costing team can begin to isolate its impact on existing products to determine where the new demand on resources will trigger constraints on overall throughput.

The creation of cost estimates for existing or new processes provides the basis for developing capital acquisition plans and finalizing product profitability analysis. Table 5.7 provides an example of a process-specific cost list that details prime assumptions and current demand for parts of the process affected by a new product.

Whether process costing is used to understand the overall impact of a new product on the existing plant or to estimate the cost implications of various design decisions, it plays a pivotal role in creating the probable cost estimate for current and new products and processes.

5.1.1.3.2 Component Cost Analysis. Component cost analysis decomposes the product level target cost into the major component and parts categories. For example, a target cost list might be broken down by the following major component categories and then by more detailed parts categories:

• Breakdown of chassis functions: front axle, front brakes, rear brakes, etc.;

• Breakdown of body functions: white body metal, bumpers, window glass, etc.; and

• Breakdown of interior functions: seats, air conditioning, interior panels, audio system, etc.

A major component category may be further broken down into detailed part categories, for example, breakdown of seat systems:

frame, slide rails, reclining mechanism, trim covers, etc.

Table 5.7 Rate Master List of Process Costs, (Andersen A. ,1998)

Direct department	Process	Unit of measure	Annual estimated rate for variable processing costs	Annual estimated rate for fixed processing costs	Estimated equipment depreciation cost	Unit for annual estimates	Estimated processing cost rates	
							Variable cost rate	Fixed cost rate
Team 1	Lathe	Labor-hours	56,683,000	37,580,000	16,793,000	20,000	47.2	17.3
Team 1	NC lathe	Labor-hours	57,533,000	35,980,000	15,853,000	20,000	47.9	16.8
Team 1	Vertical milling machine	Labor-hours	59,404,000	37,341,000	15,324,000	20,000	49.5	18.3
Team 1	Horizontal milling machine	Labor-hours	59,344,000	37,146,000	15,314,000	20,000	49.5	18.3
Team 1	NC vertical milling machine	Labor-hours	57,052,000	36,440,000	17,454,000	20,000	47.5	15.8
Team 1	NC horizontal milling machine	Labor-hours	59,288,000	39,608,000	18,291,000	20,000	49.4	17.8
Team 1	Drill press	Labor-hours	56,407,000	38,381,000	17,845,000	20,000	47.0	17.1
Team 1	Vertical boring machine	Labor-hours	57,747,000	38,827,000	16,544,000	20,000	48.1	18.6
Team 1	Horizontal boring machine	Labor-hours	56,691,000	36,406,000	18,388,000	20,000	47.2	15.0
Team 1	NC vertical boring machine	Labor-hours	58,614,000	38,677,000	19,478,000	20,000	48.8	16.0
Team 2	Cutting	Labor-hours	57,284,000	39,917,000	17,656,000	20,000	47.7	18.4
Team 2	Punching	Labor-hours	66,580,000	53,563,000	6,483,000	20,000	55.5	30.2
Team 2	Bending	Labor-hours	66,580,000	53,563,000	6,483,000	20,000	55.5	30.2
Team 2	Restricting	Labor-hours	66,580,000	53,563,000	6,483,000	20,000	55.5	30.2
Team 3	Lathe turning	Labor-hours	25,416,000	22,961,000	1,745,000	12,000	35.5	29.5
Team 3	Drilling	Labor-hours	25,416,000	22,961,000	1,745,000	12,000	35.5	29.5
Team 3	Boring	Labor-hours	25,416,000	22,961,000	1,745,000	12,000	35.5	29.5
Team 3	Milling	Labor-hours	25,416,000	22,961,000	1,745,000	12,000	35.5	29.5

Component cost analysis is particularly useful for assembly industries that purchase thousands of components, parts, and subassemblies. Component analysis has several important uses. First, it identifies the expensive components of a product. Second, it focuses on the cost relationships between components. This helps to determine if decreasing the cost of one component increases the cost of another component. Finally, it ensures that no outdated or soon to be out-of-production components are used.

Table 5.8 illustrates a component cost matrix. The *cost* column reveals the component cost and the *availability* column provides the last available date for the component before it becomes unavailable. The plus or minus entries highlight positive or negative relationships between the costs of components. A plus sign indicates that as the cost of the component in row 1 is reduced, the cost of the component in the column increases. For example, when the cost of component C1 is reduced, the cost of component C2 increases, but the cost of component C3 decreases.

Table 5.8 Component Cost Analysis (Andersen A. ,1998)

Components	C_1	C_2	C_3	C_4	C_n	Cost	Available Until
C_1		+	-	+		$aaa	1997
C_2	+			-		bbb	1999
C_3	-					ccc	1996
C_4		-				ddd	2005
C_n	+					nnn	2004

Inputs and outputs required for effective component cost analysis include:

Inputs:

- function-specific target cost outline;
- actual costs of internal components in existing or similar products;
- current costs of purchased components in existing or similar products;

• component functional drawings and concept manuals that show that the QFD objectives are being met;

• component-specific comparison of specifications for current and proposed models;

• planned volume of products that will use common components; and

• component availability information.

Outputs:

• component-specific target costs of in-house components;

• component-specific target costs of purchased components; and

• component-specific target costs for the complete product.

Table 5.9 provides a breakdown of component costs for a hypothetical coffeemaker. This information can be used to identify and prioritize cost-reduction efforts at the component level. Care must be taken to ensure that the sum of the component-level target costs does not exceed the target cost of the product. Often an increase in the cost of one component requires an exploration of ways to reduce the costs of other components by an equivalent amount.

Table 5.9 Component Cost Breakdown (Andersen A. ,1998)

		Cost	
Component	***Function***	***Amount***	***Percent***
Brew basket	Grinds and filters coffee	$ 9	18%
Carafe	Holds and keeps coffee warm	2	4
Coffee warmer	Keeps coffee warm	3	6
Body shape and water well	Holds water and encasement	9	18
Heating element	Warms water and pushes it	4	8
Electronic display panel	Controls grinder/clock settings	23	46
Total		$50	100%

5.1.1.3.3 Cost Tables. Calculating the probable cost of current and new products and processes depends, in large part, on reliable historical data. Cost tables enable estimating costs for materials, parts, utilities, and conversion. In essence, a cost table is a database that defines and depicts the cost effects of using different materials, production methods, and product designs.

Figure 5.6 shows one branch of a hypothetical cost table. Additional branches would stem from each of the cost driver alternatives under "*drilling activity*." In addition, similar branches would be prepared for "*cutting*" and "*lathing.*" At each stage, the cost table would show unit product cost split into direct material, direct labor, and production overhead.

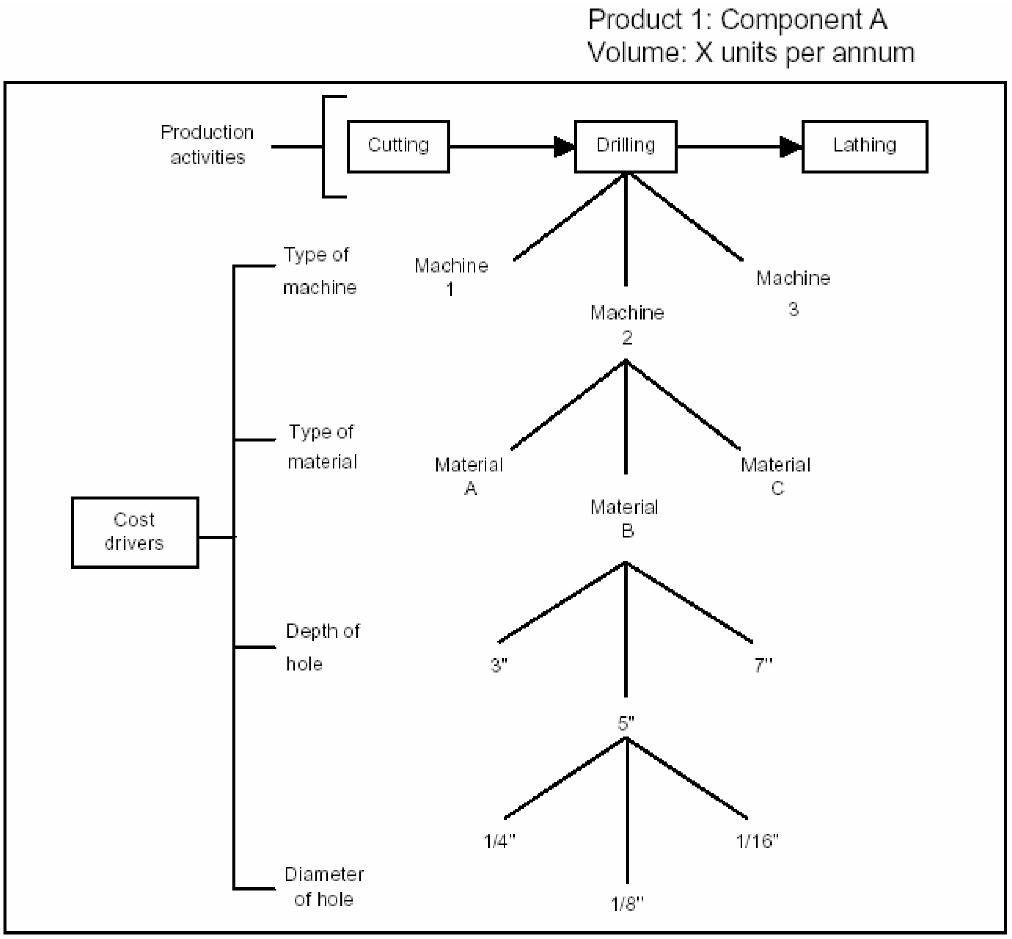

Figure 5.6 Cost Table Structure (Andersen A. ,1998)

There are two general types of cost tables: approximate cost tables and detailed cost tables. Approximate cost tables emphasize a small number of key variables that are known to have significant impacts on the final cost of a product, such as the impact of different engine specifications on the cost to design and produce a motorcycle.

Relatedly, a detailed cost table includes the relationship between a large number of variables and their relevant costs. Typically developed over many years, cost tables are used from the original design throughout the life cycle of the product. They are updated on an ongoing basis, serving as a critical decision-making aid in the design and ongoing management of a product portfolio.

Cost tables are typically developed using both internal and external expertise from across multiple functions, perspectives, and organizations. Since upwards of 80 percent of a product's lifecycle cost is set before the product is launched into production, the time and effort required to develop and maintain cost tables is an essential investment in current and future profitability.

Combined with computer-aided design (CAD), cost tables can provide for real-time analysis of the cost implications for a proposed change in product or component design or redesign. Finally, cost tables are often used to support "what if" (sensitivity) analysis at all stages of the product life cycle.

Toyota uses cost tables in five key production steps: machining, casting, body assembly, forging, and general assembly. The cost tables detail the machine rates for each step of the production process. These rates include labor, electricity, supplies, and depreciation costs. The exact form of Toyota's cost tables depends on the type of production step being analyzed; for example, for stamping, the cost table contains the cost per stroke while for machinery it contains the cost per machine hour. Toyota's cost tables are highly detailed, and in most cases, each production line has its own cost table.

5.1.1.4 Establishing the Target Cost

Once the target market price and target profit have been established, the target cost can be calculated. The target cost reflects the relative competitive position of the organization. It also represents the cost at which the product must be manufactured if it is to achieve the target profit margin when sold. The target cost acts as a signal to all involved in the target costing process as to the magnitude of the cost reduction objective that eventually must be achieved. The established target cost should be attainable, but only with considerable effort. Objectives that drive the achievement of these goals include:

- setting continuous improvement targets;
- measuring performance; and
- communicating cost requirements.

Target costs can be calculated using the target return-on-sales ratio or a compilation of estimated costs. In the former case, one of two primary formulas can be used to set a sales-price-based target cost:

Target cost = target sales price x (1– target return-on-sales ratio)

or

Target cost = target sales price – target operating profit.

Relatedly, the target cost can also be calculated by subtracting the per-unit profit improvement target from the estimated cost, then isolating those costs.

Having established the basic parameters for the target costing system and identified the appropriate level of execution at which it should be carried out, attention turns to establishing specific cost and performance targets. A useful tool that can be used in this step is benchmarking.

5.1.1.4.1 Benchmarking. One of the most important aspects of creating a target cost for a product or service is guaranteeing, at both the total and component level, that functionality and costs are competitively established. Benchmarking, which compares costs of specific products, activities, and outcomes to those of competitive or best-practice companies, provides valuable input to target costing in this effort. Issues that can be addressed through benchmarking studies include:

- identification of the best practice in completing core and support activities for the product or service;
- establishment of objective cost targets and performance metrics for component suppliers and internal processes;
- definition of quality and delivery parameters for similar products, processes, or components across comparable industries;
- identification of process improvements that can provide quantum improvements in overall cost and profit performance;
- development of innovative analysis and design techniques based on benchmarking site visits and case studies; and
- creation of an ongoing network of organizations capable of supporting current and future improvements and target costing initiatives.

The benchmarking process has been formalized into several steps by the leading practitioners. They all use an integrated approach to benchmarking reflected in the following five general steps:

planning, data gathering, analysis and integration, implementation/ execution, and re-calibration .

Organizations that are at a significant competitive disadvantage will benefit most from estimating benchmark costs and calculating the difference between those costs and their target cost. If the disadvantage is significant, it might not be possible to reach the benchmark costs in a single generation of product design. Such organizations will have to adopt a multi-release strategy of product design, setting ever more aggressive cost targets for each release. The narrowing gap between the benchmark and the target cost would demonstrate the achievement of competitive parity.

5.1.2 Product Design and Development Phase

5.1.2.1 Attaining the Target Cost

Once the target cost has been established, the goal is to develop a new product concept that attains the target cost while meeting all customer requirements. The process of attaining the target cost is supported by various methods that reveal cost-reduction potentials and show ways to transform those potentials into design alternatives.

Key objectives at this stage of the target costing effort include:

• optimize the relationship between materials, parts, and manufacturing processes;

• minimize costs;

• focus design efforts on market-driven variables for quality and cost of ownership;

• link product development with customer desires and to achieving a sustainable competitive advantage;

• link the product development process so that it assures product quality; and

• estimate the cost prior to implementation.

Turning the allowable cost target into an *achievable cost* requires three primary steps: (1) compute the cost gap; (2) design costs out of the product; and, (3) release the design to manufacturing and undertake continuous improvement.

5.1.2.1.1 Computing the Cost Gap. Calculating the difference between the target cost (calculated from the target price and profit margin) and current cost estimates is the first step in attaining target costs. Using the total, fully absorbed costs as the baseline, current costs represent the "as-is" estimate of the cost of producing the product or providing the service.

The resulting cost gap is decomposed into two primary parts: lifecycle costs and value-chain costs. Life-cycle decompositions emphasize the total product cost of the birth-to-death activities performed in research, manufacturing, distribution, service, general support, and disposal. Conversely, value-chain analysis examines costs based on whether they are incurred and controlled by the organization or by one of its value-chain partners (e.g., suppliers, dealers, or disposers). As noted by Ansari, "the two breakdowns take the same total cost but provide two different kaleidoscopic views of the product cost. Each helps to highlight where cost reduction efforts need to be focused." Table 5.10 provides a detailed illustration of the cost gap analysis effort.

Table 5.10 Computing the Cost Gap (Andersen A. ,1998)

Value Chain	Inside			Outside		
Life Cycle	**Allowable**	**Current**	**Gap**	**Allowable**	**Current**	**Gap**
Research and Development	3.60 $ (4%)	5 $	1.40 $			
Manufactoring	15.30 (17%)	20	4.7	21.60 (24%)	30 $	8.40 $
Selling and distribution	5.40 (6%)	6	0.6	12.60 (14%)	17	4.4
Service and support	9.00 (10%)	10	1			
Genereal business overhead	18.00 (20%)	19	1			
Recycling costs	4.50 (5%)	7	2.5			
Total	55.80 $ (62%)	67 $	11.20 $	34.20 $ (38%)	47 $	12.80 $

Value Chain	Total		
Life Cycle	**Allowable**	**Current**	**Gap**
Research and Development	3.60 $	5 $	1.40 $
Manufactoring	36.9	50	13.1
Selling and distribution	18	23	5
Service and support	9	10	1
Genereal business overhead	18	19	1
Recycling costs	4.5	7	2.5
Total	90 $	114 $	24 $

5.1.2.1.2 Designing Costs Out of the Product. Reducing costs through the product design stage is the most critical step in attaining target costs. The key to achieving desired reductions lies in the answer to one specific question: *How does the design of this product affect all costs associated with the product from its inception to its final disposal?* Identifying all costs, whether incurred in distribution, selling, warehousing, service, support, or recycling, is essential as all of these cost elements, which are generated by the different functions, are affected by the design chosen.

For instance, the weight and control panel are two elements of a convection oven that are affected by the product's design. A heavy oven will increase loading, transportation, and installation costs if two people are required to perform these activities. Relatedly, an elaborate control panel will increase the time required to explain the product's use to customers, as well as increasing the potential for product support and repair costs, due to failures in electronic and mechanical components. Finally, the materials used may ultimately pose an environmental hazard that has to be handled at the point of disposal. All these factors add to the product's cost with little or no improvement in customer satisfaction.

5.1.2.1.3 Releasing Design to Manufacturing and Undertaking Contin. Improv. The final stage in attaining the target cost is to continue to make product and process improvements that will reduce costs beyond the point where it is possible through design alone. It includes eliminating waste (scrap, rework, etc.), improving production yield (i.e., getting more production from raw materials), and other such measures.

Achieving cost reductions before production begins is aided by the use of two specific tools and techniques: (1) design for manufacture and assembly and (2) value engineering.

5.1.2.1.3.1 Design for Manufacture and Assembly (DFMA). DFMA is an approach to product design that can improve an organization's ability to compete based on its manufacturing capability. Specifically, DFMA focuses on reducing costs by making products easier to manufacture, while holding functionality at specified levels. DFMA guides development of the detailed product design, ensuring that at every stage of the assembly and manufacture process minimal cost and waste elimination targets will be reached.

The DFMA methodology is based on five basic principles:

• Reduce the number of parts by combining parts (i.e., multifunction parts). Seek to combine parts unless separate parts are necessary because they must be of a different material, move relative to each other, or are necessary to ease assembly or disassembly.

• Assemble from the top down, rather than from the side or bottom.

• Design symmetry into parts so that they may be assembled in many orientations. If this is not possible, be sure they are very symmetrical so they can be easily oriented and fed.

• Design parts to be easily handled and inserted without restricted access.

• Use flexible manufacturing processes wherever possible (e.g., powder metal processing, injection molding, stamping).

Without DFMA, the projected benefits of a new product design may not be attained. For instance, at an organization making a variety of mechanical counters, a product was designed that required extreme dexterity to manufacture because multiple wires had to be encapsulated in a snap-together casing. Once the casing was assembled, it could not be disassembled (it became scrap). As the product rolled out to manufacturing, it was found that only one person could produce it reliably. No one else in the plant could consistently accomplish the task of getting all the wires into the casing before its closure. The entire production of this item was limited by poor execution of a good design concept , a failure to apply DFMA.

DFMA enables the attainment of cost targets by finding unique, low-cost, yet robust ways, to transform product concepts into reality. The benefits it can provide include:

• elimination of excess parts;

• active inclusion or development of common parts for a wide range of applications;

• through disassembly, reduction of life-cycle costs for maintaining the product in the field;

• reduction of potential defects and related engineering-change notices to correct design or assembly problems;

• increase in assembly efficiency and effectiveness; and

• improve throughput and time-to-market.

DFMA methodology has been successfully applied at many organizations, including several different development programs within the Boeing Company. In each case, cross-functional teams were established to develop a new product that either enhanced performance and/or reduced cost. These specific examples include 737 flight deck air valve, 737 windshield replacement, and 737/ 757 passenger cabin sidewall panel assemblies. The teams applied the DFMA process in developing their new products. Table 5.11 shows the top level results from these three different programs.

Table 5.11. Boeing DFMA Application Results Summary (Andersen A. ,1998)

	Program		
Measure	Valve	Windshield	Sidewall Panel
Cost Reduction	90%	25%	42%
Part count reduction	79%	10%	45%
Assembly time reduction	94%	70%	22%
Team size	3 people	7 people	5 people
Study duration	5 months	6 weeks	5 months

5.2.1.3.2 Value Engineering (VE). VE is used by organizations to increase product functionality and quality while at the same time reducing costs. The scope of VE includes design costs reduction, process improvements and working with suppliers. The output of VE is a series of improvement plans that raise the value of the target product. Emphasizing functionality and meeting customer requirements within the allowable cost parameters, VE goes beyond the particular styles or configurations of current products to consider the functions that lie at the heart of the product in order to come up with innovative ways to achieve desired functionality with less cost or effort.

As suggested by Figure 5.7, VE studies the various requirements of functionality and quality that occur during the entire life cycle of a product. These include:

- *user requirements*: use-objectives, use-conditions and environments, performance features, reliability, safety, durability, design, shape, color, etc.;
- *sales requirements*: selling points, competitive performance features, competitive pricing, and related factors;
- *design-related requirements*: performance levels, addedfunction levels, etc.;
- *manufacturing-related requirements*: processing technologies, manufacturing processes, and related labor hours, materials, and purchased parts;
- *distribution-related requirements*: packaging, loading, storage, transportation, etc.;
- *cost-related requirements*: management of progress toward achieving target costs; and
- *legal and regulatory requirements*: patents and utility models, environmental protection laws, industry regulations, government guidelines, and related factors.

Table 5.20 illustrates an example of VE cost-cutting ideas that focus on reducing the number of parts, simplifying the assembly, and not over-engineering the product beyond what will meet a customers' needs.

Isuzu is a significant user of VE. The development of their NAVI- 5 transmission system, which combines the higher fuel efficiency and performance of a manual transmission with the convenience of an automatic transmission, used VE concepts. Specifically, VE was used to develop a Gemini (ceramic) heater that would reduce the time it took to warm up a car's interior by focusing early heat from the engine through a secondary heating system that directed warm air at occupants' feet until the engine was warm enough to support the traditional heating system. Also, VE was used to develop a gear lever that would fold down while the vehicle was stationary but that would not collapse while the vehicle was in motion.

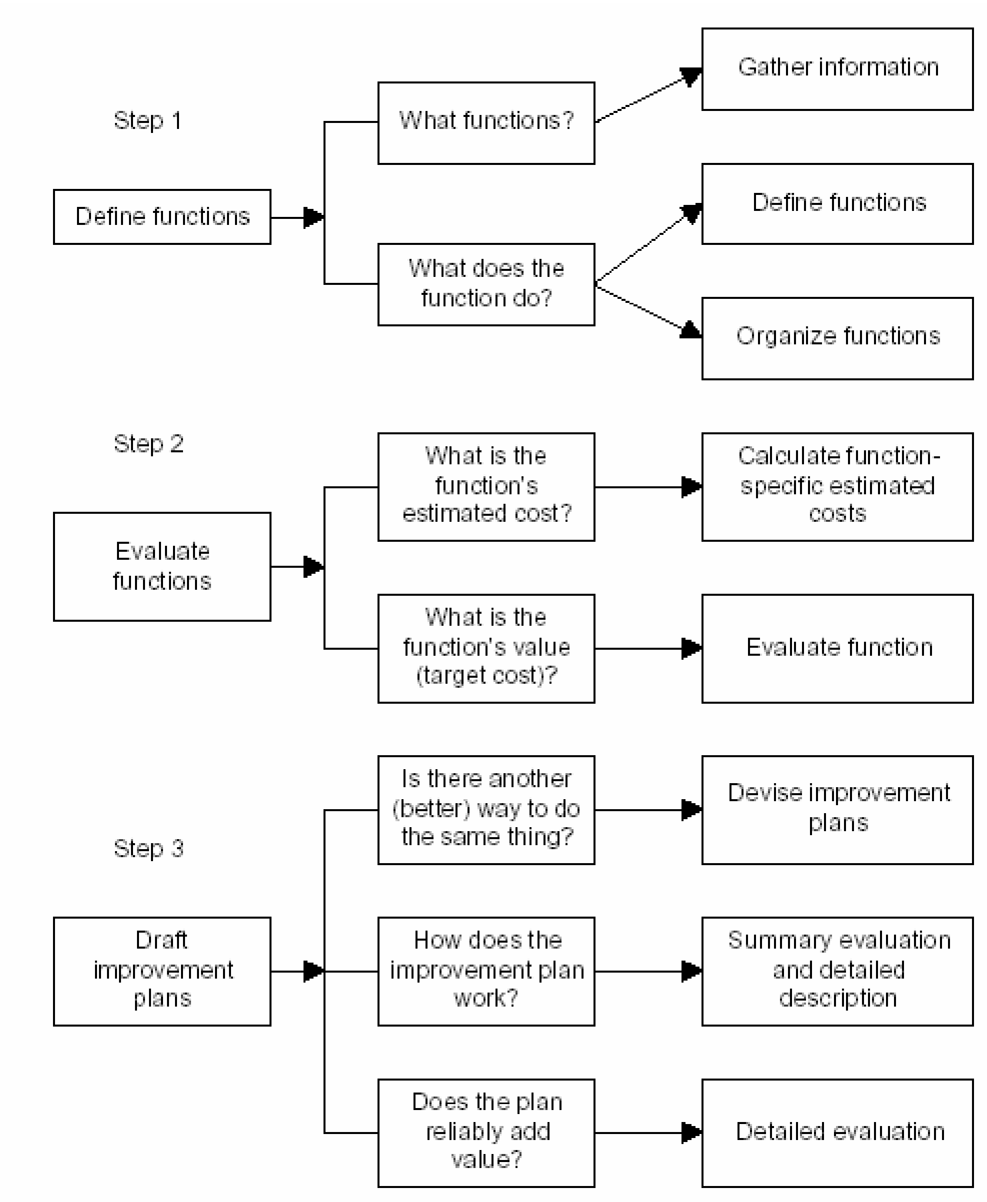

Figure 5.7 Value Engineering (VE) Framework, (Andersen A. ,1998)

Table 5.12 Value Engineering (VE) Ideas to Reduce Costs

Panel Subcomponent	Cost Reduction Idea
Power supply	Reduce wattage-more than needed in current design.
Flexible circuit	Eliminate flexible circuit. Use iwring harness.
Printed wire board	Standardize board specifications. Use mass-produced unit.
Clock timer	Combine with printed wire board.
Central processor chip	Substitute standard 8088 chip instead of custom design.
Heater connector	Rearrange layout of board to heater connection.

Having made the improvements required to transform the target costs into achievable costs, attention can now turn to achieving continuous improvements on the plant floor.

5.1.3 Pursuing Cost Reductions Once Production Has Started

The start of production signals the beginning of the cost maintenance phase, which emphasizes the stabilization of or continuous improvement in product- and component-level costs. The objective at this stage is to pursue cost reductions relentlessly at every stage of manufacturing to close any remaining gaps between targeted and actual profits.

Organizations that have successfully implemented target costing, such as Texas Instruments and Toyota, note the importance of cost information in cost reduction initiatives. Key objectives at this stage include:

- providing improved product cost information;
- providing improved performance monitoring; and
- improving understanding of the true cost structure.

A useful tool for this cost reduction effort is activity-based costing/ activity-based management (ABC/ABM).

5.1.3.1 ABC and ABM

Achieving cost reduction objectives requires information that identifies the causes of current cost and the potential impact of attacking these cost drivers. ABC and ABM are valuable target costing tools because they focus attention on how product design leads to the consumption of various activities and therefore, increases overall costs. For instance, material handling is related to the number of unique parts purchased, which is a function of design complexity. 98 ABC and ABM can also be used to increase the understanding of cost items such as manufacturing overhead, marketing, distribution, service and support, and general business overhead. Where ABC and ABM provide inputs to a decision technique for improving the use of current and anticipated resources, target costing applies this information to change the nature and amount of currently available resources.

Table 5.13 details the relationship between ABC, ABM, and target costing. The interaction of reductions in direct costs that remain the primary focus of target costing and the cuts in, or improvement of, indirect costs and activities under ABC and ABM creates an ongoing basis for improvement and development of a competitive cost and profit profile for existing and new products.

Table 5.13 Relationships between ABC, ABM, and Target Costing

Tools	Main Purpose	Cost Elements	Emphasis
ABC	Product profitability analysis	Overhead	Cost assignment for managerial decision making
ABM	Process reengineering	Overhead and direct costs	Process improvement
Target Costing	Strategic cost management	Overhead and direct costs	Cost reduction

At almost every turn, target costing can utilize information available in ABC and ABM systems to identify current actual costs, analyze the causes of that cost, and find ways to reduce overall indirect costs by changing the ways products are designed, developed, manufactured, and sold. Using ABC and ABM in the target costing process provides the following benefits:

• quantification of costs, both value-added and nonvalue-added, by activity, cost element, component, and product;

• identification and estimation of the costs to meet specific customer functionality and quality requirements;

• analysis of the costs of complexity;

• measurement of the impact of QFD, DFMA, and VE initiatives on current and projected costs;

• enhanced ability to take action to reduce overhead costs;

• support of cost of quality and related analysis, which reflect trade-offs made by the organization to hit cost targets;

• sensitivity analysis, which incorporates the underlying behavior of cost and the cost of idle or unused capacity to increase the accuracy of target cost estimates; and

• creation of cross-functional, process-oriented costing tools that support brainstorming, concurrent engineering, and kaizen costing efforts.

ABC and ABM are important tools that support target costing. Both tools are applied on a prospective basis to estimate product and process costs. During the early stages of product development, ABC is used to estimate product cost at a general level. This is useful for preliminary evaluation of product feasibility. As product and process definition become more precise, predictive ABM process cost models are applied to estimate the costs of particular functions and components using particular processes. This has been particularly valuable to engineers as they work to reduce product and process cost, improve utilization of current machines and equipment, and eliminate waste and process variation.

5.2 The Factors Influencing TC Process

All of the target costing processes documented contain three major steps, marketdriven costing, product-level target costing, and component-level target costing.

Figure 5.8 The Target Costing Process (Cooper R.,1997)

Each step has a defined output: allowable cost, product-level target cost, and component-level target costs respectively. While these outputs are essentially identical across firms, the process of target costing is more difficult to observe and varies by firm. There are at least five major factors that apparently influence the target costing process. Two of these primarily influence the market-driven costing portion of the target costing process. These are the intensity of competition and the nature of the customer. The next two factors influence the product-level target costing process. These are the firm's product strategy and the characteristics of the product. Finally, the last factor, the firm's supplier-base strategy shapes the component-level target costing process.

5.2.1 Factors Influencing Market-driven Costing

The factors that apparently help shape the market-driven costing portion of the target costing process include the intensity of competition and the nature of the customer (Figure 5.9). These two factors help determine how difficult it will be to ensure that products are successful when launched and hence, the magnitude of the benefits derived from target costing. They also help determine the nature and extent of the information collected about customers and competitors in the market analysis portion of the target costing process. It is reasonable to suspect that the intensity of competition is a factor to consider since it has been shown in other environments to influence the energy expended on cost management (Khandwalla, 1972).

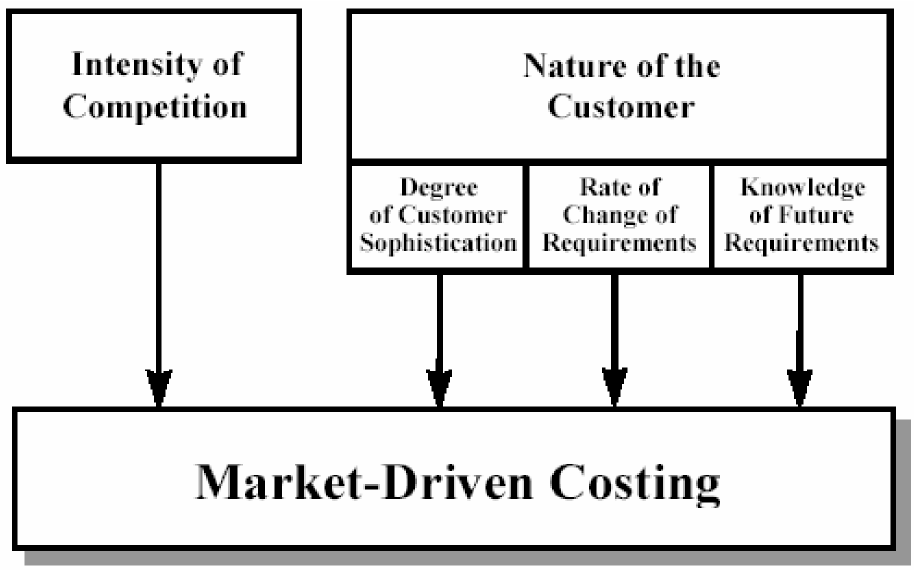

Figure 5.9 Factors Influencing Market-Driven Costing (Cooper R.,1997)

5.2.1.1 Intensity of Competition

The intensity of competition apparently influences how much attention the firm is paying to competitive offerings in the target costing process. All of the firms studied could identify four to six direct competitors who were fairly evenly technologically matched. These firms had adopted a confrontational strategy because they lacked the ability to develop sustainable competitive advantages over each other (Cooper, 1995). Three product-related characteristics, referred to as the survival triplet, play a critical role in determining the success of firms. The survival triplet comprises the product price, quality and functionality. Quality is defined as conformance with product specification.

Functionality, which includes service, refers to the degree of success in designing the product to meet the specifications that customers require.

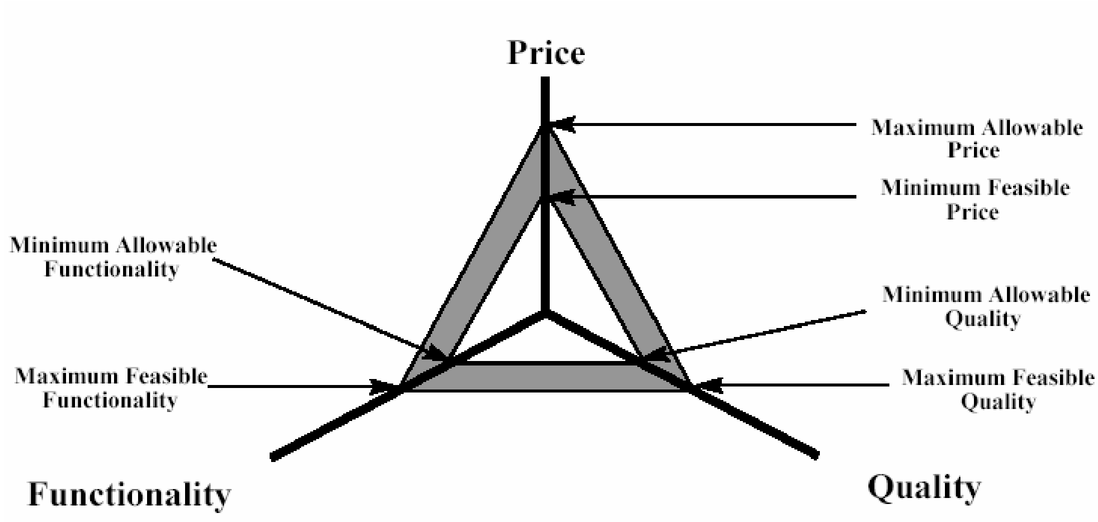

Figure 5.10 The Survival Zone for a Product (Cooper R.,1997)

A product's survival zone (Figure 5.10) is bounded by the minima and maxima of these three elements. For example, there will be a level of functionality above which it will be too costly for the firm to operate if it wishes to retain customers by charging prices that they are prepared to pay. Similarly, there will be minimum levels of quality and functionality required by customers. In markets with perfect information and only strictly economic rational customers, the specific customer trade-offs between price, quality and functionality would be clearly visible and a well specified functional relationship between values for the three triplet elements could be set down as the basis for determining strategy. In reality, firms can usually only identify the approximate position of the maxima and minima of the three triplet elements. There is in other words, a three-dimensional space within which a product can succeed that is bounded by the maxima and minima of price, quality and functionality. Where the minima and maxima are set widely apart, it may not be possible to detect trade-offs in a precise functional form and it will be more likely that there will be more than one survival zone with customers forming rivalry groupings, such as those competing on cost for a minimum quality and functionality in contrast to those attempting to operate a differentiated product strategy (Figure 5.11). But, increasingly, and especially in markets faced by the Japanese companies described in this study, competition is very different. Customers have become more informed, rivals more aggressive and survival zones have been squeezed. In such a situation, the traditional approach of selecting whether to use a cost-leadership or differentiated product strategy is no longer available. If a firm wants to survive, there is no alternative but to compete head on in terms of cost, quality and functionality.

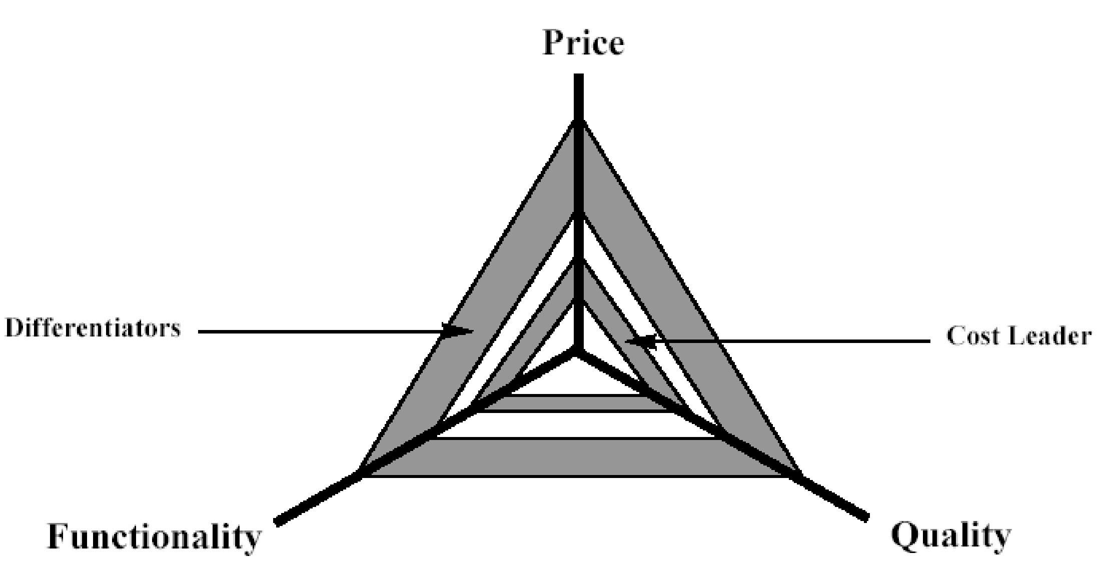

Figure 5.11 The Survival Zone of the Cost Leader and Differentiators (Cooper R.,1997)

When these conditions exist, certain realities are present (Cooper, 1995):

- Profit margins are low,
- Customer loyalty is low,
- First mover advantages are small,
- Product that are launched outside their survival zones fail dramatically.

Under such conditions, the benefits of target costing are potentially high. The low profit margins and customer loyalty mean that the firm can not afford to make too many mistakes when launching new products. By transmitting the competitive pressure faced by the firm to its product designers and suppliers, target costing increases the probability that new products are inside their survival zones when launched. In contrast, in environments where the intensity of competition is lower, non-confrontational strategies, such as cost leadership and differentiation, can be successful. Such strategies allow for higher profits and increased customer loyalty. Therefore, the benefits of target costing will be potentially lower in such environments.

The ability of competitors to rapidly bring out me-too products makes it difficult for firms to recoup their investments in product development. First, the rapid copying leads to shorter life cycles and second, the inability to reap first mover advantages leads to lower profits. Thus, the firm is forced to amortize its development costs over fewer units that are generating lower profits. Therefore, the ability of the successful products to offset failures is reduced. This inability creates significant pressure on the firm to minimize product failures.

Consequently, it is postulated that target costing is particularly valuable for firms that have adopted confrontational strategies because failure to launch products that are in their survival zones typically leads to rapid and significant loss of market share. These losses are driven by the narrow survival zones that result from equivalent competitors chasing the same customers. In general, it is conjectured that as the intensity of competition increases, so does the value of target costing to the firm. For example, Sony has managed to differentiate its products based upon their superior functionality over those of the firm’s competitors. This lowered intensity of competition is thought to be one of the main reasons that Sony has a less well developed target costing process compared to the other firms in the sample. In contrast, all of the other firms are in confrontation and, with the exception of Topcon, have well developed and elaborate target costing systems.

5.2.1.2 Nature of the Customer

There are many characteristics of customers that can influence the intensity of consumer analysis that is undertaken by firms, but evidence suggests that three are particularly important in helping determine the benefits derived from target costing.

The first is the degree of customer sophistication, the second is the rate at which future customer requirements are changing, and the final characteristic is the degree to which customers understand their future product requirements. These three characteristics appear to help determine the benefits that a firm can potentially derive from target costing because they deal with the width, rate of change of location, and ease of predicting the location of survival zones. Analysis of the practices observed in the six companies suggests that target costing is particularly valuable for firms that have to compete in environments that have narrow survival zones, whose locations are changing rapidly, but are relatively predictable.

5.2.1.2.1 Degree of Customer Sophistication. The degree of customer sophistication determines how good customers are at detecting differences between the price, quality, and functionality of competitive products. Sophisticated customers are highly educated about the product offerings that are available, can detect minor differences, and will freely switch between manufacturers to buy the products that best satisfy their needs. Consequently, as customers become more sophisticated, the survival zones of products become narrower. When survival zones are narrow, it is easier to launch products that fall outside them and hence fail. To increase the probability that products are launched inside these narrow survival zones, firms expend considerable energy on consumer analysis trying to determine the location of survival zones when the product is launched.

For example, in the automobile industry, the primary characteristic of the survival triplet used to differentiate products is functionality. Firms compete by continuously increasing the functionality of their products while keeping the price and quality essentially unchanged. Customers therefore, have come to expect a steady increase in product functionality and have quite clear expectations for their future purchases. For example, to ensure that their products are successful, Toyota and Nissan both expend considerable energy on consumer analysis to help them identify the future automobiles that will both satisfy their customers and sell sufficient volumes to be profitable. The same holds true in the camera industry where most consumers are highly sophisticated and capable of identifying the exact features they expect in a new camera. Survival zones are narrow in that industry and there is no price freedom. For example, Olympus expends considerable energy on collecting qualitative information about consumer preferences. The firm collects information about consumer trends from seven sources including recent purchases, professional photographers, and focus groups. In addition, the firm monitors its competitors' actions closely.

The evidence suggests that target costing becomes especially valuable in environments with highly sophisticated customers because survival zones are narrow and therefore, products must be designed that satisfy customer requirements as closely as possible. For example, without the discipline of target costing engineers sometimes add extra functionality to the products in the belief that they are attractive to customers. Unfortunately, these extra features often cost more than the value that the customer places on them. The outcome of such design "improvements" is products that cost too much and therefore have profits that are below expectations. However, in confrontational environments profits are already low and there is little room for error, rendering the discipline on the product designers imposed by target costing critical to firm survival. Therefore, it is postulated that target costing systems will be especially valuable in environments with sophisticated customers. In addition, the target costing process will have a strong external orientation in such environments because understanding the customer's requirements is critical. In contrast, it is postulated that in environments where consumers are less sophisticated, target costing will not be as beneficial and will be more internally focused.

5.2.1.2.2 The Rate at which Customer Requirements Change. The rate at which customer requirements change defines how rapidly the location of survival zones moves over time. When survival zones are moving rapidly, it becomes more difficult for the firm to predict where a product's survival zone will be when it is launched. This inability makes it more difficult to ensure that new products are inside their zones when launched than when zones move more slowly. In the automobile industry, the rate of change of customer expectations is relatively high and therefore, Nissan samples consumer preferences on a regular basis during the product design process. For example, the market is sampled when the product is first conceptualized, just before it enters the product design stage, and just before it enters the production stage. The primary purpose of these market revisits is to capture how the position of survival zones has changed since the last survey. The product's design is then modified where possible to increase its probability of success. In contrast, Komatsu's customers are commercial buyers not consumers. They are highly sophisticated and well aware of their preferences which given the nature of the firm's products (bulldozers and excavators), do not change rapidly. Therefore, it is easier for Komatsu to keep track of changing customer expectations than it is for an automotive company. Consequently, Komatsu expends considerably less energy than Nissan's or Toyota's on customer analysis. Consequently, it is postulated that target costing is more beneficial in environments where consumer preferences are changing rapidly. Under such conditions it is easier to launch products that are outside their survival zones. Firms with such customers are forced to expend considerable effort on predicting future customer requirements. In contrast, it is postulated that when customer requirements are stable, less effort is required to locate the position of a product's survival mode and target costing provides smaller benefits. Reflecting the diminished benefits, the target costing systems at these firms are more internally focused.

5.2.1.2.3 The Degree to which Customers Understand their Future Product Requirements. The degree to which customers understand their future requirements, in part, determines the amount of energy expended on customer analysis in the target costing process. As the degree of understanding increases, it becomes more beneficial to rely upon espoused customer preferences to determine the future location of survival zones. In contrast, when customers have little understanding of their future requirements, firms that pay too much attention to customers risk launching products that fail because they are outside their survival zones.

In the earth moving business, customers have a high degree of awareness of their future requirements. For example, Komatsu's customers can be relied upon to tell the firm what needs to be improved in their designs and to a certain extent by how much. In such an environment, target costing will offer considerable benefits because the customer is able to specify quite accurately the location of future survival zones. In contrast, in the consumer electronics industry consumers have a lower degree of understanding of their future requirements. Consequently, product failures are more common because the critical attribute often only becomes apparent after the firm has launched a new product. Consequently, it is postulated that target costing is less beneficial in environments where the future locations of survival zones are hard to predict. In contrast, it is postulated that target costing will be more beneficial when the future locations are predictable.

5.2.2 Factors Influencing Product-Level Target Costing

Based upon the analysis of the target costing practices at the sample firms, it is conjectured that the factors that help shape the product-level target costing portion of the target costing process are the firm's product strategy and the characteristics of the product (Figure 5.12). These two factors help determine the nature and extent of the information collected about historical cost trends and customer requirements. The product strategy establishes the number of products in the line, the frequency of redesign, and the degree of innovation in each generation of products. The characteristics of the product include the complexity of the product, the magnitude of the up-front investments, and the duration of the product design process.

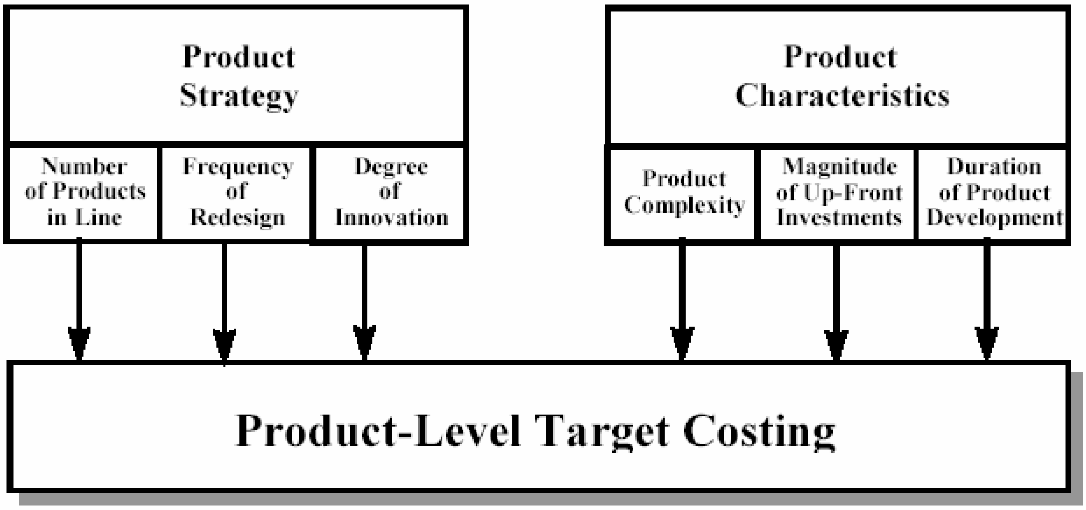

Figure 5.12 Factors Influencing Product-Level Target Costing (Cooper R.,1997)

5.2.2.1 Product Strategy

The evidence suggests that the firm's product strategy is a primary determinant of the degree of effort expended on target costing and where and how that effort is expended. Therefore, it is postulated that firms with product strategies that create a lot of uncertainty about how the customer will react to new products will typically spend considerable efforts on target costing, while those whose product strategy creates only a small amount of uncertainty will typically expend less energy. There are three characteristics of a firm's product strategy that analysis indicates help determine the benefits to be derived from target costing, these are the number of products in the line, the frequency of redesign, and the degree of innovation.

5.2.2.1.1 Number of Products in the Line. Customers have different requirements and these can be satisfied by developing products that are either vertically or horizontally differentiated. Vertically differentiated products differ by the degree of functionality they provide and their selling price. The higher the price, the higher the functionality (and perhaps quality) of the product. Horizontally differentiated products sell at the same price, but deliver a different bundle of quality and functionality. Relatively small variations in functionality and price are often achieved by developing optional features; for example, a Corolla with or without a passenger airbag. In contrast, major variations in functionality are achieved via the introduction of different product models; for example, a Corolla versus a Camry.

The greater the number of different products1 that the firm supports, the higher the overall level of customer satisfaction. The evidence suggest that as the number of products in the line increases, so does the effort expended on target costing because new product launches occur more frequently. This observation is intuitively reasonable because target costing operates predominantly at the individual product level, hence the benefits must derive at that level. For example, Olympus had a relatively ineffective target costing system prior to the reconstruction of its camera business. As part of their strategy to reconstruct their camera business they significantly increased the number of horizontally differentiated products in its line. The enhanced benefits from target costing that was the outcome of the increased number of products might have helped motivate the decision to upgrade the firm's target costing system.

An exception to the above observation occurs when customers demand a greater variety of products than the firm can afford to support. When this condition exists, the market analysis the firm undertakes must include procedures to identify the products that are going to be launched. Such procedures are necessary if the firm's overall profit objective is to be met. As the number of products has to be rationed, the role of the target costing system shifts away from helping ensure individual product profitability towards helping identify the most profitable mix of products. For example, at Nissan, computer simulations are used to ensure that the right mix of products is developed. Thus, it is postulated that target costing is especially beneficial for firms that have to ration the number of products they produce. In contrast, it is postulated that firms that can launch as many new products as they choose will derive lower benefits from target costing.

5.2.2.1.2 Frequency of Redesign. At the heart of the product strategies of the sample firms is the objective to increase product functionality as rapidly as possible. This objective is achieved via the rapid introduction of new products with each new generation incorporating the latest technology and hence providing increased functionality. In all of the firms, product development times have been reduced to enable more frequent product introduction to occur. Thus, intense competition has forced the firm to become expert at developing and launching products at a rapid rate.

However, this ability has a downside. First, the duration of the manufacturing phase is short, therefore the time available to generate an adequate return on the up-front investment is limited and it leads to lower sales volumes of each product. To remain profitable, the firm must launch a high percentage of profitable as opposed to unprofitable products.

Second, due to the short product life cycles, there is inadequate time to correct any errors. If an unprofitable product is launched, it will often remain unprofitable until it is withdrawn. Therefore, it becomes critical to design new products so that they are profitable. Consequently, it is postulated that the higher the rate of new product introduction, the greater the benefits derived from target costing. Therefore, such firms are expected to have well developed target costing systems that subject the product design process of all new products to systematic cost reduction pressures. In contrast, it is hypothesized that firms that rarely introduce new products will not require formal target costing systems, but will probably apply target costing principles on an ad hoc basis as required.

5.2.2.1.3 Degree of Innovation. The degree of innovation in each new product generation helps determine how much historical cost information can be used to estimate future costs. As the degree of innovation increases, information about past products becomes less valuable. Especially, for revolutionary products that rely upon completely new technologies, historical cost information about earlier products will have little value. Similarly, customer, competition, and supplier information can be invalidated by significant innovations in product design. In contrast, for products that are similar to the ones that they are replacing, the past is often highly predictive of the future and value engineering techniques such as functional analysis, which depend upon the use of the same technology, can be applied.

Target costing is most difficult to apply to revolutionary products. First, target selling prices are often difficult to establish because the value to the customer of the new product is difficult to estimate. Second, because the firm has never applied the technology in its products, historical cost information is not available and third, a higher percentage of new suppliers are typically involved. When the new model does not rely upon existing designs, the target costing system is of less value as more intuition as opposed to hard facts is required. For example, when Toyota introduced the Lexus, they were able to derive less benefits from target costing because of the high degree of innovation in the new vehicle. When the degree of innovation is low, then the target costing process becomes relatively straightforward. First, the selling price of the new product is primarily determined by the selling price of the product it replaces and second, historical cost information is highly predictive of the costs of the new products. Third, the suppliers are typically unchanged. For example, most new Walkmans are essentially technologically equivalent to the ones they replace. Therefore, Sony derives less advantage from target costing than Nissan or Toyota where the level of innovation in each new product generation is higher. It is postulated that target costing has increased benefits in environments where the degree of innovation is relatively low and decreased benefits when high. Furthermore, in environments where the degree of innovation is low, the target costing system will rely more heavily upon historical information than in environments were the rate of innovation is higher.

5.2.2.2 Characteristics of the Product

There are three characteristics of the product that apparently have a particularly strong influence on the benefits derived from target costing and the way it is practiced. These characteristics are the product complexity, the magnitude of up-front investments, and the duration of the product development process. The complexity of the product captures how difficult it is to manage the product design process. The magnitude of up-front investments captures the amount of capital consumed in the research and development process, getting ready for production, and actually launching the product. The duration of the product development process captures the time it takes to go from product conception to release to production.

5.2.2.2.1 Product Complexity. Product complexity captures the number of components in the product, the number of distinct production steps required to manufacture it, the difficulty of manufacturing the components it contains, and the range of technologies required to produce them. As the complexity of the product grows, there are two major reasons that the benefits of target costing increase. First, the degree to which costs can be influenced in the product design stage versus the manufacturing stage increases. Second, it becomes more difficult to manage the product design process and ensure that component-level target costs sum to the product-level target cost. Therefore, the benefits of target costing are expected to increase with the complexity of the product. However, as the complexity increases, so does the cost of applying target costing at the component level. Fortunately, there are ways to simplify the target costing process to reduce the effect of product complexity by only performing detailed target costing on two or three representative variations, as opposed to all of them.

Consequently, as product complexity increases, it is postulated that target costing becomes more beneficial and ways to reduce the costs of performing target costing emerge. Toyota, Nissan, and Komatsu manufacture products that are considerably more complex than the other firms. Their target costing processes reflect this increased complexity by being more formalized. This formalization helps the firms cope with the large number of components that have to be subjected to target costing.

5.2.2.2.2 Magnitude of Up-Front Investments. As the magnitude of the up-front investment increases, the number of products that a firm is willing to launch typically will decrease because the firm will be less willing to take risks. Consequently, firms that produce products that have high up-front investments typically develop a fairly small range of products, each carefully designed to satisfy a specific market segment. For firms that have products with high up-front investments target costing will have increased benefits, because every product has to have the maximum probability of being successful. In contrast, when up-front investments are small, the benefits of target costing are lower. Furthermore, for firms with product with high up-front investments that have short manufacturing lives, target costing is even more important because it is critical that the products launched have both adequate profit levels and sales volumes. Under such conditions, careful product selection is critical and target costing can play an important role in helping ensure that product profitability is adequate.

Finally, for high up-front investment products, life cycle analyses are especially important. Therefore, it is postulated that life cycle target costing is more commonly practiced in such firms than those producing products with low up-front costs. For example, Nisan uses life-cycle analysis to justify the launching of new automobiles, whereas Sony does not.

5.2.2.2.3 Duration of Product Development. The length of time it takes to develop a new product also helps determine the benefits derived from a target costing system. As the duration of design gets longer, the probability that the market conditions that were used to validate the design of the new product might change increases. Therefore, for products with long development cycles, such as automobiles and bulldozers, the target costing system needs to contain several stages at which market conditions are reviewed. In contrast, for products with short development cycles, such as cameras and consumer electronics, fewer reviews are required. Thus, as the product design cycle increases in length, the target costing system typically becomes more complex with greater interaction with the marketing function.

The product development cycle for automobiles is relatively long at six years. This extensive period required multiple reviews of market conditions and decision points about continuing the project. For example, at Nissan and Toyota reviews occur at the beginning and end of the conceptual design stage and during the product design stage. In addition, just prior to entering production, a final adjustment to the new model specifications is undertaken to make sure that it achieves its target cost. Consequently, just prior to product launch, the firm decides exactly which features will be treated as optional versus standard. This fine tuning ensures that, where possible, the target cost will be achieved and that the new model satisfies the customer.

It is postulated that longer product development cycles make target costing more beneficial because the long time between design and launch increases the risk that unsuccessful products will be launched. In addition, it is postulated that longer product development cycles typically lead to more formal target costing systems with multiple decision points reflecting a disciplined product development process. Even when the duration of product development is short, as is the case with Olympus cameras, there does not appear to be any significant delays introduced into the process by target costing. The target costing process is so integrated into the market analysis and product development processes that most if not all of the extra time required by the target costing process can be undertaken in parallel.

5.2.3 Factors Influencing Component-Level Target Costing

The analysis indicates that the component-level target costing portion of the process is most influenced by the supplier-base strategy of the firm. This strategy helps determine the benefits that can be derived from component-level target costing because it shapes the amount of information that the firm has about the costs and design capabilities of its suppliers.

5.2.3.1 Supplier-Base Strategy

There are three aspects of the supplier-base strategy that have a particularly strong influence on the benefits derived from component-level target costing (Figure 5.13). These characteristics are the degree of horizontal integration, the power over suppliers, and the nature of supplier relations. The degree of horizontal integration captures the percentage of the total cost of the firm's products that are sourced externally. The power over suppliers helps establish the ability of the firm to legislate selling prices to its suppliers. Finally, the nature of supplier relations deals with the degree of cooperation that the firm can expect from its suppliers and in particular the amount of design and cost information sharing.

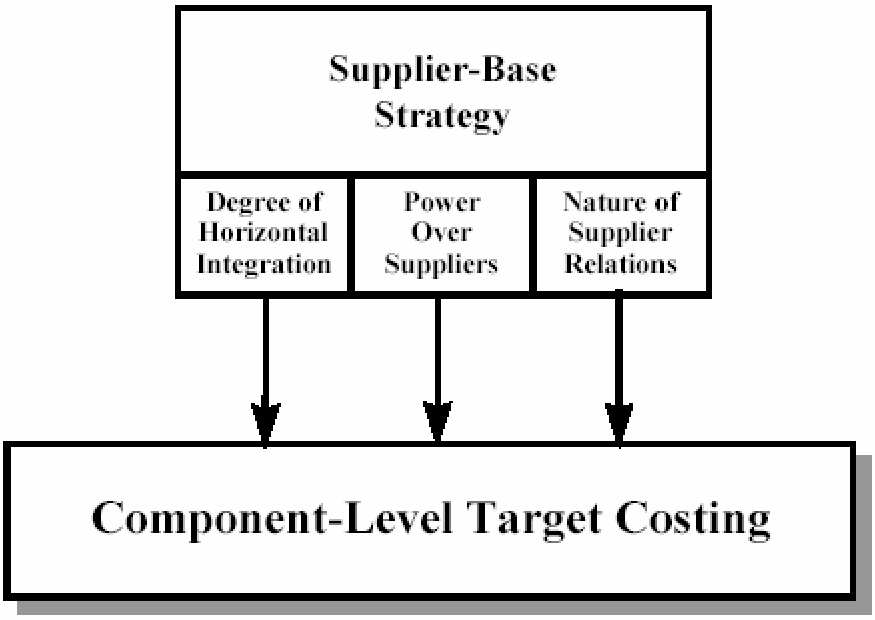

Figure 5.13 Factors Influencing Component-Level Target Costing. (Cooper R.,1997)

5.2.3.1.1 Degree of Horizontal Integration. Lean enterprises are typically horizontally not vertically integrated. Therefore, they buy a large percentage of the inputs required to produce their products from external sources. The higher reliance that lean enterprises place upon external suppliers increases the importance of supplier management and hence, component-level target costing. Evidence suggests that the potential benefits that can be derived from component-level target costing are increased for two primary reasons. First, since a greater percentage of the product is externally sourced, there are greater potential savings because target costs can be developed for each of the externally acquired components and used to help create pressure on suppliers to reduce their prices. In contrast, in vertically integrated firms, it is often difficult to put effective pressure on the other divisions to reduce their costs. Second, the returns from focusing supplier creativity are greater. Suppliers not only provide a higher percentage of the firm's products, they are also responsible for a greater portion of the design. For example, Komatsu's suppliers are now asked to design and produce complete engine cooling systems instead of producing individual components such as radiators, electric motors, and fans.

5.2.3.1.2 Power over Major Suppliers. The relative power of buyer-supplier relations determines how much energy is expended on determining purchase prices for components. When buyer power is high, it is hypothesized that buyers will expend considerable energy developing component-level target costs (i.e., purchase prices) for purchased components. In contrast, in industries where production volumes are low and buyer power is low, the firms will expend less energy on developing target costs for purchased components because suppliers will not accept them as the selling prices for their products (unless they provide adequate returns). Therefore, it is postulated that the more power the firm has over its suppliers, the more benefits it can derive from target costing by using it to create cost pressures on its suppliers. In contrast, it is postulated that when a firm has little power over its suppliers, the benefits of target costing will be reduced. For example, Topcon due to the low volume of specialty ophthalmic equipment it sells has little power over its suppliers and therefore expends little energy on developing component-level target costs. In contrast, the other firms have considerable power over their suppliers and have sophisticated component-level target costing systems.

5.2.3.1.3 Nature of Supplier Relations. The evidence suggests that as supplier relations become more cooperative, the target costing process in general and, in particular, the component-level step become richer and more beneficial. At the heart of the increased benefits lies the ability of the two firms to combine their design creativity to find superior ways to reduce costs. For example, Komatsu's design engineers frequently visit their suppliers and help them with design problems. In addition, in cooperative relations it can be supplemented by a number of inter-organizational cost management techniques. These other mechanisms primarily enable product designers and suppliers to pool their expertise to find creative solutions to increase functionality and quality or reduce costs through joint meetings and frequent interactions. When used in this cooperative setting, component-level target costing still places suppliers under considerable cost pressure. However, this pressure is offset, to some extent, by the product designers helping suppliers to find ways to achieve their cost reduction objectives. In contrast, in adversarial supplier relations, while component-level target costing can be used to force selling prices on the firm’s suppliers, there is no mechanism to take advantage of any synergy between the designers.

CHAPTER SIX
CASE STUDY

6.1 Objective of the Case Study

The objective of the case study is to apply target costing to a real life situation of product redesign. The analysis is conducted retroactively on the product redesigning of DEKORPAN's D-ELK-9 towel radiator.

DEKORPAN is a manufacturer of towel radiators. The D-ELK-9 towel radiator is manufactured by Dekorpan during the late 90s was the D-ELK-9, and it did not meet the increasing demands of customers. This required DEKORPAN to introduce an improved version of the D-ELK-9 , known as the D-ELK-10 .

This case study retroactively analyzes the design process of the D-ELK-10 towel radiator model from the D-ELK-9 model using target costing to determine the insights target costing could have provided to DEKORPAN today.

6.2 Introduction to DEKORPAN

The towel radiators that considered as the principal indicator among the functional and aesthetics features of stylish and modern life , are produced as an independent industrial item by DEKORPAN, which is a leading company in its sector all around the world.

When examining the company profile of leader DEKORPAN ,which targets a perfection in design , production and system quality , you will notice, both for your personal and commercial needs, the signs of meticulous production and service quality, then explore, in a wide range of products, the immaculate optimization of design, capacity, quality and price.

DEKORPAN, carrying on its commercial activities with a plant having 15.000 m2 closed area, 750 personnel and 3.500 pcs/per day production capacity in Kemalpaşa-izmir , has an inaccessible status among the EEC countries. Knowing well that preserving a leadership is harder than having it, DEKORPAN , by its self experience and skill, has succeeded to form her own design and production technologies, on a sound, highly dynamic superstructure and institutional body and then , with % 95 of her production, has obtained and deserved a unique market share , firstly in UK and among other leading EEC countries such as Germany, France, Italy, Spain and Greece.

With her modern investments and highly professional management and production staff, DEKORPAN is fully capable to meet her customers needs in various design, specification, high production quality and suitable prices , and besides these, is the first and only producer having ISO 9001 (2000) certificate in the sector. Furthermore, DEKORPAN towel radiators are produced under a conformity certificate providing TSE_EN-442 norms.

The meticulous production, starting from quality raw material, passing the special welding and polishing phases in black production, ends in a world famous chromium coating plant , specially designed by DEKORPAN for only towel radiators and also fully automatic electrostatics powder paint plant , designed by expert industrialists. One of the main feature of DEKORPAN production that gains appreciation is the utmost care given to the raw material and the process that subject to the highest quality criteria, with contemporary devices, equipped as per the latest technology , used for product controls.

On the other hand, apart from the serial production, DEKORPAN, having a special design supported by an effective production capacity, forms an excellent source for the architects who design Turkish and European interiors.

6.3 Problem Statement

Product redesigning and development is a continuous process and this process started for D-ELK-9.

The current report takes the goals established by the management and tries to redesign the D-ELK-9 to compete with the competitors' products. The actual re-designing is considered outside the scope of the current report. But the report identifies the components that required redesigning and the components that require to be made cost efficient.

Target costing was used to lead a customer-focused pricing system in order to improve the current model of the D-ELK-9. The data used for the analysis is obtained from DEKORPAN. Hypothetical estimates were made assuming myself as the customer where data is not available.

Figure 6.1 Basic DEKORPAN Electrostatic/Chrome Flat towel radiators

6.4 Applying Target Costing in Product Design

6.4.1 Product Strategy and Profit Planning

The objective of DEKORPAN's re-designing effort is to increase its market share in the segment of towel radiators, especially in the category of electrical towel radiators.

Rapid industrialization led to an increase in the demand for towel radiators are;

- The heating need for towels and bathroom increasing all over the world because of the moisture.
- Most attractive and decorative than towel rail.

6.4.2 Product Concept Development and Feasibility

As mentioned earlier, this section selects the best feasible product concept from various alternatives, if available. In the current case study, new product concepts that satisfy customer requirements are not considered. Instead the current product is analyzed for re-design to meet customer requirements.

The preliminary list of customer requirements can be obtained by analyzing the life of the product using the Pugh Method. The basic list of customer requirements considered by DEKORPAN is as follows:

- Better heating performance
- Lower owning and operating costs
- Greater comfort / ergonomics
- Increased operator and environmental safety
- Attractive appearance
- Aesthetics
- Modular design

- More tubes
- Bigger profiles.

Some of the major customer requirements are technically established to analyze product concepts and they are:

- Heating power (Watt) > 400.
- Output (Kcal) > 350.
- Better surface cover.
- Less energy expences.

Two basic approaches for redesigning the D-ELK-9 were considered;

- First, Dekorpan could use the basic D-ELK-9 model and to add some modifications to meet the performance requirements.
- The second concept consisted of complete re-designing; this would involve greater effort from the Research and Development (R&D) department.

The target price for the new model is incrementally established based on the current model (D-ELK-9). The D-ELK-9 in 2005 was priced at $ 25.90. And the hypothetical price a customer is willing to pay for every improved physical attribute is listed in table.

Table 6.1 Target prices for functions (hypothetical – personal estimates)

1	Better heating performance	$7.50
2	Lower owning and operating costs	$2.00
3	Greater comfort / ergonomics	$1.50
4	Increased operator and environmental safety	$1.00
5	Attractive appearance	$1.00
6	Aesthetics	$2.00
7	Modular design	$0.50
8	More tube	$0.50
9	Bigger profile	$0.50
10	Other factors	$2.00
	TOTAL	$18.50

The incremental pricing technique is currently not in practice due to the heavy competition. This is particularly true for the computer industry. But in the late 70s, the price of tractors was increasing and the customer was willing to pay the increase in price for a better model.

The price a customer is willing to pay for the new product, the Target Price, is obtained by adding all the prices of improved physical attributes to the price of D-ELK-9,

$ 25.90 + $ 18.50 = $ 44.40

and it is calculated to be $ 44.40 . The desired profit "is usually determined by the financial rates of return". In the current case study, ROS is used to measure the desired profit to be $ 8.88 at 20% (over sales price). The target cost is then estimated using the equation;

Target cost* = *Target Price – Desired Profit
= $ 44.40 - $ 8.88
= $ 35.52

Product concepts must be analyzed to see if they can be manufactured within the target cost. Product re-designing concept 1, that involves scaling up, can meet the target cost (estimated, exact cost not available) as the manufacturing processes are the same.

The re-designing concept 1 would not involve any changes in the processes, materials, work-methods and many components can be made common with the D-ELK-9. The requirement by R&D and the risk of marketability will be less. But it involves some major tradeoffs, such as the increased weight makes it hard to operate, increasing wear and making it cumbersome to assemble or transport. No real estimates for the cost of manufacturing the first concept are available and it was assumed to be \$ 37.5. This cost almost meets our requirement of target cost. But it would have been very difficult to manufacture such a large tractor. For example, a tractor-size link would have been needed for the scaled-up D-ELK-10 and was considered impractical. In this scenario,

Concept 2, involving re-designing becomes our only option. For the purpose of the case study, the initial estimate for manufacturing concept 2 is taken to be \$ 40.

Concept 2 Profitable = (44.40 – 40.00)/44.40 = about 10%

This makes our concept profitable (to about 10%) and further efforts must be taken to increase the profit margin to 20% as desired. The next step determines design specification based on customer requirements. It also identifies potential candidates for cost reduction.

6.4.3 Product Design and Development

DEKORPAN's list of customer demands is shown in Table 6.2.

Table 6.2 List of customer attributes

Performance / Capability	**Safety / Environment**
a. Productive	a. Sound
b. Efficient	b. Safety
c. Predictable	c. Temperature
d. Versatile	
e. Severity capability	
Operating Costs	**Perceptions / Impressions**
a. Reliable	a. Technology Leader
b. Serviceable	b. Apperance
c. Durable	c. Quality
d. Maintainable	
e. Repair costs	**Costs**
f. Electric Economy	a. Lower costs
Comfort / Ergonomics	**Others**
a. Comfortable	
b. Operable	
c. Quiet	
d. Visibility	

The customer requirements listed above are correlated to product components/functions so as to determine the candidates for major redesign using QFD. The resultant QFD table is shown in Appendix Table 6.3.

The important customer requirements are listed on the left-hand side of the table and the point to which (on a scale of 5) these requirements are satisfied (hypothetical) in the current (D-ELK-9) and new (D-ELK-10) models is listed on the far right side. The desired level (D-ELK-10) is divided by the current level (D-ELK-9) to obtain the ratio of importance.

Some functions are more marketable than others are and due weight should be given to user-preferences. This weight is given by multiplying the ratio of importance by a value known as Sales point. The sales point, which is the marketing weight, for each customer requirement is determined hypothetically and multiplied with the ratio of improvement to obtain the absolute weight. Ideally, sales point should be limited within the range of 0.5 to 1.5 to avoid excessive influence of marketing. In the current analysis, a constant sales ratio of 1 is considered, as the marketability of functions is not precisely known. This makes the absolute weight equal to the ratio of improvement. The demanded weight for every requirement is calculated as a percentage of the total absolute weight. These values are determined hypothetically in the analysis.

The complete list of components or assemblies is taken on top of the table and the extent to which every component effect the performance of a customer requirement (correlating value) is mentioned in the body of the table. These correlating values are also hypothetical and are multiplied with the demanded weight of every requirement and added along the column.

The customer requirements are correlated to components. For example, Bigger Profile helps improve the performance and is strongly correlated (9). The decreased wear will result in lower costs and it is less strongly correlated to Bigger Profile (3) similar to perceptions. Final cost is strongly influenced (9) due to the costs incurred in designing Bigger Profile, and ergonomics improved due to the improved commort (1). Similarly, correlation between customer requirements and all physical components considered for re-designing is established.

The ratio of importance is determined by dividing the level of satisfaction to be obtained for the new model by the current level. For example, the performance is currently at a level of 2 on a scale of 5 and the new model will achieve a level of 5. This will give a ratio of importance of 2.5 for performance capability. Similarly, the ratio of importance is calculated for the other functions. The ratio of importance is multiplied by the sales point to get absolute weight. The demanded weight is calculated as the percentage of the total of absolute weight.

The values of correlation are multiplied by the demanded weight and added up along the column. The relative importance of every component is obtained by calculating the percentage of the totals. For example, the sum of 9 times 22.9, 3 times 12.2, 1 times 18.3, 3 times 9.2 and 9 times 6.9 obtains the total value for Bigger Profile. The current analysis lists the important components based on the correlating values, which are determined hypothetically.

Based on the hypothetical values, the major components that need to be considered for re-designing are , heating performance, more tubes and reparability of equipment. The actual process of re-designing is technical and is considered out of scope for the current report. But, it is supposed that the re-designing is done to meet the customer requirements and the report proceeds to identify potential cost reduction candidates.

After the re-designing, the costs of manufacturing components are related to the importance of components so as to identify potential cost reduction candidates. This is achieved by using value engineering and the detailed calculations of value engineering are shown in the appendix.

The weight of each function is determined based on the total functionality and the values are determined hypothetically. The sum of the weights should equal the number of involved functions (7 in the current case). The contribution of each component to the satisfaction of a function is determined. The sum total contribution of all components for every function should equal a value of 100. The percent importance of a component is determined by the sum total of the product of the contribution of the components with the importance of every function. The percent of total cost consumed by a component is divided by the percent of importance to obtain the value index for that component. All the values in this analysis are hypothetical. The Table 6.4 illustrating the calculation of value indices for different products is shown below.

Table 6.4 Value Indices of components (hypothetical)

Components	% of total cost	% importance of components	Value index
Bigger Profiles	**12.50**	**12.11**	**1.03**
Better Heating Performance	**7.50**	**22.71**	**0.33**
More Tubes	**15.00**	**15.61**	**0.96**
Thickness of Tubes	**10.00**	**6.07**	***1.65***
Thickness of Profiles	**7.50**	**4.82**	***1.56***
Shapes of Profile	**7.50**	**4.82**	***1.56***
Transportation (modularity)	**10.00**	**4.89**	***2.04***
Repair (ease and costs)	**10.00**	**6.11**	***1.64***
Materials	**2.50**	**2.41**	**1.04**
Frame Size and Weight	**5.00**	**3.98**	***1.26***
Package	**5.00**	**4.64**	**1.08**
Overall Safety	**5.00**	**5.75**	**0.87**
Optional equipment	**2.50**	**6.07**	**0.41**
Total	**100.00**	**99.99**	

Potential cost reduction candidates are the components with value indices greater than 1 and they are drive train, bulldozer, ripper, modularity, repair, and frame size and weight. Supposing that the cost of manufacturing the mentioned components is reduced to obtain a value index of 1, the present cost of manufacturing is calculated as shown in Table 6.5 (based on hypothetical value engineering tables):

Table 6.5 Cost reductions obtained by component

Components	Value index	current cost	new cost
Thickness of Tubes	**1.65**	**4**	**2.43**
Thickness of Profiles	**1.56**	**3**	**1.93**
Shapes of Profile	**1.56**	**3**	**1.93**
Transportation (modularity)	**2.04**	**4**	**1.96**
Repair (ease and costs)	**1.64**	**4**	**2.44**
Frame Size and Weight	**1.26**	**2**	**1.59**
TOTAL		**20**	**12.28**

The reduced cost of manufacturing is then calculated to be
=20.00 – 12.28 = $ 7.72

Cost Of Manufacturing ; 40.00 – 7.72 = $ 32.28.

So; The profit margin at this cost is ;
= (44.40-32.28) / 44.40 = 27%

6.4.4 Recommendations for Cost reduction

Some recommendations for reducing the cost of manufacturing the above mentioned components are as follows.

1. Different materials can be investigated to reduce the cost of manufacturing.
2. The customer demands and needs of a operator's station must be listed from the QFD or value engineering table along with their importance. This process will help us in concentrating our efforts on the correct issues.
3. Transportability can be studied along with the marketing department. The amount of transportability required for an international market will be greater than a national market and our efforts must be in proportion to the area of the market covered.
4. The components that are most fatigued must be made modular and more serviceable to provide for easy replacement.
5. The transportability can be studied from a servicing perspective and the method by which spare parts and tools are distributed should be analyzed. The spare parts must be available separately, but must be easy to assemble.
6. The value engineering table must be made dynamic to verify the cross links between the several components and functions instead of a one time thing.
7. The service department can be contacted and most wearing parts can be identified to improve performance.
8. Implement concurrent engineering to avoid the designing of similar part by various departments.

6.4.5 Production and Logistics

This step of target costing is the actual implementation phase. The approved product concept is taken and the designs are set in production. Data is collected to verify the costs and performance of products. Opportunities for further improvement are identified during implementation.

If the costs of production vary from the estimates, the value-engineering phase must be conducted again in order to reduce the total manufacturing costs. As the new product becomes old, competition catches up and the company needs to add more features and reduce the prices for old features. This constant process of updating a product should be carried on in order to stay ahead of competitors.

6.5 Case Study Results

Retroactively analyzing the customer requirements and the feasibility of the product concepts, it is more beneficial to re-design the D-ELK-9 than to make a scaled up version. The target costing analysis achieved the following:

1. Compared different concepts based on manufacturing feasibility along with their profit making ability.
2. Applied QFD and identified components to be re-designed based on customer requirements. It is known that these were the components that were re-designed to achieve the desired profit in real life. Conducting a target costing analysis would have helped the Dekorpan designing team in identifying the components to be re-designed.
3. Identified potential cost reduction candidates to obtain the desired profit. If the cost of manufacturing in reality was higher than the selling price, value engineering would have helped DEKORPAN in cost reduction. However, no data is available to compare the real cost of manufacturing to the estimates.

CHAPTER SEVEN

CONCLUSION

Target costing seeks to anticipate costs before they are incurred, continually improve product and process designs, externally focus the organization on customer requirements and competitive threats, and systematically link an organization to its suppliers, dealers, customers, and recyclers in a cohesive, integrated profit and cost planning system.

Target costing is the means to achieve competitive advantage through active management of the unavoidable trade-offs and constraints faced by any organization providing goods and services to the market. Emphasizing proactive, rather than reactive, cost containment, target costing ensures short- and long-term profitability and success by putting customer needs and functionality first, using them to drive the design, development, manufacture, and provision of products. Target costing redefines the competitive playing field a challenge that cannot be avoided, only enjoined.

This report explained the process of target costing and mentioned the aspects to be considered during the implementation of target costing in a manufacturing firm. It also illustrated the process of applying target costing with a real life analysis. It is hoped that the illustration of the process along with the analysis will help industries in implementing target costing.

Some aspects not covered by the current report include the measurement of product life cycle costs and the establishment of organizational and employee preparedness. The importance of product life cycle costs depends on the type of the product. The costs of ownership were considered. But, the costs of disposal and environmental effects were not considered. Methods to analyze organizational and employee preparedness were mentioned. But, precise methods for evaluating software, employee understanding of target costing, etc. are not mentioned. The case study does not address the change of customer attributes over the life cycle of the product. Last but not least, the actual process of designing is not described, due to the involved complexity.

The process of target costing and the case study illustrate the following points:

- The feasibility and the method of integrating product designing and manufacturing into the overall planning.
- Application of QFD to provide the designing team with goals.
- Designing takes the concerns of manufacturing from the initial stages of concept development..
- Identifies the components / functions to be designed or innovated.
- Identifies the components / functions to reduce the costs.
- Increases the understanding between functional departments.

It is finally concluded that target costing will provide a company with the means to improve decision making by structuring the process of product introduction and designing.

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APPENDIX

Table 6.5: QFD table to identify candidates for the re-design of a towel radiator

Customer requirements	Importance (weight)	Bigger Profiles	Better Heating Performance	More Tubes	Thickness of Tubes	Thickness of Profiles	Shapes of Profile	Transportation (modularity)	Repair (ease and costs)	Materials	Frame Size and Weight	Package	Overall Safety	Optional equipment	D9 Model (on a scale of 5	D10 Model (on a scale of 5	Ratio of Importance(Improvement)	Sales Point	Absolute Weight	Demanded weight
Performance / Capability		**9**	**9**	**3**	**3**	**3**	**3**			**1**		**3**		**1**	2	5	2,50	1	2,50	22,9
Owning and Operating Costs		**3**	**3**	**9**	**1**	**1**	**1**	**3**	**9**	**1**				**1**	3	4	1,33	1	1,33	12,2
Comfort / Ergonomics		**1**	**1**	**9**		**1**	**1**					**1**	**9**	**3**	2	4	2,00	1	2,00	18,3
Safety / Environment				**3**					**9**						3	4	1,33	1	1,33	12,2
Perceptions / Impressions		**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**		**3**	**3**		**3**	3	3	1,00	1	1,00	9,2
Costs		**9**	**9**	**9**		**3**	**3**		**1**	**3**			**3**	**3**	4	3	0,75	1	0,75	6,9
Others									**1**	**1**			**1**	**3**	2	4	2,00	1	2,00	18,3
Total	**2523**	**350**	**350**	**469**	**108**	**147**	**147**	**64**	**273**	**74**	**28**	**115**	**204**	**193**					10,91	100,00
Percentage (%)		**13,87**	**13,87**	**18,59**	**4,28**	**5,83**	**5,83**	**2,54**	**10,80**	**2,93**	**1,09**	**4,56**	**8,09**	**7,65**						
Company now																				
Competitor 1/ (D9)																				
Plan (D10)																				

9-Strongly Related , 3-Less Strongly related , 1-Weakly Related