CHAPTER 2
LITERATURE SURVEY

2.1 INTRODUCTION

The Literature survey undertaken by the Researcher, with a view to consolidate the developments in the field of Target Costing, and specifically, the key issues pertaining to Cost and Quality Engineering are discussed in this chapter.

2.2 REVIEW OF LITERATURE PERTAINING TO TARGET COSTING SYSTEMS

Toshiro Hiromoto’s (1988) Harvard Business Review article “Another Hidden edge: Japanese Management Accounting” appears to be the first English speaking Journal to feature Target Cost Management. This article compares the differences in accounting between United States and Japan. The article observes that the Japanese companies commonly apply a market-driven approach of Target Pricing to a product in the early stages of design instead of waiting until the developmental stages. The article discusses the success story of Daihatsu, a Japanese car manufacturer, wherein the manufacturer lowers the product cost by implementing adequate product planning and establishes a Target Cost before producing the product.

Cooper (1988) observes that the success of Activity Based Management (ABM) depends heavily on the availability of accurate estimates of activity costs. For that reason, he says, ABM abandoned simple volume based product costing traditionally used by firms. Complexity has replaced volume as primary cost driver in modern firms. He refers complexity as the degree to which diverse inputs and outputs must be managed and transformed by shared limited resources.

Sakuri (1989) has reported that the established Target Cost should be obtainable but obtainable only with considerable effort. He observes that the considerable effort is spent by the product designers in search of cost reduction ideas.
According to Monden and Hamada (1991), the Japanese word “Kaizen” in Kaizen Costing and English word “improvement” refer to two different concepts. “Kaizen” refers to continuous accumulations of small betterment activities rather than innovative improvement. Therefore Kaizen Costing includes cost reduction in the manufacturing stage of existing products. Innovative improvement based on new technological inventions is usually introduced in the developing and designing stage.

Monden (1992) has made significant contributions to Target Costing by suggesting cost models for Target Cost deployment. He explains the cost accounting, cost control and cost planning methods used in Japanese automobile industry. His work details on how companies strategically use Target Costing, Value Engineering and other improvement methods to gain competitive advantage.

Shank and Govindarajan (1993) have observed that Strategic Cost Management has emphasized the importance of costs within the value chain, but the discussions on cost drivers stays on a general level.

Kato (1993) has suggested that the easiest way to achieve Target Cost is to lower the quality level of the product.

Morgan (1993) has reported that 70 – 80 % of the cost of a product is “immune” after the design stage. This fact has been agreed and reported by further research studies conducted by Lee (1994) and Chew & Cooper (1996).

Kato, Boer and Chew (1995) have suggested that the use of Target Costing can lead to longer development periods, because of the intensive search for cost reduction ideas.

Monden (1995) presents more details on Target Costing with chapters on how it works in division based companies, how companies do Target Costing semi-concurrently with their part manufacturers and how to use Value Engineering in Target Costing. This is one of the few rare Literatures in Target Costing wherein Target Costing has been viewed from the Engineering perspective. Monden also
suggests certain cost models for Target Cost deployment in this work. However, a linkage between Quality and Cost aspects could not be derived from these models.

Gagne and Discenza (1995) have observed that Target Costing is dynamic, constantly pushing for improvement. They found that applying Target Costing in both design and production stages help managing costs, however Target Costing in design stage has the greatest cost reduction potential. They also conclude that assembly oriented industries as opposed to repetitive process industries, companies using factory automation / Flexible Manufacturing systems (FMS), Computer aided Manufacturing (CAM) and companies involved in the diversification of their product lines benefit most from the Target Costing process.

Player and Keys (1995) report that Activity Based Management (ABM) is the broad discipline that focuses on achieving customer value and profit via management of activities. Atkinson et al (1997) offer a similar view and describe ABM as a process that uses activity cost information to improve organizational profitability.

Chew and Cooper (1996) have established that Target Costing is a discipline that harmonizes the labour of disparate participants in the development effort, from designers and manufacturing engineers to market researchers and suppliers. Their work also indicates that Leading Japanese Electronics and Vehicle manufacturers have used Target Costing to their advantage and companies are now introducing Target Costing in the United States, Germany and elsewhere.

Corrigan (1996), Cooper & Slagmulder (1997) have reported in separate studies that one of the significant differences between using the Target Costing concept (even for existing products) and standard costing techniques or Kaizen costing is the fact that the later concepts tend to accept existing structures and lead to only incremental cost reductions. Target Costing tends to be more radical and provides the opportunity for a completely new and innovative approach / process. This fact has been agreed and reported again by further studies conducted by Shank and Fischer (1999).
Cooper and Slagmulder (1997, 1999) have made significant contributions to the Target Costing process with state-of-the-art case studies conducted at 25 major Japanese manufacturers. They have observed that Target Costing makes cost an input to the product development process, not an outcome of it. Also they observe that in Japan, lean enterprises have learned to view Target Costing not as a stand-alone program, but an integral part of the product development process.

In the words of Cooper and Slagmulder (1999),

*Once a company has established the Target Cost reduction objective, it must find ways to achieve it. Several Engineering techniques can help product designers to reduce product costs, including Value Engineering (VE), Design for Manufacture and Assembly (DFMA) and Quality Function Deployment (QFD). VE is a multi-disciplinary approach to product design that maximizes customer value; it increases functionality and quality while reducing cost. In contrast, DFMA focuses on reducing cost by making products easier to assemble or manufacture, while holding functionality at specified levels. QFD provides a structured approach to ensure that customer requirements are not compromised during the design process.*

Cooper and Slagmulder (1997 & 1999) have also observed that the companies purchase a significant portion of their material and parts from external instead of internal suppliers. At Toyota, they observe that third party suppliers are responsible for approximately 70% of the parts and materials required to produce the company’s cars. This high level of dependency on external items makes supplier relations extremely important for Toyota’s success. In their view, cost and quality of third party supplied parts is considered critical.

Cooper and Slagmulder (1997) highlight and explain how pro-active cost management increases competitiveness and optimizes profitability. With state-of-the-art analysis of Cost Management systems at 25 Japanese manufacturing companies, the authors have researched how companies compete by balancing Functionality, Quality and Cost. This work is one among a few literatures available where the implementation issues in a Target Costing process are addressed. However, a perfect
linkage between the supporting tools and Target Costing process could not be derived from this literature.

Williamson (1997) suggests that the aim of Target and Kaizen Costing is no less than to allow companies to make a profit in a competitive market, by giving customers what they want at a competitive but profitable price. He suggests that cost reduction can be accomplished by Value analysis and Process re-design. He also concludes that non-manufacturing fixed costs can be reduced by Kaizen exercises.

Omar (1997) has examined the rigorous cost management technique of Target Costing which helps prevent senior managers from launching low margin cars which do not generate enough Return on Investment (ROI). He has found that UK-based car manufacturers determine ideal selling price, establish the feasibility of meeting the price and then control costs to ensure that the set price is met.

Kaplan and Cooper (1997) have reported that cost management techniques look at the internal cost of companies, especially direct and indirect costs. They have also suggested that Activity Based Costing (ABC) provides an alternative approach to the allocation of indirect costs among products.

Ansari and Bell (1997) have reported that understanding ranking of the various requirements is a key element in Target Costing and product development in general. In a subsequent activity, they say product features that fulfill the customer requirements at specific performance levels are determined. They have also cautioned that an over emphasis on Target Costing can lead to longer product development cycles.

Bayou and Rienstein (1998) explain three alternative routes that Target Costing projects can pursue to reach the goals viz., (1) Total Cost Management (2) Cost cutting (3) Cost shifting. They observe that basic strategies of comprehensiveness, integration, flexibility, dynamic and long term continuity form the strength that Target Cost management needs to reach the targets. They also suggest that Target Cost Management can be diverted into cost cutting and cost shifting practices.
Bonzemba and Okano (1998) have examined how Target Costing has been implemented by business organizations. The study based on a field observation at Renault, France has concluded that Target Costing has been implemented by Renault since 1980's. The authors have observed that Target Costing implementation was made possible by radically re-designing the product development, Management, Organization System and type of supplier relations.

Kato and Yoshida (1998) have clarified the relationship between organization related theories and Target Cost Management. They suggest that organizations better understand their capabilities to implement new management concepts. They emphasize that a thorough understanding on whether new managerial concepts like Target Cost Management will contribute to the performance of organization is required before its implementation.

Cooper and Slagmulder (1999), in their study at Japanese auto manufacturers have concluded that, in a highly competitive environment, companies must manage costs aggressively if they have to survive. They also suggest that Cost management must start at the earliest stages of a product's life because, the ability to change the product significantly increases the degree to which costs can be reduced.

Sauers (1999–2000) has stated that Japanese companies tend to use a technique called “Target Costing” to determine the price of the products. By starting with the anticipated acceptable market price, the companies subtract the desired profit margin to obtain a target manufacturing cost. Then the Design and Manufacturing Engineers are responsible to bring the product into being at this cost. In his view, by applying Target Costing, price concerns can be driven down to process level and hence continuous improvement can be acted by listening to price concerns of the market place.

Quirmbach, Wilke and Igenbergs (2000) have developed an Integrated System Cost Model (ISCOM) to integrate Cost Analysis, Cost Planning, Accounting and Systems Engineering. This model supports Target Costing by allocating Target Costs to functions, objects and processes. The model has been applied to Satellite systems and adaptability of the same to other manufacturing sector is not tested.
Crow (2000), observes that product cost management must begin with the start of product development as about 70-80% of product costs are committed at that stage. He adds, development personnel must operate as entrepreneurs in making hard decisions about the product and process design to achieve Target Costs. He observes that cost models are very effective tools to be used to support decision making early in the development cycle.

Lockamy and Smith (2000) have observed that there are shortcomings in usage of traditional and Activity Based Cost Management approaches to Supply Chain Management. They have explored the usage of Target Costing for Supply Chain Management and suggest that three methods of Target Costing can be applied to Supply Chain Management viz., Price based, Value based and Activity based. Their model suggests that Target Costing can be used as a means for integrating market feedback into the supply chain through the development of a total cost structure reflective of current customer requirements. These requirements are then used to determine where cost must be reduced within the supply chain to provide enhanced levels of customer satisfaction.

Confederation of Indian Industry’s (CII) Total Cost Management Cell (2000), in a comprehensive survey in the Indian market concluded that Target Cost Management tools, when properly implemented, will provide the organization with conceptual framework for effective management of its costs. The tools suggested by the Target Cost Management cell are Finance Management, Material cost reduction, Energy cost management, Process improvement and Inventory management.

Hilton, Maher and Selto (2000) have observed that traditional cost accounting is not prepared to actively manage costs, which has led to the development of cost management techniques that are used to support specific decisions and the overall management of organizations.

Seuring (2001), in his study at a polyester lining firm, observes that input costs are often increased due to special suppliers of “Green products” due to environmental restrictions. He suggests that it is necessary to manage the whole supply chain from
raw material acquisition to customer delivery to have effective Cost Management. He suggests that cost targets are to be met at three levels viz. Direct, Activity based and Transaction levels. He concludes that Cost Management techniques like Activity Based Costing, Life Cycle costing can be applied to reduce the costs in the supply chain.

ICWAI Southern Regional Council (2001) article on Target Costing details on the history of Target Cost Management and explains the various stages of it. The article sees Target Cost Management as a systematic process of planning product and service offerings; determining their sales prices; establishing a continuously adjusting set of downward ratcheting, highly challenging costs; and motivating employees to be ever vigilant for cost reduction opportunities. The article also observes that Target Cost Management is much more than a cost reduction tool. It is reported that the goal of Target Cost Management is to balance Quality and Functionality with prices that meet both the organization's profitability and the customer's value added needs.

Chen and Chung (2002) suggest a Cause-Effect Analysis tool for Target Costing. With the aid of a case study at a Polyester fibre plant, they have established that a CEA helps the Target Costing process to integrate tools like Activity Based Costing, Design for Manufacture, Quality function Deployment and Value Engineering. The tools however operate in a stand-alone way and Cause-Effect Analysis tries to bridge them with the Target Costing process.

Crow (2002) has reported a case of combining QFD and Target Costing with a live case conducted in a company manufacturing Quick Release Top Nozzle. The study was conducted by a Cross Functional Team and the team has used Target Costing, Value Analysis and QFD for the process. He further reports that the entire process took twenty weeks from the start of training to selection of the final concept alternatives for development. It is also observed by Crow that the most time consuming activities are collecting the voice of the customer in the beginning and the preliminary engineering development of the concepts including the cost estimates.

Hergeth (2002), in his research work in a Textile and apparel industry, concludes that textiles and apparel are typically operating in a price sensitive market,
so that pricing products is extremely important. He has also found that Target Costing avoids the development of products with costs that do not match market requirements. Value Engineering, Design for Manufacture and Assembly and Quality Function Deployment have been identified as important techniques in designing cost out of a product. He has further concluded that Target Costing can be successfully used in manufacturing scenarios and in assembly industries.

Mahidhar (2002), in a study on Total Cost Management for competitiveness, defends that cost leadership is definitely a competitive advantage. He further points out that organizations focusing on differentiating their product for competitive advantage cannot ignore this either. His studies also have indicated that corporate adopting Total Cost Management gain about 5 to 10% in their cost saving or improvement of profitability by 5 to 10%.

Elram (2002), in an explorative Research has analyzed the role of Supply Management in Target Costing. Case studies at eleven organizations representing a number of industries including manufacturing and non-manufacturing firms has indicated that the role of Supply Management in Target Costing process is significant. The study discusses the levels of participation of Supplier Management in Target Costing and concludes that early involvement of Supply Management in a Target Costing process is key to the success. The study however does not give a direction on Target Cost deployment to suppliers / Quality aspects at the supplier end during Target process.

Everaert and Bruggeman (2002) have investigated the impact of using cost targets during New Product Development in terms of design quality, product cost and development time. They have demonstrated that cost targets during NPD lead to a lower- cost new products, while not impairing design quality or development time. They add a word of caution that, under high time pressure, cost targets lead Design Engineers to work longer on design, without a corresponding cost decrease.

Hung Wu (2003) has applied Target Costing for Quality Management and observes that reducing product variation from cost consideration would be essential goal for companies to survive in this competitive world. The study also summarizes
the relationship among Taguchi loss function, process capability indices and control charts to establish goal control limits when the Target Costing technique is applied. The philosophy of Target Costing technique is used here to relentlessly improve product quality and reduce cost such that comparatively a robust product would be more competitive in the market place.

2.3 REVIEW OF LITERATURE PERTAINING TO SUPPORTING TOOLS FOR A TARGET COSTING PROCESS

The literature pertaining to supporting tools for Target Costing like Quality Function Deployment, Value Engineering, and Supply Chain Management are reviewed in this section.

Miles (1966) details the fundamentals of Value Engineering and describes the overall system. He has developed the widely used cost reduction tool “Value Engineering” as early as 1948 and has established the functional approach for Value Engineering study which is still the basis for cost reduction initiatives taken up by any industry.

Wade (1967) provides a single, cost-cutting, unified technique for computing tolerance build-ups thereby simplifying the task of determining optimum tolerances for use in product design and manufacturing. He suggests that typical cost savings can be effected by reductions in Scrap, Rework, Inspection, Setup time and Cycle time. He also explains the state-of-the-art Tolerance Charting technique in this work.

Maby (1968) has compiled certain rare abstracts related to Value Engineering which gives a variety of Applications of the Value Engineering concept.

Burnside (1968) explains the essence of Value Engineering and outlines the stages in structured Value Engineering job plan.

Ferguson (1968) reports that the effective Value engineering results from the coordinated efforts of a team of qualified members, each member by virtue of specialist knowledge and experience being empowered to make decisive statements,
commitments within the team, appropriate to the department he represents. He adds that the path to product profitability would bear the approval stamp of Research, Design, Manufacturing and Marketing, with costs being a co-opted contribution as occasion demanded. Ferguson observes that Value Engineering is essentially creative and must therefore in its approach be entirely free from individual departmental practices and restrictions.

Martin (1968) reports on philosophical aspects of the search for truth and knowledge as they relate to value and suggest a similarity in problem-solving methodology between Descates in 17th century and L.D Miles in the 20th century.

Sherwin (1968) claims that it is the functional concept which distinguishes Value Engineering from many other approaches to cost reduction.

Tocco (1968) gives a comprehensive check list for Value Engineering studies in the areas of Specification review, Design criteria, Post-Design evaluation, Parts selection & evaluation, Standardization, Material, Electronic Design, Interchangeability, Serviceability and General considerations.

Tufty (1982) suggested that Life Cycle costing analysis requires the knowledge of several economic concepts of which the concept of time value of money is the primary area. He also explains the detailed Value Engineering job plan for huge construction projects.

Peck (1983) gives various suggestions and guidelines to reduce manufacturing costs by making manufacturing processes easier. In this work, he has given suggestions for Casting, Machining and Welding processes.

Tanaka (1985) introduced a QFD matrix method for product development management using value optimizing. The method has been used to analyze how individual components together form product functions. These analyses have been used to assign and visualize an importance value to each component. The method assumes that the tradeoff between customer importance and cost are proportional and that the relative importance divided by relative cost of the component should equal 1.
That is, the cost should be allocated exactly in accordance with the degrees of importance of the product's functional areas which again is based on the foundations of Value Engineering.

Hauser and Clausing (1988) have popularized the usage of Quality Function Deployment (QFD) by explaining the methodology in building the QFD matrix (or) the House of Quality (HoQ). They have also observed that a Japanese automaker with QFD made fewer changes than a U.S company without QFD. They have also strongly suggested that the foundation of HoQ is the belief that products should be designed to reflect customer's desires and tastes.

Gomes (1988) has given a practical approach to Value Engineering by suggesting the checklist method for Value Engineering. He provides a comprehensive check list for the Value Engineering studies.

Dean (1990) has presented a mathematical technique which quantifies the Design to Cost process. He also shows that cost is relatively insensitive to mass and that reduction of complexity both in the manufacturing process and product are dominating factors in reducing the cost.

Dean and Unal (1991) have found that Parametric Cost Analysis, which involves generation and application of equations to cost analysis, plays a significant role in Design–to–Cost systems.

Dean and Unal (1991) claim that Taguchi's methods can aid in integrating cost and Engineering functions through the Concurrent Engineering approach. Principal benefits include considerable time and resource savings; determination of important factors affecting operation, performance and cost; and qualitative recommendations for design parameters which achieve lowest cost, high quality solution.

Michaels (1994) has studied the role of Total Quality Management and its allied disciplines like Concurrent Engineering, Quality function Deployment and Design of Experiments in Value Engineering. He has concluded that there is total functional commonality between Value Engineering and these techniques.
Chen, Navin-Chandra and Prinz (1994) have proposed a cost-benefit analysis as an approach for a decision maker to balance between the amount of effort invested in dis-assembly and recycling of a product and the revenues that are realized.

Juran and Gryna (1995) have developed a quality survey technique for evaluating the supplier's ability to meet quality requirements on production lots. They have evaluated various quality activities by quantifying them using a scoring system.

Day (1996) proposed that "Voice of the Customer (VoC) goes beyond traditional market search and surveys to better understand the customer needs and uncover the unstated needs. A well-executed VoC investigation results in fundamental insights into customer needs that lead to products that provide superior value to customer. He also adds that failure to properly understand the customer's voice, their wants and needs means that any endeavor to develop new or revised products with major handicap.

Ross (1996) has reported that Taguchi addresses quality in two areas: Offline and Online quality control. Offline quality control refers to the improvement of quality in the product and process development stages. He also emphasizes more on offline quality control in his work because of the paucity of materials on this phase of Taguchi's methods and the positive impact of cost that is obtained by improving quality at the earliest times in a product life cycle. He also reports, "to determine the best design of a product or process requires the use of a strategically designed experiment which exposes the product or process to the varying environmental conditions". In his view, parameter design is to achieve high quality and relatively low cost in the product / process by selecting the appropriate specifications.

Smith and Mason (1996) have reported that Neural Networks will be used with increasing frequency as a substitute for Regression by the parametric cost estimating community because analysts will find that in particular situations, Neural Networks provide a superior cost estimate. He however adds that, the concerns of Neural Network modeling apart from model accuracy should not be ignored and
represents formidable hurdles to wide spread use and acceptance of Neural cost Estimation relationships.

Ross (1997) found that fuzziness describes the ambiguity of an event; whereas randomness describes the uncertainty in the occurrence of the event. He gives a methodology to model uncertainty in day to day problems using Fuzzy logic.

Temiko (1997) has observed that Taguchi’s approach to robust design, QFD and TRIZ (Theory of inventive problem solving) together become an unbeatable powerhouse of customer driven robust innovations. His observations include: QFD gathers and translates Voice of Customers into Engineering characteristics: Organization’s performance measures in QFD become TRIZ’s initial input functions: TRIZ develops design concepts and Taguchi’s methods are used to determine the design specifications.

Jagannathan (1997) reports that, Functional Analysis Systems Technique (FAST) is an advanced technique developed by Charles Bytheway to determine the relationship between functions in the analysis of an entire system, process or a complicated assembly and gives a better understanding of the interrelation of functions and their costs.

Kinnan and Martin (1997) have reported that there are many misconceptions regarding the Value method right from the days of L.D Miles. They observe that the main hurdles for a Value Engineering program are, “The product is already as good as it can be”, “There is no time”, “There is no money for it”, “Everyone has already agreed to this concept” and “We already do VE”. They add, as Value method strives to continually produce innovative alternatives, Value professionals should continue to find ways to address the misconceptions that surround the Value method and Value studies.

Martin (1997) has examined some of the differences between different applications of the value method viz., Value Engineering, Value Analysis and Value management.
Vittal (1997), based on his wide consultancy experience in Value engineering, summarizes that, in the fast changing economic, business and industrial scenario, industry and business will be able to survive and succeed only by offering
a. better quality and value to the customers
b. competitive prices by reducing costs and
c. drastically reducing the processing time

Vittal also reports that Value Engineering has emerged as the most effective and appropriate management tool available to industry in order to ensure that essential functional requirements of a product / service are provided at the lowest cost, without however any reduction of quality and reliability.

Martin (1998) reports that value programs must be periodically reviewed and analyzed to determine if they provide the intended benefits.

Tomar and Gupta (1998), in their study in Indian Automotive market have observed that about 80% of a product's cost is contributed by raw material and bought out components. They have hence reported that managing the Supply chain and participation of Supply chain early during New Product Development process is vital for a product's success.

Asiedu and Gu (1998) have done a state-of-the-art review on product Life Cycle Cost analysis and discussed the issues of LCC analysis and tools that have been developed to provide Engineers with cost information to guide them in design. They have concluded that it is apparent that there is a need to develop a model and a framework that can readily provide estimates with minimal inputs, include the treatment of uncertainties, identify cost drivers and offer optimal design solution.

Bode and Fung (1998) have attempted to incorporate financial considerations in QFD. The key issues like degree of attainment of technical attributes, resource requirements and cost targets are however not addressed by the model and the authors have indicated these as a future research scope.

Prasad (1998) describes an integrated template for product improvement by tactically combining real-time market research data like QFD, Value Engineering, and
a Value Graph. This process template gives the product development teams a synthesis tool to predict what product offerings customers would be interested in, which the company can build and market to make a fair profit.

Limaye and Modak (1999) have developed a process based cost estimation model for sub-contracted parts. Their approach tries to prevent the use of distorted information and wrong strategic signals about certain situations. The model is perceived to be beneficial by providing a strong base for negotiating the sub-contractor's cost. However the model has been developed to suit sub-contractor's parts alone.

Smith (1999) has applied Value Analysis to a Value Engineering program to study ways and means to improve the Value Engineering process. The study has proved that Value engineering can be applied to any process, program or project. He adds that, as long as the job plan is followed and functional analysis is performed, the potential of improvement is high. He observes that a Value Engineering program requires a continuous support from customers and suppliers throughout the Supply Chain and without that, a Value Engineering program can easily slip back.

Chan and Lewis (2000) developed a Computer Aided Design tool ‘DFM-C’ to enable product designers in small to medium size companies to incorporate manufacturability and cost criteria into their decision making. However, absence of cost targets and quality information makes the system a stand-alone system to facilitate Design For Manufacturing.

Feng, Kroll and Li (2000) have developed a methodology to map product functions into product features using fuzzy logic. They conclude that such mapping would assist design Engineers in selecting features or evaluating a candidate component design.

Brinke, Lutters, Streppel and Kals (2000) have proposed variant based cost estimation system based on product information structure related to the Manufacturing Engineering reference model. They have classified product
characteristics into four cost drivers - Geometry, Material, Process and Production Planning for proper use in different Engineering applications.

Rao (2000) has reported based on his study in a service department that there should be a balance between the cost and quality of a product. He also suggests that this can be achieved through the effective utilization of resources and elimination of non-value added activities. He further adds that Functional analysis can be applied to areas like product improvement, process development, resource allocation, etc. Relative importance and cost associated with various activities are the factors which will decide the importance of various functions in this approach. He cautions that an unbiased systematic approach is to be followed while assessing the functional relationship.

Sinha and Ramalingam (2000) have applied a linear programming approach to reduce the cost of ferro alloys in Steel making. They claim that combination of common sense, Technical approach and Quantitative approach gives a comprehensive total approach to reduce costs.

Blackstone (2001) gives a comprehensive, state-of-the-art review on Theory of Constraints (TOC), a widely used management tool. He reports that, ten years ago, TOC was applied only for production and presently, it can be applied to a wide range of areas like Finance, Costing, Supply Chain, etc. In his work, he details how TOC can be applied strategically to various application areas other than production.

Dey (2001) reports that Materials Management function is always a major concern to the management of any industrial organization as high inventory and an inefficient procurement process affect the profitability to a great extent. He also adds that material costs constitute to 60 % of the total working capital of any industrial organization. He observes that a vendor evaluation criterion is one of the common issues associated with materials management (Supply Management) function.

Sohn and Choi (2001) have addressed reliability issues during product planning stage by developing a fuzzy QFD model. Supply Chain Management
concepts have been addressed and the work expects to make significant contribution in creating a relatively error free reliability review system.

Vanegas and Labib (2001) have observed that the main objective of QFD is to determine target values of Engineering Characteristics (EC's). They observe that conventional QFD aims only empirically to find these targets making it difficult for the EC's to be optimum. Fuzzy numbers when used to represent the imprecise nature of judgments and to relate between Customer Attributes (CA's) and EC's give better EC target values.

Gupta (2001) has integrated the philosophies of Activity-Based Management and Theory of constraints into a cohesive model. He has suggested that the model can be modified to implement various process and product improvement scenarios from the published literature on Quality Management and Cycle Time Management. The primary limitation is that product costing and pricing is not included in this model.

Chaudhary (2002) emphasizes that one main reason why India does not have a substantial share in international trade is due to high cost of products. He claims that Value Engineering has a great potential in Indian industry, especially at times of industrial slanginess.

Fung, Tang, Tu and Wang (2002) have reported that most of the existing approaches and models for QFD planning seldom consider the resource constraints in product design, nor do they normally take into account the impacts of correlation among various Technical Attributes (TA). They have added that most of the QFD applications assume that the resources committed fully to attain the design target for one TA have no impacts on those for other TA. They have proposed a non-linear fuzzy model to offer a more practical and effective means of incorporating the resource factors in QFD planning.

Karsak, Sozer and Alptekin (2002) have observed that QFD is a customer oriented design tool with cross functional team members reaching a consensus in developing a new or improved product to increase customer satisfaction. They have also reported that, in a period of intensifying competition, the interaction of different
approaches should be embraced and incorporated within the QFD process in order to realize its full potential.

Lin and Chang (2002) have developed a Cost-Tolerance analysis model based on Neural Networks. They have proved that the application of this model yields better performance in controlling the average fitting error than all conventional fitting models. This model can reduce the chances of error in tolerance design and cost estimation.

Yamashina, Ito and Kawada (2002) have developed an Innovative Product Development Process (IPDP). This process is claimed to execute all of the processes from product planning to conceptual design by integrating QFD and TRIZ.

Mendez and Narasimhan (2002) have examined the market oriented aspects of Cost of Quality. Using data from automotive industry, they have studied the relationship between unit cost and economies of scale, experience curve effects and imputed cost of quality in a specific content. They have reported that there is a positive relationship between unit cost and quality improvements. They have also suggested that these market oriented effects have to be secured through optimal pricing decisions and that the firms must actively manage for realizing the potential benefits that can be had from quality improvements.

Martin (2002) has explored the usage of the Value method to conduct Value studies on non-engineering applications like administrative, procurement. He observes that the Value method is appropriate and efficient in those areas as well.

Martin (2002) reports that fostering the co-operative attitude while maintaining the independence of Value study team will assist in obtaining the optimum results within the entire Value program. He adds that this co-operative spirit is achieved through active fostering of the joint aspects of team work.

Plante (2002) has proposed a formal modeling and optimization approach for assessing quality improvement targets for suppliers. A constrained non-linear
optimization model has been developed by him for determining an optimal allocation of variance reduction target that minimizes the expected total cost.

Laseter and Ramdas (2002) have empirically examined whether suppliers for different sourced products play distinctly different roles in product development, by analyzing survey data on a wide range of sourced automotive products. This research provides an insight into how product characteristics can influence supplier roles in product development.

Zaim, Sevkli and Tarim (2003) have suggested a Fuzzy Analytical Hierarchy Process (FAHP) for supplier selection and tried their model for a Television manufacturer for supplier selection.

Cell and Arratia (2003) have explored the possibility of combining Value Engineering and lean principles. Taken together, Value Engineering and lean principles offer synergy. They have suggested that Value Engineering and lean when taken together will cover respective weaknesses, and the respective strength amplify and leverage the other. They conclude that together Value Engineering and lean produce results where the total significantly exceeds the sum of the parts.

Ramesh (2003), Pradeep (2003), Pandey, Jha and Ranjan (2003) have given live cases of Value Engineering implementation. Each case clearly demonstrates the robustness of the Value Engineering methodology.

Dong, Zhang and Wang (2003) have developed a Green Quality Function Deployment model (GQFD - IV ) in which they have incorporated a Life Cycle Cost estimation model based on Fuzzy Multi – Attribute Utility Theory (FMAUT). They report that FMAUT cost estimation has an excellent performance in the early design stage of product development. They also observe that, because of fuzzy operations of opinions from a number of experts’ experiences, the subjectivity is reduced in assessing product life cycle costs.

Rajam Ramasamy and Selladurai (2004) have proposed an innovative method of determining optimum rating of Engineering Characteristics (ECs) by simulating the
QFD matrix for randomized Customer Attribute (CA) rating in the fuzzified range. The rule based knowledge system defines the relationship between the EC’s and CA’s. This work forms a basis for handling uncertainty in the QFD matrix.

2.4 CONCLUDING REMARKS ON LITERATURE SURVEY

The above presented extensive literature survey in the field of Target Costing and its supporting tools revealed the following:

- Most of the research on Target Costing have been undertaken from the management accounting preview barring a very few. From the very few which describe Target Cost implementation, there exists no single work which addresses the interaction of supporting tools with Target Costing process.
- However various authors have published their contributions individually in the fields of New Product Development (NPD), Value Engineering (VE), Quality Function Deployment (QFD), Design for Manufacture (DFM), Supply Chain Management (SCM), Fuzzy Logic and few have tried to link individual tools with Target Costing.
- An integrated approach establishing the role of these tools with reference to Quality and Cost aspects in a Target Costing process during NPD process is non-existent.
- Few authors have suggested that Target Costing is not a stand-alone process but depends on tools like QFD, VE and DFM. Some authors have also tried to establish the role of SCM in Target Costing. However the ways and means of using these tools in connection with Target Costing has not been noticed in any of these literatures.

Based on above observations and the growing interest in Target Costing in developing countries, the study on Cost and Quality Engineering aspects in a New Product development process with specific reference to the Target Costing process and the impact of supporting tools on Target Costing is perceived to be appropriate. The Research objective was framed based on the above survey and is given in the next section.
2.5 RESEARCH OBJECTIVES

The primary objective of this research is to study the Cost and Quality Engineering aspects in a Target Costing process and to understand the role of supporting tools in the process. Once the Target Cost has been set, issues such as achieving the Target Cost without compromising Functionality, Quality and maintaining the Target Cost throughout the life cycle arises. Given that there has been limited research in this area, this research is a study that aims to provide an initial understanding. The major research questions that were framed to meet the objective are listed below.

2.5.1 Research Questions

Most of the Literature on Target Costing indicates that an explorative work has been done on the Management Accounting side of Target costing. Very few researchers have attempted to develop certain implementation models for Target Costing and even in those models the following questions arise.

- Can Customer requirements along with Target Cost be incorporated into the Target Costing model? If so, what will be the role of tools like Quality Function Deployment in a Target Costing process?
- Once the Target Cost has been set, what are the techniques the firm can adopt to achieve the set cost? Can cost reduction needs be addressed using techniques like Value Engineering?
- How is uncertainty handled in a Target Costing process? Can Fuzzy Logic be helpful in the model?
- For lean manufacturers where bulk of the parts is supplied by suppliers, what role can Supply Chain Management (SCM) play in the Target Costing process?
- After all efforts, if Target Cost is still not met, how is the drifting cost reduced?
- Once the Target Cost is met, how is it maintained in the long run? Can Kaizen Costing play a role in such situation?

The above questions have been the basis for the Research. The methodology and the proposed model are outlined in the next chapter.