APPLICATION OF TQM PRINCIPLES & TOOLS IN A CARPET BACKWARD LINKAGE (CARPET BACKING CLOTH, ABBREVIATED CBC) INDUSTRY AND TO MEASURE IT'S IMPACTS ON CUSTOMER SATISFACTION.

by

Md. Abu Hadid.

A thesis submitted in partial fulfillment of the requirements for the degree of Master of Science in Engineering in Industrial Engineering and Management.

Khulna University of Engineering & Technology
Khulna 920300, Bangladesh.
January, 2008.

Approval

This is to certify that the thesis work submitted by Md. Abu Hadid entitled "Application of TQM principles & tools in a carpet backward linkage (carpet backing cloth, abbreviated. CBC) industry and to measure it's impacts on customer satisfaction" has been approved by the board of examiners for the partial fulfillment of the requirements for the degree of MSc Engineering in the Department of Industrial Engineering and Management (IEM), Khulna University of Engineering and Technology, Khulna, Bangladesh in January, 2008.

BOARD OF EXAMINERS

19/01/08

1. Sikder Mainul Hasan
Assistant Professor,
Department of Industrial
Engineering & Management (IEM) Khulna.
Khulna University of Engineering &
Technology, Khulna-920300.

Chairman
(Supervisor)

14/01/08

2. Prof. Dr. Md. Kutub Uddin
Head, Dept. of Industrial
Engineering & Management,
Khulna University of
Engineering & Technology
Khulna-920300.

Member

14/11/08

3. Dr. Shaymal Kanti Biswas,
Profesor
Department of Mechanical Engineering
Chittagong University of Engineering &
Technology, Chittagong.

Member
(External)

DECLARATION

This to certify that the thesis work entitled "Application of TQM principles and tools in a carpet backward linkage (Carpet Backing Cloth, abbreviated CBC) industry and to measure it's impacts on customer satisfaction" has been carried out by Md. Abu Hadid in the Department of Industrial Engineering and Management (IEM), Khulna University of Engineering and Technology, Khulna, Bangladesh. The above thesis work or any part of the work has not been submitted anywhere for the award of any degree or diploma.

14/01/08

Sikder Mainul Hasan
Assistant Professor,
Department of Industrial Engineerig & Management,
Khulna University of Engineering and Technology,
Khulna.

14/01/08

Md. Abu Hadid
Roll: 0411501

DEDICATION

In loving memory of my parents

CONTENTS

Chapter 1
Introduction

Chapter 2

Literature Review

Caption of Contents Page

Chapter 3

Procedure/Methodology

Caption of Contents Page

Chapter 4

Results and Discussions

Chapter 5

Conclusions and Recommendations

LIST OF FIGURES

LIST OF TABLES

LIST OF PICTURE

LIST OF ABBREVIATIONS OF TECHNICAL TERMS

IEM:	Industrial Engineering and Management
CBC:	Carpet Backing Clothe
TQM:	Total Quality Management
QFD:	Quality Function Deployment
BTA:	Bangladesh Tossa A
BTB:	Bangladesh Tossa B
BTC:	Bangladesh Tossa C
BTD:	Bangladesh Tossa D
BTE:	Bangladesh Tossa E
BWA:	Bangladesh White A
BWB:	Bangladesh White B
BWC:	Bangladesh White C
BWD:	Bangladesh White D
BWE:	Bangladesh White E
BMA:	Bangladesh Mesta A
BMB:	Bangladesh Mesta B
BMC:	Bangladesh Mesta C
BMD:	Bangladesh Mesta D
X	Cross
SMR:	Standard Morrah Rejection
LANB:	Los Alamos National Bank
MOH's	Mohsin Jute Mills Product
CAR's	Carpeting Jute Mills Product
JJI's	Jessore Jute Mills Product
JIT	Just in Time
SQC	Specific Quality Control
BJMC	Bangladesh Jute Mill Corporation
JAF	Jute and Allied Fiber
BJSA	Bangladesh Jute Spinners Association

MCC	Microcrystal Cellulose
CMC	Carboxymethyl Cellulose
GOB	Government of Bangladesh
BJRI	Bangladesh Jute Research Institute
QR	Quality Ratio
PVC	Polyvinylchloride
RC	Rubber Coated
SS	Single Side
Ds	Double Side
FJF	Finer Jute Fabric

ACKNOWLEDGEMENT

The author expresses his heartiest gratitude to Sikder Mainul Hasan, Assistant Professor, Department of Industrial Engineering and Management (IEM), for his careful supervision, important suggestions at all stages of the thesis. The author is greatly indebted to him.

The author would like to express his sincere appreciation to professor Dr. Md. Kutub Uddin, Head, Department of Industrial Engineering and Management for his encouragement, assistance & constructive suggestions for the work.

The author is highly grateful to Md. Lutfor Rahman, Asstt. Professor, Department of Industrial Engineering and Management for his cordial support at different level of the thesis. My special thanks go to Sk. Mohammad Ali, P.D (S&M) and additional chief Engineer, BADC, for their coordinated and effective encouragement during long continuation of research. The author would like to express his deep appreciation to Md. Anwarul Momin, General Manager, Mohsen Jute mills Ltd, Md. Ikbal Hossain, APM, Md. Anwar Hossain, Asst. Manager, (QC), A.K.M Al Mamun, Asst. (QC), carpeting Jute mills. Suvendra kumar Ghosh, Mechanical Engineer, J.J.I mills, for the opportunity given to work in the mills and making arrangement to provide the necessary information's and data by sparing their valuable time.

In this respect the author must mention the name of Engr. Md. Mozahar Hossain, Principal, Technical Training Centre, Khulna and author's colleagues who directly and indirectly helped him in completing the work.

The author would like to extend his heartiest love to his wife Thamina khanam (Mukul) who always encouraged him during the thesis work.

KUET
January, 2008

Md. Abu Hadid

ABSTRACT

Total Quality Management (TQM) is an enhancement to the traditional way of doing business. It is a proven technique to guarantee survival in world-class competition. TQM provides a quality product and/or service to customers. This will increase productivity and reduce cost. The improved quality, results in improvement in productivity, capacity and profit. With a higher quality product and lower price, competitive position in the market place will be ensured. Poor quality cost comprises significant percentage of gross sales for manufacturing organization and for service industries. One of the most significant planning tools of TQM is quality function Deployment (QFD). QFD planning tool incorporate customer voice in manufacturing process. QFD method achieves dramatic improvement in the design development process, including reductions of Engineering changes and design cycle time and start up costs.

The organization, in which study was made mainly produces CBC and exports the same to different countries. Jute is the only raw material for CBC manufacturing. Different classes and grades with different ratios of Jute were used for manufacturing of thread for weaving CBC. Most of the Jute mills including the Jute mill under study are unaware of quality improvement tools and techniques. Both the customer and manufacturer don't have sufficient knowledge regarding the QFD planning tools. In the proposed thesis work QFD planning tool has been utilized in the CBC manufacturing Jute mill under study for enhancement of customer satisfaction and also to establish a house of quality matrix to show which proportion of materials and what types of weaving process is the best for desired customer satisfaction.

CHAPTER-1
INTRODUCTION

1.1 Definition of Quality

The term quality is perceived differently by different people. There were instances when a product that was perceived as good quality by one individual was perceived to be of bad quality by another. In such situations it is difficult for industries to take up quality as a focus and orient their actions.

Quality has become one of the most important consumer decision factors in the selection among competing products and services. Quality Improvement is the reduction of variability in processes and products. A specific type of failure is called nonconformity. A nonconforming product is considered defective if it has one or more defects, which are nonconformities that are serious enough to significantly affect the safe or effective use of the product.

There are two general aspects of fitness for use: Quality of design and Quality of conformance. Quality engineering is the set of operational, managerial, and engineering activities that a company uses to ensure that the Quality characteristics of a product are at the nominal or required levels [2 & 20]. Quality has to be defined in clear terms for the industries as follows:

- Conform to specification
- Fitness for purpose
- Satisfy the customer
- Delight the customer
- Enchant the customer
- Inversely proportional to variability.

1.2 Dimensions of Quality

The quality of a product can be evaluated in several ways. It is often very important to differentiate these different dimensions of quality. Key points concerning these dimensions of quality are as follows [2]:

1. Performance: It means how the product will do the intended job.

2. Reliability: It finds how often the product fails.

3. Durability: It means how long does the product last.

4. Serviceability: It means how easy the product is repair.

5. Aesthetics: It means what the product looks like.

6. Features: It means what the product does.

7. Perceived Quality: It means what is the reputation of the company or its product.

8. Conformance to Standards: It means the product made exactly as the designer intended.

1.3 Drivers of Quality

Every change is made effective by certain drivers of quality. If Quality Management principles are to be followed in industries, one or more of the following drivers are essential [4]:

- Competition in the market
- Knowledge explosion
- Threat for survival
- Demand form Stakeholders
- Promise of greater profit
- Desire to do better

1.4 Benefits of Quality Management

All over the world, many industries, service organizations and educational institutions have implemented quality systems. There have been several success stories and a few failures. Quality management has many advantages[4]. The important ones are shown in Fig. 1.1

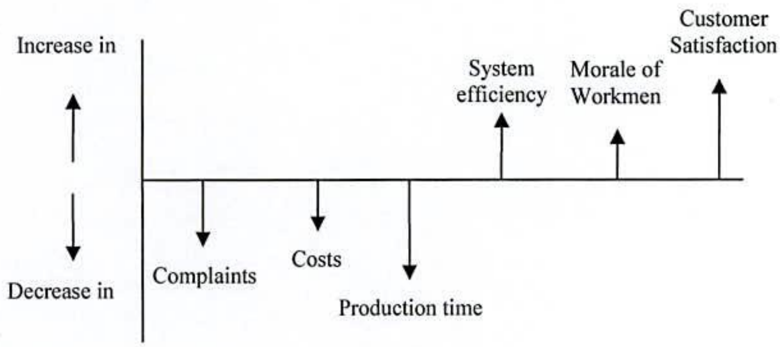


Figure:1.1 Benefits of Quality Management

- Reduction in complaints from customers, both internal and external.
- Reduction in cost of the product.
- Reduction in production time.
- Increased system efficiency.
- Increased morale of workmen
- Increased customer satisfaction.

1.5 Total Quality Management

Total Quality Management (TQM) is an enhancement to the traditional way of doing business. It guarantees survival in world-class competition. TQM is a philosophy and a set of guiding principles that represent the foundation of continuously improving organization. It is the application of quantitative methods and human resources to improve all the processes within an organization and exceed customer needs now and the future. TQM integrates fundamental management techniques, existing improvement efforts, and technical tools under a disciplined approach.

Management must participate in the quality program. A quality council must be established to develop a clear vision, set long-term goals, and direct the program. Managers participate on quality improvement teams and also act as coaches to other teams. TQM is continual activity that must be entrenched in the culture-it is not just a one-shot program. TQM must be communicated to all people. The key to an effective TQM program is its focus on the customer. An excellent place to start is by satisfying internal customers. We must listen to the "voice of the customer" and emphasize design quality and defect prevention. Do it right the first time and every time, for customer satisfaction is the most important consideration. TQM is an organization wide challenge that is everyone's responsibility. All personnel must be trained in TQM, statistical process control (SPC), and other appropriate quality improvement skills so they can effectively participate in project teams. People must come to work not only to do their jobs, but also to think about how to improve their jobs, People must be empowered at the lowest possible level to perform processes in an optimum manner.

There must be a continual striving to improve all business and production processes. Quality improvement projects, such as on time delivery, order entry efficiency, billing error rate, customer satisfaction, cycle time, scrap reduction, and supplier management, are good places to begin. Technical techniques such as SPC, benchmarking quality function deployment, ISO 9000, and designed experiments are excellent for problem solving. On the average 40% of the sales dollar is purchased product or service, therefore, the supplier quality must be outstanding. A partnering relationship rather than an adversarial one must be developed. Performance measures such as uptime, percent nonconforming, absenteeism, and customer satisfaction should be determined for each functional area. These measures should be posted for everyone to see. Quantitative data are necessary to measure the continuous quality improvement activity. The purpose of TQM is to provide a quality product and/or service to customers, which will, in turn, increase productivity and lower cost. With a higher quality product and lower price, competitive position in the marketplace will be enhanced [1, 21 & 22]. This series of events will allow the organization to achieve the objectives of profit and growth with greater ease.

1.6 TQM Framework

TQM Framework begins with the knowledge provided by gurus of quality: Shewhart, Deming, Juran, Figenbaum, Ishikawa, Crosby, and Taguchi. As the figure shows, they contributed to the development of principles and practices and/or the tools and techniques. Some of these tools and techniques are used in the product and/or service realization activity. Feedback from internal/external customers or interested parties provides information to continually improve the organization system, product and/or service [1]. Shows the framework for the TQM system in Figure 1.2.

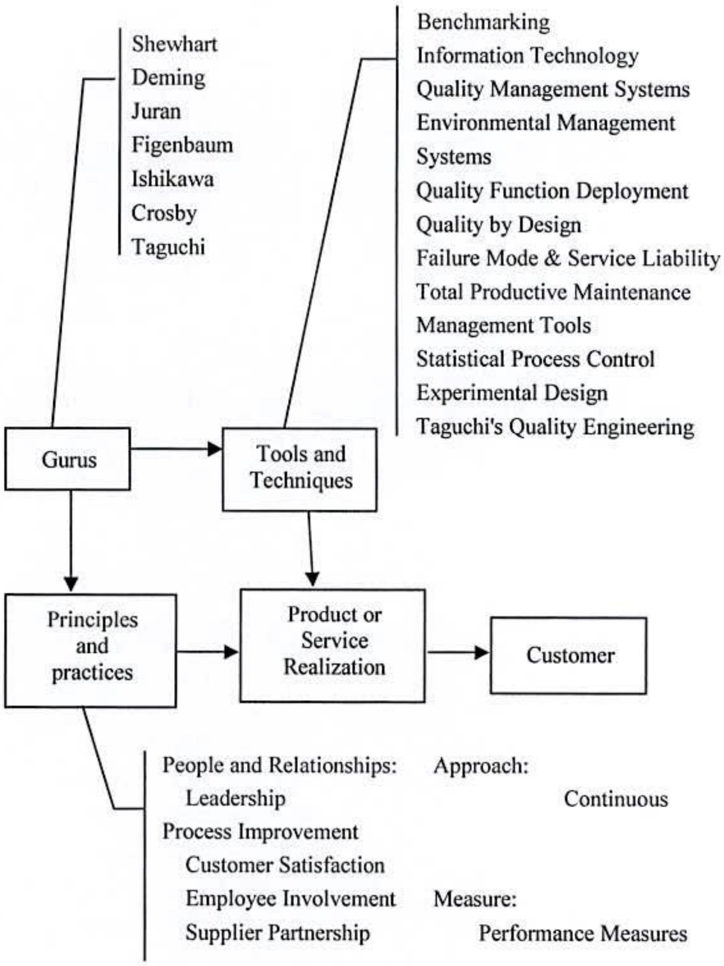


Figure:1.2 TQM Framework

TQM principles and practices are therefore enumerated as follows:

- Continuous improvement.
- People involvement.
- JIT. (Just in time)
- Bench Marking.
- Use of tools.

And again the tools and techniques of TQM are therefore can be enumerated as follows:

Benchmarking
Information Technology
Quality Management Systems
Environmental Management Systems
Quality Function Deployment
Quality by Design
Failure Mode & Service Liability
Total Productive Maintenance
Management Tools
Statistical Process Control
Experimental Design
Taguchi's Quality Engineering

Among these Total Quality Management tools, Quality Function Deployment (QFD) is the most important planning tools.

1.7 Evolution of Quality function Deployment.

With the changing techno-economic scenario around the entire world, the market has turned from seller to buyer type. The main objective of every organization is to satisfy the stated and implied needs of the customer. It has been observed and demonstrated that fast growing companies are those, which take care of their customer's satisfaction. To ensure continued business success every company should have its own process to constantly monitor and update its knowledge of customer. Thus, voice of the customer has become the important factor in designing products and service to satisfy the needs. [5, 23 & 24]

This concept of utilizing the voice of the customer for designing the products was first introduced at Mitsubishi's kobe shipyard in 1972. This method of structuring customer requirements and translating the same into technical specifications as a basis for new product development is called NIN SHITU KI NOTEN KAI Which has been translated into English as ``Quality Function Deployment (QFD)" [5]

1.8 QFD Concept

QFD has been developed to help translate requirement as seen by the customer into technical specifications that can be used by design and production. It is a method for linking customer requirements to technical specification. QFD is not a tool, it is a planning process. It helps the organization to plan for the effective use of other technical tools to support and complement each other and address issues on priority.

QFD helps to focus on needs of the customers by using matrices, and charts to help organization hear and understand the customer voice, develop the definition of quality for them and then deploy that definition to the development and production of all services and components of the system. It is not a design or problem solving tool but its purpose is to inform and educate the managers and employees in the product characteristics that will interest the customer. The QFD concept is represented in the Table 1.1

• QFD is a planning process
• Inputs-Customers wants and needs.
• Matrix format is used for recording vital information
• It permits analysis and determination of priority issues
• Output-Key action issues for improved customer satisfaction based on customer inputs.

Table: 1.1 QFD Concepts

1.9 Features of QFD

Some of the features of QFD methodology are as follows:

(i) It is a planning process as opposed to a tool for problem solving.

(ii) It uses matrix to display the information

(iii) The customer's desires and needs are the inputs to the matrix

(iv) The collection of information in the matrix format facilitates analysis, examination and cross checking.

The QFD Process has three requirements-

- Development of customer requirements
- Development of technical information
- Analysis of results

The steps in QFD Process are-

1. Determine the voice of the customer
2. Survey the customers for importance and competitive rating
3. Develop customer portion of the matrix
4. Develop technical portion of the matrix
5. Analyze the matrix, choose priority items.
6. Compare the proposed design concept, synthesize the best.
7. Develop a part characteristic matrix for priority design requirement
8. Develop a process planning matrix for priority process requirement
9. Develop a manufacturing planning chart [5].

1.10 QFD Approach

The product-planning matrix of house of quality contains the most critical information that one needs regarding relationship to customer and comparative position in the market.

QFD is a 5 step, 4 phase technique to integrate the

- Needs
- Engineering
- R & D Manufacturing management

The customer is cascaded into design, process, and production as shown in the Table 1.3. This is achieved by creating new matrices [5].

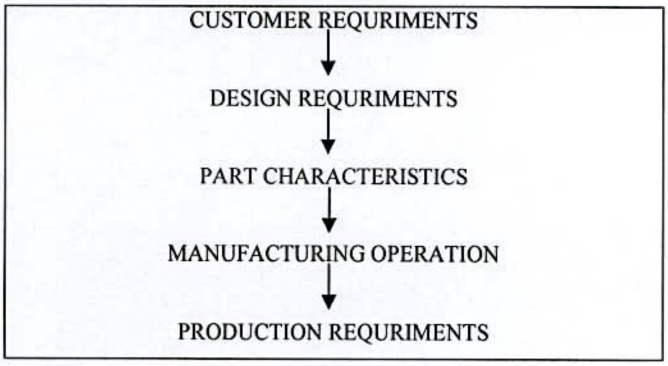


Table 1.2 QFD Approach

CHAPTER-2

LITERATURE REVIEW

2.1 Background of QFD

Dr. Mizuno, professor emeritus of the Tokyo Institute of Technology, is credited with initiating the Quality Function Deployment (QFD) system. The first application of (QFD) was at Mitsubishi, Heavy Industries Ltd, in the lobe Shipyard, Japan in 1972. After four years of case study development, refinement, and training. QFD was successfully implemented in the production of mini-vans by Toyota. Using 1977 as a base, a 20% reduction in startup costs was reported in the launch of the new van in October 1979, a 38% reduction by November 1982, and a cumulative 61% reduction by April 1984. Quality Function deployment was first introduced in the United States in 1984 by Dr. Clausing of Xerox. QFD can be applied to practically any manufacturing or service industry. It has become a standard practice by most leading organizations.

2.2 Introduction

Quality function deployment (QFD) is a planning tool used to fulfill customer expectations. It is a disciplined approach to product design, engineering, and production and provides in depth evaluation of a product. An organization that correctly implements QFD can improve engineering knowledge, productivity, quality and reduce costs, product development time, and engineering changes.

Quality function deployment focuses on customer expectations or requirements, often referred to as the voice the customer. It is employed to translate customer expectations, in terms of specific requirements into directions and actions, in terms of engineering or technical characteristics, that can be deployed through:

Product Planning
Part development
Process Planning
Production Planning
Service industries

Quality function deployment is a team based management tool in which customer expectations are used to drive the product development process. Conflicting characteristics or requirements are identified early in the QFD process and can be resolved before production. Organization today uses market research to decide what to produce to satisfy customer requirements. Some customer requirements adversely affect others, and customers often cannot explain their expectations. Confusion and misinterpretation are also a problem while a product moves from marketing to design to engineering to manufacturing. This activity is where the voice of the customer becomes lost and the voice of the organization adversely enters into the product design. Instead of working on what the customer expects, work is concentrated on fixing what the customer does not want. In other words, it is not productive to improve something the customer did not want initially. By implementing QFD, an organization is guaranteed to implement the voice of the customer in the final product or service.

Quality function deployment helps to identify new quality technology and job functions to carry out operation. This tool provides a historic reference to enhance future technology and prevent design errors. QFD is primarily a set of graphically oriented planning matrices that are used as the basis for decisions affecting any phase of the product development cycle. Results of QFD are measured based on the number of design and engineering changes, time to market, cost, and quality.

Quality function deployment enables the design phase to concentrate on the customer requirements, thereby spending less time on redesign and modifications. The saved time has been estimated to be one third to one half of the time taken for redesign and modification using traditional means. This saving means reduced development cost and also additional income because the product enters the market sooner.

2.3 Some Recent Work on QFD

The research on QFD was widely employed in manufacturing industry, service industry, food industry, hospitality industry and even on software industry. Some recent research on QFD has been discussed below.

QFD is a tool for bringing the voice of the customer into the product development process from conceptual design through to manufacturing. It begins with a matrix that links customer desires to product engineering requirements, along with competitive benchmarking information, and further matrices can be used to ultimately link this to design of the manufacturing system. Unlike other methods originally developed in the U.S. and transferred to Japan, the QFD methodology was born out of Total Quality Control (TQC) activities in Japan during the 1960s and has been transferred to companies in the U.S. The article reports on the results of a 1995 survey of more than 400 companies in the U.S. and Japan using QFD. The U.S. companies reported a higher degree of usage, management support, cross-functional involvement, use of QFD driven data sources, and perceived benefits from using QFD. For the most part, the main uses of QFD in the U.S. were restricted to the first matrix ("House of Quality") that links customer requirements to product engineering requirements and rarely was this carried forward to later matrices. U.S. companies were more apt to use newly collected customer data sources (e.g., focus groups) and methods for analyzing customer requirements. Japanese companies reported using existing product data (e.g., warranty) and a broader set of matrices to a greater extent [6]. The use of analytical techniques in conjunction with QFD (e.g., simulation, design of experiments, regression, mathematical target setting, and analytic hierarchy process) was not wide spread in either country. U.S. companies were more likely to report benefits of QFD in improving cross-functional integration and better decision-making processes compared to Japanese companies.

Neural Network method was introduced in QFD analysis for product development. In the early phases of the development of new products (pre-CAD phase) Quality Function Deployment (QFD) was used for product planning. A major drawback of its application is the need to input a large amount of data and the necessity to estimate values on a rather subjective basis in order to complete the House of Quality. This data is plentiful and often designers lack the knowledge with satisfying accuracy. The work (introduction of Neural Network) suggests a machine learning approach in which a neural network automatically determines the data by learning from examples [7]. Unlike conventional neural networks the topology and the weight values are not random but represent real circumstances and can directly interpret the terms of the application.

Research on service quality and customer satisfaction has become significant in the hospitality industry. Previously proposed or introduced research paradigms focused exclusively on customers without equally emphasizing the intra-organizational service generation and delivery processes. A recent work considered both external & internal service management issues and subsequent service innovations based on the framework of Quality Function Deployment (QFD) [8]. The study developed a hypothetical application in the lodging industry in order to illustrate future application and analysis strategies. QFD was also widely used in food industry [9]

QFD was used to improve software quality. Because it was recognized several issues are common with production/service industry and information systems (IS) development, it was worthwhile to apply QFD to IS development as well. It was tried to make the approach to somewhat more realistic by applying it in a hypothetical manner to an actual case. The impression is that QFD has features which help the participants to understand each other's requirements [10]. The benefits and drawbacks of the technique learned during the process were reported in the paper.

Developing a high quality and low cost product is an important policy of an enterprise in today's highly competitive marketplace. To reach this objective, a systematically transparent method by integrating several techniques was proposed in a study. With this systematic methodology, a high quality and low cost product that more fits the consumer needs was designed and consequently the competitiveness of the product was improved. The design of a secure music-toy for children aged under seven was taken as a case study to specify the implementation procedures of QFD method [11]. The qualitative design parameters and design criteria were first deployed with the quality function deployment and failure mode and effect analysis technologies and then quantified with the analytic hierarchy process technology to get the best design targets with which the detail design was completed. The design for assembly technology was also used to analyze the assembly performance and the costs of design alternatives.

QFD framework was designed considering cost of technical attributes. Conventional Quality Function Deployment (QFD) is technically one-sided. Prioritization of technical attributes, attempts to maximize customer satisfaction without considering the costs incurred. Product design is usually a techno-economic process, hence there is always a tradeoff between quality goals and limited budgets [12]. Based on a prioritization method suggested by Wasserman this work integrated design costs into the QFD framework. This proposed approach enabled designers to optimize product development resources towards customer satisfaction and conduct analytical investigations to facilitate decision making in product design and development.

As a marked increase in the number of musculoskeletal disorders was noted in many industrialized countries and more specifically in companies that require the use of hand tools, the French National Research and Safety Institute launched a research on the topic of integrating ergonomics into hand tool design. After a brief review of the problems of integrating ergonomics at the design stage, the researchers showed how the "Quality Function Deployment" method can be applied to the design of a boning knife and highlight the difficulties encountered [13]. It also demonstrated how this method can be a methodological tool, geared to greater ergonomics consideration in product design.

QFD has had considerable success in terms of its implementation in companies. It has also been the subject of many studies in recent years. It seems, however, that there are some shortcomings in the research on this subject and in particular the lack of an adequate conceptual framework suitable for empirical research. The study proposed a model which examines QFD in relation to three dimensions of performance: improvement of product quality, reduction in costs for R&D, shorter R&D time. The model is empirically tested on data gathered on a stratified random sample of manufacturing plants through the application of valid and reliable measures. The model is tested using structural equation modeling. The results show three distinct paths of direct influence which lead, respectively, to superior economic performance. The empirical study has shown that the success of a QFD project is mainly influenced by motivated employees in the QFD project team. A comprehensive technical support for the QFD project is also a crucial key success factor. The strict organization of the QFD project is of minor, however still remarkable importance for the success [14].

This research modeled apparel product development as a market driven process and integrated the consumer purchase decision in the model of proactive product development integrating consumer requirements (PPDICR). The PPDICR links the consumer purchase decision and multiple consumer research strategies to specific stages of the no-interval coherently phased product development model for apparel through 15 avenues of consumer input. The PPDICR model contributes to our understanding on how consumer input can be used to facilitate the process and through what avenues that input may be acquired [15].

2.4 The QFD Team

When an organization decides to implement QFD, the project manager and team members need to be able to commit a significant amount of time to it, especially in the early stages.

There and two types of teams designing a new product or improving and existent product. Teams are composed of members from marketing, design, quality, finance, are production. The existing product team usually has fewer members, because the QFD process will only need to be modified. Time inter-team communication is two very important things that each team must utilize to their fullest potential. Using time effectively is the essential resource in getting the project done on schedule.

Team meetings are very important in the QFD process. The team leader needs to ensure that the meetings are run in the most efficient manner and that the members are kept informed. The duration of the meeting will rely on where the team's members are coming from and what needs to be accomplished. Information to be collected between times that will ensure that the right information is being entered into the QFD matrix.

2.5 Benefits of QFD

Quality function deployment was originally implemented to reduce start up costs. Organizations using QFD have reported a reduced product development time. For example, U.S. car manufacturers of the late 1980s and early 1990s needed an average of five years to put a product on the market, from drawing board to showroom, whereas Honda put a new product on the market in two and a half years and Toyota did it in three years. Both organizations credit this reduced time to the use of QFD.

Product quality and, consequently, customer satisfaction improve with QFD due to numerous factors depicted in Figure: 2-1

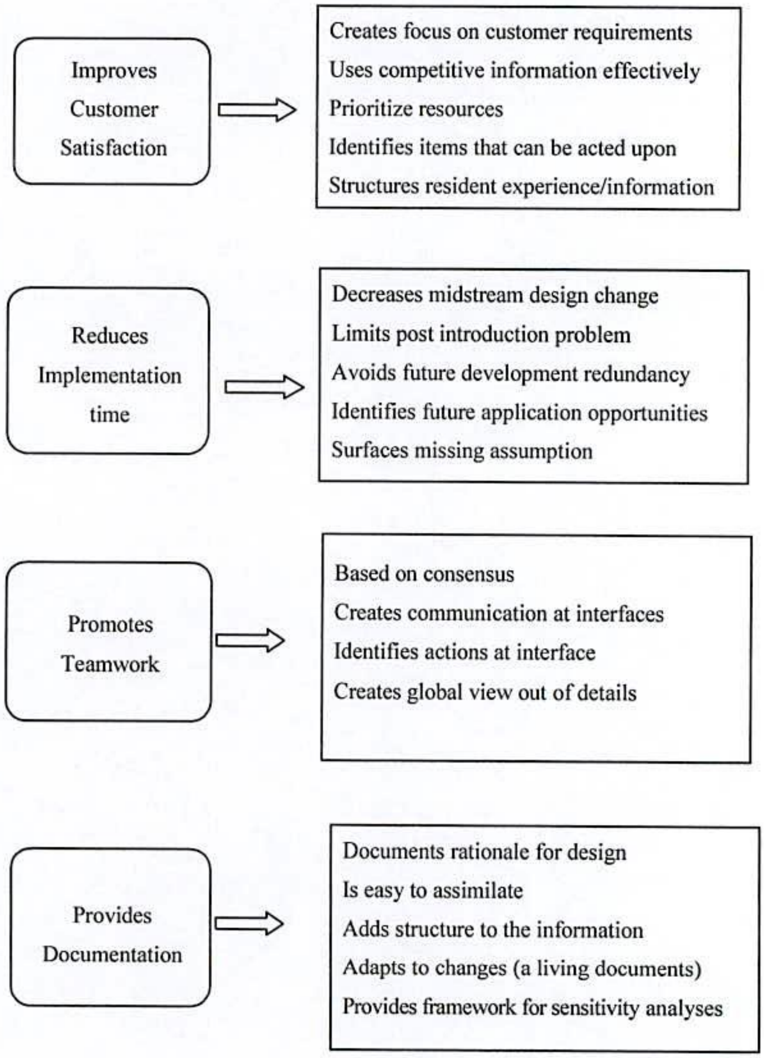


Figure: 2-1 Benefits of QFD

Improves Customer Satisfaction

Quality Function Deployment looks past the usual customer response and attempts to define the requirements in a set of basic needs, which are compared to all competitive information. All competitors are evaluated equally from customer and technical perspectives. This information can then be prioritized using a **Pareto diagram.**

Management can then place resources where they will be the most beneficial in improving quality. Also, QFD takes the experience and information that are available within an organization and puts them together as a structured format that is easy to assimilate. This is important when the organization's employee leaves a particular project and a new employee is hired.

Reduces Implementation Time

Fewer engineering changes are needed when using QFD and when used properly, all conflicting design requirements can be identified and addressed prior to production. This results in a reduction in retooling, operator training, and changes in traditional quality control measures. Bu using QFD, critical items are identified and can be monitored from product inception to production. Toyota reports that the quality of their product has improved by one-third since the implementation of QFD.

Promotes Teamwork

Quality function deployment forces a horizontal deployment of communication channels. Inputs are required from all facets of an organization, from marketing to production to sales, thus ensuring that the voice of the customer is being heard and that each department knows what the other is doing. This activity avoids misinterpretation, opinions, and miscues. In other words, the left hand always knows what the right hand is doing. Efficiency and productivity always increase with enhanced teamwork.

Provides Documentation

A database for future design or process improvements is created. Data that are historically scattered within operations, frequently lost and often referenced out of context, are now saved in an orderly manner to derived future needs. This database also serves as a training tool for new engineers. Quality function deployment is also very flexible when new information is introduced or things have to be changed on the QFD matrix.

2.6 Voice of the Customer

QFD concentrates on customer expectations and needs; a considerable amount of effort is put into research to determine customer expectations. This process increases the initial planning stages of the project definition phase in the development cycle but the result is a total reduction of the overall cycle time in bringing to the market a product that satisfies the customers.

The driving force behind QFD is that the customer dictates the attributes of a product. Customer satisfaction, like quality, is defined as meeting or exceeding customers expectation. Words used by the customers to describe their expectations are often referred to as the voice of the customer. Sources for determining customer expectations are focus groups, surveys, complaints, consultants, standards, and federal regulations are vague and general in nature. Quality function deployment begins with marketing to determine what exactly the customer desires from a product. During the collection of information, and QFD team must continually ask and answer numerous questions such as

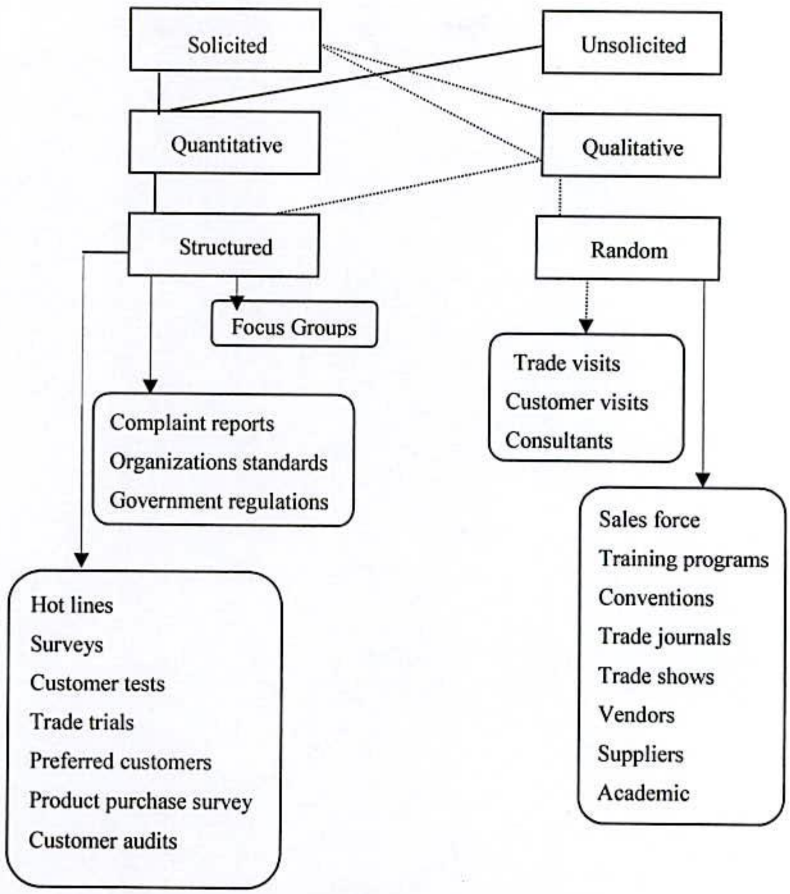


Figure: 2.2 Types of Customer Information and How to collect it

What does the customer really want?

What are the customer's expectations?

Are the customer's expectations used to drive the design process?

What can the design team do to achieve customer satisfaction?

2.7 House of Quality

The primary planning tool used in QFD is the House of quality. The house of quality translates the voice of the customer into design requirements that meet specific target values and matches those against how an organization will meet those requirements. The exterior walls of the house are the customer requirements. On the left side is a listing of the voice of the customer, or what the customer expects in the product. On the right side are the prioritized customer requirements, or planning matrix. Listed are items such as customer importance rating, target value, scale up factor and sales point.

The ceiling, or second floor, of the house contains the technical descriptors. The interior walls of the house are the relationships between customer requirements and technical descriptors. Customer expectations (customer requirements) are translated into engineering characteristics (technical descriptors) The roof of the house is the interrelationship between technical descriptors. Tradeoffs between similar and/or conflicting technical descriptors are identified. The foundation of the house is the prioritized technical descriptors. Items such as the degree of technical difficulty, and target value are listed. The structure of QFD can be thought of as a framework of a house, as shown in Figure 2.2

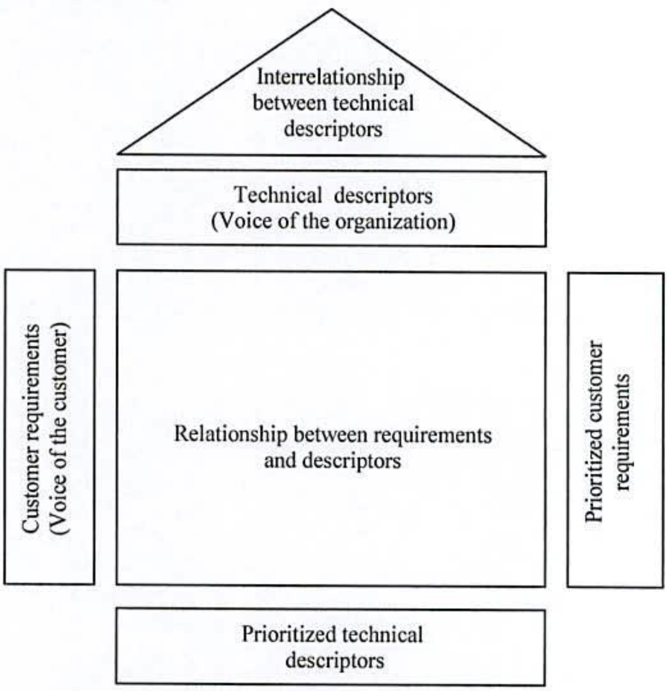


Figure: 2.3 House of Quality

2.8 Building a House of Quality

My thesis work objective is to Building a House of Quality matrix. There is considerable amount of information within this matrix there we plotted collected factory data in the House of Quality matrix and significantly simplified in the third chapter. A sample of same House of Quality matrix is shown in figure 2.4

Building a House of Quality

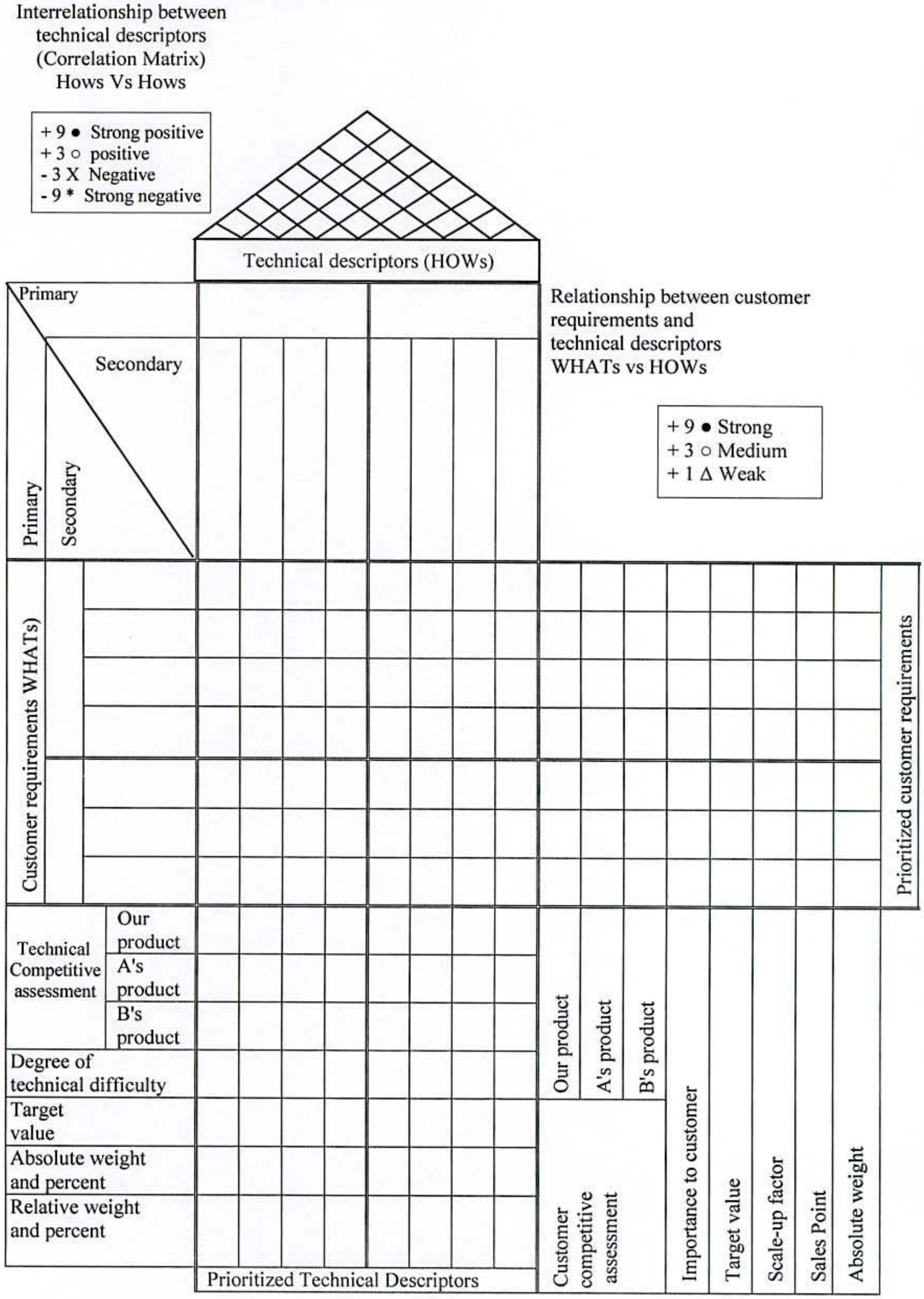


Figure: 2-4 Basic House of Quality matrix

CHAPTER-3
PROCEDURE/METHODOLOGY

3.1 Introduction to Jute & Jute grades.

Jute: It's scientific name is chorchorus Iliaceae & organic formula is $C_{46}H_6O_{48}$. It's fiber has staple length, tensile strength, cohesiveness, natural twist, hygroscopic capacity. It's fibers chemical combination are as follows:

Ash	0.68%
Hygroscopic capacity	9.93%
Fat & candle substance	0.39%
Cellulose	64.24%
Aqueous substance	1.03%

As Jute fiber contains significant percent of cellulose, so it is called hemi cellulosing material. [18]

White Jute: It's scientific name is chorchorus capsularies. It is found in North Bengal. It's fiber looks white.

Tossa Jute: It's scientific name is chorchorus olitorious. Fibers are very strong and light bright, golden color. It is found in hard district named greater Faridpur.

Mesta: It is not really a Jute. But it is a one types of fiber like Jute.
Various quality of Jute grows in different places in different names. **BJMC** has given some standard name of Jute fibers. Which are depicted in Table 3.1

BJMC Classified the Jute in the following abbreviated form:

White	Tossa	Mesta
A : BWA	A : BTA	A : BMA
B: BWB	B: BTB	B: BMB
C: BWC	C: BTC	C: BMC
X: BWD	X: BTD	
SMR: BWE	SMR: BTE	

Name of Jute		Quality of Jute
Top	White Top	Very strong rigid fiber, white, cream white, light bright golden color. Required cutting weight 20%.
	Tossa Top	Very strong fiber, white, cream white, light bright golden color. Required cutting weight 15%.
Middle	White Middle	Strong fiber, standard length, white, light cream, radish, glitters. Required cutting weight 20%.
	Tossa Middle	Strong fiber standard length, white milky color, light golden. Required cutting weight 15%.
B Bottom	White B-Bottom	Strong fiber standard length, silver white, light cream. Required cutting weight 25%.
	Tossa B-Bottom	Strong fiber standard length, silver white, copperish color, light cream. Required cutting weight 25%.
C Bottom	White C-Bottom	Standard strong fiber. Required cutting weight 33%.
	Tossa C-Bottom	Standard strong fiber. Required cutting weight 20%.

Table 3.1 Classes of Jute

Different ratios & grades of Jute are mixed to get different strength of fiber. However it is assumed in CBC manufacturing the following grades and ratios makes Equivalent fiber strength.

1. → BTC 70%, BTD 30%
2. → BTC 70%, BWC 20%, BTD 10%
3. → BTC 70%, BWC 10%, BTD 10%, BMB 10%

Emulsion: Emulsion is a mixture of oil, water and emulsifier which makes Jute fiber soft and matured for required use. It is produced by the following proportion of materials:

JBO-Jute Batching oil	20% - 24%
Water	79.5% - 75%
Emulsifier	0.5% - 1%

Starch: Starch is added to Jute for smooth aligns of fibers and also increases rigidity. Starch is the mixture of tamarind seed, wax, fat, wheat, oil, soap, zinc chloride and water. The following proportions of materials are given bellow:

Tamarind seed	2.50%
Wax	0.10%
Soft soap	0.03%
Zinc chloride	0.03%
Water	97.33%

3.2 Company Profile

Mohsen Jute mill, mainly produces CBC and exports the same to different countries..

Mohsen Jute mill was erected in 1969 by Syed Mohsen Ali & is it's commercial production started in 4th January 1971. It covers 19.66 acres of land. It is situated at shiromony near the bank of the river Vairob, 15 kilometers form khulna town. It produces 100% CBC and exports in European countries & in India. It has 65 Broad looms. It's production capacity is10 metric ton per day and 3000 metric ton per year approximately. In the house of quality matrix **our product** is assumed as Mohsen Jute mills product

And the other jute mill, Carpeting Jute mills commercial production started in 1963. It covers 23 acres of land. It is situated at Rajghat, Jessore near the bank of the river. Vairob 36 kilometers form khulna town. It produces 100% Carpet Backing Cloth (CBC) and exports in European countries. It has 86 Broad looms. It's production1209 metric ton per year approximately. Carpeting Jute mill product is assumed as **A's Product** in the quality matrix.

Jessore jute mill was erected in 27th January 1970 by vice admiral S.M Ahsan Governor of East Pakistan in the presence of His Royal Highness Prince Karim Agakhan and Begum Salina Agakhan. It covers 79.63 acres of land. It is situated at Rajghat, Jessore near the bank of the river. Vairob 35 kilometers form Khulna town. It manufactures following Jute goods. It has 456 looms of different types. It's production 29.09 metric tons per day and 8699 metric ton per year approximately.Jessore Jute Industries (JJI's) product is assumed as B's product in the quality matrix.

Product Varieties at Jute Mills.

Mohsen's main product is CBC. However they also produces other type of products. A brief description of different type of products has been given below:

Hessian: Cloth and Bags of various specifications usually made from cloth of width of 22 to 80inches with weight from 5 to 14 ounce per square yard. These products can be of natural textures well as bleached or dyed depending on the users' requirement. Cloth is usually packed 700-2000 yards per pressed bale or roll. Bags are usually packed 500-100 pieces, flat or folded, in steel bound bales.

Sacking: Like Hessian this category is also available in cloth or bag form but they are little heavier Like Hessian this category is also available in cloth or bag form but they are little heavier in materials and in use. Cloths are usually 20-37 inches wide with weight 11-24 ounce per square yard. Packing of sacks is usually done in steel bound bales of 200-500 pieces. Weave of cloth is either twill or plain.

Carpet Backing Cloth (CBC): Available for primary backing or secondary backing of carpet, 40-203 inches wide, 5.5 - 7.5 ounce per square yard in rolls of 500-1000 yards.

Jute Felt: Polyvinylchloride (PVC) coated felt, rubber coated (RC), single side (SS) and double sides (DS) needle punched jute felts, width 54 inches.

Jute Webbing: Width 1" - 3.5", weight 6 - 26 lbs. Per gross yd. (144 yds) depending on width. Design plain and stripe, Packing 6 - 12 gross yd. Per bale.

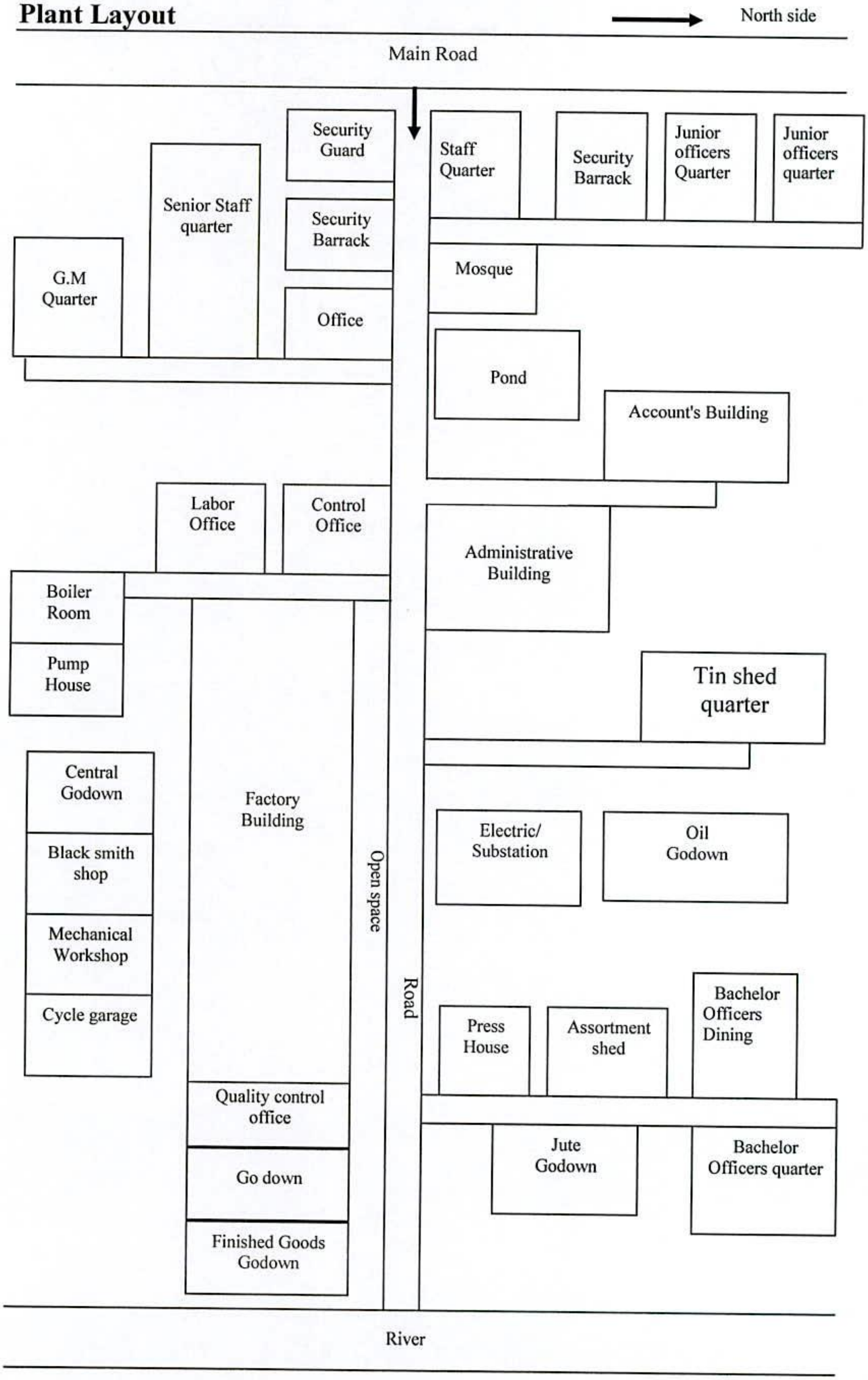
Laminated Fabric and Bag: Polythene-coated colored/natural Hessian/ CBC/ Sacking/Cam7as"Tarpaulin for packing sugar, fertilizers etc. packing 1000 bags per bale.

Geo-Jute/Soil Saver

Jute, the natural fiber has the most environment-friendly characteristics because of its manifold inherent unique properties and counts of advantages over other manmade artificial polymer fiber products, especially in geo jute; soil saver. Width: 1.22 m; Weight: 610 gins per meter: Warp: 6.5 ends per 10cm: Weft: 4.5 ends per 10 cm; Packing 600-900 meter per bale.

MOHSEN JUTE MILL'S

Plant Layout



3.3 Manufacturing Process of CBC

CBC is manufactured from raw jute with some intermediate steps. Usually good graded jute is selected for CBC manufacturing. The production specifications of CBC depend on customer requirements. Defect less Jute (excluding lower 15%-20% cut) is used for CBC manufacturing. Spreader machine is used for emulsion application and doubling (overlapping of fibers) of Jute fibers in Rolls form. The Rolls are then piled for 48 to 72 hours to develop maturity & softening of the fibers. Maturity Jute Rolls are used in Breaker card machine for carding operation and making Roll. After making Roll, Finisher card machines are used for making more uniform carding action. Primary, Secondary and Tertiary drawing machines are required for combing action, elongation and regular to give shape in the fibers. After Drawing, slivers are used in spinning frames (shown in picture 3.1) for elongating fibers and to produce various types of yarn count. Spinning bobbins have been made Roll form by winding machines for making spool Rolls & cops. Cop is used for weft yarn and Spool Roll is used for warp yarn. In Pre-beam machine how many yarns needed is calculated and spool rolls are utilized for beam formation (shown in picture 3.2). Starch is added to make the yarn more rigid, and then it is dried up by Hebert Dressing machines (shown in picture 3.3). With this estimated -beam buyers desired cloth are manufactured. Cloth inspection machines are used for to find the defect and to repair cloth. Rolling up machines are then engaged to give the desired dimension in the rolls (shown in picture 3.4). Two-sided plastic tubes are required for packing and then marking also indicate the serial number, weight, destination, length for shipment. The whole production process has been shown by flow diagram in Figure 3.4

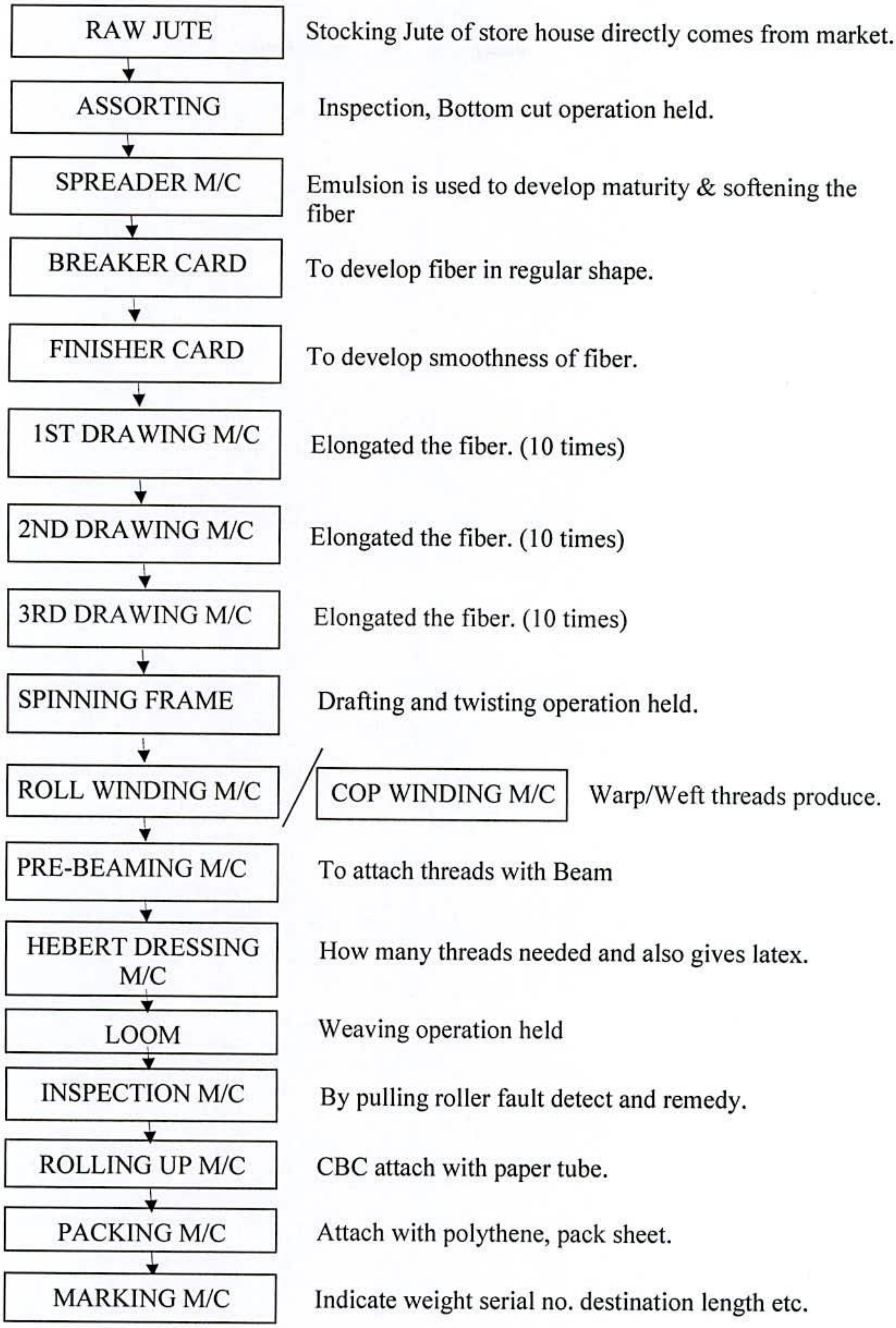
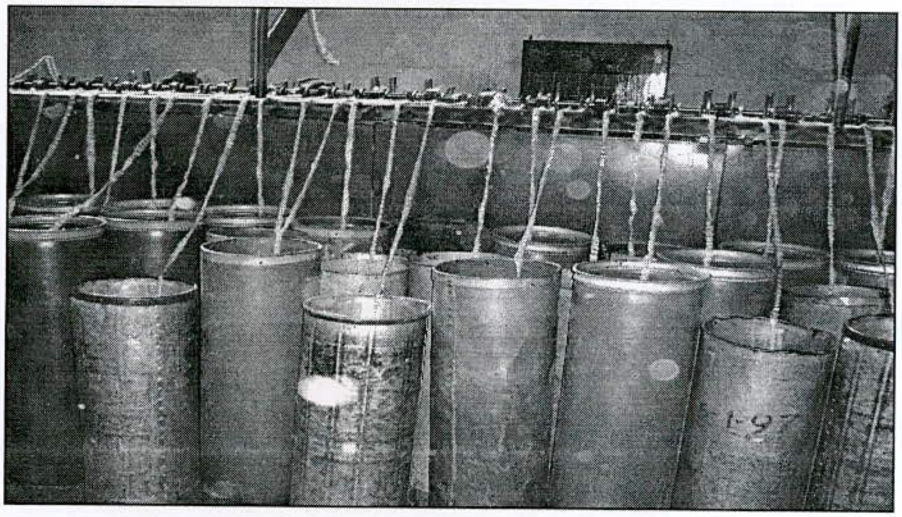


Figure: 3.1 Flow Diagram of CBC manufacturing

Spinning Machine

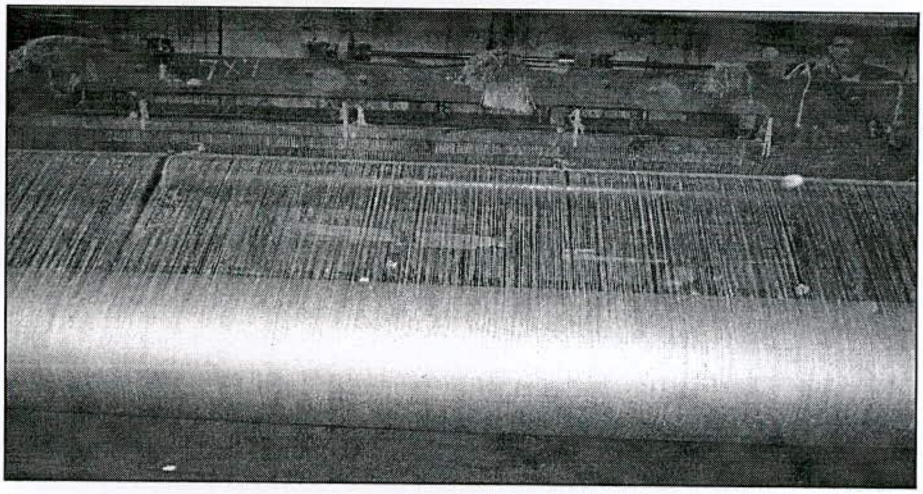
Jute yarn is needed in weaving operation of CBC. Jute fibers turn into required count yarn by elongating and twisting from spinning operation. A photograph of Spinning machine operation is shown in picture 3.1



Picture: 3.1 Spinning Machine.

Pre-Beaming Machine

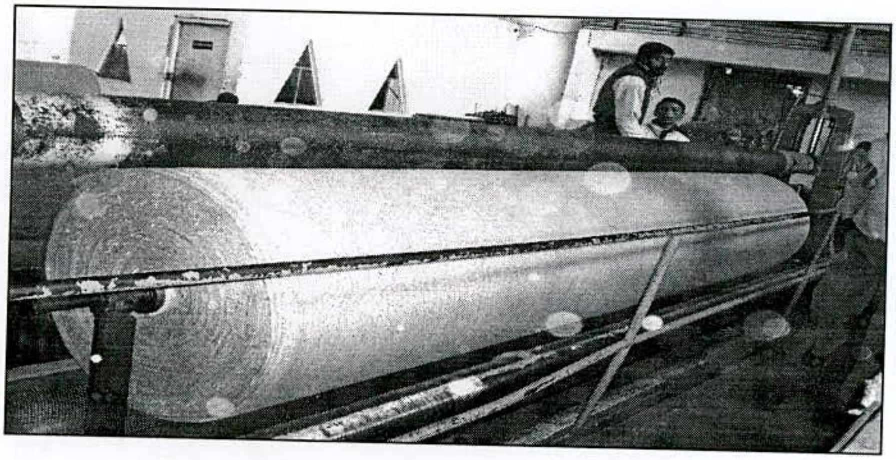
CBC has certain width. How many warp yarn needed calculated and wrapped in a beam. A photograph of Pre-Beaming machine operation is shown in picture 3.2



Picture: 3.2 Pre-Beaming machine

Hebert Dressing Machine

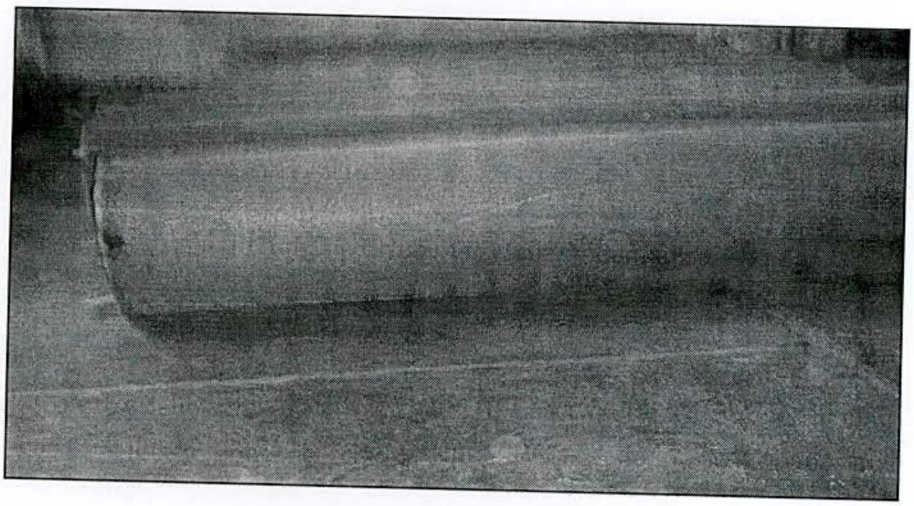
In CBC manufacturing it is required to increase the rigidity of the warp yarn. Starch makes the warp yarn rigid and strong. Starch is applied by Hebert dressing machine. A photograph of Hebert dressing machine operation is shown in Picture 3.3



Picture: 3.3 Hebert dressing machine:

CBC Rolled Up

CBC is export oriented jute goods. When CBC is exported in foreign countries the dimension is required to adjust for shipment. CBC is rolled up with paper tube /two-sided plastic tubes by this operation. A photograph of CBC rolling operation is shown in Picture 3.4



Picture: 3.4 CBC Rolled Up

Quality Ratio:- Quality ratio is the percentage of average strength with actual count.

$$Q.R = \frac{\text{Average Strength}}{\text{Actual count.}} \times 100$$

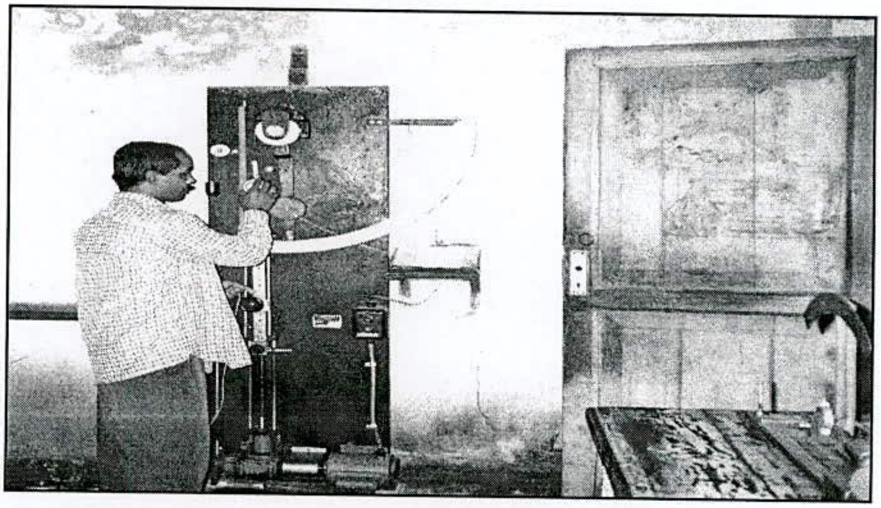
Quality ratio of CBC is 95%

3.4 Quality Testing Machine

For customer satisfaction Quality testing is very important. There are many qualities testing machine to test different parameters of Jute yarns as well as CBC. Description and operation of some quality testing machines are given below:

Tensile Stress Machine

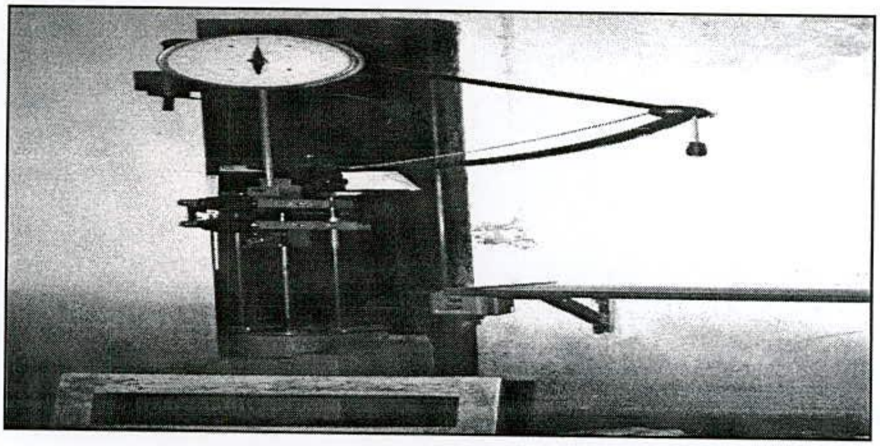
Tensile stress yarn machine is used for testing the certain count yarn stress and finds the quality ratio. A photograph Tensile stress machine is shown in picture 3.5



Picture: 3.5 Tensile Stress Machine.

Tensile Stress Fabric Machine

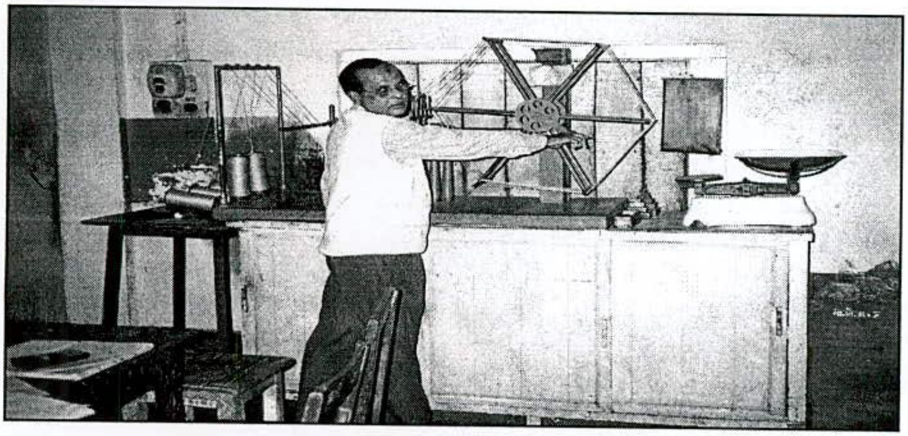
Tensile stress for fabric machine is used for testing the fabric strength of CBC. A photograph of Tensile stress for fabric is shown in picture 3.6



Picture: 3.6 Tensile Stress for Fabric

Yarn Reading Machine

Yarn reading is very important for CBC manufacturing .It place a vital role for ensuring quality. Several spools of certain count are attached to wheel and by the rotation of wheel some yarn wrap over the wheel. According to the diameter of the wheel the length of the wrapped yarn can be determined by counting rotation. After wrapping yarn of specific length, then the yarn is taken out from the wheel and weight is measured. A photograph of Yarn reading operation is shown in Picture 3.7.



Picture: 3.7 Yarn Reading Machine.

3.5 Inspection Report

An inspection report is prepared for the company's appraisal for their product "CBC". It actually finds the defect keeping in mind the buyer's requirements. An example of sample Inspection report (Cloth on Rolling Machine) has been shown below:

1. Roll: 8/10 - (Means 800 yards roll, 10 number roll)
2. Loom No: 30 (No. of loom)
3. Specifications: 13 X 9-150"/6.7ozs/36"
4. Date of Manufacture: (Manufacturing date)
5. Yardage (a) STD: (800 yards ± 5%), Yardage actual: (What actually count)
6. Weight (a) STD: 633 kg. Weight actual: (What actually count)
7. Heavy/Light: (If actual weight < Std. weight, then it is light)
8. Side Alignment: (Both side equal)
9. Tightness of roll: (No loose allowed)
10. Selvedge: (Both side regular)
11. Width: (150"± 1.5)
12. Ends/Inch: (13)
13. Short/Inch: (9)
14. Weft Distortion: (No bias allowed)
    (Bow/bias, combined bow & bias)
15. Cleanliness: (To keep neat and clean)
16. Loops: (No allowed)
17. Moisture Regain: (16%)
18. Roots: (No bark allowed)
19. Pin Marks: (No displace allowed)
20. Core Ends: (4")
21. 3" Gum Taps: (To attach CBC on paper roll)
22. Slub: (Without twisting yarn-not allowed)
23. Oil content on fabric 2/% Max

3.6 Weaving Faults

During weaving time there arises some faults which are called weaving faults. Negligence of workmen and weaving machines problem are major reasons for weaving faults. Some of the major faults are stated below:

Weaving faults of CBC are :

i) Snarls: Some yarns are tied up now and then.

ii) Bars (Shorting bar): Required space is absent in weaving.

iii) Gaw: above required space is absent in weaving.

iv) Reed mark: Warp yarn comes up in pair.

v) Scub: Large worn out in product.

vi) Broken ends: Tear out warp yarn.

vii) Wept Missing: without weft yarn shuttle moves.

viii) Double peaks: When two weft yarn moves by the shuttle.

ix) Drans: After repair if faults remain.

Sample Copy of Customer Order

Customers usually order in a prescribed form where the specifications are clearly defined. A sample ordering form is given in Table 3.2

Order Number	C/3052/07
Width	186"
Ozs./Sq. Yd.	7ozs
Warp/1"	10
Weft/1"	10
Type of Weave	Plain
Yds./Rolls	600 Yds.
Total Yds.	90,000 Yds
No. of Rolls	150 R
Dia. of Tube	As Usual
Due Date.	December-07
Destination.	Italy
Sp. Inst. & Shipping Marks.	

Table: 3.2 Customer Ordering Form

3.7 Customer Requirements (WHATs)

Quality function deployment starts with a list of goals/objectives. This list is often referred as the WHATs that a customer needs or expects in a particular product. The list of customer requirements is divided into a hierarchy of primary, secondary customer requirements, a primary customer requirement might be dependability and the corresponding secondary customer requirements could include reliability, longevity, and maintainability.

Two primary customer requirements might be aesthetics and performance. Secondary customer requirements under aesthetics might be reasonable cost, nice finish, brightness, oil content. Secondary customer requirements under performance might be light weight, strength and durability. These primary and secondary customer requirements are shown in Figure 3-2.

	Primary	Secondary	
Customer requirements	Aesthetics	Reasonable cost	
		Nice finish	
		Oil Content	
		Brightness	
	Performance	Strength	
		Durable	
		Light Weight	

Figure: 3.2 Refinements of Customer Requirements

3.8 List Technical Descriptors (HOWs)

The goal of the house of quality is to design or charge the design of a product in a way that meets or exceeds the customer expectations. The customer needs and expectations have been expressed in terms of customer requirement's the QFD team must come up with engineering characteristics or technical descriptors (HOWs) that will affect one or more of the customer requirements. These technical descriptors make up the ceiling, or second floor, or the house of quality.

The list of technical descriptors is divided into a hierarchy of primary, secondary, technical descriptors, shown in Figure 3-3.

	Primary	Secondary	
Technical descriptors (HOWs)	Manufacturing Process	BTC 100%	
		BTC 70%, BTD 30%,	
		BTC 50%, BTD 50%,	
		BTD 100%,	
	Material selection	9 X 8-163.5" 5.5ozs/36"	
		10 X 10-150" 6.ozs/36"	
		13 X 9-150" 6.7ozs/36"	
		13 X 10-203" 7ozs/36"	

Figure: 3-3 Refinement of Technical Descriptors

3.9 Develop a Relationship Matrix between WHATs vs HOWs

Building a house of quality is to compare the customer requirements and technical descriptors and determine their respective relationships. Tracing the relationships between the customer requirements and the technical descriptors can become very confusing, because each customer requirement may affect more that one technical descriptor, and vice versa. The relationship matrix is used to represent graphically the degree of influence between each technical descriptor and each customer requirement. It is common to use symbols to represent graphically the degree of relationship between the customer requirements and technical descriptors.

A solid circle represents a strong relationship.

A single circle represents a medium relationship.

A triangle represents weak relationship.

The box is left blank if no relationship exists.

The symbols that are used to define the relationships are now replaced with numbers, for example,

● = 9

○ = 3

Δ = 1

After the relationship matrix has been completed, it is evaluated for empty rows or columns. An empty row indicates that a customer requirement is not being addressed by any of the technical descriptors. Thus, the customer expectation is not being met. Additional technical descriptors must be considered in order to satisfy that particular customer requirement. An empty column indicates that a particular technical descriptor does not affect any of the customer requirements and, after careful scrutiny, may be removed from the House of Quality.

In figure 3.4, the relation between BTD 100% and nice finish is represented by a triangle (Δ).Triangle means the relation between them is weak. BTD 100% is a low quality of Tossa jute. The jute like such a quality cannot produce a nicely finished product. So, the interrelationship between BTD 100% and nice finish is obviously weak.

Primary	Secondary		Technical descriptors (HOWs)							
			Material selection				Manufacturing Process			
Primary	Secondary		BTC 100%	BTC 70%, BTD 30%,	BTC 50%, BTD 50%,	BTD 100%,	9 X 8-163.5" 5.5ozs/36"	10 X 10-150" 6.ozs/36"	13 X 9-150" 6.7ozs/36"	13 X 10-203" 7ozs/36"
Customer requirements (what's)	Aesthetics	Reasonable Cost	Δ	○	○	●	●	○	Δ	Δ
		Nice finish	●	●	○	Δ	○	○	●	●
		Oil Content	●	●	○	Δ	○	○	Δ	Δ
		Brightness	●	●	○	Δ	Δ	Δ	●	●
	Performance	Strength	●	●	○	Δ	Δ	○	●	●
		Durable	●	●	○	Δ	Δ	○	●	●
		Light Weight	●	●	○	Δ	●	●	○	Δ

Relationship between customer requirements and technical descriptors WHATs vs HOWs

+ 9 ● Strong
+ 3 ○ Medium
+ 1 Δ Weak

Figure: 3.4 Relationship matrix between WHATs vs HOWs

3.10 Develop an Interrelationship Matrix Between HOWs

The roof of the house of quality, called the correlation matrix, is used to identify any interrelationship between each of the technical descriptors. The correlations matrix is a triangular table attached to the technical descriptors, as shown in Figure 3-5. Used to describe the strength of the interrelationships; for example,

A solid circle represents a strong positive relationship.

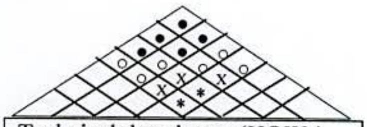
A circle represents a positive relationship.

An X represents a negative relationship.

An asterisk represents a strong negative relationship.

Interrelationship between technical descriptors (Correlation Matrix) Hows Vs Hows

+ 9 ● Strong positive
+ 3 ○ positive
- 3 X Negative
- 9 * Strong negative



Primary	Secondary		Technical descriptors (HOWs): Material selection				Manufacturing Process			
			BTC 100%	BTC 70%, BTD 30%,	BTC 50%, BTD 50%,	BTD 100%,	9 X 8-163.5" 5.5ozs/36"	10 X 10-150" 6.ozs/36"	13 X 9-150" 6.7ozs/36"	13 X 10-203" 7ozs/36"
Customer requirements (what's)	Aesthetics	Reasonable Cost	Δ	○	○	●	●	○	Δ	Δ
		Nice finish	●	●	○	Δ	○	○	●	●
		Oil Content	●	●	○	Δ	○	○	Δ	Δ
		Brightness	●	●	○	Δ	Δ	Δ	●	●
	Performance	Strength	●	●	○	Δ	Δ	○	●	●
		Durable	●	●	○	Δ	Δ	○	●	●
		Light Weight	●	●	○	Δ	●	●	○	Δ

Relationship between customer requirements and technical descriptors WHATs vs HOWs

+ 9 ● Strong
+ 3 ○ Medium
+ 1 Δ Weak

Figure: 3.5 Develop interrelationship between technical descriptors HOWs vs HOWs

The symbols describe the direction of the correlation. In other words, a strong positive interrelationship would be a nearly perfectly positive correlation. A strong negative interrelationship would be a nearly perfectly negative correlation. This diagram allows the user to identify which technical descriptors support one another and which are in conflict.

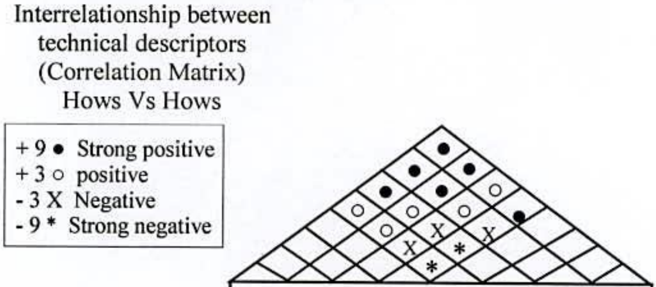
3.11 Customer Competitive Assessments

The customer competitive assessment is the block of columns corresponding to each customer requirement in the house of quality on the right side of the relationship matrix. The numbers 1 through 5 are listed in the competitive evaluation column to indicate a rating of 1 for worst and 5 for worst and 5 for best. These rankings can also be plotted across from each customer requirement, using different symbols for each product.

The customer competitive assessment is a good way to determine if the customer requirements have been met and identify areas to concentrate on in the next design. The customer competitive assessment also contains an appraisal of where an organization stands relative to its major competitors in terms of each customer requirement. Both assessments are very important, because they give the organization an understanding on where its product stands in relationship to the market.

In figure 3.6, the reasonable cost of Mohsen's product is weighted by 2. Mohsen uses best quality of jute goods (BTC 100%). The cost of BTC 100% is very high. So Mohsen product cannot satisfy reasonable cost efficiently and the weight is very poor which is indicated by 2

.



Relationship between customer requirements and technical descriptors WHATs vs HOWs

+ 9 ● Strong
+ 3 ○ Medium
+ 1 Δ Weak

			Technical descriptors (HOWs)								Customer competitive assessment		
Primary			Material Selection				Manufacturing Process						
Primary	Secondary	Secondary	BTC 100%	BTC 70%, BTD 30%,	BTC 50%, BTD 50%,	BTD 100%,	9 X 8-163.5" 5.5ozs/36"	10 X 10-150" 6.ozs/36"	13 X 9-150" 6.7ozs/36"	13 X 10-203" 7ozs/36"	Moh's product	Car's product	Jji's product
Customer requirements (WHATs)	Aesthetics	Reasonable Cost	Δ	○	○	●	●	○	Δ	Δ	2	3	4
		Nice Finish	●	●	○	Δ	○	○	●	●	5	4	3
		Oil Content	●	●	○	Δ	○	○	Δ	Δ	3	2	2
		Brightness	●	●	○	Δ	Δ	Δ	●	●	4	3	2
	Performance	Strength	●	●	○	Δ	Δ	○	●	●	5	4	2
		Durable	●	●	○	Δ	Δ	○	●	●	4	3	2
		Light Weight	●	●	○	Δ	●	●	○	Δ	4	3	2

Figure: 3.6 Adding Customers Competitive Assessment to the House of Quality

Calculation:

The test data are converted to the numbers 1 through 5, which are listed in the competitive evaluation row to indicate a rating, 1 for worst and 5 for best.

Mohsen Jute mills (Rating)

- Reasonable Cost = 2
- Nice finish = 5
- Oil Content = 3
- Brightness = 4
- Strength = 5
- Durable = 4
- Light Weight = 4

Carpeting Jute mills (Rating)

- Reasonable Cost = 3
- Nice finish = 4
- Oil Content = 2
- Brightness = 3
- Strength = 4
- Durable = 3
- Light Weight = 3

Jessore Jute Industries(JJI)Ltd. (Rating)

- Reasonable Cost = 4
- Nice finish = 3
- Oil Content = 2
- Brightness = 2
- Strength = 2
- Durable = 2
- Light Weight = 2

3.12 Technical Competitive Assessment

The technical competitive assessment makes up a block of rows corresponding to each technical descriptor in the house of quality beneath the relationship matrix, as shown in Figure 3.7. After respective units have been established, the products are evaluated for each technical descriptor.

The customer competitive assessment, the test data are converted to the numbers 1 through 5, which are listed in the competitive evaluation row to indicate a rating, I for worst and 5 for best.

Customer requirements and technical descriptors that are strongly related should also exhibit a strong relationship in their competitive assessments. If and organization's technical assessment shows its product to be superior to the competition, then the customer assessment should show a superior assessment.

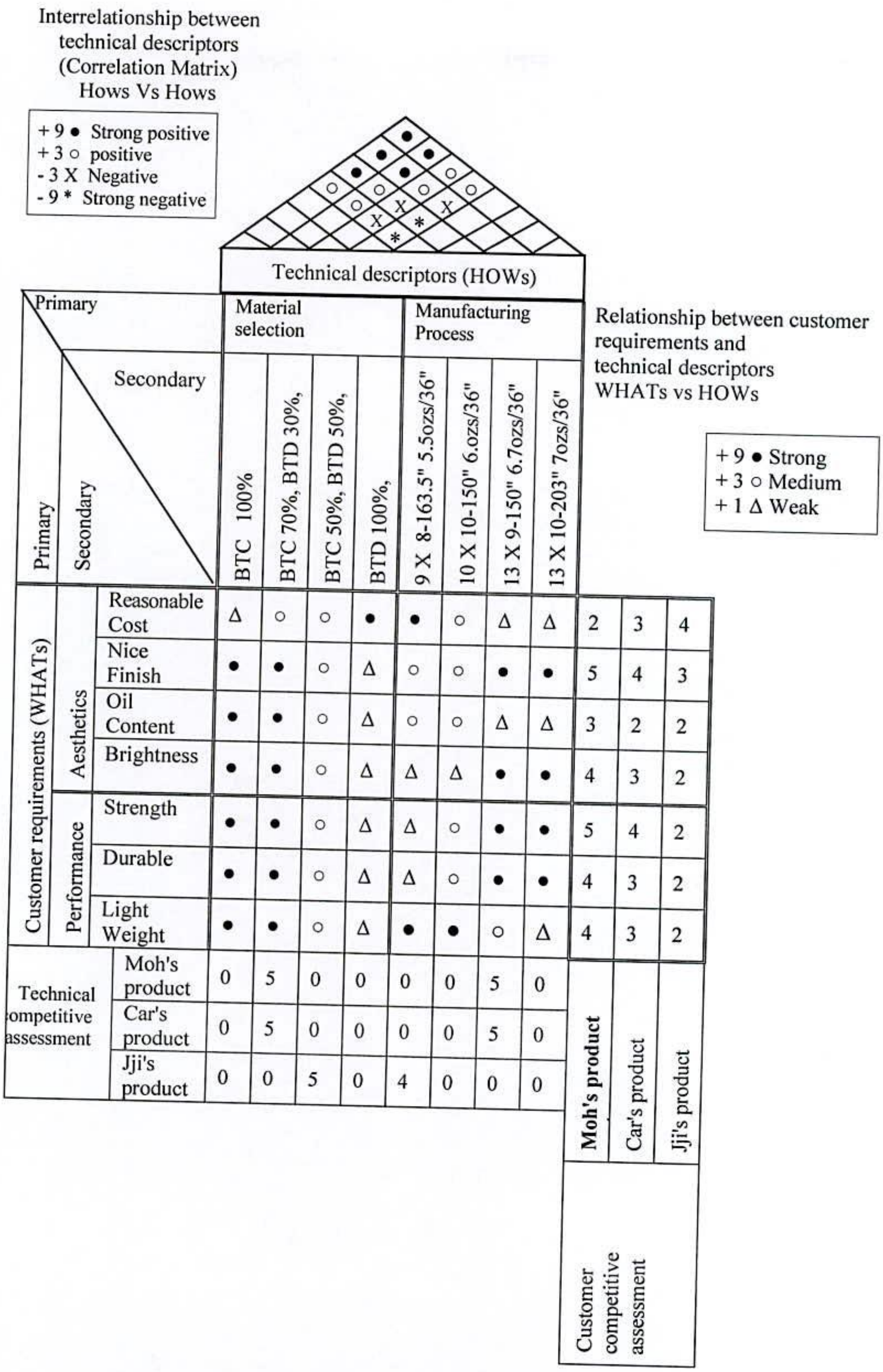


Figure: 3.7 Adding Technical Competitive Assessment to the House of Quality

Calculation

Mohsin Jute mills use BTC 100% and manufacturing process 13 X 10-203" 7ozs/36" both ratings are 5.

Carpeting Jute mills use BTC 70% BTD 30% and manufacturing process 13 X 9-150" 6.7ozs/36" both ratings are 5.

JJI Jute mills use BTC 50% BTD 50% and manufacturing process 9 x 8-163.5" 5.5ozs/36" both ratings are 5 and 4 respectively.

3.13 Develop Prioritized Customer Requirements

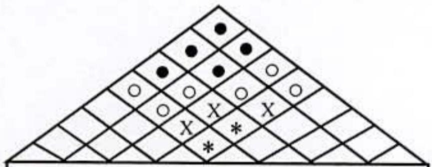
The prioritized customer requirements make up a block of columns corresponding to each customer requirement in the house of quality on the right side of the customer competitive assessment as shown in Figure 3.8 These prioritized customer requirements contain columns for importance to customer, target value, scale-up factor, sales point, and an absolute weight.

In figure 3.8 among the customer requirements suitable strength of the product is vital want to the most of the customers. Suitable strength means the tensile stress of the product should be high. So importance given by the customer on strength among the customer requirements is indicated by 9 which is very high.

In target value, the reasonable cost of Mohsen's product is indicated by 4. Which was 2 before. It means that Mohsen wants to marketing there suitable product at a reasonable price to the customer. So they want to satisfy this factor (reasonable cost) more efficiently. Weight 4 means it is stronger than weight of 2 in reasonable cost analysis.

Interrelationship between
technical descriptors
(Correlation Matrix)
Hows Vs Hows

+ 9 ● Strong positive
+ 3 ○ positive
- 3 X Negative
- 9 * Strong negative



Technical descriptors (HOWs)

Relationship between customer requirements and technical descriptors WHATs vs HOWs

+ 9 ● Strong
+ 3 ○ Medium
+ 1 Δ Weak

Primary	Secondary		Material selection: BTC 100%	BTC 70%, BTD 30%,	BTC 50%, BTD 50%,	BTD 100%,	Manufacturing Process: 9 X 8-163.5" 5.5ozs/36"	10 X 10-150" 6.0zs/36"	13 X 9-150" 6.7ozs/36"	13 X 10-203" 7ozs/36"	Moh's product	Car's product	Jji's product	Importance to customer	Target value	Scale-up factor	Sales Point	Absolute weight
Customer requirements (WHATs)	Aesthetics	Reasonable Cost	Δ	○	○	●	●	○	Δ	Δ	2	3	4	8	4	2	1.5	24
		Nice Finish	●	●	○	Δ	○	○	●	●	5	4	3	9	5	1	2	18
		Oil Content	●	●	○	Δ	○	○	Δ	Δ	3	2	2	8	4	1.3	1	10
		Brightness	●	●	○	Δ	Δ	Δ	●	●	4	3	2	7	4	1	1.5	11
	Performance	Strength	●	●	○	Δ	Δ	○	●	●	5	4	2	9	5	1	2	18
		Durable	●	●	○	Δ	Δ	○	●	●	4	3	2	8	4	1	2	16
		Light Weight	●	●	○	Δ	●	●	○	Δ	4	3	2	8	4	1	1	8
Technical competitive assessment		Moh's product	0	5	0	0	0	0	5	0								
		Car's product	0	5	0	0	0	0	5	0								
		Jji's product	0	0	5	0	4	0	0	0								

Moh's product, Car's product, Jji's product: Customer competitive assessment

Prioritized customer requirements

Figure: 3.8 Adding Prioritized Customer requirements to the House of Quality

Importance to Customer

The QFD team-or, preferably, the focus group-ranks each customer requirement's by assigning it a rating. Numbers I through 10 are listed in the importance to customer column to indicate a rating of 1 least important and 10 for very important. In other words, the more important is the customer requirements, the higher the ratings.

Calculation

The rating for

Reasonable Cost = 8

Nice finish = 9

Oil Content = 8

Brightness = 7

Strength = 9

Durable = 8

Light Weight = 8

Target value

The target-value column is on the same scale as the customer competitive assessment (1 for worst, 5 for best). This column is where the QFD team decides whether they want to keep their product unchanged, improve the product, or make the product better than the competition.

Calculation

The rating for

Reasonable Cost = 4

Nice finish = 5

Oil Content = 4

Brightness = 4

Strength = 5

Durable = 4

Light Weight = 4

Scale-up-Factor

The scale up factor is the ratio of the target value to the product rating given in the customer competitive assessment. The higher the number, the more effort is needed. Here, the important consideration is the level where the product is now and what the target rating is and deciding whether the difference is within reason. Sometimes there is not a choice because of difficulties in accomplishing the target. Consequently, the target ratings often need to be reduced to more realistic values.

Calculation

The rating for

Reasonable Cost = 4/2 = 2

Nice finish = 5/5 = 1

Oil Content = 4/3 = 1.3

Brightness = 4/4 = 1

Strength = 5/5 = 1

Durable = 4/4 = 1

Light Weight = 4/4 = 1

Sales Point

The sales point tells the QFD team how well a customer requirement will sell. The objective here is to promote the best customer requirement and any remaining customer requirements that will help in the sale of the product. The sales point is a value between 1.0 and 2.0, with 2.0 being the highest.

Calculation

The rating for

Reasonable Cost = 1.5

Nice finish = 2

Oil Content = 1

Brightness = 1.5

Strength = 2

Durable = 2

Light Weight = 1

Absolute Weight

The absolute weight is calculated by multiplying the importance to customer, scale-up factor and sales point:

Absolute Weight = (Importance to Customer) (Scale-up Factor) (Sales Point) A sample calculation is included in Figure 3.8 After summing all the absolute weights, a percent and rank for each customer requirement can be determined. The weight can then be used as a guide for the planning phase of the product development.

Calculation

Reasonable Cost = 8 * 2 * 1.5 = 24

Nice finish = 9 * 1 * 2 = 18

Oil Content = 8* 1.3 * 1 = 10

Brightness = 7 * 1 * 1.5 = 11

Strength = 9 * 1 * 2 = 18

Durable = 8 * 1 * 2 = 16

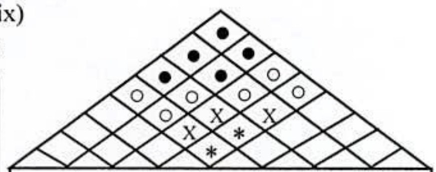
Light Weight = 8 * 1 * 1 = 8

3.14 Develop Prioritized Technical Descriptors

The prioritized technical descriptors make up a block of rows corresponding to each technical descriptor in the house of quality below the technical competitive assessment, as shown in Figure 3.9 These prioritized technical descriptors contain degree of technical difficulty, target value, and absolute and relative weights. The QFD team identifies technical descriptors that are most needed to fulfill customer requirements and need improvement.

Interrelationship between technical descriptors (Correlation Matrix) Hows Vs Hows

+ 9 ● Strong positive
+ 3 ○ positive
- 3 X Negative
- 9 * Strong negative



Technical descriptors (HOWs)

Relationship between customer requirements and technical descriptors WHATs vs HOWs

+ 9 ● Strong
+ 3 ○ Medium
+ 1 Δ Weak

Primary	Secondary	Primary / Secondary	Material selection: BTC 100%	Material selection: BTC 70%, BTD 30%,	Material selection: BTC 50%, BTD 50%,	Material selection: BTD 100%,	Manufacturing Process: 9 X 8-163.5" 5.5ozs/36"	Manufacturing Process: 10 X 10-150" 6.ozs/36"	Manufacturing Process: 13 X 9-150" 6.7ozs/36"	Manufacturing Process: 13 X 10-203" 7ozs/36"	Customer competitive assessment: **Moh's product**	Customer competitive assessment: Car's product	Customer competitive assessment: Jji's product	Importance to customer	Target value	Scale-up factor	Sales Point	Absolute weight
Customer requirements (WHATs)	Aesthetics	Reasonable Cost	Δ	○	○	●	●	○	Δ	Δ	2	3	4	8	4	2	1.5	24
		Nice finish	●	●	○	Δ	○	○	●	●	5	4	3	9	5	1	2	18
		Oil Content	●	●	○	Δ	●	○	Δ	Δ	3	2	2	8	4	1.3	1	10
		Brightness	●	●	○	Δ	Δ	Δ	●	●	4	3	2	7	4	1	1.5	11
	Performance	Strength	●	●	○	Δ	Δ	○	●	●	5	4	2	9	5	1	2	18
		Durable	●	●	○	Δ	Δ	○	●	●	4	3	2	8	4	1	2	16
		Light Weight	●	●	○	Δ	●	●	○	Δ	4	3	2	8	4	1	1	8
Technical competitive assessment		Moh's product	0	5	0	0	0	0	5	0								
		Car's product	0	5	0	0	0	0	5	0								
		Jji's product	0	0	5	0	4	0	0	0								
Degree of technical difficulty			2	5	5	9	5	6	8	9								
Target value			5	5	3	1	2	3	5	5								
Absolute weight and percent			449	**465**	171	121	219	205	**337**	321								
Relative weight and percent			753	**801**	315	297	417	341	**625**	609								

Prioritized Technical Descriptors

Prioritized customer requirements

Figure: 3.9 Adding Prioritized Technical Descriptors to the House of Quality

Degree of Technical Difficulty

Many users of the House of Quality add the degree of technical difficulty for implementing each technical descriptor, which is expressed in the first row of the prioritized technical descriptors. The degree of technical difficulty, helps to evaluate the ability to implement certain quality improvements. The degree of difficulty is determined by rating each technical descriptor from 1 (Least difficult) to 10 (very difficult)

Calculation

BTC 100% = 2

BTC 70%, BTD 30% = 5

BTC 50%, BTD 50% = 5

BTD 100% = 9

Manufacturing Process

9 X 8-163.5" 5.5ozs/36" = 5

10 X 10-150" 6ozs/36" = 6

13 X 9-150" 6.7ozs/36" = 8

13 X 10-203" 7ozs/36" = 9

Target Value

A target value for each technical descriptor is also included below the degree of technical difficulty. This is an objective measure that defines values that must be obtained to achieve the technical descriptor. How much it takes to meet or exceed the customer's expectations is answered by evaluating all the information entered into the house of quality and selecting target values.

Calculation

BTC 100% = 5

BTC 70%, BTD 30% = 5

BTC 50%, BTD 50% = 3

BTD 100% = 1

Manufacturing Process

9 X 8-163.5" 5.5ozs/36" = 2

10 X 10-150" 6ozs/36" = 3

13 X 9-150" 6.7ozs/36" = 5

13 X 10-203" 7ozs/36" = 5

Absolute Weight

The last two rows of the prioritized technical descriptors are the absolute weight and relative weight. To determining the weights is to assign numerical values to symbols in the relationship matrix. The absolute weight for the *j*th technical descriptor is

$$aj = \sum_{i=1}^{n} RijCi$$

Where aj= row vector of absolute weight for the technical descriptors

$(j = 1,\dots\dots m)$

R_{ij} = weights assigned to the relationship matrix $(i = 1\dots\dots n, j = 1\dots\dots m)$

c_j = Column vector of importance to customer for the customer requirements $(i = 1,\dots\dots n)$

m = number of technical descriptors

n = number of customer requirements

Calculation

For Material selection

Symbols are used

+ 9 ● Strong

+ 3 ○ Medium

+ 1 Δ Weak

BTC 100%

$a_1 = 1 * 8 + 9 * 9 + 9 * 8 + 9 * 7 + 9 * 9 + 9 * 8 + 9 * 8 = 449$

BTC 70%, BTD 30%

$a_2 = 3 * 8 + 9 * 9 + 9 * 8 + 9 * 7 + 9 * 9 + 9 * 8 + 9 * 8 = 465$

BTC 50%, BTD 50%

$a_3 = 3 * 8 + 3 * 9 + 9 * 8 + 3 * 7 + 3 * 9 + 3 * 8 + 3 * 8 = 171$

BTD 100%,

$a_4 = 9 * 8 + 1 * 9 + 1 * 8 + 1 * 7 + 1 * 9 + 1 * 8 + 1 * 8 = 121$

Manufacturing Process

9 X 8-163.5" 5.5ozs/36"

$a_5 = 9 * 8 + 3 * 9 + 3 * 8 + 1 * 7 + 1 * 9 + 1 * 8 + 9 * 8 = 219$

10 X 10-150" 6ozs/36"

$a_6 = 3 * 8 + 3 * 9 + 3 * 8 + 1 * 7 + 3 * 9 + 3 * 8 + 9 * 8 = 205$

13 X 9-150" 6.7ozs/36"

$a_7 = {}_1 * 8 + 9 * 9 + 1 * 8 + 9 * 7 + 9 * 9 + 9 * 8 + 3 * 8 = 337$

13 X 10-203" 7ozs/36"

$a_8 = 1 * 8 + 9 * 9 + 1 * 8 + 9 * 7 + 9 * 9 + 9 * 8 + 1 * 8 = 321$

Relative Weight

In a similar manner, the relative weight for the jth technical descriptor is then given by replacing the degree of importance for the customer requirements with the absolute weight for customer requirements. It is

$$bj = \sum_{i=1}^{n} Rijdi$$

Where b = row vector of relative weights for the technical descriptors (j = 1,......m)

di = column vector of absolute weights for the customer requirements.

(i = 1,......n)

Calculation

For Material selection

Symbols are used

+ 9 ● Strong
+ 3 ○ Medium
+ 1 Δ Weak

BTC 100%

$b_1 = 1 * 24 + 9 * 18 + 9* 10+ 9 * 11 + 9 * 18 + 9 * 16 + 9 * 8 = 753$

BTC 70%, BTD 30%

$b_2 = 3 * 24 + 9 * 18 + 9* 10 + 9 * 11 + 9 * 18 + 9 * 16 + 9 * 8 = 801$

BTC 50%, BTD 50%

$b_3 = 3 * 24 + 3 * 18 + 3 * 10 + 3 * 11 + 3 * 18 + 3 * 16 + 3 * 8 = 315$

BTD 100%,

$b_4 = 9 * 24 + 1 * 18 + 1 * 10 + 1 * 11 + 1 * 18 + 1 * 16 + 1 * 8 = 297$

Manufacturing Process

9 X 8-163.5" 5.5ozs/36"

$b_5 = 9 * 24 + 3 * 18 + 3 * 10 + 1 * 11 + 1 * 18 + 1 * 16 + 9 * 8 = 417$

10 x 10-150" 6ozs/36"

$b_6 = 3 * 24 + 3 * 18 + 3 * 10 + 1 * 11 + 3 * 18 + 3 * 16 + 9 * 8 = 341$

13 x 9-150" 6.7ozs/36"

$b_7 = 1 * 24 + 9 * 18 + 1 * 10 + 9 * 11 + 9 * 18 + 9 * 16 + 3 * 8 = 625$

13 x 0-203" 7ozs/36"

$b_8 = 1 * 24 + 9 * 18 + 1 * 10 + 9 * 11 + 9 * 18 + 9 * 16 + 1 * 8 = 609$

CHAPTER-4
RESULTS AND DISCUSSION

4.1 Results:

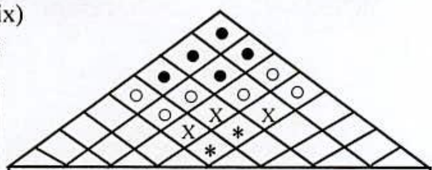
We have worked on Mohsin Jute Mill located at Khulna district, Jessore Jute Industry (JJI) located at Jessore district and Carpeting Jute Mill also located at Jessore district. The data was collected with extensive talk with the managers, supervisors, technicians and the buyers of CBC. The buyers of the CBC are assumed as the customers and hence their opinion is given the most weight age in the QFD matrix. In the jute mills raw jute is directly purchased from intermediaries at the market. The best quality of Jute gives best quality of yarns but at the same time it is costlier therefore, the manufacturer thinks for blending of different grades of Jutes to make CBC. On the other side customer wants better quality, nice finish, strong, bright, durable and light weight CBC. Therefore, we have tried to establish a relationship matrix of Customer's Voice with the Technical Descriptors to get a tradeoff. QFD planning tools actually establish a relation by developing a House of Quality. Different classes and grades with different ratios of Jute were used for manufacturing of thread for weaving CBC. Again in the weaving there are different weaving process which also has impact on quality. This lot of variables actually messes up a producer regarding his decision on material selection and manufacturing process. A house of quality matrix is therefore constructed to show which proportion of materials and what types of weaving process is the best for desired customer satisfaction.

The QFD matrix has been finally constructed and the final matrix has been shown in Figure.

It is noticeable that the greater values of absolute and relative weight indicate that the CBC should be a material selection of Bold marked BTC 70% BTD 30% and manufacturing process (weaving) is 13 X 9 - 150" 6.7ozs/36". It is matter of fact that the final result is truly different from our initial approximation that the best result will be obtained with the combination of BTC 100% and 13X10-203"7ozs/36".

Interrelationship between technical descriptors (Correlation Matrix) Hows Vs Hows

+ 9 ● Strong positive
+ 3 ○ positive
- 3 X Negative
- 9 * Strong negative



Technical descriptors (HOWs)

Relationship between customer requirements and technical descriptors WHATs vs HOWs

+ 9 ● Strong
+ 3 ○ Medium
+ 1 Δ Weak

Primary	Secondary		Material selection: BTC 100%	Material selection: BTC 70%, BTD 30%,	Material selection: BTC 50%, BTD 50%,	Material selection: BTD 100%,	Manufacturing Process: 9 X 8-163.5" 5.5ozs/36"	Manufacturing Process: 10 X 10-150" 6.ozs/36"	Manufacturing Process: 13 X 9-150" 6.7ozs/36"	Manufacturing Process: 13 X 10-203" 7ozs/36"	Customer competitive assessment: Moh's product	Customer competitive assessment: Car's product	Customer competitive assessment: Jji's product	Importance to customer	Target value	Scale-up factor	Sales Point	Absolute weight	
Customer requirements (WHATs)		Reasonable Cost	Δ	○	○	●	●	○	Δ	Δ	2	3	4	8	4	2	1.5	24	Prioritized customer requirements
	Aesthetics	Nice finish	●	●	○	Δ	○	○	●	●	5	4	3	9	5	1	2	18	
		Oil Content	●	●	○	Δ	●	○	Δ	Δ	3	2	2	8	4	1.3	1	10	
		Brightness	●	●	○	Δ	Δ	Δ	●	●	4	3	2	7	4	1	1.5	11	
	Performance	Strength	●	●	○	Δ	Δ	○	●	●	5	4	2	9	5	1	2	18	
		Durable	●	●	○	Δ	Δ	○	●	●	4	3	2	8	4	1	2	16	
		Light Weight	●	●	○	Δ	●	●	○	Δ	4	3	2	8	4	1	1	8	
Technical competitive assessment		Moh's product	0	5	0	0	0	0	5	0									
		Car's product	0	5	0	0	0	0	5	0									
		Jji's product	0	0	5	0	4	0	0	0									
Degree of technical difficulty			2	5	5	9	5	6	8	9									
Target Value			5	5	3	1	2	3	5	5									
Absolute weight and percent			449	**465**	171	121	219	205	**337**	321									
Relative weight and percent			753	**801**	315	297	417	341	**625**	609									

Prioritized Technical Descriptors

4.2 Discussion:

Total Quality Management (TQM) is a proven technique for the survival in the fierce competitive global market. TQM integrates fundamental management technique, existing improvement efforts, and technical tools under disciplined approach. The purpose of TQM is to provide a quality product and/or service to customer, which will in turn, increase productivity and lower cost. With a higher quality product and lower price, competitive position in the market place will be enhanced.

In TQM tools and technique Quality Function Deployment (QFD) is one of the most important tools for TQM application. QFD is applied to fulfill customer expectation. It is disciplined approach to product design, engineering and production and provide in depth evaluation of a product. An organization that correctly implements QFD can improve engineering knowledge, productivity and quality and reduce cost, product development time, and engineering changes. In QFD conflicting characteristics or requirements are identified early and can be resolve before production. Result of QFD are measured based on the number of design and engineering changes, time to market, cost and quality. Quality function deployment enables the design phase to concentrate on the customer requirements, thereby spending less time on redesign and modification. The saved time has been estimated at one third to one half of the time taken for the redesign and modification using traditional means.

Customer often can not explain their expectation and some times confusion and misinterpretation digress the goal of the QFD analysis. Therefore a special care has been taken in translating the language of customer voice from marketing to design to engineering to manufacturing. In WHATs list two primary customer requirements performance and aesthetics have been introduced in the QFD matrix. They were detailed by further breaking them to strength, durability, light weight and reasonable cost, nice finish, oil content and brightness. The customer needs and expectation have been expressed in terms of customer requirement, in the next step engineering characteristics or technical descriptor HOWs that will affect one or more customer requirement have been defined. Material selection and manufacturing process have been introduced as primary technical descriptor and they were further detailed by grades BTC 100%, BTC 70% & BTD 30%, BTC 50% & BTD 50%, BTD 100%, and manufacturing processes 9 X 8-163.5" 5.5ozs/36", 10 X 10-150" 6.ozs/36", 13 X 9-150" 6.7ozs/36" and 13 X 10-203" 7ozs/36". Reasonable cost and high grade jute (BTC 100%) are weakly (+1) related but strongly (+9) related with the manufacturing process of less count no of yarns per inch (9 X 8-163.5" 5.5ozs/36") in the relationship matrix. Strength is weakly (+1) related with poor grade jute (BTD 100 %,) but strongly (+9) related with the manufacturing process of higher count no of yarns per inch (13 X 10-203" 7ozs/36").

In the interrelationship matrix it was found BTC 100% and 13 X 10-203" 7ozs/36" are strongly correlated; this means these technical descriptors supports one another. A strong negative co relation exist between technical descriptor BTD 100% and 9 X 8-163.5" 5.5ozs/36". In customer competitive assessment Mohsin Jute Mill's relative position is better comparative to Carpeting Jute Mill and Jessore Jute Industry. From the Customer Importance rating it was observed reasonable cost, nice finish, durability and strength are important to customer. From Target value rating it was observed Mohsin is interested to change their position regarding reasonable cost and oil content.

- The greater value of absolute weight indicates that CBC should be made of material BTC 70%, BTD 30%, manufacturing process 13 X 9-150" 6.7ozs/36". From the interrelationship matrix it is evident that this material BTC 70%, BTD 30% and this manufacturing process 13 X 9-150" 6.7ozs/36" supports one another since there is a strong interrelationship between these two descriptors. This strong relationship is also exhibited in technical competitive assessment.

4.3 Customer Satisfaction: TQM breaks out of existing boundaries.

Is Total Quality Management (TQM) just another management buzzword for Mohsen Jute Mill destined to become a passing fad, or will it leave a lasting effect on improving business by creating greater customer satisfaction?

The answer is yes and yes. It actually depends on a company how it implements TQM and what level of commitment it makes. Simply waving the TQM banner over the latest half-hearted attempt at employee motivation will doom the attempt to failure before it begins.

Quality historically was driven by inspection. While advancing from "quality control" to "quality assurance," the primary purpose of most quality programs continued to focus on inspecting products to be that sure they met standards set by the company. Although customers demanded increasingly tighter adherence to their own specifications, most programs remained internally driven.

TQM, by contrast, starts with the customer's needs and expectations and builds the rest of the process around them. It works to eliminate the need for mass inspection by building quality into the product in the first place. In its best form, it goes beyond simply giving customers what they want and attempts to generate what the Japanese call "Kansei," which means developing innovations that delight and surprise customers. More than anything else, this takes creative thinking that pushes or breaks out of existing boundaries.

For the past decade, TQM has been gaining in popularity, but not always in effectiveness. Implementing a total quality culture requires a deeper management commitment than simply appointing a committee and making a pronouncement that "we now have TQM."

Most successful companies have found that they can't achieve success by just taking a prepackaged program

Any successful program of TQM launched by Mohsen must be driven from the start by customer satisfaction. The meaning of customer satisfaction in this context has evolved from simply meeting the minimal requirements to reaching beyond them with new products and services. This is the "delight" factor that makes a program a real winner, not only for the customer, but for the company behind it.

To be truly successful, Mohsen must also remember to treat its employees as the internal "customers" they are, by understanding their needs and responding to their expectations in the same way as with traditional external customers. Going beyond their expectations will pay off in many ways. For instance, ongoing employee training is an integral part of any successful program which can produce benefits in both improved employee relations and greater customer satisfaction.

Until recently, a shortage of evidence on the benefits of restructuring an organization around a TQM program has restricted the level of commitment that many companies were willing to make strictly on faith. A survey conducted by the U.S. General Accounting Office (GAO) documents measurable improvements in customer satisfaction at 20 Baldridge Award-winning companies, as well as gains in employee relations, operating procedures and financial performance.

Among the improvements found at these companies were an average 11.6% drop in customer complaints, a 12% reduction in order-processing time, and a 10.3% decline in defects.

A focus on meeting and beating customer expectations is common to all successful programs.Mohsen, if wants be successful with TQM must spend considerable amounts of time and resources to gather customer feedback on the quality of their products and services. It must attempt to resurrect ist performance at the moment of truth and try to identify the reasons for any shortfall. Then it redesign if operations to ensure improved customer satisfaction, whether or not the customer is watching. In this way, the needs of the customer, not the company, truly define quality. This approach generally requires new ways of gathering information on customer expectations with fresh approaches to generating customer feedback. Customers, in fact, must be allowed an open channel of communication if Mohsen is to get a reality check on how its values are affecting service.

Moreover, to develop a program that will be successful over the long term, it is also necessary to understand the interdependence between meeting the needs of internal and external customers. Instead of just setting up a token committee, companies that have been successful spend a considerable amount of time and energy ensuring that all employees are involved in TQM activities.

This is usually reflected in a training program that is a continuous process, rather than a one-time activity. What's more, management must provide the systems and processes that allow employees to apply their new knowledge and techniques once they are trained. This empowerment factor drives quality efforts down to the lowest levels of the organization, often manifesting itself in groups such as self-directed work teams (SDWTs), which are responsible for making day-to-day decisions. Most companies that are recognized for their quality leadership use some type of employee problem-solving team. Given an opportunity to put his or her improved skills and attitudes into practice like this, a well-trained and informed employee will become an even better employee who will also produce a higher quality of output. This will form the basis for a corporate culture that will then lead the way to greater customer satisfaction.

The companies in the GAO survey recognized this, with 18 of the 20 companies studied increasing their training activity as their programs developed. In one of its recent annual searches for "America's Best" manufacturing plants, Industry Week magazine found that every one of the 25 finalists emphasized cross-training, which leads to workforce flexibility and encourages a sense of "ownership" of the production process. On average, employees in these firms received 6.5 days, or 52 hours, of formal training annually.

Does it pay off? The GAO survey showed an overall increase in customer satisfaction for 12 out of 14 companies reporting in this area. Customer complaints declined in five of six reporting companies, while customer retention improved in four out of ten firms.

Customer Satisfaction

As a company moves into the realm of total quality and works to anticipate its customers' needs, flexibility must be high [18]. In 92% of the plants studied in Industry Week's search, quick-changeover methods were widely adapted to facilitate shorter production runs and smaller lot sizes. At the same time, 88% reported significant reductions in customer lead-times. All of this translates into the ability to respond more completely to the customer's requirements and provide quality of service as well as product.

A key to the future of any TQM program will be its interrelationship with other business initiatives and strategies. Many concepts are not mutually exclusive, but rather closely related. Within the framework of total quality, Mohsen must provide an environment where ideas flow freely, communication is open, individuals are given greater responsibility, and teamwork is encouraged. As a result, re-engineering, new product development, and quality improvement initiatives will achieve greater success.

Most importantly, before beginning the process and throughout its implementation, the commitment to TQM has to come from the Mohsen top Management. Unless the Mohsen's general manager fully understands and appreciates the potential impact of the company's value structure, the TQM process will have little long-term impact on customer satisfaction.

The other tools and techniques like QFD can be analyzed in Mohsen jute mill to get an initial idea. Based on these ideas a successful program can be launched for TQM application in Mohsen Jute Mill.

CHAPTER-5

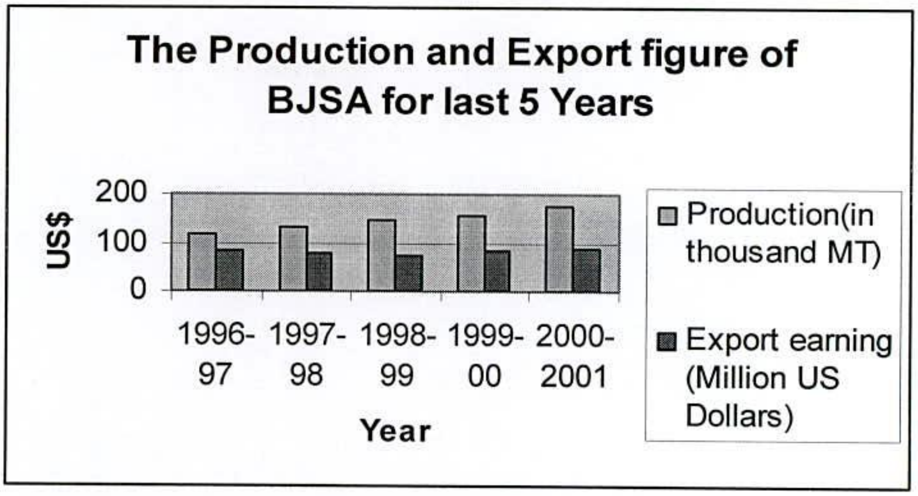
CONCLUSIONS AND RECOMMENDATIONS

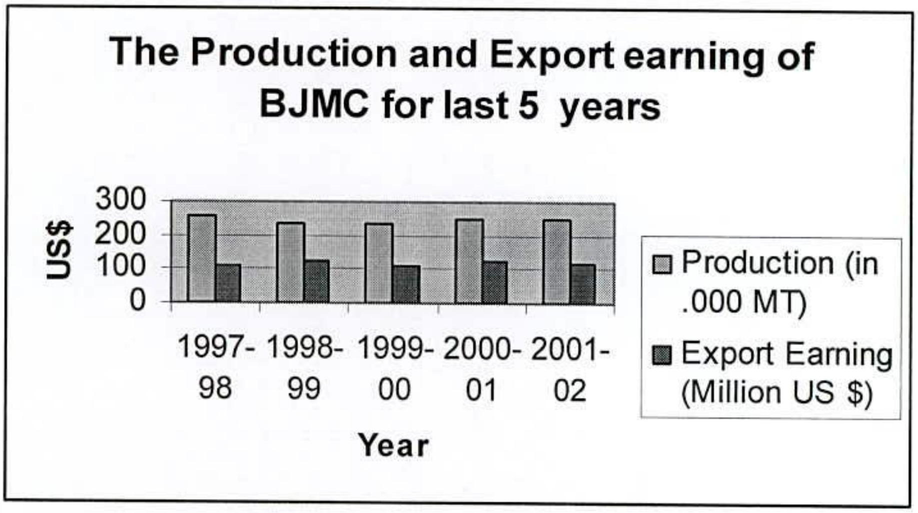
5.1 Conclusions

Jute is still a major source of foreign exchange; the government earns much revenue from jute sector. Nevertheless, jute in Bangladesh is passing a crisis time. Poor factory management, high input cost, use of low grade jute, insufficient marketing support and extension services affected the production of jute industries and the export earnings. However, jute is gaining its past golden time, regaining its popularity perhaps for the reason that jute is the most environment friendly fiber. The increasing trend of export of jute goods is very evident in Figure 5.1

In the country there are several allied institutions working on jute including BJMC, BJC, JDPC, BJRI, BJA, BJMA, BJSA etc.

Presently BJMC has an installed loom capacity of over 13,000 of which around 70-75 % remain in operation. On an average, BJMC produces about 200-250 thousand metric tons of jute goods annually of which almost 85 percent are exported fetching about Tk. 6000 million on an annual basis. The products are mainly Hessian, Sacking, CBC, Carpets, Mats, Felts, Yarn/Twine, etc. The non-traditional product range includes natural, Bleached and Colored Finer Jute Fabric (FJF) and products thereof, such as decorative fabric, household items, carry bags, fashion bags, purses and other consumer items.





The

Figure 5.1 Institutional Export of Jute Goods

The Bangladesh Jute Spinners Association (BJSA) is an all country organization representing the jute-spinning sector of Bangladesh. The Association has a total membership of 50 Jute spinning mills. The Association is found considerably dynamic, vibrant for providing relevant and useful information and other services to its members comprising the leading entrepreneurs and manufacturers of Jute Yarn & Twine. The member mills produce a wide variety of jute yarn and twine from the world's best quality raw jute, meeting the international quality and quantity requirements the world over. It's products are used for Carpet Weaving (Wilton & AX

Minister Carpet), Wall Covering, Jute Webbing. Fabrics for shopping Bags, Caps, Handicrafts, Jute cloth for various uses like Canvas, Decorative Fabrics, Laminated cloth, Safety Fuse for Explosive and many more other uses. Bangladesh Jute Research Institute BJRI has a wing carrying out agricultural research and technological research on Jute & Allied Fiber (JAF) crops. Technological research includes process development for the production of blankets from jute-acrylic blend, home-furnishing fabrics, jute products, chemical processes development for the production of cellulose derivatives such as Microcrystal cellulose (MCC), Carboxymethyl cellulose (CMC), oxalic acid, cellulose acetates, cellulose nitrates and activated charcoal from jute and jute wastes. From above discussion it is very evident that there are several organizations working on jute or jute goods but no body is found to working on development of product quality management. BJRI is actively involved for agricultural research and chemical process development research. BJRI can take initiative for research in the field of statistical quality control or development of production process. Quality function deployment is an important tool for managing total quality in the organization. The commercialization or marketing of research outcome of BJRI can be diffused by BJMC and BJSA to their respective member industries. The government of People's Republic of Bangladesh has declared jute sector as the thrust sector for our economy. Now the concerted effort can be made by the GOB, different jute institutions and academic professional of the engineering universities so that the jute can get its momentum "the re-birth".

The Thesis work actually finds the current status of CBC manufacturing in the country. The author's feeling is simultaneously exhilarating and shocking. The author finds there is huge potential of exporting CBC to foreign countries by developing the quality of CBC through QFD or TQM application in the industry. QFD analysis helps one to get a effective solution of mess-up problems regarding quality decision.

Future TQM will find more importance in how to align company-wide activities to customer focus. It is this author's belief that Voice of Customer should be common bedrock for creating a partnership of such activities. For companies to attain customer satisfaction, it is important that all employees acquire customer focused thinking through the value chain created by the awareness that "the next process is your customer." It is with QFD that companies will be able to accomplish this future challenge. QFD will serve as a tool for creating this alignment, where true partnership can sprout [16 & 17].

5.2 Recommendation for Future Work

1. In the current QFD analysis the weaving process is assumed same "the Hand looms". Hand looms are used for weaving CBC. Some other automated machined are currently coming to the market for weaving CBC. Though in this region those are not found. However extensive search may explore different CBC weaving machines. This machines might act How's in the QFD matrix for future work.

2. Higher absolute and relative rating identifies areas where engineering efforts need to concentrated. These weights show the impact of the technical characteristics on the customer requirement. The future work can be done to organize them into a Pareto diagram to show which characteristics are important in meeting customer requirement.

3. The QFD matrix can further be decomposed. It is still necessary to refine the technical descriptors further until an actionable level of detail is achieved. The process in accomplished by creating a new chart in which the HOWs (technical descriptors) of the previous chart became the WHATs (customer requirements) of the new chart, as shown in Figure 5-1. This process continues until each objective is refined to an actionable level.

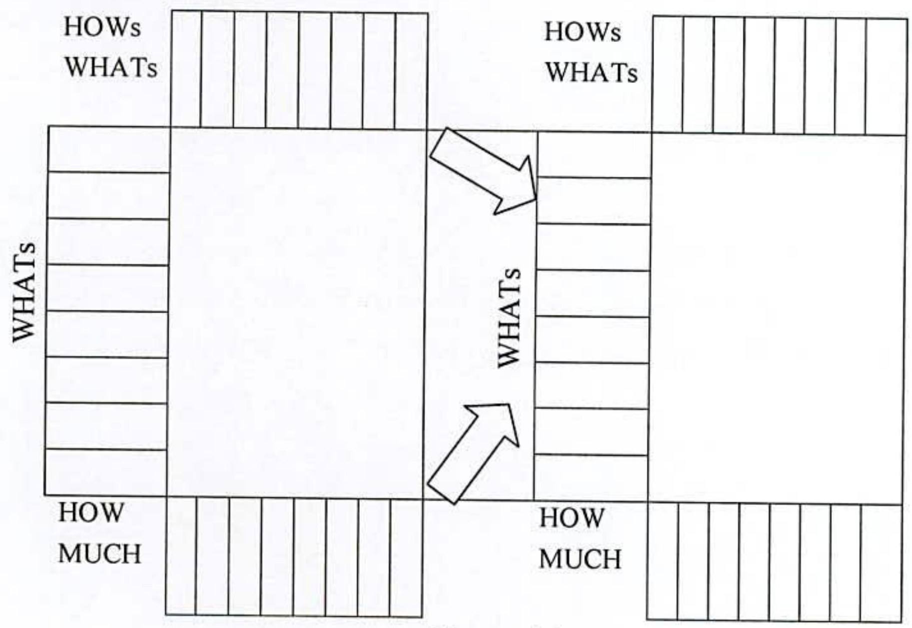


Figure: 5.1

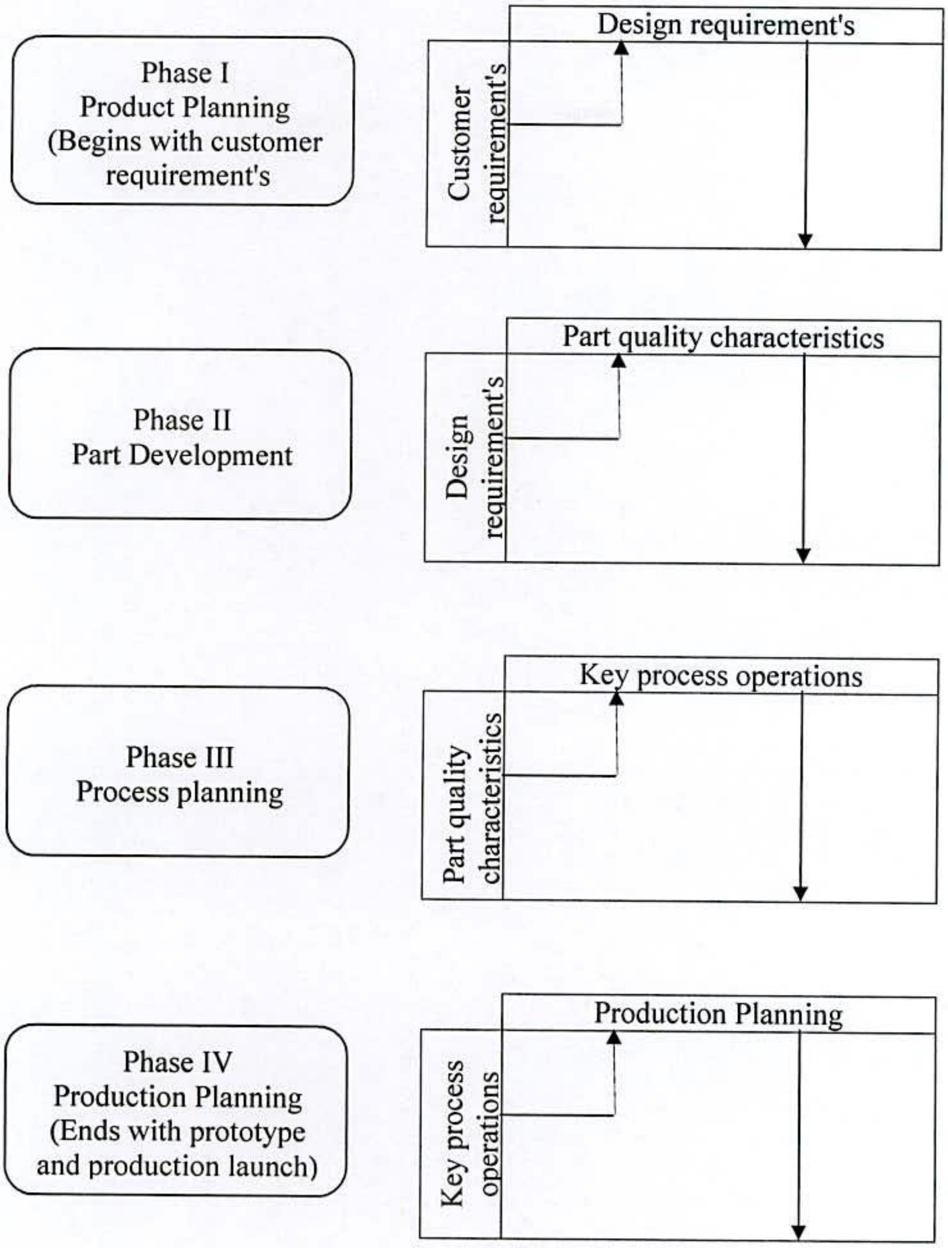


Figure: 5.2 House of Quality planning

4. New product development will also require price design along with quality design. Therefore it can be price design and deployment method need to be developed in addition to quality design. It can be a good research work.

References

1. Dale H. Besterfield "Total Quality Management" Pearson Education.
2. Douglas C. Montgomery "Introduction to Statistical Quality Control. John Wiley & Sons Inc. New York.
3. Joel E Ross "Total Quality Management" Venetia Books International, New Delhi.
4. L. Suganthi "Total Quality Management" Eastern Economy Edition.
5. Martand Telsang "Industrial Engineering and Production Management" S. Chand & Company Ltd.
6. Cristiano, John J.; Liker, Jeffrey K.; White, Chelsea C. "Customer-driven product development through quality function deployment in the u.s. and japan" Journal of product Innovation Management,Volume 17, Number 4, July 2000 , pp. 286-308(23)
7. **Xiping Zhang, Jiirgen Bode and Shouju Ren** "Neural networks in quality function deployment" Computers & Industrial Engineering Volume 31, Issues 3-4, December 1996, Pages 669-673 18th International Conference on Computers and Industrial Engineering
8. **Jeong Miyoung and Oh Haemoon** "Quality function deployment: An extended framework for service quality and customer satisfaction in the hospitality industry" International Journal of Hospitality Management Volume 17, Issue 4, December 1998, Pages 375-390.
9. **A. I. A. Costa, M. Dekker and W. M. F. Jongen** "Quality function deployment in the food industry: a review" Trends in Food Science & Technology Volume 11, Issues 9-10, 10 September 2000, Pages 306-314
10. **I Erikkson and F McFadden** "Quality function deployment: a tool to improve software quality" Information and Software Technology Volume 35, Issue 9, September 1993, Pages 491-498

11. **Shih-Wen Hsiao** "Concurrent design method for developing a new product" International Journal of Industrial Ergonomics Volume 29, Issue 1, January 2002, Pages 41-55

12. **Jürgen Bode and Richard Y. K. Fung** "Cost engineering with quality function deployment Computers & Industrial Engineering" Volume 35, Issues 3-4, December 1998, Pages 587-590

13. **Jacques Marsot** "QFD: a methodological tool for integration of ergonomics at the design stage" Applied Ergonomics Volume 36, Issue 2, March 2005, Pages 185-192

14. Andreas Herrmann, Frank Huber, René Algesheime, Torsten Tomczak. (2006) An empirical study of quality function deployment on company performance. *International Journal of Quality & Reliability Management* **23**:4, 345

15. Traci May-Plumlee, Trevor J. Little. (2006) Proactive product development integrating consumer requirements. *International Journal of Clothing Science and Technology* **18**:1, 53

16. *Abbie Griffin* "Evaluating QFD's Use in US Firms as a Process for Developing Products" Journal of Product Innovation Management Volume 9 Issue 3 Page 171-187, September 1992

17. Akao Yoji. 1995. "Voice of Customer - Basis for Partnerships – As a Viewpoint from QFD. 3rd Quality Summit. 2-4 November. Bangalore.

18. Sadar uddin Ahmed & Kazi Azizul Huq "Jute in Industry"

19. Marketing Management by philip Kotler Kevin Lane Keller Eastern Economy Edition.

20. P.L Jain" Quality Control & Total Quality Management".

21. R.K Mital " Total Quality Management".

22. Joseph Berk "Total Quality Management" Newness.

23. Pannerselvam" Production & Operation Management" Eastern Economy Edition.

24. Mark D. Hanna & W. Rocky " Integrated Operations Management". Eastern Economy Edition.