



ADDIS ABABA UNIVERSITY
FACULTY OF TECHNOLOGY
SCHOOL OF GRADUATE STUDIES
DEPARTMENT OF MECHANICAL ENGINEERING

***MODEL DEVELOPMENT OF QUALITY MANAGEMENT
SYSTEM FOR ETHIOPIAN TEXTILE INDUSTRIES***

A CASE STUDY AT BAHIRDAR AND AKAKI TEXTILE SHARE COMPANIES

*A THESIS SUBMITTED TO SCHOOL OF GRADUATE STUDIES OF
ADDIS ABABA UNIVERSITY IN PARTIAL FULFILLMENT FOR
DEGREE OF MASTERS OF SCIENCE IN INDUSTRIAL ENGINEERING
(MECHANICAL ENGINEERING)*

BY
AMARE MATEBU

ADVISOR
Dr.Ing. DANIEL KITAW

JUNE, 2006

ACKNOWLEDGEMENT

First of all, I would like to thank God our father, for what he has done to me. Thank be to Holly Virgin Mary, and His saints too, for helping me during those hard times.

I am very grateful to Dr.Ing Daniel Kitaw, who is the Associate Professor of Mechanical Engineering for exposing me to such kind of explorative and investigative thesis work. His encouragement, excellent guidance, creative suggestions and critical comments have greatly contributed to the thesis work. By letting me work on such a topic of my choice, he enabled me to broaden my thought through reading lots of available materials. I believe that what I have learnt during the last two-year M.Sc study period will have an infinite profit for the rest of my life. Again, I would like to express my deepest thanks to Dr.-Ing Daniel Kitaw.

During my study, special cooperation and continual support has given by Ato H/Mariam H/Melekot vice head of training center in Akaki textile share company, Ato Weldegebreal Birhane head of training center in Bahirdar textile share company, w/ro Emun Abdu head of quality control department in Akaki textile share company, Ato Abay Getachew head of quality control department in Bahirdar textile share company. Thus, I need to express my appreciation to all of them and also many thanks to them.

I would like to thank all who responded to my questionnaires and interviews, which helped me in a great deal in my study. Thanks also to the Quality and Standards Authority of Ethiopia (QSAE), especially to the staff of Quality promotion and training Directorate particularly to Ato Tadele Kumie and Ato Eshetu Jifar for their excellent co-operation and support.

Finally, I thank my father Matebu Kassa, my sister Selam Matebu, My wife Mulluken Shiferaw, and my son Fikrewold Amare for their encouragement, continual support and love during my study.

TABLE OF CONTENT

TABLE OF CONTENT	ii
LIST OF FIGURES.....	v
LIST OF TABLES	vi
CHAPTER 1 INTRODUCTION.....	1
1.1 BACKGROUND	1
1.1.1 Objectives.....	2
1.1.2 Significance of the study	3
1.1.3 Scope and limitations	3
1.2 STRUCTURE AND CONTENT OF THESIS	4
1.3 RESEARCH METHODOLOGY.....	5
CHAPTER 2 QUALITY AND QUALITY MANAGEMENT IN TEXTILE	
INDUSTRY.....	7
2.1 QUALITY.....	7
2.2 TEXTILE QUALITY CHARACTERISTICS.....	9
2.2.1 Fiber quality characteristics.....	9
2.2.2 Yarn quality characteristics	12
2.2.3 Fabric quality characteristics	13
2.3 QUALITY CONTROL IN TEXTILE INDUSTRY	15
2.3.1 Textile testing	15
2.3.2 Inspection in textile industries	17
2.4 QUALITY AND PROCESS IMPROVEMENT	18
2.4.1 Barriers of quality and process improvement.....	20
2.5 ISO 9000 QUALITY MANAGEMENT SYSTEM.....	21
2.5.1 Background of ISO 9000 quality standards.....	21
2.5.2 Definition and principles of quality management.....	22
2.5.3 Structure and content of ISO 9001:2000	25
2.5.4 Development of quality management.....	26
2.5.5 Design of quality management system.....	27
2.5.6 Implementing steps of ISO 9000 Quality Management System	29

2.6 DEVELOPMENT OF TEXTILE QUALITY STANDARDS	32
2.6.1 <i>Quality management system in Ethiopia</i>	33
2.6.2 <i>Quality management system in Ethiopian Textile Industries</i>	36
CHAPTER 3 PROBLEM IDENTIFICATION.....	37
CHAPTER 4 DATA COLLECTION AND ANALYSIS.....	42
4.1 DATA COLLECTION	42
4.1.1 <i>Survey questionnaire</i>	42
4.1.2 <i>Structured interviews</i>	45
4.1.3 <i>Direct observation</i>	45
4.2 DATA ANALYSIS AND INTERPRETATION.....	46
4.2.1 <i>Survey findings</i>	46
4.2.2 <i>Observations and conclusions</i>	50
CHAPTER 5 PROPOSED QUALITY MANAGEMENT SYSTEM FOR ETHIOPIAN TEXTILE INDUSTRIES.....	51
5.1 INTRODUCTION	51
5.2 HISTORICAL DEVELOPMENT OF TEXTILE QUALITY IN ETHIOPIA	52
5.3 GENERAL BACKGROUND OF ETHIOPIAN TEXTILE INDUSTRIES	53
5.4 QMS-IMPLEMENTATION GUIDELINES FOR ETHIOPIAN TEXTILE INDUSTRIES.....	56
5.4.1 <i>Management responsibilities</i>	56
5.4.2 <i>Resource management</i>	58
5.4.3 <i>Textile product and process design</i>	62
5.4.4 <i>Textile quality control</i>	70
5.4.5 <i>Textile quality improvement</i>	72
5.4.6 <i>Quality assurance in textile industries</i>	74
5.4.7 <i>Quality auditing and reviews</i>	74
5.4.8 <i>Quality system documentation</i>	75
5.4.9 <i>Cost of Quality</i>	76

CHAPTER 6 QMS –IMPLEMENTATION CASE STUDIES.....	85
6.1 QMS-IMPLEMENTATION MODEL FOR BDTSC	85
6.1.1 Profile of Bahirdar textile Share Company	85
6.1.2 QMS - Assessment at Bahirdar textile share company.	97
6.1.3 Proposed QMS- implementation model at BDTSC.....	108
6.1.4 Recommendation.....	119
6.2 QMS-IMPLEMENTATION MODEL FOR ATSC	120
6.2.1 Profile of Akaki textile share company	120
6.2.2 QMS -Assessment at Akaki textile share company	127
6.2.3 Proposed QMS- implementation model at ATSC.....	132
6.2.4 Recommendation.....	140
CHAPTER 7 CONCLUSIONS AND RECOMMENDATIONS	141
7.1 CONCLUSIONS.....	141
7.2 RECOMMENDATIONS.....	142
REFERENCES.....	144
<i>APPENDIX-I QUESTIONNAIRE FOR SURVEY.....</i>	<i>146</i>
<i>APPENDIX-II EMPLOYEES SURVEY RESPONSE TO QUESTIONNAIRES</i>	<i>152</i>

TABLE OF FIGURES

Figure 1.1	Structure of the thesis	5
Figure 2.1	Meaning of quality	8
Figure 2.2	Quality characteristics of cotton fiber	11
Figure 2.3	Quality characteristics of yarn.....	13
Figure 2.4	Quality characteristics of fabric.....	14
Figure 2.5	Flowchart of quality improvement	19
Figure 2.6	The supply chain	26
Figure 2.7	Progress in quality management concept	27
Figure 2.8	Quality management process model	28
Figure 2.9	ISO 9000 Certified Textile Industries by Country and Year.....	35
Figure 4.1	Causes of poor quality in textile industries	48
Figure 5.1	Supply chain in textile industries	60
Figure 5.2	Three main categories of textile industries.....	63
Figure 5.3	Main Processes and intermediate products in spinning plant.....	66
Figure 5.4	Weaving Process	68
Figure 5.5	Fabric Finishing Process	69
Figure 5.6	QMS- Model for Ethiopian Textile Industries	81
Figure 5.7	QMS-Implementation Model for Ethiopian Textile Industries	84
Figure 6.1	Organizational structure of Bahirdar textile share company	86
Figure 6.2	Planned and actual productivity at BDTSC for fiscal year 1997 E.C.....	88
Figure 6.3	Planned and actual sales at BDTSC in fiscal year 1997 E.C.....	88
Figure 6.4	Down time in spinning and weaving plant at BDTSC for fiscal year 1997 E.C	90
Figure 6.5	Yarn manufacturing process at Bahirdar textile share company	92
Figure 6.6	Fabric manufacturing process at Bahirdar textile share company.....	94
Figure 6.7	Fabric finishing process at Bahirdar textile share company	96
Figure 6.8	Causes of poor quality products at BDTSC	102
Figure 6.9	Supplier- customer relationships at Bahirdar textile share company.....	104
Figure 6.10	Percentages of quality cost elements	115
Figure 6.11	QMS for Bahirdar textile share company	116
Figure 6.12	QMS-Implementation Model for Bahirdar textile share company	118
Figure 6.14	Yarn manufacturing process at ATSC.....	123
Figure 6.15	Fabric manufacturing process at ATSC.....	125
Figure 6.16	Cotton fabric finishing process at ATSC.....	126
Figure 6.17	Causes of poor quality products in ATSC.....	130
Figure 6.18	Quality management system for Akaki textile share company	138
Figure 6.19	QMS-Implementation model for ATSC	139

LIST OF TABLES

Table 4.1 Respondents rate of four textile industries.....	45
Table 4.2 Consolidated responses on decision making at four textile industries	47
Table 4.3 Causes of poor quality products in textile industries	48
Table 5.1 Major produced items	55
Table 5.2 Volume of production of textile products during periods of 1996/97 to 2000/01	55
Table 5.3 Prevention quality cost elements for Ethiopian textile industries.....	77
Table 5.4 Appraisal quality cost elements for Ethiopian textile industries.....	78
Table 5.5 Internal failure quality cost elements for Ethiopian textile industries	79
Table 5.6 External failure quality cost elements for Ethiopian textile industries	80
Table 6.1 Comparing of production rate at BDTSC for the years 1996 and 1997 E.C.....	87
Table 6.2 Total cost of production at BDTSC in 1997 E.C	89
Table 6.3 Total idle time and loss of production at BDTSC in fiscal year 2004/05	90
Table 6.4 Customers of BDTSC for years 1994 -1997 E.C.....	100
Table 6.5 Responsibility for quality at BDTSC.....	101
Table 6.6 Obstacles for quality improvement at BDTSC	101
Table 6.7 Causes of poor quality products at BDTSC	102
Table 6.8 Amount of waste at BDTSC in year 1997 E.C	107
Table 6.9 Total estimated cost of quality for fiscal year 2004/05 at BDTSC.....	114
Table 6.10 Estimated total cost of quality for QMS-implementation at BDTSC	115
Table 6.11 Designed and Actual capacity of production at ATSC	120
Table 6.12 Results of Respondents on decision making at ATSC.....	128
Table 6.13 Obstacles for quality improvement at ATSC.....	129
Table 6.14 Causes of poor quality products at ATSC.....	130

ABSTRACT

Today competition is truly global. Higher product quality is required for a company to become more competitive both local and in international market, and quality is the ultimate weapon. Any company basically competes on its reputation - for quality, reliability, price and delivery. And most people now recognize that quality is the most important of these competitive weapons. With the increasing global pressure of quality requirements, the traditional concept of quality control must be expanded to the concept of quality management. Quality management relies on people and involves everyone. Quality management is both a philosophy and a set of guiding principles that represent the foundation of a continuously improving organization, all the processes within the organization, and the degree to which present and future needs of the customer are met.

Currently, almost all textile industries in Ethiopia are suffering from quality related problems. These problems include: poor performance of products in the export market, low quality and insufficient raw material supply, incompetence in the world market, customer dissatisfaction, low productivity, and poor utilization of the resources. Because of these problems, most of the textile companies in the country are not profitable and most are in a huge loss. This research work mainly focused on how this loss and low market share in textile companies could be removed with the help of quality management system (QMS).

The objective of the thesis is to identify the major components of QMS for textile industries and to propose the appropriate implementation model of quality management system. Based on the survey of four textile industries and two case studies (Bahirdar and Akaki textile share companies), nine major components have been identified for QMS-implementation in Ethiopian textile industries.

QMS provides consistency and satisfaction in terms of methods, materials, equipment, and interacts with all activities of the companies, beginning with the identification of customer requirements and ending with their satisfaction, at every transaction interface. A strong organizational culture with determined management and controlled feedback mechanism would ensure the effective implementation of the quality management system in textile industries.

CHAPTER 1 INTRODUCTION

On top of providing some background information on the features of textile, this chapter presents description of the objectives, significance, scope and limitation of the study. The structure of the study and the methodologies utilized are also dealt with briefly.

1.1 BACKGROUND

Textile is any kind of woven, knitted, knotted or tufted cloth, or a non-woven fabric. Non-woven fabric is a fabric which is made of fibers / yarn that have been bonded into a sheet like structure by means of mechanical actions or chemical bonding.

Textile also refers to the yarns, threads and wools that can be spun, woven, tufted, tied and otherwise used to manufacture cloth. The production of textiles is an ancient art, whose speed and scale of production has been increased almost beyond recognition by mass-production with the introduction of modern manufacturing techniques.

The textile industry comprises of establishments that produce yarn, thread, and fabric and a wide variety of other textile products for use by individuals and businesses, but not including apparel or garment. Some of the items made in this industry include household items, such as carpets and rugs; towels, curtains, and sheets; cord and twine; furniture and automotive upholstery.

Textile mills take natural and synthetic fibers, such as cotton and polyester and transform them into yarn, thread, or webbing. Yarns are strands of fibers in a form ready for weaving, knitting, or otherwise intertwining to form a textile fabric. They form the basis for most textile production and commonly are made of cotton, wool, or a synthetic fiber such as polyester. Yarns also can be made of thin strips of plastic, paper, or metal. To produce spun yarn, natural fibers such as cotton and wool must first be processed to remove impurities and give products the desired texture and durability, as well as other characteristics. After this initial cleaning stage, the fibers are spun into yarn.

Fabrics are mostly produced by means of weaving, knitting, or tufting. Workers in weaving mills use complex, automated looms to transform yarns into cloth, a process that has been known for

centuries. Looms weave or interlace two yarns, so they cross each other at right angles to form fabric. Knitting uses automated knitting machines to interlock a series of loops of one or more yarns to form goods, such as sweaters, socks, and underwear. Tufting, used by carpeting and rug mills, is a process by which a cluster of soft yarns is drawn through a backing fabric.

At any time during the production process, a number of processes, called finishing, may be performed on the fabric. These processes, which include dyeing, bleaching, and stonewashing, among others, may be performed by the textile mill or at a separate finishing mill. Finishing encompasses chemical or mechanical treatments performed on fiber, yarn, or fabric to improve appearance, texture, or performance.

Most of the textile industries in Ethiopia produce yarns and fabrics from 100 % cotton fiber for domestic consumption. Some of them such as Almeda textile share company; Awassa textile Share Company produces yarns and fabrics by blending the cotton fiber with polyester fiber for different end use.

1.1.1 Objectives

General objectives of the thesis

- ❖ To identify the major components of quality management system (QMS) for textile industries.
- ❖ To propose the appropriate implementation model of quality management system for textile industries in Ethiopia
- ❖ To provide guidance to the management of textile industries on the application and use of quality management system to improve its overall performance.

Specific objectives of the thesis

- To assess the quality related problems in textile companies and suggest the appropriate solution.
- To suggest a better organization's quality objectives and quality policies that considers customer requirements.
- To assess different internationally accepted quality standards, textile quality standards, quality management activities, which is important to textile industries.

- To create awareness about quality concepts and its importance in textile industries.
- To show the importance of quality management system for the textile industries in Ethiopia.
- To formulate the quality management system (QMS) for the case studies based on the predefined standards, strategies and data obtained from the same.

1.1.2 Significance of the study

As this study is devoted to investigating the solutions to the quality related problems in textile industries and proposing the appropriate model for implementing the quality management system, therefore, the primary merits of the study goes to the Ethiopian textile industries. Currently, more than five textile industries are on the way to implement quality management system. Hence, this study has been done on the appropriate time that could be of great importance to them to get the basic concepts and applicability of quality management system. The researcher believes that Ethiopian textile companies will be motivated to implement results of the study on quality management system.

Government bodies such as Ministry of Trade and Industry, Quality and Standard Authority of Ethiopia and other interested sectors could draw important concepts out of the study.

Proper implementation of the quality management system concept and policies helps to avoid poor quality of the textile products, be competent in the local and international markets, enhance customer satisfaction, increase the productivity of the companies, and avoid poor utilization of resources.

1.1.3 Scope and limitation

The scope of this thesis work is to focus on textile industries for modeling and implementing quality management system so that overall activities of the companies (including technical, administrative, and human factors affecting the quality of the products or services) are under control. Further more, the experience of the researcher in teaching of textile engineering provides a better understanding of the technological and manufacturing processes of textile products. This has a positive impact on this thesis work. Therefore, in the study, in addition to the main task,

some important factors in the process control, testing, and inspection of textile raw materials and products are considered.

The proposed quality management system will only serve as a starting point for those who try to implement it. Thus it requires regular updating based upon the current situation on the ground. Minor adjustments must be made to accommodate the type, size and technology employed in the industry being under consideration.

1.2 STRUCTURE AND CONTENT OF THESIS

The thesis is organized in seven chapters. Chapter one begins with an introduction and background of the research. Chapter two is a literature review that discusses the fundamental concepts of quality and quality management. This chapter gives theoretical background for the thesis work. It also includes ISO 9000 quality management system, quality and process improvement and historical background of textile standards.

Problem identification is the third chapter in which major quality related problems of textile industries are identified. Chapter four is about the data collection and its analysis. The data collected from six textile industries is analyzed which would be used in proposing of the implementation model of QMS for Ethiopian textile industries.

In fifth chapter, an attempt is made to identify and discuss the major components of quality management system and proposed QMS-implementation model for Ethiopian textile industries based on the data analysis and assessment on six different textile industries. Those components are: management responsibilities, resource management, textile product and process design, textile quality control, quality improvement, quality assurance, quality auditing and review, quality system documentation, and cost of quality.

The practical aspect of quality management system implementation is discussed taking into account the case studies in chapter six. The existing situations of these companies are assessed and based on this result an implementation model of QMS has been proposed. Finally, in the last chapter, the conclusions and recommendations have been presented.

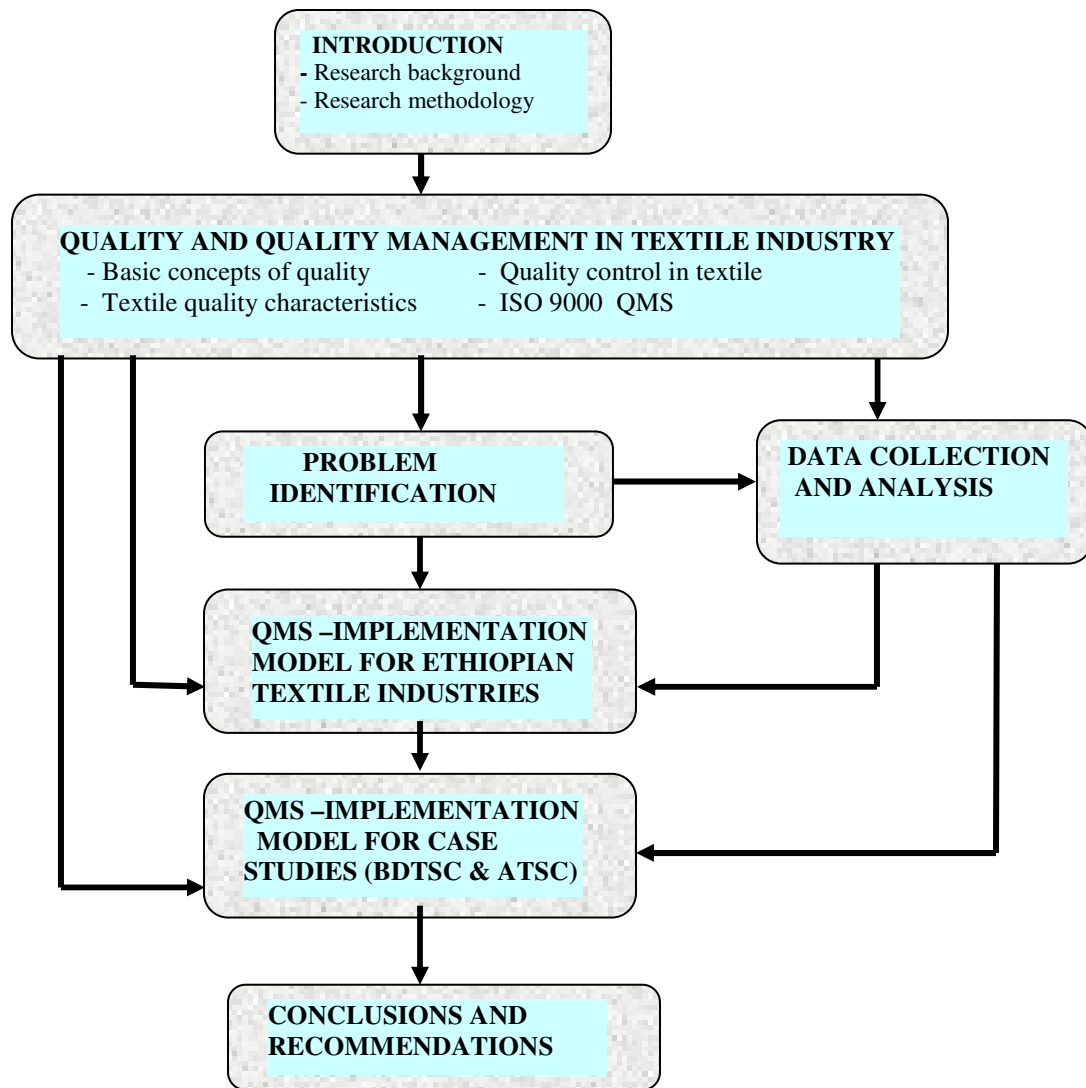


Figure 1.1 Structure of the thesis

1.3 RESEARCH METHODOLOGY

For conducting an empirical research work, there are two methods of data collection: Qualitative and quantitative. Those two methods have their strengths and weakness. The qualitative method permits researchers to study selected issues in depth and detail. On the other hand, the quantitative method requires the use of standardized instruments so that varying perspectives and experience of people can fit a limited number of predetermined response categories, to which numbers are assigned.

Different research methodologies have been employed for the preparation of this thesis work. The researcher has used four general methods of collecting data from six textile industries: Survey questionnaires, structured interview questions, direct observation and assessment, and secondary sources such as published documents, annual reports, of the textile companies under review.

The survey questionnaires have been prepared to investigate the overall view and attitude of textile companies towards the concept of quality management system and its implementation. The sources of information for the preparation of the survey questionnaire are thesis works of the former postgraduates of industrial engineering, QMS gap analysis questionnaire, which is prepared by Quality and Standard Authority of Ethiopia (QSAE), and other books.

The interview questions have been prepared on the basis of the objectives of the study itself. Some of these questions are similar to the questions of the survey questionnaire. And this has been used for crosschecking purposes. Selecting the appropriate persons such as general manager, production and technical manager, quality control head, planning and programming head has carried out the interview.

Direct observation has also done by the researcher for collecting data and observing the manufacturing process of textile products in textile companies. Documents of each textile company such as profile of each company, annual reports, and other publications have been used as an alternative source of data in the study.

CHAPTER 2 QUALITY AND QUALITY MANAGEMENT IN TEXTILE

INDUSTRY

This chapter is a literature review that covers quality and quality management in textile. The definitions of quality and textile quality characteristics have been discussed briefly. Important textile quality characteristics are identified. An overview of quality control in textile industries has also covered. Moreover, the general overview of ISO 9000 quality management system, its general principles and implementing steps are included.

2.1 QUALITY

Quality connotes different meaning to different people. Its concepts may be easy to grasp but formulating a universal definition is difficult. Several quality masters have defined quality in different ways considering different attributes of a product [14].

Badiru (1990) points out that “good quality is every body's responsibility while bad quality is every body's fault ”. What is quality? Several definitions have been offered for quality in recent years. Quality refers to the combination of characteristics of a product, process, or service that determines the product's ability to satisfy specific needs [1]. Some definitions are given below.

- ❖ Quality is fitness for purpose or use. Or quality is customer satisfaction. (Juran).
- ❖ Quality is conformance to requirements. (Crosby).
- ❖ Quality is the total composite product and service characteristics of marketing, Engineering, manufacture, and maintenance through which the product and service in use will meet the expectation by the customer. (Feigenbaum).
- ❖ Quality should be aimed at the needs of the customer, present and future. (Deming).

Different writers give different interpretations to the term quality. For Engineers it is conformance to specifications, from manufacturing point of view it is fitness for use, for marketing personnel it is the degree of excellence at an acceptable price that will influence the market share. For customer service personnel, a quality product is that with fewer customers compliant and that which will not raise warranty issue, that which is free of defects in material and workmanship.

Of the many meanings of the word “quality,” two are of critical importance to managing for quality (J.M. Juran):

1. "Quality" means those features of products, which meet customer needs and thereby provide customer satisfaction. In this sense, the meaning of quality is oriented to income. The purpose of such higher quality is to provide greater customer satisfaction and, one hope, to increase income. Higher quality in this sense usually "costs more". In this case, higher quality enables the companies to: increase customer satisfaction, make products salable, meet competition, increase market share, and provide sales income.
2. "Quality" freedom from deficiencies - freedom from errors that requires doing work over again (rework) or that result in field failures, customer dissatisfaction, customer claims and so on. In this sense, the meaning of quality is oriented to costs, and higher quality usually "costs less".

The meaning of quality could also be expressed by considering consumer's and producer's perspectives. They are dependant on each other. Consumer's perspective is 'PRICE' and Producer's perspective is 'COST'. Finally consumer's view must dominate.

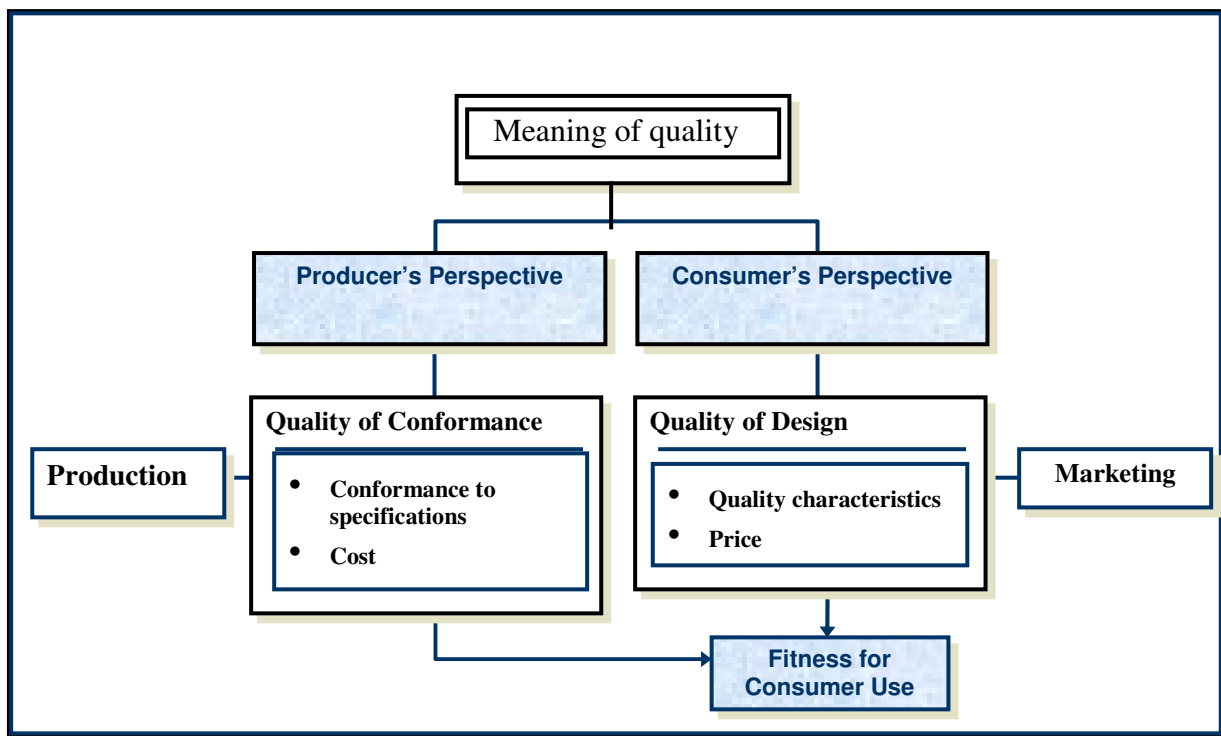


Figure 2.1 Meaning of quality

The quality of a textile product can be evaluated based on some dimensions of quality such as performance, reliability, durability, and aesthetics. The customer may focus on the ability of textile product (such as yarn and fabric) to fit the intended purpose provided that it is supplied at the right time and price. On the other hand, it may focus on the durability of these products. Most textile industries in Ethiopia, define quality as “conformance to specification”. In effect, they assumed that products that conformed to specifications also would meet customer needs. This assumption may be logical, if they seldom had direct contact with customers. However, the assumption can be seriously in error. Customer needs include many things not found in product specifications. Evaluation of quality is based on mainly on the responsiveness to customer satisfaction. The degree of satisfaction depends on the manufacturer's ability to meet customers' needs and keep constantly in contact.

2.2 TEXTILE QUALITY CHARACTERISTICS

Quality characteristics of textile products include the quality characteristics of fibers, yarn and fabric. This is any distinguishing feature of a grade or a textile product i.e. ***appearance, dimension, performance, length of life, strength, thickness, reliability, durability, attractiveness, etc.*** Hence, every textile product possesses a number of elements that jointly describe what the user or consumer thinks of as quality. The category of the above is as follows.

1. Physical characteristics- *length, weight, volume, thickness, air permeability, etc.*
2. Mechanical characteristics- *Strength (tensile, tearing, Bursting), extensibility, stiffness, etc.*
3. Time orientation- *Reliability, durability, and serviceability.*
4. Chemical characteristics - *color fastness, water absorbency, etc.*
5. Geometrical characteristics - *structure of fibers, yarn and fabric.*

2.2.1 Fiber quality characteristics

Fiber is a class of materials that are continuous filaments or are in discrete elongated pieces which is used to make yarns. They can be spun into filaments, thread, string or rope. Cotton fiber is one of the most widely used fibers in textile industries. Cotton fiber is a soft fiber that grows around the seeds of the cotton plant . The fiber is most often spun into thread and used to make a soft, breathable textile. Cotton is a valuable crop because only about 10% of the raw weight is

lost in processing. Once traces of wax, protein, etc are removed, the remainder is a natural polymer of pure cellulose. The characteristics of cotton fibers vary based on varieties of cotton, growth areas, and climatic conditions from year to year. Some quality characteristics are discussed below [11].

- *Cotton color*: The color of cotton fiber is a physical characteristic and could be white, grey, and reddish. Cotton colorimeter is used to determine the color of cotton fiber. It is also possible to determine its color by visual observation.
- *Cotton staple length*: It is a physical characteristic. Among all the tests that are made to evaluate the physical characteristics of cotton, probably none are more frequently used and in most cases more important than the length. Staple length is associated with not only spinning performance but also yarn properties and characteristics. Some factors that are influenced by length are spinning limit (how fine a yarn may be spun), yarn appearance, evenness, and strength. The accurate determination of staple length is important not only from a financial point of view, but also from the standpoint of processing and quality.
- *Cotton fiber Maturity*: Maturity indicates ripeness or full development; where as immaturity indicates lack of full development. Maturity of cotton fiber could influence the quality of the next product (cotton yarn). Immature cotton fiber has low strength.
- *Cotton fiber fineness*: Fiber fineness and maturity seem to be associated closely not only from the physical characteristics themselves, but from some of the testing methods developed for their evaluation. Fiber fineness is the weight fineness of cotton fibers and is usually expressed in units of micrograms per inch that is the average weight of 1 inch lengths of fiber expressed in micrograms (0.000001 gram).
- *Moisture content of cotton fiber*: Most textile fibers are hygroscopic; that is they have the ability to absorb or give up moisture. This moisture is picked up or absorbed by the hygroscopic material from the atmosphere if the relative amount of moisture in the air is greater than that in the material. Conversely, the material gives up the moisture if the relative amount of moisture in the air is less than that in the material. The moisture content of the cotton fiber is the percent weight of moisture based on its original weight.

$$\text{Moisture content of fiber} = \frac{(\text{Original weight} - \text{dry weight})}{\text{Original weight}} \times 100 \text{ [\%]}$$

- *Non-lint content of cotton fiber:* The determination of the non-lint content of cotton taken from the bale or at any stage in processing up through carding or drawing can be of value to mill management. The measurement on the raw stock gives an accurate estimation of the amount of trash in the bale, and the non-lint content of the cotton at different steps in the opening and carding areas is a good measure of efficiency of the cleaning equipment.
- *Fiber structure:* It is the structure of fiber under microscope. Mature and immature cotton fiber could be identified using a microscope.
- *Strength of cotton fiber:* It is a mechanical characteristic of a fiber. The importance of testing cotton fibers for strength and the best method to use in measuring the strength is considered very well. The strength of the fiber has a direct effect upon the strength of the yarn and fabric.

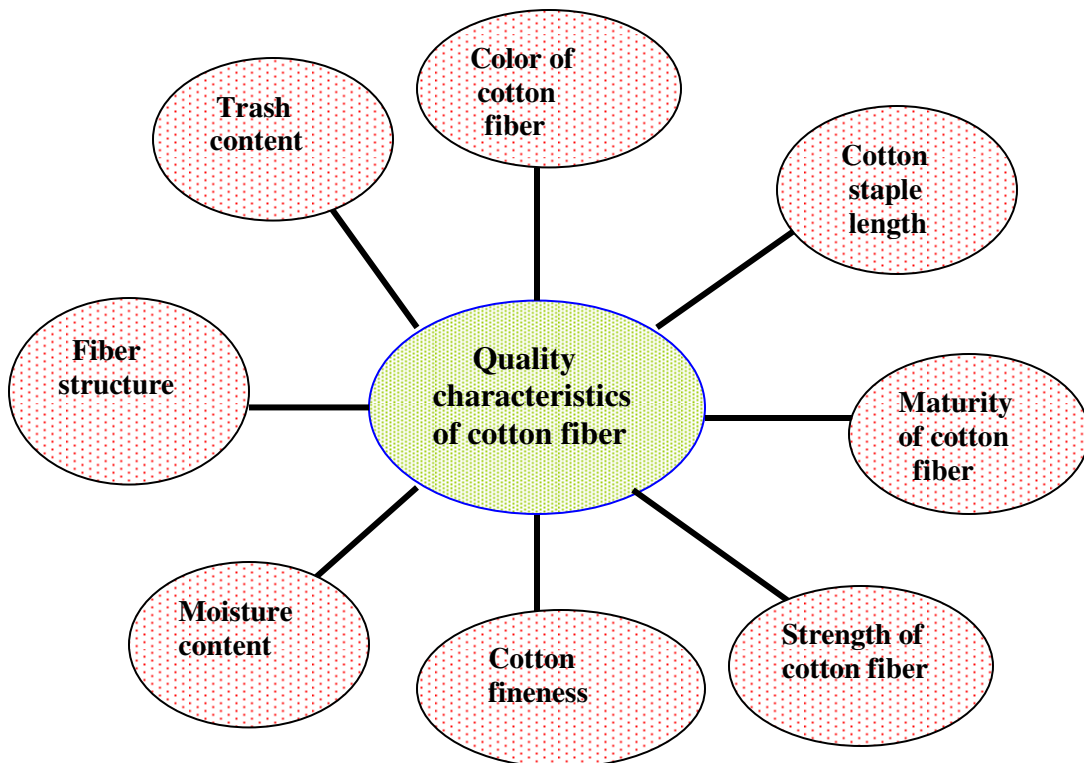


Figure 2.2 Quality characteristics cotton fiber

2.2.2 Yarn quality characteristics

Yarn is a long continuous length of interlocked fibers, suitable for use in the production of textiles, sewing, crocheting, knitting, weaving and rope making. Yarn can be made from any number of synthetic or natural fibers. The following are some quality characteristics of cotton yarn [11].

- *Yarn count (Yarn numbering)*: In spinning room, increased efficiency of operation and improved yarn quality are two major benefits to be derived from effective quality control throughout the preceding operations. The important features of yarn, which are evaluated to determine its quality, are yarn number (count), strength, twist, appearance and evenness. Common yarn numbering systems are cotton English system, Tex, Denier, Metric count, and Worsted system.
- *Yarn strength*: Strength has been accepted by many, as one of the most vital characteristics of yarn. The factors which influence the yarn strength are: staple length of fiber- the longer the fiber the stronger is the yarn, fiber fineness- fine fiber gives greater yarn strength than coarse fibers, fiber strength, twist (as the twist value increase the strength of yarn also increase), and fiber length distribution in the yarn (variation in the distribution of fiber length will cause a variation in yarn strength).
- *Twist of cotton yarn*: The cotton yarn twist is characterized by the number of twists or turns per meter of length and the directions of twist S-twist and Z-twist. Yarn twist needs continuous follow up during production process to minimize the variations.
- *Hairiness of yarn*: These are protruding ends of single fibers or loops formed by separate fiber on the yarn surface. The presence of fiber ends or loops on the yarn surface is called hairiness or fluffiness. The yarn hairiness depends on the kind of fibers, the degree of their straightening, methods of spinning and twisting, and other factors.
- *Yarn evenness*: A deviations in linear density of spinning products (sliver, roving, and yarn) or man-made filament yarns in some portions on one or other side from the mean value determine their unevenness in linear density.
- *Cotton yarn tension*: The tension of yarn should be constant during production or process. There should be a standard value (limit) of yarn tension for each type and count of yarn. When the tension of yarn increase, internal deformation takes place and leads to breakage.

- *Yarn abrasion*: at any stages of processing in the textile industry the fibers and yarns often rub against each other and against the surfaces of the machines working parts.

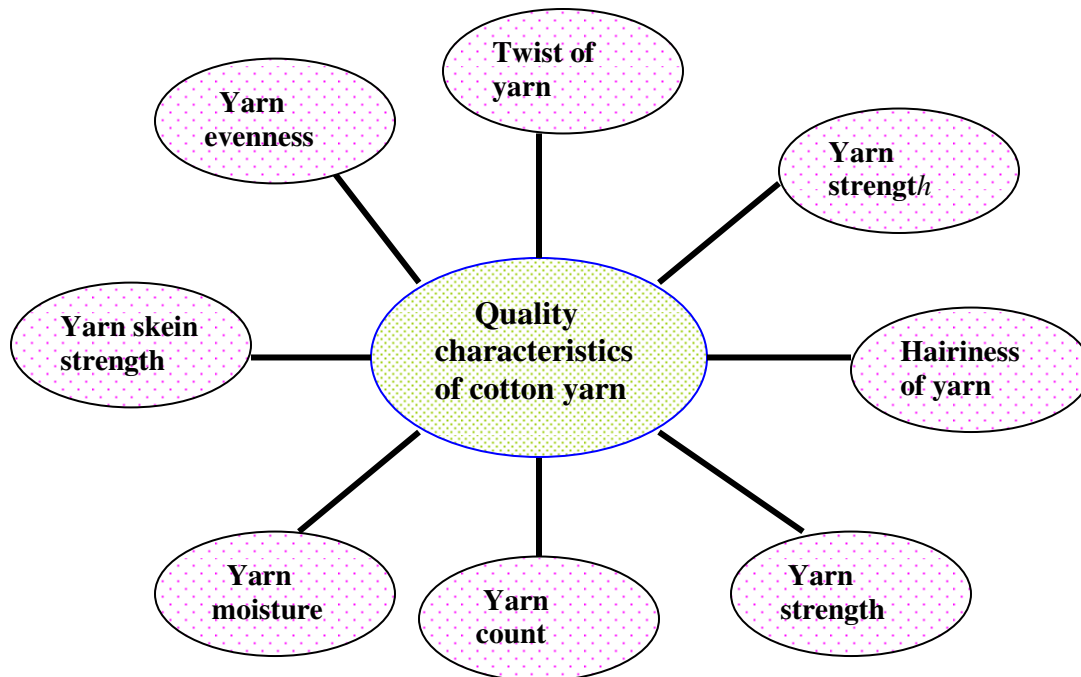


Figure 2.3 Quality characteristics of yarn

So in considering yarns spun from staple fibers, there are many inherent variables that influence the final strength of the spun yarn.

2.2.3 Fabric quality characteristics

Woven fabric made by interlacing two systems of yarns (warp and weft yarn) mutually in perpendicular direction. Some quality characteristics of fabric are [11]:

- *Strength of fabric*: The strength of a fabric may be determined from three approaches: its resistance to a tensile load, its resistance to a tearing force, or its resistance to a bursting force. Each of these three measurements has its usefulness. The breaking strength is a measure of the resistance of the fabric to a tensile load. The tearing strength is a measure of the resistance to tearing force.
- *Drapability of fabric*: Drapability is the ability of fabric to form soft rounded folds with a small radius of curvature or stand. Stiffness and durability of fabrics depend on their fibrous composition, structure, and thickness.

- *Stiffness of fabric:* Stiffness is the ability of textile fabrics to resist changes in their shape at bending deformation and it affects their draping capacity. Stiffness is determined by the cantilever method. Stiffness of fabric should be determined on both warp and weft direction.
- *Abrasion of fabrics:* Wear is a process occurring in time under the action of some factors and impairing the structure and properties of the fabric or causing its destruction. Abrasion is one of the most largely encountered kinds of wear, as a result of which a considerable part of the fabric is lost under the action of friction.
- *Fabric pilling:* Pilling is the tendency of fabric to form on their surface rolled up ends of fibers forming ball like structure called pills. The methods for the determination of fabric pilling consists in formation of a pile and then pills on the fabric surface and counting of the number of pills on the given area.
- *Color fastness:* Color fastness is the chemical characteristics of fabric. There are color fastness due to washing, color fastness due to sunlight and others.

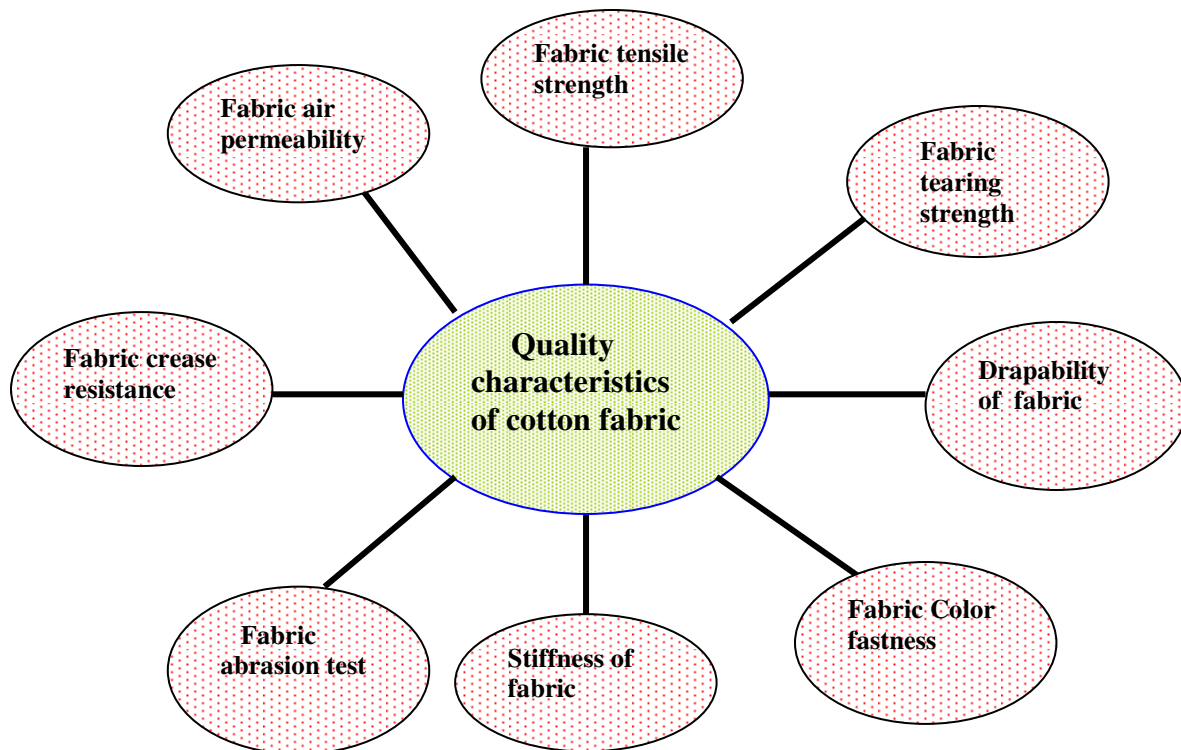


Figure 2.4 Quality characteristics of fabric

2.3 QUALITY CONTROL IN TEXTILE INDUSTRY

The biggest impediment to upgrading quality in industry of developing countries is the manufacturer's lack of awareness of its economic benefits. Inspection was the first formal quality control at the beginning of this century in developed countries; nowadays some define it as in Engineering and manufacturing. Quality control or quality engineering is a set of measures taken to ensure that defective products or services are not produced, and that the design meets performance requirements

Quality control is concerned with the operational techniques for detecting, recording, and taking actions to eliminate quality problems. It refers to all activities (processes) and technologies that are used to achieve or maintain the quality of a product or service. Quality control focuses on finding and eliminating of sources of defects and monitoring the manufacturing process. Quality control consists of developing, designing, producing, marketing and servicing products and services with optimum cost-effectiveness and usefulness, which customers will purchase with satisfaction, (Ishikawa). Under the notion of quality management, quality control inspectors serve only as an aid in detecting quality problems and providing signals for needed improvements. Quality inspection will not necessarily lead to better quality product.

In textile industry, quality control should be concerned with the evaluation of test data and its application to the control of the textile process, raw materials, intermediate products, and final products. It is concerned not only with quality level and the cost of maintaining this level, but also with the presentation of tangible values to measure quality and changes in quality.

2.3.1 Textile testing

In textile industries, testing and inspection of the textile materials such as fiber, yarns and fabrics takes place in the physical and chemical laboratories. The quality control department is responsible for testing and regular inspection of those textile materials.

Textile testing is the application of engineering and science to the measurement of the properties and characteristics of, and the conditions affecting, textile fibers, yarns, fabrics and materials. It involves the use of techniques, tools, instruments, and machines in the laboratory for the

evaluation of the properties of these different forms of textiles. Textile testing is broad in scope. It can include, for instance, the means for determining the properties of a fiber, a yarn or a fabric. It can be used to measure the outside factors that influence test results. A quality control program should include a testing program involving the performance on a periodic basis of certain routine tests designed to measure the characteristics of the raw or processed material. The testing and control objective is to meet:

- Standards established by an individual organization. For example, the staple length of raw cotton, the size of roving, the strength of yarns, and the number of filaments in rayon yarns.
- Established scientific specifications. For example the specifications set up by American society for testing materials (ASTM), or other established authorities.
- Market requirements or Standards. For example meeting the requirements for fabric width, number of ends, number of picks and weight for certain standard fabrics.
- Consumer needs or demands: For example to forecast the effectiveness of a material to meet consumer needs for wear or for color fastness.
- The needs of improving the ratio of quality to cost.

In order for test results to be reliable, instruments must be in calibration. Failure to maintain proper calibration of balances, scales, strength test machines, or other instruments will introduce serious errors in the results obtained, thus nullifying all efforts of proper control. Such a condition can lead to costly errors in manufacturing. Failure to maintain proper atmospheric conditions, or to make proper corrections to standard conditions from existing conditions, can introduce errors in results. For example, if cotton yarn is tested at a high level of say 80 percent relative humidity, its weight and strength will be high in comparison to what it should be at standard conditions.

It should be understood that variations exist in any textile process. Similarly, raw material, material in process, and the finished product all contain variations. As long as these variations are normal or within some system of chance causes, conditions of control exist. However, if abnormal variations occur that are due to assignable cause, then the control program spots such a condition and corrects it. The program for successful testing and quality control must consider: space and arrangement of space, tests to be performed and the equipment for these tests,

personnel to perform the tests and evaluate the results, and the methods and procedures for sampling, performing, evaluating and applying the results. The space allotted to the textile testing laboratory in the textile plant should be separated from the manufacturing division, but accessible to and by it. The laboratory rooms should have controlled atmospheric condition that is a conditioning system capable of maintaining, standard conditions of 70 °F temperature and 65 percent relative humidity. Personnel should include trained individuals to perform the tests and persons capable of properly interpreting and analyzing the results.

2.3.2 Inspection in Textile Industries

The success of an industry is measured by producing high quality products at lower cost that satisfies customer needs. Inspection does not create quality but it helps to control it. The aim is to prevent defects by finding and eliminating the causes of the problem. Inspection is the function to judge the quality of a product. Inspection is the process of measuring the quality of a product or service in terms of established standards. Inspection is an important aspect of production control. Products should be checked at various stages for the size, shape, and quality. The technical knowledge and skill in the art of inspection is essential for quality inspector, he should understand his responsibility and be able to work with patience. Quality inspector must know statistical quality control techniques, and be cost conscious to minimize or prevent wastage of resources.

In big industries such as textile, there are three methods of inspection. Those are:

- *Screening or 100 % inspection:* It is that method of inspection in which each and every unit manufactured is inspected to meet the desired specifications. The aim is to catch all the defective products produced. Hundred percent inspections would result 100 percent destruction of products. For instance, in filament test of electric bulb. Therefore, it is necessary to identify where to use 100 percent inspection. Hundred percent inspections is necessary for: important components upon which the functioning of the whole assembly depends, where a process normally yields a high percentage of defective products. For instance, inspection machine before it deliver to textile finishing department.

- *Lot by lot Inspection:* This is also known as sampling inspection. It was developed to eliminate the high cost of screening inspection. Small number of samples is drawn randomly from the lot and the inspector judges from them the acceptability of the whole lot. In textile industry, it is used in inspecting of raw material (textile fiber) to decide whether to accept or not.
- *Process Inspection:* The purpose of this method of inspection is to search out defective products where and when they occur, so that an immediate corrective action can be taken. This inspection deals with all causes of defective work, be it operator, operation, raw material, tool, machine, etc. Therefore, in process inspection, inspector patrols in assigned areas and checks machine, methods of operations, and occasional pieces of product from raw material to finished products. Examples in textile industry are inspection of the grey fabric width, the density of warp yarns (EPC), the density of weft yarns (PPC), and so on.

Inspection may be done either at the machines or in a central inspection room separated from actual production (laboratory rooms). Floor inspection saves the cost of transportation of the material from the place of production to the inspection room. Floor inspection is very useful especially when the product is very bulky and when it becomes very difficult to carry the products from production site to inspection room. On the other hand, it is necessary to decide when to inspect. This problem of ‘when to inspect’ depends upon the nature of products and the procedure employed for manufacture. There is no general rule that can be given about whether inspection should be done after each operation in the process or only at the final stage of completion. Usually a product or semi-product is inspected when it is transferred from one production department to another, so that responsibility may be fixed for any defective work. Inspection is necessary after that operation in which there is more chance of defects, so that main aim of inspection to control the quality with a minimum possible cost can be achieved.

2.4 QUALITY AND PROCESS IMPROVEMENT

Quality improvement requires that we should not be satisfied with the current quality level, regardless of how satisfactory it may be. Efforts should be made continuously to improve quality. Old bad habits and hype should be abandoned in favor of real quality improvements. Short-term goals of quality improvement should be extended to long-term and permanent

improvement strategies. Writing and speaking about quality improvement is not enough. The following figure 2.5 is a flow chart of a quality improvement process. The business mission and overall quality objectives must be integrated with customer needs with respect to organizational capabilities. There must be a feedback mechanism through which changes in customers; needs are conveyed to drive the mission of the business further. Getting closer to the customer and employee empowerment is two of the basic requirements for achieving quality improvement.

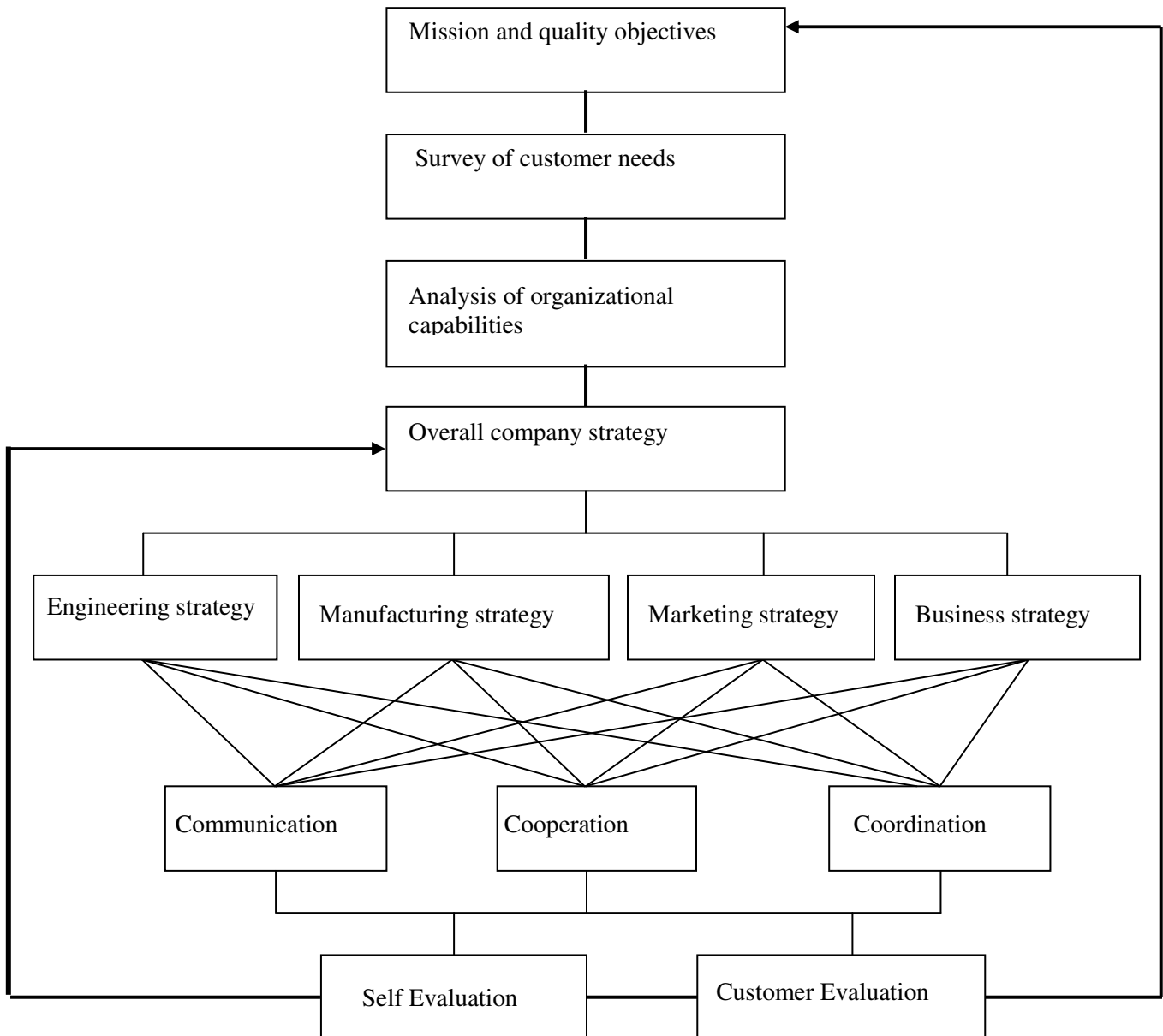


Figure: 2.5 Flowchart of quality improvement [18]

2.4.1 Barriers of quality and process improvement

Regardless of the preparation and efforts committed to quality and process improvement, there still exist some barriers to improvement. Examples of typical obstacles to implementing quality and process improvement are discussed below.

1. *Lack of employee commitment:* There may be an indifferent attitude to organizational goals among employee. The general feeling that prevails among employees is that management exploits workers to pursue unachievable goals. This feeling must be removed and employees must be positively motivated.
2. *Emphasis on short change:* Some companies are after short-term goals or immediate returns. This is one of the main obstacles to a lasting improvement.
3. *Resistance to change:* It is natural for people to resist changes. All organizations experience some form of opposition from the employees whenever a new change is introduces. Designing the new process closely parallel to existing process and involving people right from the conceptual stage of the proposed changes can reduce this.
4. *Interdepartmental problems:* These problems are not uncommon in any organization. These problems are arising due to the general tendency of individual departments to conceal their shortcomings, while blaming others for their problems. The other sources of these problems are poor communication, lack of cooperation, personality clashes, and competition for scarce resources.
5. *Lack of focus:* To be successful, a quality improvement effort must have focus and carry high priority within the organization. Too much concentration on short-term returns can preclude focus and priority for long-term quality improvement.
6. *Lack of clear responsibility:* As stated earlier, “Good quality is everybody’s responsibility while bad quality is everybody’s fault”. Every body is responsible for quality improvement. The quality control department should serve as the facilitator for quality improvement rather than as a quality enforcement group.
7. *Technology obsolesce:* Obsolete technology is another obstacle to quality improvement. It is not uncommon to have technologies that are decades old in companies that are aspiring to improve quality to world- class levels.

8. *Lack of foresight*: To remain competitive, a company must have the foresight and sense of anticipation for what the customer wants what the competition is doing. In ability to respond quickly to the changing needs of the customer is a major obstacle to quality improvement.

A process is a collection of interrelated activities designed to generate specific outputs based on the application of specific inputs. A process can be only one task or a sequence of tasks where people, tools, materials, and environment act together to perform operation(s), which cause one or more characteristics of a product to be altered or generated. Process improvement must guide by a comprehensive quality improvement program. A lasting quality improvement can be achieved only by improving the underlying process. The underlying process must be improved bottom-up.

2.5 ISO 9000 QUALITY MANAGEMENT SYSTEM

2.5.1 Background of ISO 9000 quality standards

Nowadays, wherever you go it seems that you are always hearing the word ‘quality’ especially in relation to the requirements of ‘ISO 9000’, but even though these have become everyday words, they are often misused, misquoted and misunderstood. But why is this? Well, normally you will find that when most people talk about the quality of an object, they are talking about its excellence, perfection and/or value. In reality, of course, they should be taking about how much it meets its designed purpose and comes up to the manufacturer’s or suppliers’ original specifications.

The International Organization for Standardization was established in 1946 and is located in Switzerland. It oversees the development of common international standard. ISO takes its name from the Greek word, isos meaning equal. Its members represent over 161 national bodies. The organization’s trump card, ISO 9000, has revolutionized the quality domain. It is the most widely recognized and important quality standard in existence. ISO 9000 applies to all kinds of organizations. It helps both product and service oriented institutions attain unprecedented improvements in quality. They can be implemented in small, medium, and large-scale organizations, and is applicable to users in the industrial, software as well as service sectors. The ISO 9000 standards are treated as a set of international quality management standards and

guidelines. The first publication of ISO 9000 was in 1987, which have earned a global reputation as the basis for establishing quality management systems. It has been acknowledged that investment in quality management systems, in addition to responding to customer needs, enhance the efficiency of the organization, its operations and economic performance. The revised standards will be of specific help to organizations wishing to go beyond simple compliance with QMS requirements for the sake of certification.

2.5.2 Definition and principles of quality management

ISO 9000: 2000 defines quality management as “coordinated activities to direct and control an organization with regard to quality.” Thus quality management falls within the overall management function of a company. Here the emphasis is on understanding and meeting customer requirements and expectation and on "getting it right first time". It comprises the organizational structure, procedures, processes and resources needed to implement quality management." It establishes quality policy, quality objectives and allocates responsibilities within the organization for achieving the stated quality policy and objectives. The means used to implement the quality policy and attain objectives are quality planning, quality control, quality assurance and quality improvement.

Manufacturing industries or service sectors can successfully practice QMS if they have a conducive work environment. A conducive work environment will enable the successful implementation of QMS and ensures that it becomes a way of life for the organization. To create such an environment, they must emphasis on eight management principles that is described as follows.

1- Customer focus

The customer determines quality. A quality output is one that can satisfy the target group namely the customers. Hence, under TQM, departments are required to focus on their customers in all work aspects. A department needs to know what the requirements of the customers are before it can produce a quality output. The requirements serve as a basis in determining the characteristics of an output to be produced as well as the processes involved. The following points could be considered.

- a) *Identifying the customers:* This step will enable a department to focus its efforts and resources towards providing services to the customers identified.
- b) *Identifying customers' requirements:* Customers' requirements vary and differ depending on the types of output, time, place and a number of other factors. It is therefore important for the departments to identify customers' requirements exactly.
- c) *Translating the requirements into standards of quality output:* Customers' requirements that have been identified need to be translated into quality output standards. The standards must be clear and if possible measurable.
- d) *Establishing the processes involved in producing the output:* The work processes involved in producing an output must be formulated in line with the standards set in producing a quality output. This will ensure process capability for providing quality outputs.
- e) *Implementing the processes:* This step involves the implementation of the work processes in order to produce the required output. The department should also carry out quality inspection to ensure that the quality standards set are met.

2- Leadership

Leaders establish unity of purpose and direction of the organization. They should create and maintain the internal environment in which people can become fully involved in achieving the organization's objectives. Applying the principles of leadership typically leads to: considering the needs of all interested parties including (customers, owners, employees, suppliers, financiers, local communities and society as a whole), establishing a clear vision of the organization's future, setting challenging goals and targets, establishing trust and eliminating fear, and providing people with the required resources, training and freedom to act with responsibility and accountability.

3- Involvement of people

People at all levels are the essence of an organization and their full involvement enables their abilities to be used for the organization's benefit. Applying the principle of involvement of people typically leads to: people understanding the importance of their contribution and role in the organization, people identifying constraints to their performance, people accepting ownership of problems and their responsibility for solving them, people evaluating their performance against their personal goals and objectives, people actively seeking opportunities to enhance their competence, knowledge and experience and people openly discussing problems and issues.

4- Process Approach

A desired result is achieved more efficiently when activities and related resources are managed as a process. Applying the principle of process approach typically leads to: systematically defining the activities necessary to obtain a desired result, establishing clear responsibility and accountability for managing key activities, analyzing and measuring of the capability of key activities, focusing on the factors such as resources, methods, and materials that will improve key activities of the organization.

5- System approach to management

Identifying, understanding and managing interrelated processes as a system contribute to the organization's effectiveness and efficiency in achieving its objectives. Applying the principle of system approach to management typically leads to: structuring a system to achieve the organization's objectives in the most effective and efficient way, understanding the interdependencies between the processes of the system, structured approaches that harmonize and integrate processes, providing a better understanding of the roles and responsibilities necessary for achieving common objectives and thereby reducing cross-functional barriers, targeting and defining how specific activities within a system should operate, continually improving the system through measurement and evaluation.

6- Continual improvement

Continual improvement of the organization's overall performance should be a permanent objective of the organization. Applying the principle of continual improvement typically leads to: providing people with training in the methods and tools of continual improvement, making continual improvement of products, processes and systems an objective for every individual in the organization, establishing goals to guide, and measures to track, continual improvement, and recognizing and acknowledging improvements.

7- Factual approach to decision making

Effective decisions are based on the analysis of data and information. Applying the principle of factual approach to decision making typically leads to: ensuring that data and information are sufficiently accurate and reliable, making data accessible to those who need it, analyzing data

and information using valid methods, making decisions and taking action based on factual analysis, and balanced with experience and intuition.

8- Mutually beneficial supplier relationships

An organization and its suppliers are interdependent and a mutually beneficial relationship enhances the ability of both to create value. Applying the principles of mutually beneficial supplier relationships typically leads to: pooling of expertise and resources with partners, identifying and selecting key suppliers, clear and open communication, and sharing information and future plans.

2.5.3 Structure and content of ISO 9001:2000

ISO 9001 specifies the requirements for a QMS that may be used by organizations for internal application, certification or contractual purposes. The ISO 9001 standard includes an increased focus on top management commitment, emphasis on the process approach within the organization, continual improvement, and the addition of the requirement for formal customer satisfaction. The main components of ISO 9001:2000 are outlined below and cross-referenced to the relevant clause of the standard [28].

Introduction (Clause 0): The quality management system requirements specified in this international standard are complementary to requirements for products. The introduction includes a process model and an explanation of how to interpret it. There is an explanation of the relationship between ISO 9001:2000 and ISO 9004:2000.

Scope (Clause 1): The standard gives a clear indication of its process nature and that: you need to take into account the regulatory requirements of your products you need to have processes in place for continual improvement. “Application “requires you to state clearly if any areas of the standard do not apply to your organization, together with an explanation of the reasons for this.

Normative Reference (Clause 2): This section lists from a mandatory input to ISO 9001:2000. It requires an organization to take into considerations ISO 9000:2000 quality management systems-Fundamentals and Vocabulary when applying ISO 9001:2000.

Terms and Definitions (Clause 3): In addition to those terms defined within ISO 9000:2000, an organization shall make a note of the specific terms used to describe the supply chain. The word

product is defined so as to cover all manufacturing and service outputs and so, whenever the term ‘product’ occurs, it can also mean ‘service’.



Figure 2.6 The supply chain

Quality management system (Clause 4): This clause covers the requirements for all organization to establish, document, implement, maintain and continually improve a QMS in accordance with the requirements of this standard.

Management responsibility (Clause 5): this clause includes management commitment, customer focus, quality policy, quality planning, responsibility & authority, and management review.

Resource management (Clause 6): This section covers resources with regard to training, induction, responsibilities, working environment, equipment requirements, and maintenance. The organization needs to identify and make available all the resources (example information, infrastructure, people, work environment, finance, support, etc) required to implement and improve their QMS and its associated quality processes.

Product Realization (Clause 7): This section absorbs most of the 20 elements of the old ISO 9000:1994 standard, including process control, purchasing, handling and storage, and measuring devices.

Measurement, Analysis and Improvement (Clause 8): Under ISO 9001:2000 the organization is required to determine and implement procedures to ensure product and QMS conformity and improvement. The use of statistical technique can help to understand the variability of a product and in so doing, help organizations to solve problems and improve efficiency.

2.5.4 Development of quality management

The emphasis on quality management arises from the demands of customers for ever-increasing standards of high quality, and the need by supplier's to produce quality products consistently, but with reasonable costs.

In the competitive business environment, the successful companies fulfill customer requirements, in an effective and efficient manner. Reputable manufacturers and business people generally strive to ensure that their products satisfy their customer needs and expectations. For this reason, efforts to control the quality of products have developed over time. This originated in the manufacturing industry, because most manufacturers inspected their products before shipping them. This subsequently leads to quality control, and then to the development of quality assurance and quality management as shown in figure 2.7 below.

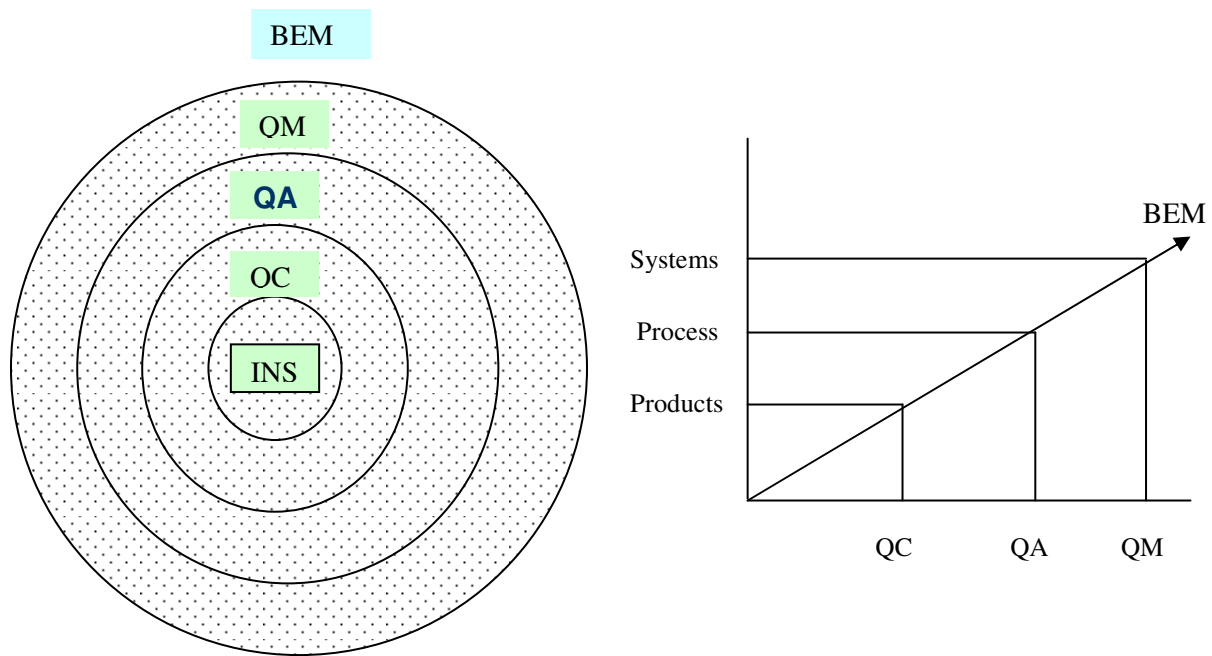


Figure 2.7 Progress in quality management concept [25].

KEY

BEM = Business excellence models INS = Inspection QM = Quality management
 QC = Quality control QA = Quality assurance

2.5.5 Design of quality management system

The quality management system should apply to and interact with all processes in the organization. It begins with the identification of the customer requirements and ends with their satisfaction, at every transaction interface. The activities may be classified in several ways- generally as processing, communicating and controlling as shown in the quality management

process model figure 2.8 below. This process model reflects graphically the interaction of four major areas:

- ❖ Management responsibility
- ❖ Resource management
- ❖ Process management
- ❖ Measurement, analysis and improvement

It is interesting to bring together the concepts of Deming's cycle of continuous improvement- PLAN, DO, CHECK, ACT – and quality management systems [17].

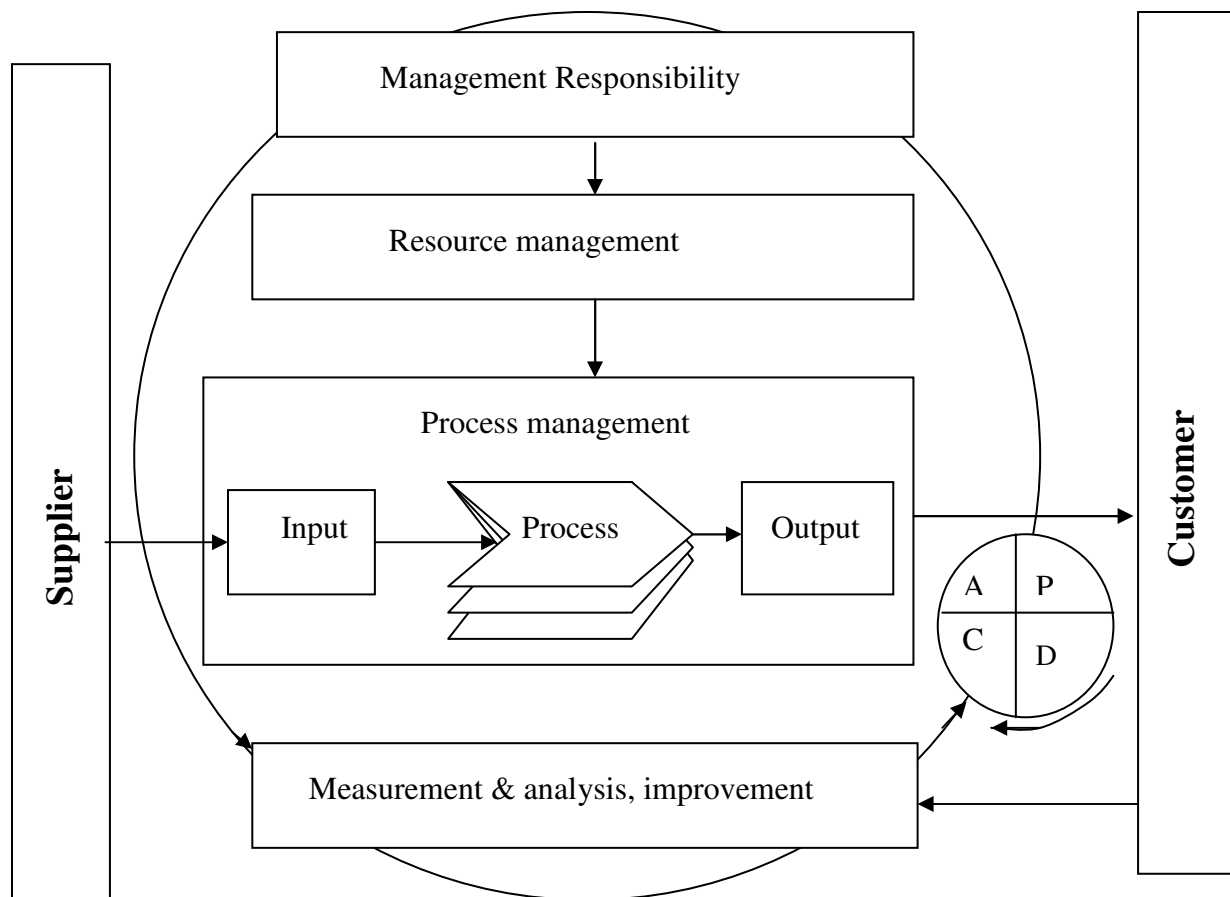


Figure 2.8 Quality management process model (Source: ISO/SCI 9001:2000 QMS, 1999)

2.5.6 Implementing steps of ISO 9000 Quality Management System

Implementation of ISO 9000 affects the entire organization right from the start. If pursued with total dedication, it results in 'cultural transition' to an atmosphere of continuous improvement. The process of implementing ISO 9000 depends on: the sophistication of your existing quality program, the size of your organization, and the complexity of your process. The 14 essential steps, briefly described below, are to be followed through in order to implement ISO 9000 quality management system successfully [42].

Step 1 Top Management Commitment

The top management (managing director or chief executive) should demonstrate a commitment and a determination to implement an ISO 9000 quality management system in the organization. Without top management commitment, no quality initiative can succeed. Top management must be convinced that registration and certification will enable the organization to demonstrate to its customers a visible commitment to quality. It should realize that a quality management system would improve overall business efficiency by elimination of wasteful duplication in management system.

Step 2 Establish Implementation Team

People implement ISO 9000. The first phase of implementation calls for the commitment of top management - the CEO and perhaps a handful of other key people. The next step is to establish implementation team and appoint a Management Representative (MR) as its coordinator to plan and oversee implementation. Its members should include representatives of all functions of the organization - marketing, design and development, planning, production, quality control, etc.

Step 3 Start ISO 9000 Awareness Programs

ISO 9000 awareness programs should be conducted to communicate to the employees the aim of the ISO 9000 quality management system; the advantage it offers to employees, customers and the organization; how it will work; and their roles and responsibilities within the system. Suppliers of materials and components should also participate in these programs. The awareness program should emphasize the benefits that the organization expects to realize through its ISO 9000 quality management system. The program should also stress the higher levels of participation and self-direction that the quality management system renders to employees. Such a focus will go far to enlist employee support and commitment.

Step 4 Provide Training

Since the ISO 9000 quality management system affects all the areas and all personnel in the organization, training programs should be structured for different categories of employees - senior managers, middle-level managers, supervisors and workers. The ISO 9000 implementation plan should make provision for this training. The training should cover the basic concepts of quality management systems and the standard and their overall impact on the strategic goals of the organization, the changed processes, and the likely work culture implications of the system. In addition, initial training may also be necessary on writing quality manuals, procedures and work instruction; auditing principles; techniques of laboratory management; calibration; testing procedures, etc.

Step 5 Conduct Initial Status Survey

ISO 9000 does not require duplication of effort or redundant system. The goal of ISO 9000 is to create a quality management system that conforms to the standard. This does not preclude incorporating, adapting, and adding onto quality programs already in place. So the next step in the implementation process is to compare the organization's existing quality management system, if there is one -- with the requirements of the standard (ISO 9001:2000).

Step 6 Create a Documented Implementation Plan

Once the organization has obtained a clear picture of how its quality management system compares with the ISO 9001:2000 standard, all non-conformances must be addressed with a documented implementation plan. Usually, the plan calls for identifying and describing processes to make the organization's quality management system fully in compliance with the standard.

Step 7 Develop Quality Management System Documentation

Documentation is the most common area of non-conformance among organizations wishing to implement ISO 9000 quality management systems. As one company pointed out, "When we started our implementation, we found that documentation was inadequate. Even absent, in some areas. Take calibration. Obviously it's necessary, and obviously we do it, but it wasn't being documented. Another area was inspection and testing. We inspect and test practically every item that leaves here, but our documentation was inadequate".

Step 8 Document Control

Once the necessary quality management system documentation has been generated, a documented system must be created to control it. Control is simply a means of managing the creation, approval, distribution, revision, storage, and disposal of the various types of documentation. Document control systems should be as simple and as easy to operate as possible - sufficient to meet ISO 9001:2000 requirements and that is all.

Step 9 Implementation

It is good practice to implement the quality management system being documented as the documentation is developed, although this may be more effective in larger firms. In smaller companies, the quality management system is often implemented all at once throughout the organization. Where phased implementation takes place, the effectiveness of the system in selected areas can be evaluated.

Step 10 Internal Quality Audit

As the system is being installed, its effectiveness should be checked by regular internal quality audits. Internal quality audits are conducted to verify that the installed quality management system: Conform to the planned arrangements, to the requirements of the standard (ISO 9001:2000) and to the quality management system requirements established by your organization, and is effectively implemented and maintained.

Step 11 Management Review

When the installed quality management system has been operating for three to six months, an internal audit and management review should be conducted and corrective actions implemented. The management reviews are conducted to ensure the continuing suitability, adequacy and effectiveness of the quality management system. The review should include assessing opportunities for improvement and the need for changes to the quality management system, including the quality policy and quality objectives.

Step 12 Pre-assessment Audit

When system deficiencies are no longer visible, it is normally time to apply for certification. However, before doing so, a pre-assessment audit should be arranged with an independent and qualified auditor. Sometimes certification bodies provide this service for a nominal charge. confidence for formally going ahead with an application for certification.

Step 13 Certification and Registration

Once the quality management system has been in operation for a few months and has stabilized, a formal application for certification could be made to a selected certification agency. The certification agency first carries out an audit of the documents (referred to as an "adequacy audit"). If the documents conform to the requirements of the quality standard, then on-site audit is carried out. If the certification body finds the system to be working satisfactorily, it awards the organization a certificate, generally for a period of three years. During this three-year period, it will carry out periodic surveillance audits to ensure that the system is continuing to operate satisfactorily.

Step 14 Continual Improvement

Certification to ISO 9000 should not be an end. You should continually seek to improve the effectiveness and suitability of the quality management system through the use of: quality policy, quality objectives, audit results, analysis of data, corrective and preventive actions, and management review.

Survey of Benefits of ISO 9001 Implementation:

- One-time and on-going savings
- Reduced defect rate averaged 64%
- Reduced cost of quality averaged 56%
- On-time delivery increased 10%
- Improvement in customer satisfaction

2.6 DEVELOPMENT OF TEXTILE QUALITY STANDARDS

The textile industry is one of the worlds oldest. The earliest known textiles include scraps of linen cloth found in Egyptian caves dating from about 5000 B.C. In the western world, textile manufacturing remained a family business until the early 1500s, when the first factories were built. In Asia, especially China, centralizing and standardizing textile production occurred as early as the Zhou Dynasty (11th to 8th centuries B.C.). Very explicit stipulations and standards existed for silk and cotton fabrics. One dynasty decree stated, "Cottons and silks of which the quality and size are not up to the standards are not allowed to be sold on the market."

In the West, an early regulation for quality assurance in the textile trade dates back to 14th-century, Germany, Called tuchshau ("showing of cloth"), the regulation involved expert inspectors who, along with an equal number of city council members, observed the entire manufacturing process starting at the loom, where warps were inspected. No piece of cloth could be sold unless it was produced under this supervision.

As in most other manufacturing industries, for many centuries quality in the textile industry was achieved through final inspection of finished goods. This final inspection was often used to create different grades of quality, products of which were then sold at various prices. Manufacturers slowly began to add inspection and control to the quality of raw materials and the production processes.

Statistical process control: The first reports on statistical quality control of yarn-manufacturing products appeared during the late 1940s and 1950s. These documents emphasized product quality and defect detection rather than defect prevention. At that time, quality assurance was very much a departmentalized function. Unfortunately for many companies in the textile industry, this condition still exists.

In spun-yarn manufacturing, testing focused on three areas: end-product testing of characteristics such as linear density, twist, strength and elongation, short-term evenness, and count variation; inspection of defects such as thick and thin places, slubs and neps, and repeating faults like mechanical errors or drafting waves; and frequency checks for end breaks during spinning. In recent years, companies have begun to focus on electronic monitoring of processing weights, faults and running performance.

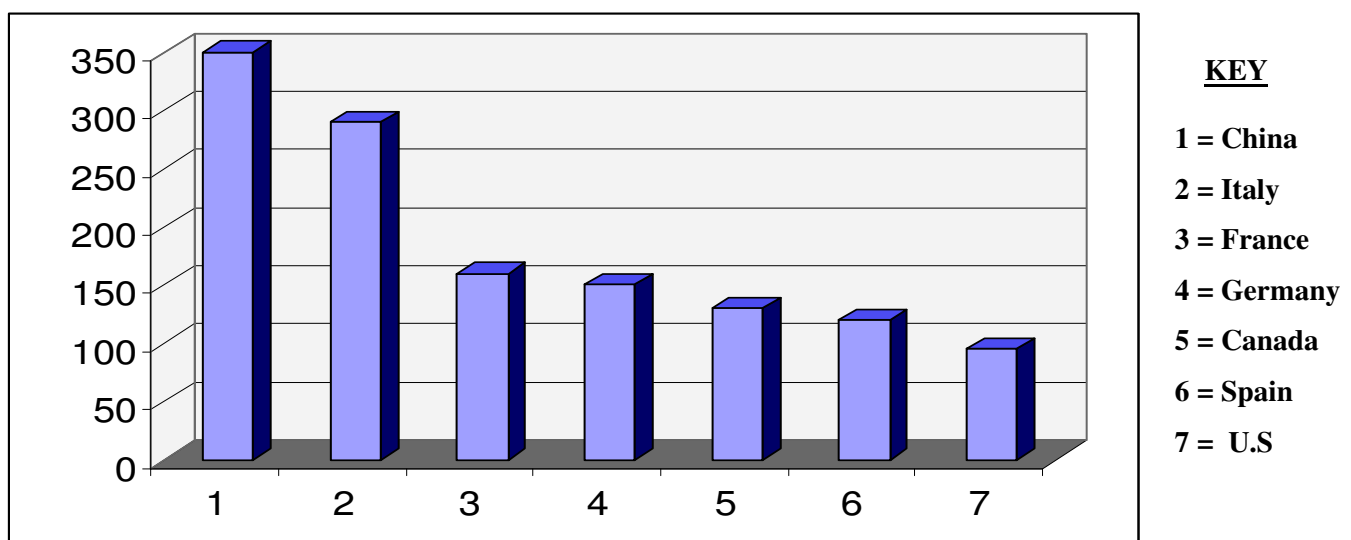
Statistical process control is also used in woven-, knitted- and nonwoven-fabric manufacturing. Many companies still focus on defect detection, sorting, situation resolution and other firefighting activities, although the recent trend has been toward continuous improvement and prevention. The relationship between yarn and fiber quality and the final fabric's quality is now better understood and managed. The third area of SPC in textiles is in dyeing and finishing. Dyeing a textile yarn or fabric is one of the most difficult, monitored and controlled processes in the textile manufacturing chain. The finishing process, by contrast, still has few controls and

relies heavily on inspection and testing. The two main processes used in finishing are chemical and mechanical.

The textile industry, especially in the United States, has recently begun to use the ISO 9000 series of standards as a quality assurance system, though registration is still seen by many companies as only necessary as a factor for exports. Ten years ago there were fewer than 100 textile companies registered. By 1996 the number had soared to 1,600, and by the end of last year, there were 3,673 registered textile companies. The number of ISO 9000 certificates in the textile industry increased 29.6 percent from 1998 to 1999. China, Italy, France and Germany lead the world in numbers of certified textile companies, whereas only a few of the more than 30,000 U.S. companies have been registered.

With the publication of the ISO 9000:2000 revision, more textile companies will likely find value in using the standards as the basis for their quality assurance systems. Also, an increase of both imports and exports from U.S. fiber, textile and apparel industries will make adopting the standards more critical. The new standards have many advantages over the original series published in 1987 and updated in 1994. These include a focus on a process model, continuous improvement and customer satisfaction. The revision also includes eight management principles discussed above.

Textile Industry ISO 9000 Certificates By Country



Source: Mathieu, Alain (2001), "Quality Certification—Its significance in the Global Textile Industry".

Textile Industry ISO 9000 Certificates By Year

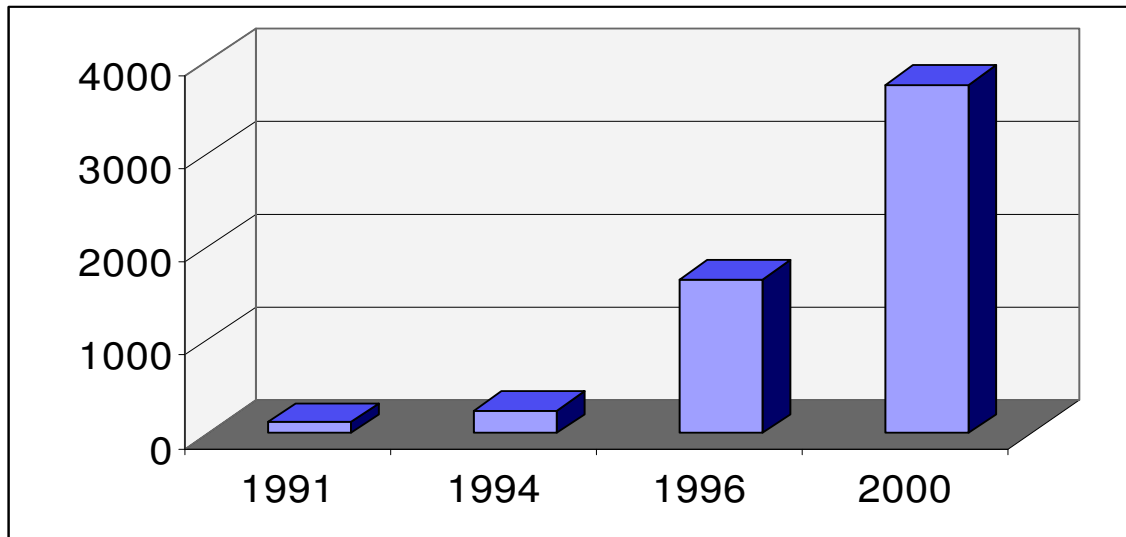


Figure 2.9 ISO 9000 Certified Textile Industries By Country and Year.

Source: Mathieu, Alain (2001), "Quality Certification—Its significance in the Global Textile Industry".

2.6.1 Quality management system in Ethiopia

The growing liberalization of trade and the globalization of market, present formidable challenges to companies in developing countries in order to survive in today's market. On the other hand, increasing number of organizations are involved in, or insist that their suppliers comply with ISO 9000 quality management system requirements. To overcome the challenges and become competitive in the international market, companies should build QMS into their processes that enable them to deliver quality products or services at expected time and competitive prices.

Ethiopia, a third world developing country, is still on the way to develop favorable conditions for ISO 9000 QMS. Most organizations are not familiar with ISO 9000 quality management system. Only few researches have done concerning quality management system in Ethiopia.

Very few researches were done before on quality management. The first research was carried out on "Implementing TQM in the technical services of Ethiopian Air Lines" by Gebeyaw Damte, July, 2001. His thesis work focuses on implementation of total quality management in the technical services of Ethiopian Air Lines.

The second research was done on “Quality management: Efforts and Problems in Ethiopian manufacturing Industries” by Fasika Bete, July, 2003. The research work was to assess and investigate the quality related problems in Ethiopian manufacturing industries and their efforts to quality management. He took 100 manufacturing industries out of 796 for his study. His thesis addresses the current situation of quality management in Ethiopia.

Ezra Tsegaye also carried out another research, on “Quality management system in Ethiopian Food processing Industries” in 2004. His thesis was concerned on surveying of the quality related problems in Ethiopian Food processing Industries. Moreover, he identified the main components of food quality management system. He prepared the implementation model of quality management system for Ethiopian Food processing Industries. Concerning quality, a research was also done on “Quality improvement in Ethiopian Textile Industries”, By Gulilat Gatew, July, 2005. His thesis was focused on quality improvement techniques for Ethiopian textile industries.

2.6.2 Quality management system in Ethiopian Textile Industries

On the same manner, ISO 9000 quality management system is not familiar in Ethiopian textile industries. Only one textile industry is implementing ISO 9000 quality management system and certified with ISO 9000 certificate lately. More than five textile companies (including Adey Ababa Yarn share company, Ethio-Japan synthetic share company, Awassa textile share company, Combolcha textile share company, Diredawa textile factory) have decided to implement quality management system lately.

In Ethiopia, almost all textile industries were in a huge loss and are still. Currently the companies are not in a position to satisfy customer requirements. They are poor in handling and utilization of their resources such as manpower, machinery, and materials.

The research on “Model Development of Quality Management System for Ethiopian Textile industries” is the first that focuses on identifying quality related problems in Ethiopian textile companies and propose the appropriate QMS- implementation model.

CHAPTER 3 PROBLEM IDENTIFICATION

The Ethiopian economy is dominated by agriculture that accounts for over 50 percent of its GDP, 90 percent of its export earnings, and 88 percent of the labor force. A variety of crops are grown seasonally in different parts of Ethiopia, consisting of coffee, cotton, cereals, and oil seeds. The main cash and industrial crops are being coffee, oil seeds, cotton, fruits, vegetables, etc. It is estimated that the crop production and livestock husbandry account over 86 percent of the agricultural GDP. Ethiopia has immense potential for the production of cotton, but only about 42000 Ha or some 2 percent of the potentially suitable area is cotton cultivated. Presently most of the cotton production comes from state farms and private commercial farms [6].

Asian countries such as China and India satisfy their domestic market and also dominate the international textile market. Those countries have identified the textile sector as the key industrial sector for their economical development. Moreover, those countries apply quality management principles. In Ethiopia, the textile industries could dominate the economy mainly due to the very high demand for their products such as yarns and fabrics in the local market, if they apply the quality management principles and produce quality products.

Organizations that produce textile products may feel that no need for the application of quality management system, as there is no pressure for quality product. But we live in the competitive world in all aspects. Further more, our economic policy declares “free market policy”. Hence, it is compulsory to involve in the international market, if the organization needs to survive.

Both in domestic and international aspects, Ethiopia have good development opportunity and huge potential in developing textile sub-sector. However, the textile sub sector is still on the lower level with little progress. The total output value in textile sub-sector is fluctuating in recent years with lower proportion in the manufacturing sector. The average quantity is still very low compared with other countries in Southern Africa, such as Kenya, Lesotho and others, which achieved fast development in textile sub-sector [5].

Public textile enterprises are generally suffering from losses. According to the Public Enterprises Supervising Authority (PESA), all public textile companies were severely at losses in 2001, and some companies were even unable to pay wages. As a result, privatizing process was held up; on the other hand of the rigid enterprise mechanism, most public enterprises were unable to find solutions. Because of undue large scale as well as large number of employees, obsolete equipment as well as long-time poor performance, the privatization made little progress.

There is inadequate leadership in Ethiopian textile industries. There is a short-term view on the business, which leads to a quantity oriented management culture. Business leaders rely on a few key members of personnel. The need for an overall coordination of activities is overlooked. Quality is regarded as a technical issue only, managed by technicians. There is no proper awareness of the strategic importance of quality to the enterprise among owners and top managers.

The other big problem in textile industries is the obsolete machines and equipments. The majority of machine and equipments in the public textile industries have been in operation for several decades and without effective maintenance over a long period of time. Shortage of spare parts and accessories is the general problem faced by these enterprises, so they cannot perform timely maintenance and replacement of easily -damaged parts. Because of the poor capacity in supplying accessories by domestic suppliers, parts and spares required by the enterprises mostly depend on import.

Machineries and equipments in textile companies established before 1960s, is generally out-dated, for example, Akaki textile share company, whose spinning and weaving equipments was mostly built in 1950s, and a large part of the equipment is too old to work properly. Machineries in the companies established in 1980s are in relatively better conditions, but there are also exists the problem of decreased productivity because of the poor maintenance.

The limited variety of products and its low quality level is another problem faced textile industries. In Ethiopia textile enterprises are mainly producing pure cotton products, with the low turnout of man-made fiber/cotton blends, because of deficient application in the raw material

species. Since they mainly produce for domestic market, these enterprises had no innovation in quality control, product development and other aspects over a long period of time. The products of each enterprise are similar, and the variety is small, while the quality is low. The product is primarily concentrated on cotton yarn, grey drills, kaki, bed sheet cloth, etc. The deficiency caused by the singular product structure can be seen in at least three aspects: first, it cannot compete with imported textile products, secondly the market opportunity for export is low and with great limitation, and thirdly it cannot satisfy the demand of garment sector for diverse fabrics. Currently in Ethiopian textile companies, the product inspection system is generally very poor. These companies possess certain laboratory equipments, most of these equipments gave a service of more than 10 years and some equipments have been in service for 20 to 30 years.

For a long time, the products made by Ethiopian textile companies have been primarily targeting at the domestic consumer market. Because of low domestic purchasing power, and protection of domestic market by high tariff, the companies are poor in market awareness, cost-awareness and competition awareness. As a result, product quality has not been improved over a long period of time. In addition product varieties have been limited. The companies are backward in craft technique; rough in management and marketing, insufficient in the means and ability for quality control, high in the product cost. After the market is opened up, under the circumstances where the market decides the price, they cannot compete with large quantity of high quality and low price imported products, so they can only be reduced to produce lower end product. They have turned from the original production of heavy –gram and high –value fabrics to that of light-gram and lower-price grey cloth as the major products, and they also produce yarn for the traditional handloom cloth (local weavers). Having been isolated from the international market for a long time, the enterprises are unable to follow the demand and trend of international textiles market because they lack information. Nor do they know to keep up with international textiles market. To compete for the export market, the enterprises' marketing and management ability, products variety structure and quality level will all meet tremendous challenge.

Governmental administration over companies is unable to break away the restriction of planned economy mode, with the result that the companies are still suffering from excessive interference

and restriction. Facing the strong impact of imported products after the market is opened up, these companies lack effective ability to adapt, and miss the market opportunity [6].

The board of directors of public companies supervision authority holds much right to make direct decisions in management for the public companies while the companies have no enough decision-making rights. The legal person status has not been formed for public companies to be market entity with independent management responsible for profit and loss, self-development, and self-control. The nation exerts too rigid management over public companies, and too particular in the administration of the companies' operation, management and personnel, which causes the limited autonomous, right for companies that lack of positive attitude and initiative.

There is a problem for domestic companies engaged in textile product trade to be scattered & fail of small scale. Complete and highly efficient marketing network has not yet been established.

Another serious difficulty in textile industries is the supply of good quality raw material. The industry structure is singular with poor foundation, and the domestic supplying ability of raw and auxiliary material and spare parts for textile production is weak, therefore it is highly dependent on import. Except cotton, which can be supplied domestically, other raw and auxiliary materials, such as manmade fibers, dyestuff and chemicals and accessories for textile machineries and equipment, etc are imported. Moreover, Ethiopian cotton has not been improved for a long time, so there exist the problems of short fiber length (around 27 mm), lower maturity, higher content of short fiber, higher content of sugar, higher content of trash, which restricts the development of intermediate and high-quality textile product. There is also a very high fluctuation in the supply of raw material. This will make the manufacturing of consistent quality product or any future quality improvement plans difficult. Quality concepts can facilitate the integration of suppliers and manufacturers by setting common goals.

Ethiopian textile sector has not formed a complete industry system. There is no comprehensive coordinating and supporting management organizations for the textile sector to develop. So, they did not become a powerful unity, and each textile company fight for itself, and the self development ability is very weak. QSAE is also far to establish comparatively complete quality

inspection and standardization system for all textile products. Currently, textile product standard only contains part of cotton fiber, yarn standard and standard for few types of fabrics.

The other serious problem is the poor quality of labor force (unskilled manpower). Currently; almost all Ethiopian textile companies have excess unskilled manpower. Of course, man power is the key for these companies to perform its activities to produce quality products. But the question may raise ‘what kind of man power? “. Skilled manpower is required. According to investigation of textile companies, employees with primary school and below education occupy 57.3 % and those with senior high school and above education occupy 6.5 %. The companies lack practical and systematic employee training programs and implementation methods. Even they do provide training; it becomes formalistic, and cannot really improve employees’ potential skills and production efficiency.

Ethiopian textile companies do not also have good infrastructure. The infrastructure is not satisfactory. In these companies there are shortcomings in areas such as power supply, transport, communication, and education. For instance, the electric power does not give guarantee for normal production of the companies. According to investigation, monthly planned power failure and unexpected power interruption often take place; sometimes in a month there are more than 100 unexpected power interruptions, which greatly affected the companies’ normal production and product quality. In addition, specific services in areas important to quality development, (example: standardization, testing, training, and consulting) is not adequate for the needs of the companies.

In general, for the problems occurred at these companies, the QMS developed must address some basic issues regarding the implementation of quality. First, it must show where the company’s quality concepts are compared with the international situation. It must also show how the gaps are met in order to make the textile products competitive on the international market. It must identify those quality approaches that will best suit the country’s condition and how they are going to be implemented in the company. Therefore, each textile company should assess the gaps between itself and its best competitors (both locally and internationally) and develop & implement its own quality management system.

CHAPTER 4 DATA COLLECTION AND ANALYSIS

4.1 DATA COLLECTION

Currently, there are about fifteen textile industries in Ethiopia. Out of which three are private integrated textile companies (Almeda Textile Company, KK blanket factory, and D.H Geda blanket factory). And the remaining are the public textile industries.

The researcher has assessed six integrated textile companies (Bahirdar textile Share Company, Akaki textile Share Company, Adey Ababa yarn Share Company, KK blanket factory, Awassa textile Share Company, and Ethio-Japan synthetic share company). More over, Quality and standards Authority of Ethiopia and Ministry of Trade and Industry was visited obtaining important information about textile industries. In the above textile industries and service sectors, the assessment was done through four methods: questionnaires, face to face interviews, direct observation of the companies, telephone, and the available documents of the respective company.

4.1.1 Survey questionnaire

The researcher has designed the survey questionnaires for assessing the quality management system in selected textile industries. This questionnaire was distributed to some persons in Bahiradr textile Share Company for its comments and suggestions before finalizing it. Furthermore, the researcher has discussed with some experts on quality and standard authority of Ethiopia (training and promotion directorate) on the relevance of this questionnaire. Similar comments were given that the questionnaire shall not contain more subjective questions. The questionnaire was finalized taking into account the above suggestions under the guidance of the advisor.

Four companies (Bahirdar textile Share Company, Akaki textile Share Company, Adey Ababa yarn Share Company and KK blanket factory) from the Ethiopian textile industry were selected for the survey of quality management system. The list includes the two case studies also. One hundred questionnaires were distributed to the selected textile companies, out of which fifty two questionnaires were returned, giving a response rate of fifty two percent.

The composition of the persons who were participated in the response of the questionnaire includes: General Managers, Production and technical managers, Quality control head, Administrative head, department heads (Spinning, Weaving and Finishing departments), personnel head, shift leaders, and supervisors. The general objectives of the questionnaire are:

- 1- To determine whether there is an application of QMS or not in the company.
- 2- To assess attitudes, tendency and commitment of all workers towards QMS.
- 3- To know the existing system and structure of quality control.
- 4- To ascertain the level of awareness of managers and workers on quality.
- 5- To propose the appropriate QMS –implementation model for Ethiopian textile industries.

The survey questionnaire contains about 90 questions requiring four types of answers.

1. The first type uses a normal scale, yes or No.
2. Comparative scale, Excellent/high, very good/Moderate, Good/Little, fair/low, poor/none.
3. Subjective type questions, which need brief answer.
4. An ordinal scale, important / not important.

Furthermore, the questions in this survey questionnaire are categorized into nine different sections with reference to textile industries in Ethiopia.

- A- *To assess the awareness level and understanding of basic concepts of quality:* This category (questions 1 -7) was designed to investigate the awareness level and basic understanding of quality in Ethiopian textile industries.
- B- *Management commitment, leadership, and decision-making:* this is the second category (8-24) and designed to understand the commitment of top management towards quality in textile companies. It also includes the leadership and decision making capacity of the leaders/ managers in the company. From this set of questions it is possible to understand the current general commitment of leaders/mangers in textile industries towards quality.
- C- *Organization and Communication:* (25-34) was designed to investigate and assess comments /suggestions on the company's organizational structure and the relationships among departments and workers.

- D- Causes of poor quality and implementation barriers of QMS in textile industries:* this category (35-37) was designed to assess the causes of poor quality textile products. The objective is to evaluate the impact of factors such as raw materials, process control, and working environment.
- E- Status of training and training program:* this category (38-46) was concerned on training program of the textile industries. This set of questions identifies the training requirements and its importance to the company relating to quality. It includes: criteria of selecting personnel for training, types of training courses and the organization who gave the training courses.
- F- Customer focus and Suppliers' relationship:* This is the sixth category (47 -57) was designed to assess the company's effort to handle its customers and suppliers. This set of questions included: identification of customer requirements, communication gap between the company and its customers & suppliers, awareness of internal and external customer, the linkage of the company objectives to customer needs and criteria for removing vendors in case of unsatisfactory performance.
- G- Status of the textile industries in: quality planning, quality design, quality control, quality improvement, and quality assurance:* This category (58-78) was designed to investigate the efforts of the company in quality management and quality control activities.
- H- Self-assessment in textile industries:* the questions (79-86) are focused on the self-assessment (internal and external auditing) of the overall activities of the respective company. This area include: the company's documentation of procedures for auditing, the responsibilities and requirements for conducting audits, the methods for recording the results, and the management action to take timely corrective action on deficiencies. It also includes the cost of quality and its calculation methods.
- I- Efforts of textile industries towards teamwork:* This is the last category (87-90) focused on the teamwork or group work in textile industries. It includes: assessment of the quality circles in the respective company, the members of the quality circle, the main functions performed by quality circles and the loyalty & trust in team work.

The following table 4.1 shows the respondent companies and their respective response rate for questionnaires. Appendix II shows the total results of the survey.

Table 4.1 Respondents rate of four textile industries

<i>S.N</i>	<i>Respondent company</i>	<i>Location</i>	<i>Number of Workers</i>	<i>Number of questionnaires distributed</i>	<i>Number of respondents</i>	<i>Respondents rate (%)</i>
1	Bahirdar textile Sh.Co.	Bahirdar	1677	25	17	68 %
2	Akaki textile Sh. Co.	Addis Ababa	1852	25	15	60 %
3	Adey Ababa yarn Sh. Co.	Addis Ababa	2216	25	11	44 %
4	KK textile Industry P.L.C	Addis Ababa	430	25	10	40 %

4.1.2 Structured interviews

Structured interviews (face to face) conducted with four textile industries and one service sector (Quality and Standard Authority of Ethiopia). Most of the interview questions conducted are similar to the questions in the questionnaire. This helped me to cross-check the response given by the respondents on both methods of assessment. The interviewees were top and senior management level officers similar to that of the survey respondents.

The general objectives of conducting the interviews are:

1. To investigate the main components of QMS for textile industries in Ethiopia.
2. To observe overall activities and processes in the respective textile companies.
3. To assess opportunities in the textile companies to implement QMS.
4. To assess the existing system of quality control and QMS in the companies.

4.1.3 Direct observation

The researcher has also used this method for collecting the required data and information from the respective companies. The manufacturing processes of the three plants (spinning plant, weaving plant and finishing plant) of each textile company have been mapped during visiting. Moreover, the infrastructure and facilities of the companies has been observed. The important documents of the respective companies such as annual reports, audit reports, company profile brochures have been also used for the assessment. Furthermore, the training manuals of quality management system, statistical process control and others have observed.

4.2 DATA ANALYSIS AND INTERPRETATION

The collected data through the means of interviews, questionnaires, direct observation and using documents are analyzed & interpreted. The results of the statistical analysis are presented in this section. The researcher believed that the current situation of the textile industries towards quality management system has exactly reflected in these questionnaires and interviews.

4.2.1 Survey findings

As described above, the total 90 questions of the questionnaire are divided into nine sections for suitability of the study. The results of these questionnaires (for the above four textile industries) are discussed below.

The general attitudes of the employees of the companies towards the quality and quality management system have been assessed using the first seven questions. The companies define quality as “conformance to the specifications”. They have product specifications, which do not consider the customer requirements. The quality awareness level and understanding of basic concepts of quality is little and the participation of the employees in quality activities is also low. Most employees do not understand that quality is the responsibility of everyone in the companies. The companies do not have the quality objectives. Moreover, their intention to recognize and solve the quality related problems are less.

The next seventeen questions were designed to assess the Management commitment, leadership, and decision-making. Fifty two percent of the total respondents agree on that the top management of the respective companies is not committed to quality initiative. Even though, the top management admits its commitment to quality, there is no demonstrated practical application. The companies do not have quality manual. Furthermore, most companies do not define properly all the functions and inter-relationships of the staff. The management does not listen to employees and he does not encourage ideas and suggestions. About eighty one percent of the respondents agreed on that the employees especially low-ranking staffs are not empowered to take decisions. The output of the respondents result on decision-making is shown in table 4.2.

Table 4.2 Consolidated responses on decision making at four textile industries

<i>Questions</i>	<i>Rating results</i>				
	<i>High</i>	<i>Moderate</i>	<i>Little</i>	<i>Low</i>	<i>None</i>
To what extent are employees at different level get involve in decision making?					
a) shop floor level	1	6	6	9	29
b) Supervisors	-	6	14	20	10
c) Shift leaders	-	7	26	11	6
d) Department heads	5	19	22	3	-
e) Production and technique head	17	16	8	3	4

The third group questions of questionnaire are focused on organization and communication system of the companies. A majority of the respondents (29 percent) have agreed on the suitability of the existing organizational structure for working environment. Most companies set their goals and targets. But, they do not implement it practically. The companies do not establish its clear vision of the future. The communication among the staff and departments is not bad, as the results of the respondents showed. A problem of upward communication (with the boss) exists especially in public textile industries.

The fourth group of questions has focused on the causes of poor quality and implementation barriers of QMS in textile industries. Accordingly, the first question was “who is/are the responsible department(s) for quality in the company”. About fifty two percent of the respondents suggested as quality control department and about twenty seven percent suggested as top management. The respondents’ response (about 49 %) indicated that the first main current obstacle for improvement in quality is the absence of the system (policy, rules and procedures). And twenty four percent of the respondents suggested the management as the second obstacle for quality improvement. The causes of poor quality have been assessed in the respected companies and the results are shown in table 4.3.

Table 4.3 Causes of poor quality products in textile industries

	<i>Causes of poor quality products</i>	<i>Frequency</i>	<i>Percentage</i>
A	Defective raw materials delivered from suppliers.	39	75.00 %
B	Inadequate training of workers in the company.	37	71.15%
C	Due to poor maintenance of machines in the company.	41	78.85 %
D	Lack of top management commitment to quality.	33	63.46 %
F	Low quality awareness of workers in the company.	29	55.77 %
G	Due to many vendors of raw materials.	21	40.38 %
H	Due to carelessness of the workers in the company.	27	51.92 %

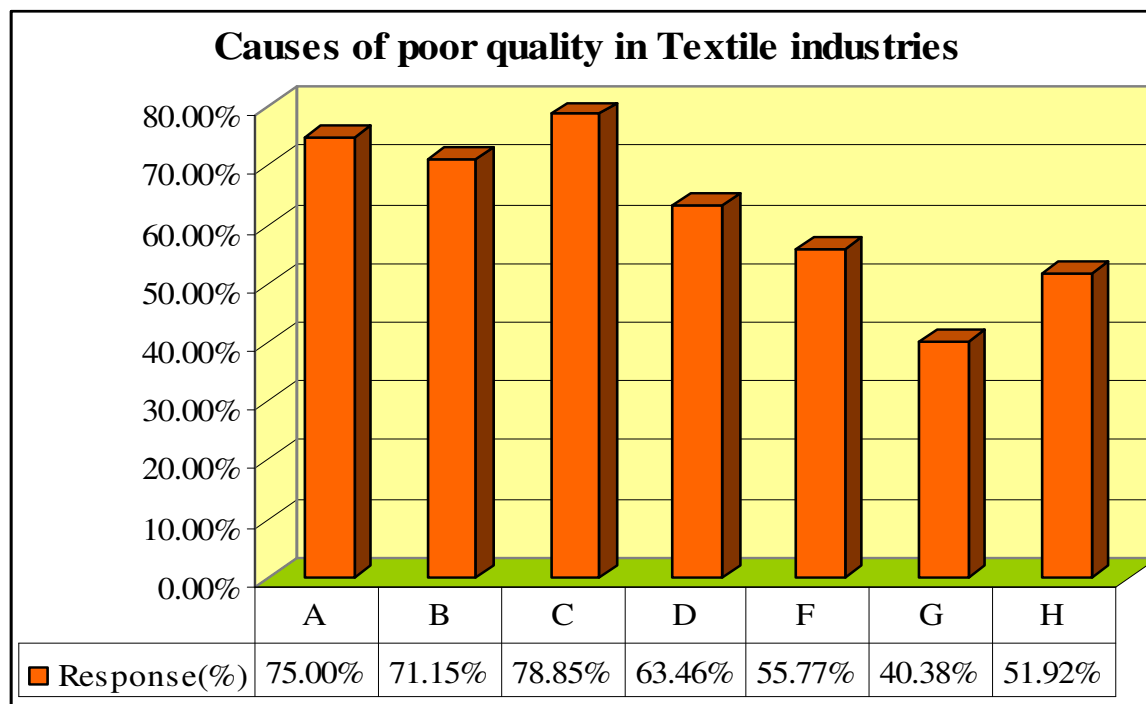


Figure 4.1 Causes of poor quality in textile industries

About seventy nine percent of the respondents have agreed that the main causes of poor quality in most textile companies are due to poor maintenance of machines. Secondly, scarcity and low quality of the raw materials (mainly cotton fiber) is another core problem of textile industries. Some textile companies have the training program within their company. Moreover, few persons of each textile company took the training given by external bodies such as Quality and Standards Authority of Ethiopia (QSAE), Ethiopian management institute and others. But the internal and

external training does not bring any change in the company specially relating with quality (as suggested by the respondents). Bahirdar and Akaki textile share companies have a training program. But the training program of those companies does not provide appropriate training and it is not related with the companies' objectives.

The sixth group of question was designed to assess the company's effort to handle customer and its relationship with the suppliers. Most textile companies do not identify customer requirements. About thirty one percent of the respondents concur that there is a gap of formal communication between the companies and their customers. The companies do not measure the customers' needs and satisfaction. Only few employees of the textile companies understand the difference between the internal and external customer. About fifty four percent of the respondents pointed out that the objectives of most companies do not linked to the customer needs and expectations. Most textile companies do not established criteria for removing vendors in case of unsatisfactory performance.

The seventh group (questions 58 -78) is concerned about status of the textile industries in: quality planning, quality design, quality control, quality improvement, and quality assurance. As stated by fifty four percent of the respondents, there is no quality planning in the respondent textile companies. Sixty one percent of the respondents have agreed on that the quality design and development process has no a documented procedure in most industries. Almost all textile companies have a quality control department. Mostly, this department is confined to testing and inspection of the incoming material and the final product. There is no quality improvement program in the companies, and they spend most of their time on detecting the defects of the products rather than preventing the defects. The monitoring and inspection of process control during production is less and they do not use the statistical process control tools. Most textile industries do not set a guarantee for their products to satisfy their customers.

Most respondents agree on that their companies audit its overall activities. But this kind of auditing is not concerned with the issues of quality and quality management system-requirements. Mainly it focuses on financing and budget (which is one of the activities of the company). Almost all respondents concur that the textile companies do not calculate the cost of quality.

The last group of questions concerns about the teamwork in textile companies. According to the respondents' response, some of the textile companies have tried to establish the quality circles. But after a time it stops its work and disappear. Even among them there was no a good sense of teamwork.

4.2.2 Observations and conclusions

From the above discussion it is possible to understand the general status of textile industries and their tendency towards QMS. The top management of most public textile industries does not show a commitment and strong sense to quality. Thus, most companies do not have their own business culture to support total employees involvement in quality improvement. They do not have a clear quality vision, mission, and objectives. They focus on short-term interest rather than long-term interest.

Most textile companies do lack knowledge on quality and quality management system. Hence, the researcher has observed that there is a big gap between the ISO 9000 quality management system requirements and the current status of these companies. The quality awareness level on all employees of the companies should be developed through training. Much has to be done on training by internal and external trainers. One of the external bodies, which can play a role on training of these companies' staff, is QSAE. The training and promotion directorate of this organization has to be encouraged and should be well organized by skilled manpower.

CHAPTER 5 PROPOSED QUALITY MANAGEMENT SYSTEM FOR ETHIOPIAN TEXTILE INDUSTRIES

The main focus of this chapter is to assist and propose quality management system, for Ethiopian textile industries. Hence, main components of quality management system for textile industries have been identified based on the results of the survey and ISO 9001 QMS-requirements. Then, the textile quality management system implementation model has been prepared.

5.1 INTRODUCTION

The economy of most developing countries is based on agriculture, which accounts for 60 to 80% of their national product (GNP), and their industries are in various stages of development. Manufacturing companies are generally family owned and professional management is confined to large companies or top production units working under license from multinationals. Consequently, most producers are not aware of the benefits of quality systems and their effect on profitability and long-term growth.

The industrial sector in Ethiopia has been characterized by a low level of development, even by the standards of many least developed countries. It accounts for 12.4% of the GDP, 9.5% of total employment and 21.2% of export earnings.

This sector is mainly focused in producing consumer goods both for domestic and international markets. The main consumer products includes textile products, foodstuff, beverage, garment products, cement, leather products, wood products, metallic and non-metallic products. Almost all of these sectors are suffering from the quality related problems.

Textile industry is one of the manufacturing industries that play a role in the economic development of a country. This industry produces yarns, fabrics, blanket, carpets, and so on.

Modern quality concepts are just beginning to be adopted by Ethiopian textile industries. Except one, all textile industries in Ethiopia do not make an effort to prepare and implement quality management system. To some extent this has contributed to the narrow perception of quality observed in the industry. Currently, more than five Ethiopian textile industries are attempting to

implement quality standards such ISO 9001. Quality is a complex and never ending process that needs a systematic approach. Quality goes far beyond meeting one or another standard. So, all textile industries must prepare their own QMS, which address their particular quality problems.

5.2 HISTORICAL DEVELOPMENT OF TEXTILE QUALITY IN ETHIOPIA

Most Textile industries in Ethiopia were established between 1950 and 1965 in Imperial period. This indicates that at the beginning, the establishment and development of textile industries were relatively fast. In the Derg regime, the number of textile industries established was reduced by some extent. The rate of growth can directly be related to the social and political conditions of the country. The ideology and relative stability of the government in power at the time significantly determined the development of the industries. The quality concept of textile starts when textile industries were established in the country. The first integrated textile factory in Ethiopia is Dire Dawa textile factory, which was established in 1939. Therefore, to study further development of quality concepts in textile industries, we shall classify into three periods: Imperial period, Derg period, and EPRDF period.

i- The Imperial Period (before 1974): - In this period, most industries and those bodies that are directly involved in the promotion and regulation of textile quality were established. Good examples of such bodies include the Quality and Standard Authority of Ethiopia (QSAE). The industries had only a means for inspecting quality of a product and had no market situation that necessitates them to go beyond. Textile quality concepts in Ethiopian industries were not given attention in this period.

ii- The Derg period (1974 - 1991): - Since 1974, the country has adopted a centrally planned socialist system. Derg pursued a socialist ideology and a centralized economic policy. The government confiscated all private enterprises. The Central Planning Authority determined the volume of production in any type of product. Absence of competition and having quota for production has limited any genuine motivation to strive for quality. There was no considerable introduction of quality concept (techniques) and the inspection-based approach from the preceding period continued. By and large the development of quality concept was sluggish during this period and for this several reasons are given. Some are: the economic strategies pursued lack of customer focus, ignorance to cost of poor quality, insufficient education and

training, exodus of intellectual to foreign countries, and different natural and man-made disasters in country. The textile industries have no quality concepts during this period and they sell what they produced.

iii- The EPRDF period (Post 1991): - For textile industries, the transition period from Derg regime to EPRDF was very difficult situation where most of them are in a crisis and the production was reduced. The current government, EPRDF replaced the socialist, later on the mixed economic approach of the Derg with that of a market led economy where competition became the rule of the game. A number of enterprises were returned to private ownership. And those that remained under the government ownership were re-organized to be administrated by a board rather than direct government control. Manufacturers are encouraged to be competitive. Ministries and government offices were also re-structured to accommodate these changes. As a result the textile industries tried to make efforts to catch up with the latest quality concepts.

There were also changes to the organizations directly involved in textile quality in the country during this period. Based on the reviews made on the authority, ESA was re-organized in 1997 as Quality and Standard Authority of Ethiopia (QSAE). QSAE is now the prime government office responsible for promoting quality and setting as well as regulating standards in the country. It has adopted ASTM and ISO/IEC 17025 standards for Ethiopian textile industries. Currently, there is no internationally accredited certifying body for any of the international standards in the country.

5.3 GENERAL BACKGROUND OF ETHIOPIAN TEXTILE INDUSTRIES

In Ethiopian textile sector, four types of establishments are distinguished. The most numerous are the establishments involved in spinning, weaving and finishing of textiles, and they also have a relatively large average number of workers per establishment (776) [33]. The knitting mills and the wearing apparel manufacturers are much smaller in size. The two large establishments manufacturing cordage, rope, twine & netting are *public* enterprises. The proportion of public enterprises is overall (38%) much larger than in the leather sector (where it is only 13%). However, the differences are large: almost two-thirds of the enterprises in spinning, weaving & finishing of textiles are public, none of the relatively small knitting mills, and only 16% of

wearing apparel establishments. Even more significantly, the minority of public enterprises have created much more employment, i.e. 66.8% of the employees.

The textile and garment factories sub-sector consists of seven integrated public textile mills, two spinning mills, two sewing thread factories, two blanket factories and five large-scale garment factories, and two Hessian sack factories. In addition, there are a few privately owned textile mills and garment factories. The textile and garment industries by and large cater for the domestic market, but they are currently facing stiff competition from imported fabrics and used clothing. With the exception of the knitting sub-sector, the textile industry in general is capital intensive.

According to the CSA medium and large-scale industries survey, the current number of establishments engaged in the textile and garment sector is 36 out of which state enterprises are 23. These establishments employ about 24000 persons. Employment by state enterprises accounts for about 65 percent.

The main products manufactured by the state enterprises are cotton fabrics, nylon fabrics, acrylic yarn, cotton yarn, woolen and waste yarn cotton blankets, and sewing threads. Most of the integrated textile mills are engaged in the production and finishing of fabrics. Market yarn for the handloom weavers (local weavers) and cottage industries is commonly produced in most of the textile mills. The privately owned factories are predominantly engaged in garment making, but the types of product manufactured by this sub-sector are diverse. Table 5.1 below show the major textile and garment products manufacture in the country and the public factories engaged in the production of these items.

Table 5.1 Major produced Items

<i>S.N</i>	<i>Major item produced</i>	<i>Enterprise engaged in the Production</i>
1	Cotton yarn	Akaki textile share company, Adey Ababa yarn share company, Arba Minch textile factory, Awassa textile factory, Diredawa textile factory, Ediget yarn and sewing factory
2	Acrylic Yarn	Diredawa textile factory, KK textile industry
3	Fabrics	Akaki textile share company, Ethio-Japan synthetic factory, Arba Minch textile factory, Awassa textile factory, Diredawa textile factory, Bahirdar textile share company, Combolcha textile factory, Almeda textile factory.
4	Blanket	Adey Ababa yarn share company, KK textile industry
5	Woven garment	Addis Garment, Akaki garment factory, Nazareth garment factory
6	Knitted garment	Adey Ababa yarn share company, Almeda textile factory
7	Sewing threads	Ediget yarn factory, Nefas Silk yarn factory

Source: Public enterprise supervisory Authority

The design capacity of both the state and private enterprises varies according to type of enterprises and product. According to the CSA data, their yearly production estimate at full capacity is about Birr 962 million, but they currently operate at 52 % of their full capacity. The table 5.2 below shows volume of production of textile products during the periods 1996/1997 to 2000/01.

Table 5.2 Volume of production of textile products during periods of 1996/97 to 2000/01

<i>Major products</i>	<i>unit</i>	<i>1996/97</i>	<i>1997/98</i>	<i>1998/99</i>	<i>1999/2000</i>	<i>2000/ 01</i>
Cotton fabrics	000 m2	34577	38030	42495	34499	44925
Nylon fabrics	000 m2	4193	4722	4047	2921	1310
Acrylic yarn	Tons	2420	1257	730	354	411
Cotton yarn	Tons	3133	2657	3408	3977	5726
Blanket(woolen)	000 m2	3763	2757	3896	3334	3095
Blanket (waste cotton)	pcs	244471	194446	182084	144653	90311

Blankets (others)	pcs	8275	16257	34744	40478	-
Bed sheets	pcs	27975	21094	7349	4129	1778
Shirts	Dozen	12376	16266	11647	7199	4646
Carpets	m2	12752	6323	-	-	4779
Gunney bags	Tons	6418	7649	4981	5708	5981
Hosieries	Dozen	174620	172040	83922	86454	37869
Wearing apparel	Dozen	21883	35988	58655	165926	142156

Source: CSA, Report on medium and large-scale manufacturing

5.4 QMS- IMPLEMENTATION GUIDELINES FOR ETHIOPIAN TEXTILE INDUSTRIES

In the previous chapter, the quality management system assessments are done for few textile industries. Based on the assessment of these industries, the following essential components have been identified for QMS-implementation in textile industries. These components make up the main focus area. The details of the components may vary for different textile companies according to the products complexity.

In general, the researcher identified nine main components of QMS for its implementation process in textile industries. Those are: management responsibilities, resource management, textile product and process design, textile quality control, textile quality improvement, quality assurance, quality auditing/review, quality system documentation, and cost of quality. There is always an interaction among these components and hence the system must take into account this interaction when trying to implement it.

5.4.1 Management Responsibilities

In textile companies, executive management and middle managements are responsible for developing and communicating the quality policy and the importance of meeting customer as well as statutory and regulatory requirements to employees within their organization. They shall ensure that it is understood and applied to the daily work of the organization through the establishment of goals and quality objectives.

In a country where power is traditionally centralized, the role of management is vital in any activity. The management is responsible for setting and updating quality vision, mission and policy of the organization. There has to be an organizational structure responsible for quality. This structure must be empowered to make important decision at all level. Quality planning plays a key role for the success of quality activities. Planning determines what is to be achieved and how it is going to be achieved. Major source of failure in the industry may be linked to planning. Adequate planning (especially strategic planning) has to be made before engaging into any quality implementation. The strategies formulated by an organization may determine its success or failure in the market. The management must show their commitment through their day-to-day activities. They must also adopt proper leadership style to encourage and motivate employee.

Textile industries are huge industries, which manage a very complex system including man power, materials, machines and equipment. Hence, in a quality management system (QMS) of textile industries, decision-making plays a role. Managerial decisions are related to the coordination and core activities of the organization. Organizational decisions are decisions which managers make in their official capacity within the bound of their legitimate authority regarding issues, problems, policies and practices of the organization it self.

Another factor, which should be considered in textile industries, is the preparation of work instructions. This provides detailed steps to conduct specific work activities. Work instructions are prepared as needed to supplement procedure requirements and to ensure that critical work scopes are carried out in a consistent manner. Managers are responsible for determining where work instructions are required in their areas of responsibility and for establishing systems for the generation, review, distribution, revision, and control of work instructions.

Each textile industry has the responsibility for defining how the requirements for quality will be met. Quality planning is a key business processes, and is used in business planning, product and process development, process management, acquisition of process equipment, and in the design and construction of new facilities. The organization shall provide and maintain the infrastructure necessary to achieve conformity to product requirements. Some of the activities included in

quality planning are: identification of customer specific requirements, identification of critical product or process characteristics, identification and acquisition of resources, development of statistical tools and techniques, application of preventative and predictive maintenance, and identification of sources for feedback on the performance of critical processes.

The management in textile industries should also give attention for their customers. The organization must recognize, throughout its ranks that the purpose of all work and all efforts to make improvements is to serve the customer better. This means that it must always know how well its outputs are performing, in the eyes of the customer, through measurement and feedback. To satisfy customer requirements, textile companies must fully understand the customer's current (and future) needs and expectations. In an ideal world, of course, management should always attempt to exceed their customers' needs and expectations and in so doing, stand to gain follow-on orders. To define customer and end-user needs and expectations, textile companies should: identify their customers (including potential customers), determine the customer's key textile product characteristics, identify and assess market competition, identify opportunities and weakness, define financial and future competitive advantages.

5.4.2 Resource Management

Textile companies need to identify and make all the available resources (such as raw materials, information, infrastructure, people, work environment, finance, and support) required to implement and improve their quality management system and its associated quality processes.

Human resources are the principal method of achieving product completion and customer satisfaction. The organization is responsible for ensuring that all personnel are trained and experienced to the extent necessary to undertake their assigned activities and responsibilities effectively. Thus whenever training needs have been identified, top management should endeavor to make the relevant training available and full records must be maintained of all training given by employees.

a) Supplier's Relationship.

One of the sources of problems for poor quality in textile industries is the quality of the raw materials. The main raw material (cotton fiber) for textile industries supplied by the ginning factories locally. Textile companies are the customers for the ginning factories. There is a big gap between the textile companies and ginning factories. There is a minimum flow of information and cooperation towards achieving a common goal. Modern approaches of quality condone such poor relations as suppliers proved to be a very important component for any total quality improvement activities. A relationship of trust and partnership may not be developed overnight and requires major behavioral and attitude change from both parties. As most of the quality gurus concur, the criteria for purchasing materials should not only be prices but also other aspects of quality. For any poor quality purchase the organization will incur extra cost. Therefore, an institutionalized procedure for assessing suppliers is essential. The basic points for evaluating suppliers are: their ability to meet the quality requirements of the product or service, availability of machinery, tools, and manpower at the required technical levels, their commercial and financial viability, their production capacity and ability to maintain specified delivery schedules and the effectiveness of their quality assurance system.

The figure 5.1 below demonstrates the customer-supplier relationship in Ethiopian textile industries for the current situation.

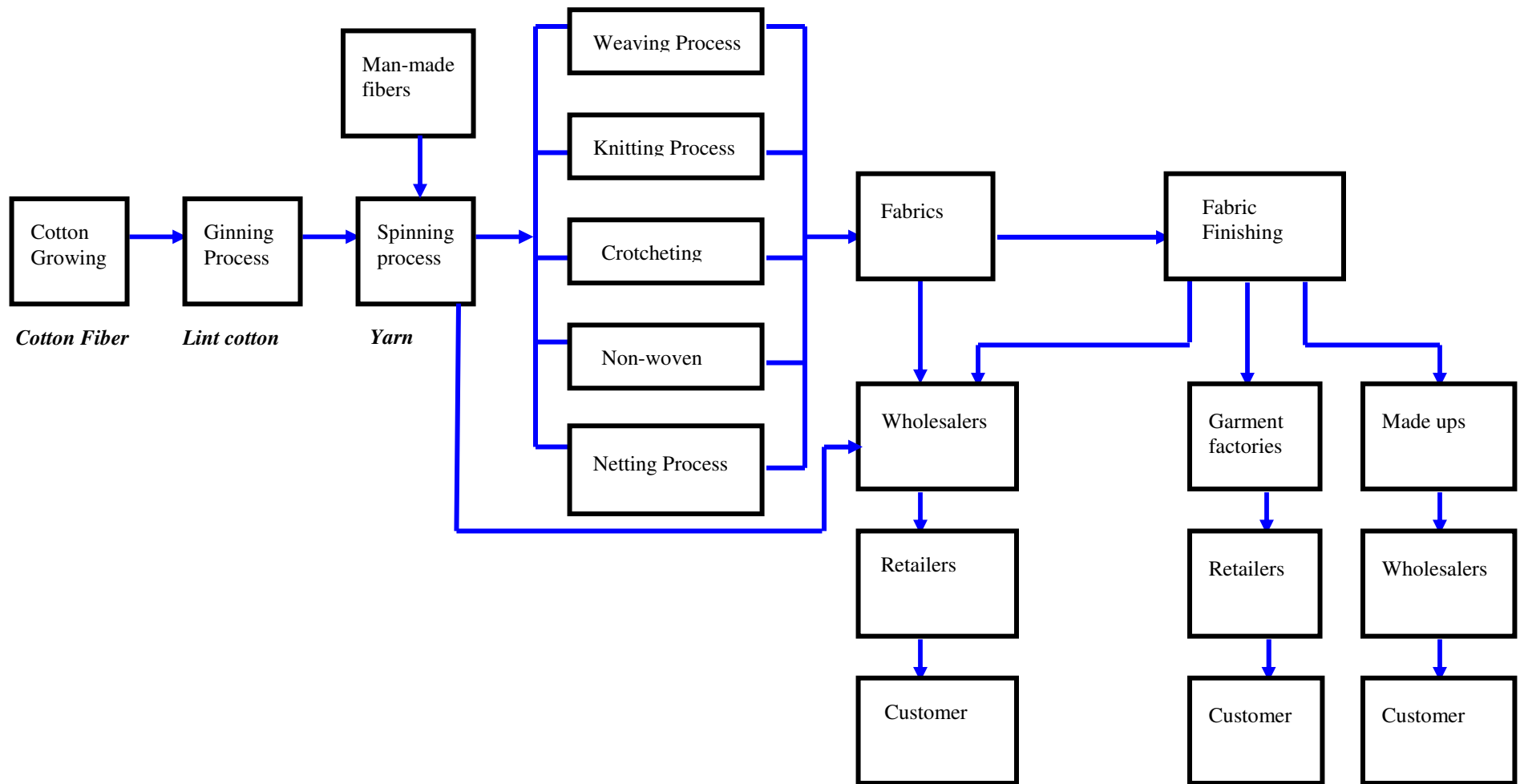


Figure 5.1 Supply chain in textile industries

b) Education and training

For the companies such as textile in our country education and training is very essential and should get attention. In most textile industries only 3 % of the total employees have a diploma & above. A key to quality upgrading is education and training, which involves necessary knowledge and skills, as well as influencing attitudes.

A clear understanding who the customers are, what their needs are, what the features should be of a training strategy and the subsequent training subject matter that responds to those needs are critical components in training for quality. A clear understanding of the customer means that all of those who will participate or benefit from the quality training must be considered in the design and delivery. Most of the time, for lack of a clearly defined company training strategy , some textile companies waste huge amounts of time and money for developing quality training or training associates on tools & techniques that they will never use.

The researcher has assessed the training programs in some textile industries. Some of the courses in their training program do not coincide with the company objectives and their current problem. Further more, the requirements of the customer; the areas that need performance improvement are not clearly defined. Therefore, in textile industry, assessment and clarification of specific quality training is required and the following questions must be answered: the persons who need training, the competitive advantage of the course, the time which the training take, the expected benefits, the number of persons to be trained, and the resources required for training.

c) Facilities.

Textile industries in Ethiopia have different capacity of production which some of them are integrated and others produce a single product (example producing only yarn). Depending on the size of the textile company and the products that it is offering, the infrastructure (example workplace and facilities) required may include plant, hard ware, software, tools and equipment, communication facilities, transport and supporting services. These companies should define, provide, develop, implement, evaluate and consider its requirements in terms of product performance, customer satisfaction and controlled improvement.

In textile industries, the program for successful testing and quality control must consider the following factors : space and arrangement of space, tests to be performed and the equipment for these test, personnel to perform the tests and evaluate the results and the methods and procedures for sampling, performing evaluating and applying the results.

d) Work environment

Another factor that should be considered under resource management is the working Environment. An organization's work environment is a combination of human factors (example work methodologies, achievement and involvement opportunities, safety rules and guidance, ergonomics etc) and physical factors (example heat, hygiene, vibration, noise, humidity, pollution, light cleanliness and airflow). All of these factors influence motivation, satisfaction and performance of employee and as they have the potential for enhancing the performance of the companies, they must be taken into consideration by the organization when evaluating product conformance and achievement.

In textile industries, the standard temperature and relative humidity should be maintained in all section of the production process. Especially those industries that produce products from the hygroscopic fibers such as cotton fiber should ensure these values. For instance, for cotton fiber processing, the standard temperature is 20 ± 5 °C and the relative humidity is 70 ± 5 %. The quality characteristics of the textile products could be highly affected by the temperature and the relative humidity.

5.4.3 Textile Product and Process Design

Most textile industries in Ethiopia contain three main plants: spinning plant, weaving plant, and textile finishing plant. These companies produce yarns from textile fibers (such as cotton, fibers, polyester fiber, nylon fiber, and acrylic fibers), fabrics (such as cotton fabrics, nylon fabrics, blankets) and others. There is a possibility to find each plant independently. For example Ediget yarn factory produces only yarn and has a spinning plant only. The same is true for weaving and finishing plant. Most of the textile industries in Ethiopia produce a woven fabric. Interlacing the warp and weft yarns makes fabric and the process is called weaving. The

final out put of weaving plant is grey fabric. The textile finishing plant makes dyeing, coating, bleaching, or printing of the fabrics. A simple diagram, figure 5.2 below, could represent the general outlook of the textile industry.

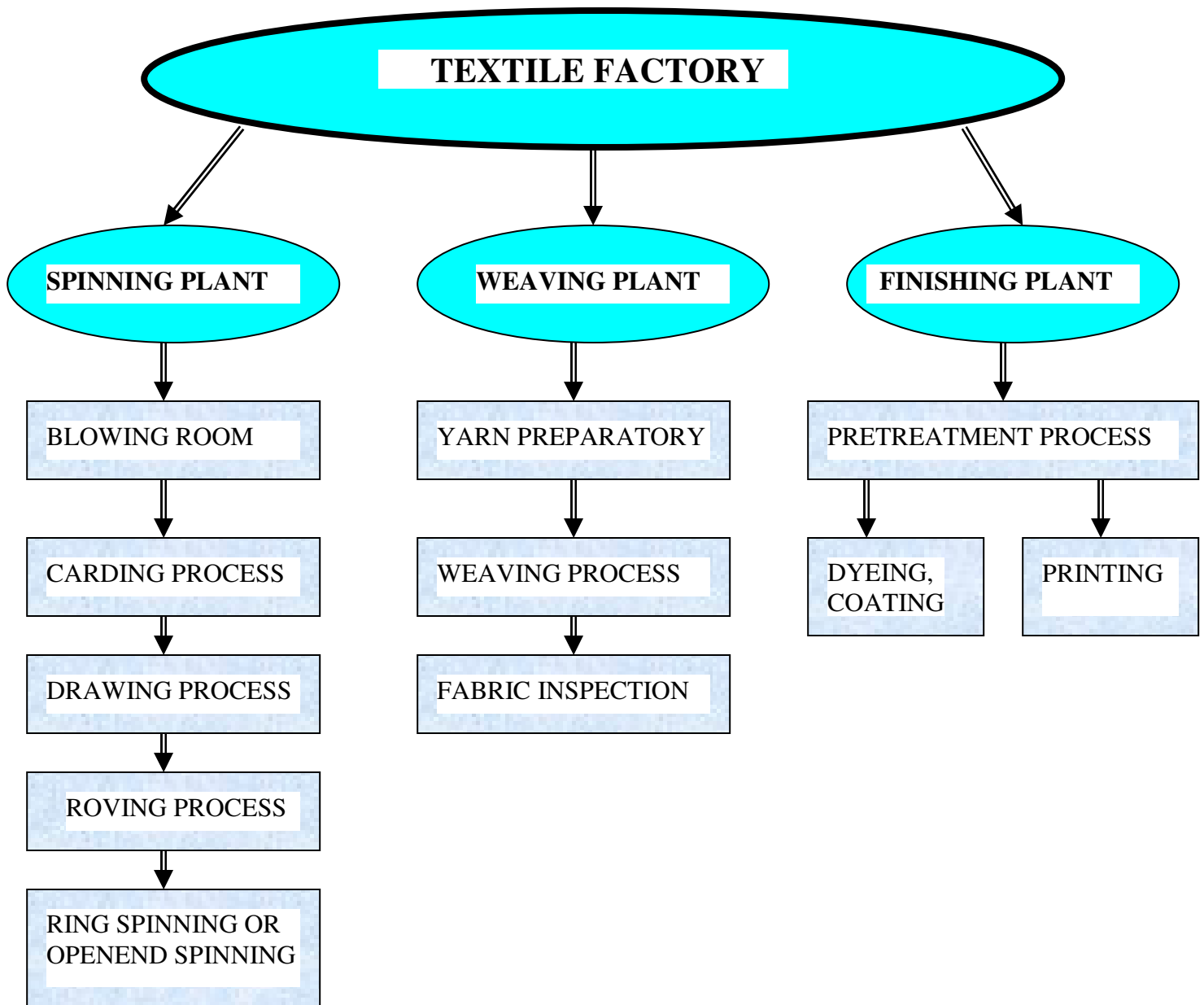


Figure 5.2 Three main categories of textile industries.

Before designing of the textile product (yarn), the specifications should be set according to the customers' requirements. Specification is an agreement between a supplier and a user about the features and characteristics of the article or service to be supplied. Without specification it is not possible to verify whether the product is conform the requirements.

There are four types of specifications: Product profile (textile product), the product specification, product formation process specification and raw material specification. In the product profile is laid down what the user expects from the product and not what the exact physical properties of the product are. The user/ customer is usually not interested in these; he only wants to know which functions the product will deliver. It may be very difficult to find out exactly which functions the user expects, resulting in a product, which supplies more than the user really wants. Usually the product profile is prepared by sales or marketing with assistance of product development, production, and quality assurance. The product profile usually gives also information about competing products.

The product specification gives exact information about the physical characteristics of the yarn and fabrics. There should be a standard values and deviations (tolerances) for each and every feature. The product specification is the translation of the product profile to the physical properties the articles should have to meet the expectations of the customer. The product specification should always give information about the validity of the specification, i.e the articles for which the specification was prepared.

Process specification describes how the textile article is manufactured. It gives information about how the machine setting methods should be i.e pressures, temperatures, machine speeds, etc. Raw material specification gives the physical characteristics of raw materials, standard values and tolerances, the testing methods and the delivery conditions.

Innovation is one important component of any product designing process. In Ethiopian textile industries, innovation is very important to compete in the local and international market. It will bring a significant reward to a company. During designing a balance must be stroke between

innovation and standard processes. On one side designers may have to use past proven materials and methods to ensure reliability, maintainability and variety control. On the other hand, they must use innovative and recently developed techniques, materials or components to avoid stagnation of the designing process.

a) Spinning Process and Yarn design

In spinning manufacturing process, the final output is either carded yarn or combed yarn. Both of these yarns are produced from cotton fibers, Polyester fibers, Acrylic fibers, or wool fibers, which depend on the end use of the yarn. The designing process of the yarn should consider all the quality characteristics of yarn (discussed in the literature review).

The spinning process starts with the inspection and acquisition of the raw material (such as cotton fiber, Polyester fiber, wool fiber, acrylic fiber). The processes of changing those fibers to the required yarn are different. For instance, for cotton fiber, the raw lint cotton comes from the ginning factories in the form of bale. Then the samples are taken from the bales to check whether the quality of lint cotton is as per the specifications. After it is checked for its fitness, the cotton fibers deliver to the first department called blowing. The main functions performed in this department are: opening, mixing and cleaning. During the opening and blending process, the fibers are separated and loosened from each other, trash is removed from the fibers, and the fibers are more randomly mixed to assure greater uniformity. Finally the fibers are formed into a thin partially oriented continuous web of intertwined fibers called chute or lap. The chute deliver to carding process to make carded sliver and this will later change into drawn sliver by drawing process. Roving is made from drawn sliver by roving machine. Finally, the ring spinning machine or open-end spinning machine produces the carded yarn.

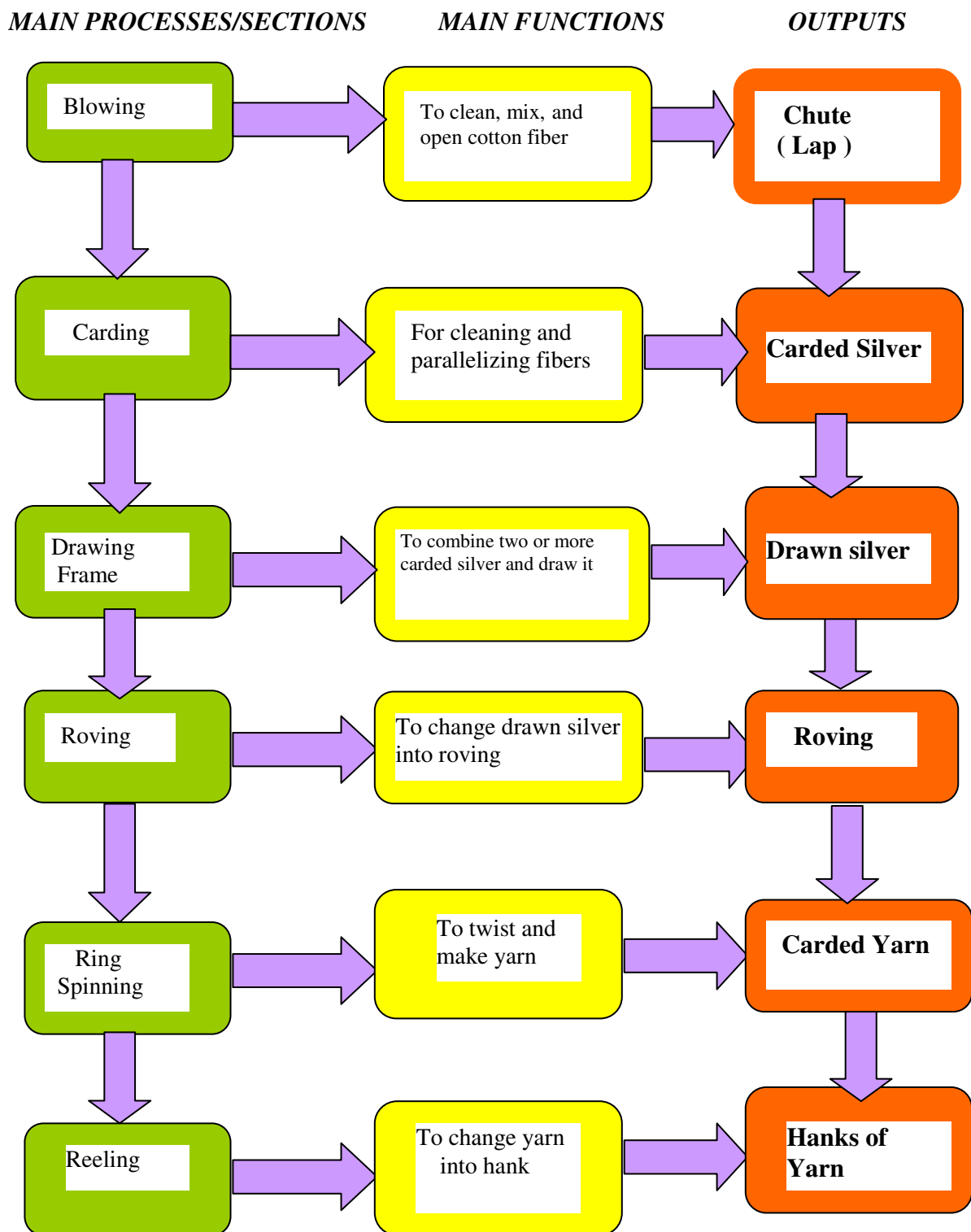


Figure 5.3 Main Processes and intermediate products in spinning plant

b) Weaving Process

Weaving is the process of forming or producing fabric by interlacing two systems of yarns (warp yarn and weft yarn) disposed in mutually perpendicular directions. Weaving has been used more widely than any other methods of fabric production and gives a tremendous range of fabric character. The output of weaving process is a woven fabric, which is one of the fabrics widely produced in the world. The inputs of weaving process are different kinds of yarns. The quality characteristics of fabric depend on the quality characteristics of yarn and the yarn quality depends on the fiber quality. Therefore, during designing of the fabric the quality of the yarn should take into consideration.

The design of a product (woven fabric) must be the result of thorough and careful consideration of the customer's requirements, the potential use of the product, the potential product life cycle and the manufacturability of the product. Design inputs shall consider: requirements established by the customer input, functional and performance requirements, design constraints, requirements for certification / agency approvals, overall fitness for and impact on the customer's application including (as applicable, usability and maintainability), supplier capability and input, performance characteristics (such as environmental and usage conditions, including any, reliability requirements), ergonomic characteristics such as ease of handling and ease of use, industry standards and safety and regulatory requirements, packaging and marking, quality / product assurance inspection activities, manufacturing and procurement requirements, analysis of similar product (including competitive product and process designs, work operations, deviations, quality records, service reports, and customer complaints to detect and eliminate potential causes of nonconforming product).

The design output shall be documented and expressed in terms of requirements, calculations and analyses, and shall: meet the design input requirements, provide the information required for manufacturing the product.

The weaving plant contains three main departments: yarn preparatory department, weaving process (fabric formation process) and grey fabric inspection process. The preparatory department is used to prepare the warp and weft yarns in different packages, which is suitable for the next process weaving. It also improves the physical and mechanical properties of yarn.

The weaving machines (looms) produce the grey fabric in the weaving room. Before grey fabric is delivered to finishing process, it must pass through inspection machines for assessing the defects of fabric. Figure 5.4 below shows the weaving process.

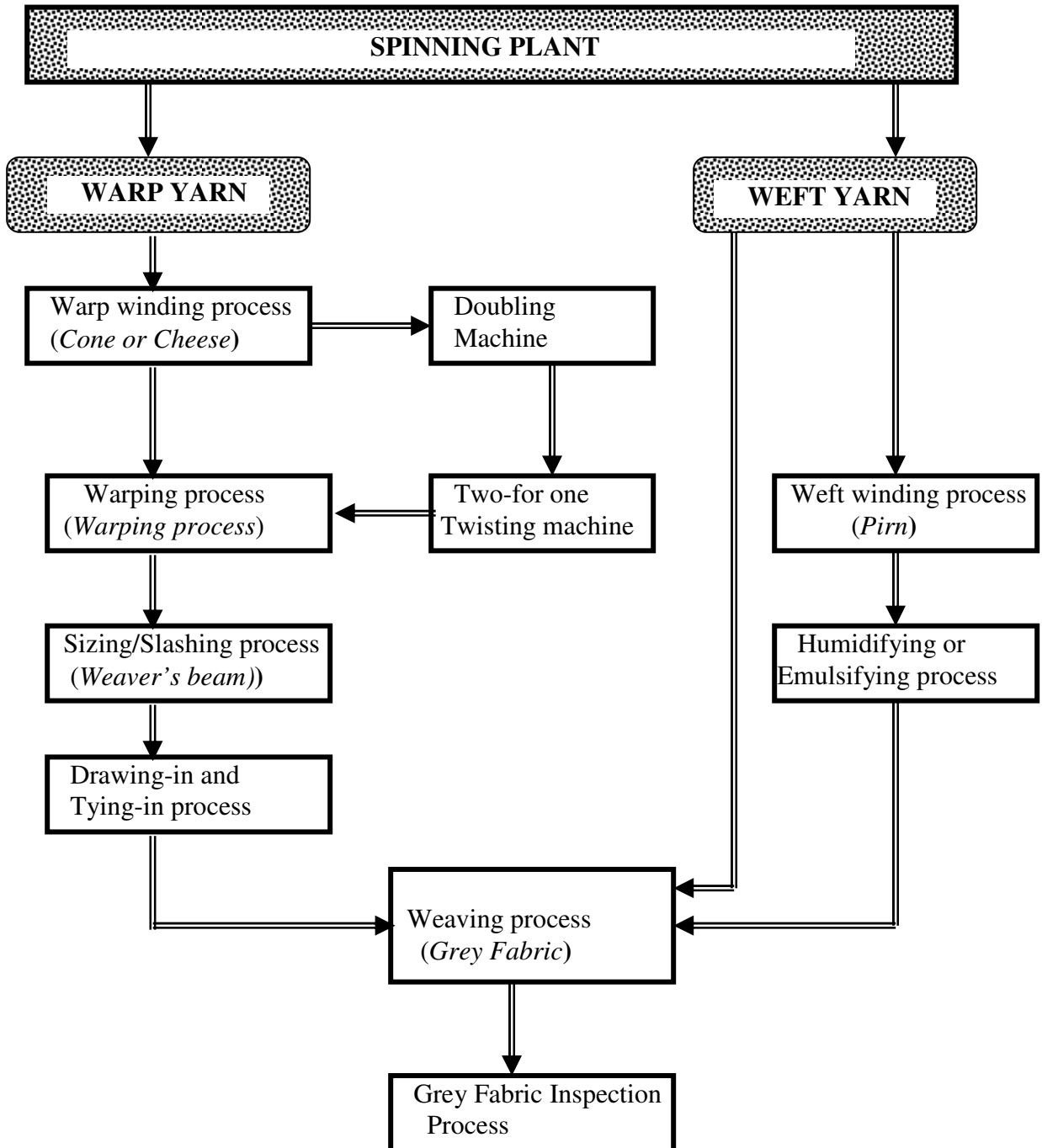


Figure 5.4 Weaving Process

c) Finishing Process

The inspected grey fabric will be delivering to this plant for final finishing. The textile designers should consider all of the previous process and select the appropriate method of fabric finishing. There are many possibilities of fabric finishing which depends on the final end use of the fabric. Hence, taking into consideration the customer requirements and all of the other inputs for designing, the proper method of fabric finishing processes should be designed. The figure 5.5 below shows simple process of fabric finishing which is common in textile.

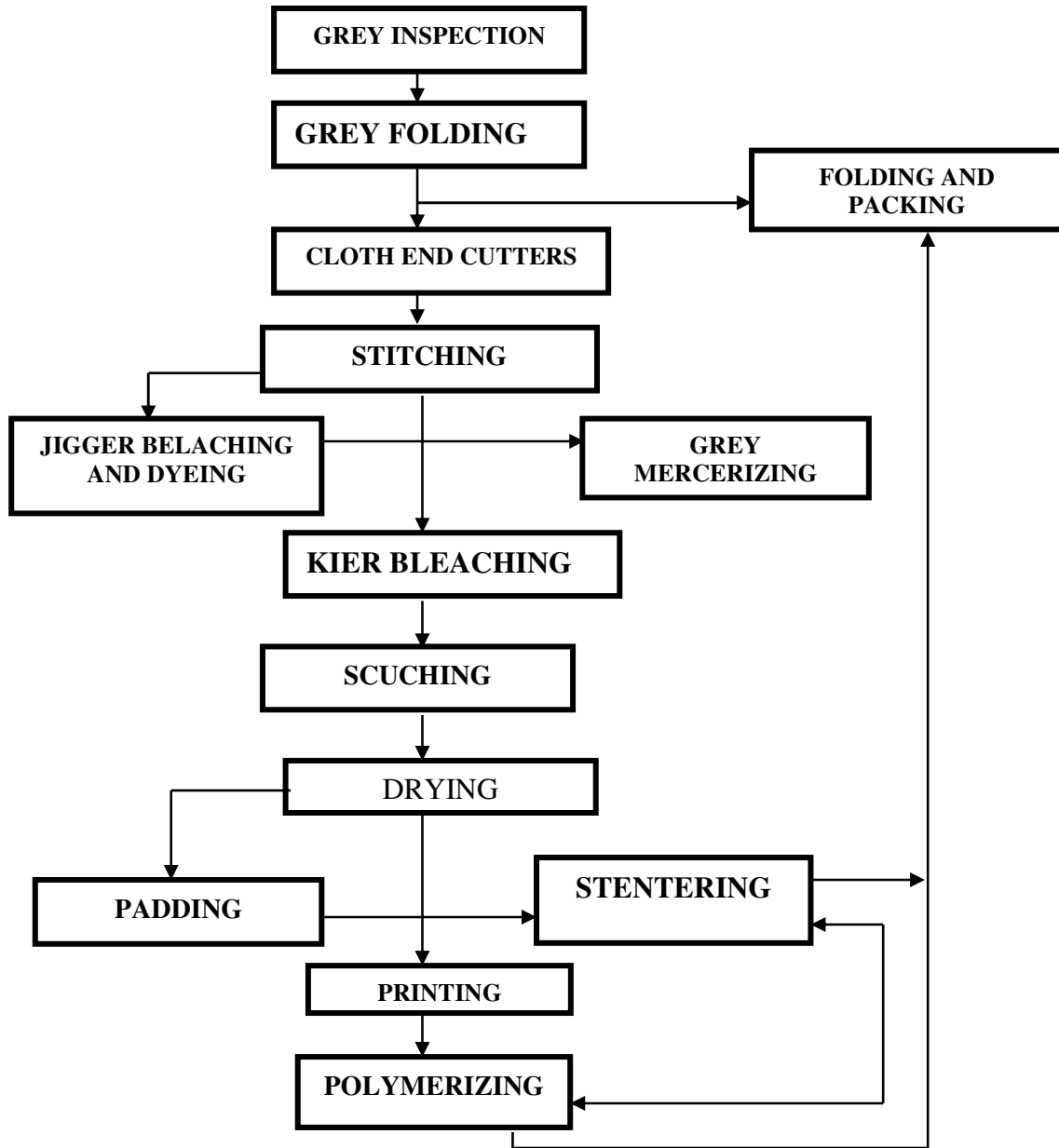


Figure 5.5 Fabric Finishing Process

5.4.4 Textile quality control

Textile industries have an integrated and complex process. Therefore, textile quality control is categorized into three major departments: spinning, weaving and finishing quality control. Under each department, identification of product defects, the use of statistical quality control (SPC) and the status of testing and inspection laboratories shall be considered.

Even though preventive approaches are adopted in this QMS, there are quality control activities that need to be established. Statistical quality control techniques can be effectively implemented in determining the quality level of raw materials and finished products. They can also be used to control manufacturing processes in the companies. Especially, control charts are handy tools that provide concrete evidence for any improvement process. Appropriate sampling procedures and suitable sampling plans and system must be prepared and used. Technical skill through training and appropriate facilities must also be provided.

Quality control has to do with the interpretation and implementation of quality plans. It consists of in-process and post-production testing, which are aimed at ensuring the product's conformity to quality requirements. The main work elements of quality control are: assistance in establishing quality controls at various points in the manufacturing processes, maintenance and calibration of process control equipment, investigation of defects and assistance in solving quality problems during production, implementation of quality control measures for incoming stores, operating a testing laboratory to carry out required tests and analysis, organizing stage and inter-stage inspections or spot checks whenever required, feedback of data on defects and customer complaints to the quality control section and others.

a) Inspection and testing in textile industries

There are three stages of inspection and testing: Incoming inspection and testing, in-process inspection, and final product inspection. Before a material, semi-processed product or finished product component purchased from a supplier is taken for processing, it should be checked to ascertain that it conforms to specifications. The level of receiving inspection and testing will depend on the confidence one has in the effectiveness of the supplier's quality assurance system.

In-process inspection, which is sometimes called stage inspection, aims at detecting non-conformity at the earliest stages of processing to avoid wasteful effort on an output that is going to be rejected. If the nonconformity is detected at an early stage, it may be possible to make modifications and thus prevent the production of a non-conformity product.

Final inspection is important because it is the last opportunity for the supplier to verify the product's overall compliance with the customers' requirements. Final inspection could include function and performance checks where applicable. In all instances, it is necessary to verify that receiving, process control and in-process inspections have been carried out and that records are available to prove that the results of these checks were satisfactory.

Processes shall have sufficient controls at all stages to ensure that only acceptable products and services are delivered to internal operations or to the external customer. Defect prevention techniques – particularly statistical process control, error proofing, and / or automated techniques– shall be used wherever possible. Inspection and test results shall be recorded.

b) Statistical Process Control (SPC) Tools

According to the assessment made on textile industries, most of them do not use statistical process control (SPC) tools. Therefore, the textile industries shall identify the need for and use of statistical techniques required for establishing, controlling, and verifying process or product inputs that impact product characteristics and process capability. The SPC requirements shall be included in the appropriate control plan. Process measurements shall be implemented and monitored at the appropriate points to ensure continual product conformance and to promote increased effectiveness of the process. The appropriate personnel should understand basic statistical concepts such as variation, control (stability), process capability and over-adjustment. Understanding and deployment of statistical concepts shall be accomplished through training and documented procedures.

In general, the defects are observed on three process and their products: spinning (yarn defects, weaving (grey fabric defects), and finishing (finished fabric defects). The philosophy of prevention of defects is the most suitable approach to quality in textile industries. It saves

organizations from a lot of problems including financial, legislative and consumer's complaints. When a successful defect prevention programs are implemented: reduction in processing loss and drop in the volume of rejects are clearly observed.

Defect prevention starts with marketing. Thorough investigation of market requirements must include: product's position relative to competitors, critical characteristics, consumer's response to the product, shelf life of product, storage requirements and target consumers in terms of age, sex, economic status etc. Based on the information gathered, products and process specification are developed. The specification should identify the quality characteristics of the product, the critical attributes and their measurement, possible defects and its impact on consumers, testing methods and sampling procedures. Specification should also be evaluated against government regulation and compiled into a manual. Based on this manual, the company can formulate its standards for finished products.

There is a serious problem of good standard laboratory facility in most textile industries. The capacity of in-plant laboratories to perform tests required for the control of processes and products is limited and thus a number of vital tests are omitted. The important quality characteristics of textile products should be controlled during the process of production and corrective actions should be taken immediately. But the existing laboratory conditions of these industries does not allow. Therefore, the textile companies should try to fulfill those facilities.

5.4.5 Textile quality improvement

Quality improvement starts by paving the way for active participation of customers, suppliers (vendors) and employees. Customer satisfaction is the base for any quality improvement activity. Customer's needs must be integrated into the company's mission and the overall quality objectives. As these needs are dynamic, there must be a feedback mechanism for coping up with the changes to drive the mission of the company further. Vendor-producer relationship is one component for quality improvement since vendors provide the raw material. A solid relation with suppliers ensures delivery of quality material at the right time and amount. Employees make quality improvement a reality. Once the employees are convinced, properly trained and equipped with the right tools, they must be encouraged to be involved in the

improvement process. One way of encouraging employee's participation is motivating them. Motivation also enhances the quality of work in an organization.

One of the major objectives of the textile companies during implementing quality management process and initiative is to foster improvement in all aspects of the company. The company should strive to improve the satisfaction of its customers with its products and services. This can be best accomplished by the on-going initiatives to improve the quality and reliability of the company's products and to improve the operating effectiveness of the manufacturing equipment and processes.

Inconsistent improvement is one of the greatest weaknesses of textile industries in the country. Most of the time the improvement processes follows the traditional approach, which has so many negative impacts. The gaps for improvement can be identified using other competitors (benchmarking) or through surveying customers. The latter approach provides a long lasting system and thus recommended to the textile industries. Improvement process must be implemented in all aspects of the industry.

Apply Continual Improvement: The textile companies shall promote and manage continual improvement in quality, productivity, service, and value. There shall be improvement projects that include as appropriate: external customer, corporate, supplier, safety and regulatory requirements. Continual improvement shall be measured against goals and objectives of the companies. One or more of the following techniques may assist with achieving the goals and objectives in textile industries:

- ❖ A regular review by management to demonstrate that processes are meeting customer requirements and internal continual improvement goals; utilizing trend chart(s), goal(s), Pareto analysis, problem summary chart(s), and verification chart(s).
- ❖ A series of tools and techniques that focus on process optimization through cycle time reduction and the elimination of waste.
- ❖ A total employee involvement technique focused upon implementing best practices that are successfully deployed in textile company's facilities.

- ❖ A formal process for integrating and controlling all business planning processes for the purpose of balancing supply and demand in the most effective and efficient way.
- ❖ Utilization of the statistical process control (SPC), design of experiments (DOE), and regression analysis.

5.4.6 Quality Assurance in textile industries

Currently, competition on the world market for textile products is harder than ever before. There are many suppliers who offer yarn and/or fabric of a sustainable quality against very competitive price. In certain countries overcapacity may even lead to still lower prices. Once the export becomes necessary, the gap between the domestic market and the world market appears to be almost unbridgeable. For this reason a strong argument can be made to maintain quality standards on international levels from the very beginning.

In textile companies, the organizational quality assurance /quality manager shall have the authority and responsibility for ensuring that the requirements of the quality management process are implemented and maintained: regularly reporting to management the current performance of the quality system and the level of customer satisfaction as a mechanism for continual improvement, ensuring that the business unit complies with the applicable requirements of ISO 9001 standards, providing liaison with external bodies on matters relating to the quality system, ensuring annually that the business unit has deployed the latest revision of ISO 9001 that supports the company's quality manual.

5.4.7 Quality Auditing and Reviews

Future amendment to the quality management system in textile companies is assured by quality auditing and reviews which are fundamental for any quality management system to function properly. Quality reviews are systematic and periodical activities carried out to check whether the system achieved the required effect. Quality auditing is an official examination of the functions or activities in a company against a standard or document. Review must use audit findings and ultimately lead to quality management system improvement. Quality management system review must be conducted at least once a year on all levels to verify compliance with planned arrangements, effectiveness and suitability to meet the objectives of the companies.

It should show any defect or potential danger in the system and indicate possible corrective action. The results of these audits shall be reviewed by management as feedback for continual improvement and verification of conformance to the quality system. Records of such audits and reviews shall be maintained. Each company shall conduct audits of the quality system in accordance with established specifications at regular intervals based on status and importance of the activity. Audits of the quality system shall be carried out by qualified personnel independent of those having direct responsibility for the area being audited and should cover all shifts. Follow-up audit activities shall verify and record the implementation and effectiveness of the corrective action taken.

Preventive action eliminates the root cause of an anticipated problem; it is proactive. A problem is an undesirable effect that involves any situation that results in customer dissatisfaction or waste. In all cases where a nonconformance is identified or where analysis indicates a nonconformance, the responsible function shall be notified in writing and shall receive a corrective action statement. The corrective action plan shall be reviewed with the function(s) responsible for implementation of the corrective action.

5.4.8 Quality System Documentation

Quality system documentation is one of the essential components for implementing quality management system. The Quality function shall establish, implement, and maintain a documented quality system as a means of ensuring that products and services conform to specified requirements. This documented system shall include this quality manual (quality policy manual, quality procedures manual) and work instructions supported with detailed procedures and specifications of the company. This manual provides a guide for design, manufacture and marketing of textile products. It represents official policy and shall be used as a standard by all departments and operations of the company in developing and administering systems for continual improvement and the control of quality and reliability of products and services. The documented quality system shall provide for timely consideration of the following activities in meeting specified requirements:

- ❖ Quality planning;
- ❖ The identification and facilitation of controls, processes, inspection, equipment, fixtures, production resources, and skills that may be needed to achieve the required quality;
- ❖ The updating, as necessary, of quality control, inspection, and testing techniques, including the development and acquisition of new instrumentation;
- ❖ The clarification and documentation of standards of acceptability for all features and requirements, including those which may contain a subjective element;
- ❖ The identification of suitable verification at appropriate stages of product or service development;
- ❖ The identification, preparation, and maintenance of quality records.

5.4.9 Cost of Quality

Cost of quality is the sum of the costs incurred by a company in preventing poor quality, the costs incurred to ensure and evaluate that the quality requirements are being met, and any other costs incurred as a result of poor quality being produced. Poor quality is defined as non-value added activities, waste, errors or failure to meet customer needs and requirements.

According to Dale and Plunkett (1995), it is now widely accepted that quality costs are: the costs incurred in the design, implementation, operation and maintenance of a quality management system, the cost of resources committed to continuous improvement, the costs of system, product and service failures, and all other necessary costs and non value added activities required to achieve a quality product or service [19].

PAF (Prevention, Appraisal, and Failure) could be applied in textile industries, since the industries have a product-oriented arrangement. The manufacturing process includes three main departments (spinning, weaving and finishing), which are based on products and are managed by department heads. Thus, the PAF method is more appropriate to use for the quality cost analysis. PAF includes four types of quality costs: prevention cost, appraisal cost, internal failure cost, and external failure cost.

For the purpose of the study of cost of quality in textile industries, identification of the departments that incurs more cost is necessary. Therefore, the departments that incur more costs are: production and technical division (spinning, weaving, finishing), quality control department, marketing and sales department, internal audit, and planning and programming section. The elements of costs of quality in textile industries are discussed below.

1- Prevention quality cost elements for textile industries

Prevention costs are the costs related to all activities to prevent defects from occurring and to keep appraisal and failure to a minimum. The following table 5.3 shows the prevention quality cost elements for Ethiopian textile industries.

Table 5.3 Prevention quality cost elements for Ethiopian textile industries

	<i>Quality cost element</i>	<i>Department incurring the cost</i>
A	Education	Production and Technical, Quality control
B	Quality related training	Production and Technical, Quality control
C	Salary of quality administrative staff	Quality control department
D	Costs of preparation of specifications	Production and Technical, Quality control
E	Quality assurance	Quality control department
F	Process Planning	Production and Technical, Quality control
G	Process Control	Quality control department
H	Market research	Marketing and sales department
I	Preventive maintenance	Production and Technical

- A. *Education cost:* The costs included under this category are costs that the textile companies incur for educating the employees especially in production and technical and quality control departments. To implement quality management system in the companies, the education program should be designed and implemented.
- B. *Training cost:* It is the cost incurred for training of the employees by the internal and external trainers. Mostly, the machine operators and quality control workers are involved.
- C. *Cost of quality administrative staff:* This is the cost incurred for the quality administrative workers of the company.

- D. *Costs of preparation of Specifications:* This is the cost incurred to prepare the specifications of the products in the company. The production and technique department as well as the quality control department are involved.
- E. *Quality Assurance:* It is the cost incurred to assure the quality of products to the standards (both locally and internationally) or it is cost of conformance to quality.
- F. *Process Planning:* process capability studies, inspection planning, and other activities associated with the manufacturing and service processes.
- G. *Process control:* In-process inspection and test to determine the status of the process (rather than for product acceptance).
- H. *Market research:* To assess the demand and market for the products may be through field-testing, etc.
- I. *Preventive Maintenance:* costs incurred to perform preventive maintenance of machines.

2- Appraisal quality cost elements for textile industries

Costs incurred to determine the degree of conformance to quality requirements. These are costs incurred while performing inspections, checking, testing, or other planned activities. The following table 5.4 shows the appraisal cost elements in textile industries.

Table 5.4 Appraisal quality cost elements for Ethiopian textile industries

	<i>Quality cost element</i>	<i>Department incurring the cost</i>
A	Job related training	Quality control department
B	Incoming inspection and testing	Quality control department
C	Quality audit	Quality control department
D	Final inspection and test	Quality control department
E	Maintenance accuracy of test equipment	Quality control department
F	Inspection and test materials and services	Quality control department

- A. *Job related training:* the cost incurred for delivering short-term training for quality testers.
- B. *Incoming inspection and test:* determine the quality of purchased product, whether by inspection on receipt, by inspection at the source, or by surveillance.
- C. *Quality audits:* Cost incurred to make quality review and auditing.

- D. Final inspection and test:* Evaluation of conformance to requirements for product acceptance.
- E. Maintenance accuracy of test equipment:* keeping measuring instruments and equipment in calibration.
- F. Inspection and test materials and services:* materials and supplies in inspection and test work where significant.

3- Internal failure quality cost elements for textile industries

These are the cost of deficiencies discovered before delivery, which are associated with the failure (nonconformities) to meet explicit requirements or implicit needs of external or internal customers. Also included are avoidable process losses and inefficiencies that occur even when requirements and needs are met. These are costs that would disappear if no deficiencies existed. Table 5.5 below shows the internal failure quality cost elements for textile industries.

Table 5.5 Internal failure quality cost elements for Ethiopian textile industries

	<i>Quality cost element</i>	<i>Department incurring the cost</i>
A	waste	Production and Technique, Quality control
B	Scrap	Quality control department
C	Rework	Quality control department
D	Re-inspection	Quality control department
E	Machine down time cost	Production and Technique
F	Down grading cost	Quality control department
G	Over time due to nonconformance	Production and Technique
H	Failure analysis	Quality control department

- A. Waste:* costs incurred for low quality of fibers, yarns and fabrics.
- B. Scrap:* The labor, material, and (usually) overhead on defective product that cannot economically be repaired.
- C. Recheck or re-inspection:* re-inspection and retest of products that have undergone rework or other revision.
- D. Rework:* correcting defectives in physical products or errors in service products.

- E. Machine down time cost:* the cost incurred due to machine idle time (stoppage time).
- F. Down grading cost:* the cost incurred due to lower grade (example if the company sell grade “A“ product at the price of grade” B” product) due to nonconformance.
- G. Overtime due to nonconformance:* cost incurred for the extra time due to nonconformance.
- H. Failure analysis:* Costs for analyzing nonconforming goods or services to determine causes.

4- External failure quality cost elements for textile industries

Costs associated with defects found after the customer receives the product or service. These are also costs that would disappear if no defects existed in the product after shipment to the customer. Also included are lost opportunities for sales revenue.

Table 5.6 External failure quality cost elements for Ethiopian textile industries

	<i>Quality cost element</i>	<i>Department incurring the cost</i>
A	Warranty charges	Production and technique division
B	Complaints	Quality control department staff
C	Returns	Production and technique division
D	Loss of Good will	All departments

- A. Warranty charges:* the costs involved in replacing or making repairs to products that are still within the warranty period.
- B. Complaint adjustment:* the costs of investigation and adjustment of justified complaints.
- C. Returned material:* The costs associated with receipt and replacement of defective product.
- D. Loss of Good will:* loss of potential customer due to lower quality product.

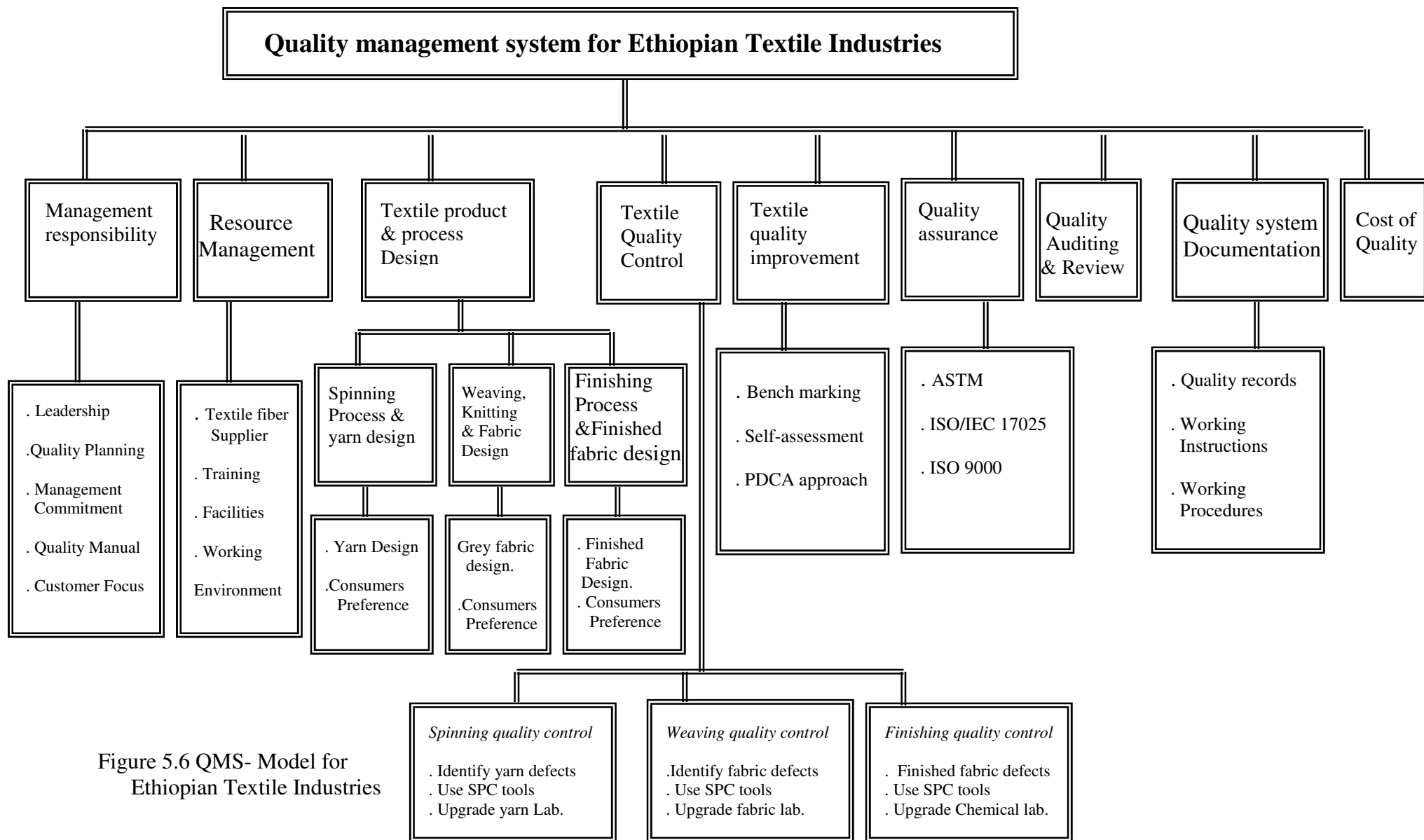


Figure 5.6 QMS- Model for Ethiopian Textile Industries

Implementation of quality management system in Textile Company affects the entire organization right from the start. If pursued with total dedication, it results in 'cultural transition' to an atmosphere of continuous improvement. The process of implementing QMS in textile industries depends on the size of the company, the complexity of the process and on the sophistication of the existing quality program.

There are three main stages, which shall be considered during implementation of QMS in the textile companies at current conditions. Those are: the development stage, implementation stage and QMS- maintenance stage. The development stage considers what happens in the company's process. Development stage includes: management commitment, assigning of management representative, establishing/upgrading quality control department, establishing QMS- implementation team, conducting gap analysis, and revising of the existing facilities for ASTM and ISO/IEC 17025 standards. The responsibilities and authorities should also be defined. The implementation team or the task force should be trained before the implementation process starts.

Tasks and main responsibilities of the management representative/quality manager are:

- ❖ Coordinate and work with other management functions such as production and technical section, marketing and sales department, etc to ensure that the quality system is established, implemented, and maintained effectively.
- ❖ Conduct quality audit and report on the performance of the quality system to the management.
- ❖ Coordinate quality improvement program.
- ❖ Plan and initiate the top management to undertake periodic reviews on the effectiveness of the quality system.
- ❖ Initiate corrective and preventive actions on the identified actual and potentials nonconformance.

The implementation team must include persons from key functional areas such as production & technique, quality control, and others which should be manageable. The involvement of

employees should also be considered. This team should: prepare the QMS-implementation plan, coordinate the creation and the revision of the QMS documents.

The second stage is the QMS- implementation stage. At this stage every body in the company needs to have an access to the documentation that relates to their activities. They need to be given some insight into how the quality management system works and why. At this stage, every body needs to be trained to understand how to keep the quality management system up-to-date. They also need to know how to make changes to the quality management system as well as noting problems and putting forward ideas for improvement.

The final stage is maintenance of the quality management system. Under this stage: the preparation of improvement program, the implementation and monitoring/ evaluating of the improvement program, auditing and review of the effectiveness and taking corrective actions are included. The company shall conduct auditing to assess the status and effectiveness of the implemented QMS. Conducting of the management review is also used to ensure the suitability and continuity of the QMS using the feed back of information from the quality management system including audit findings and customer complaints. Identify the root causes of the nonconformities and date of realization to take corrective actions. Monitoring of the effectiveness of corrective actions taken is another important point in this stage.

Finally, the companies should continually seek to improve the effectiveness and suitability of the quality management system through the use of their: quality policy, quality objectives, audit results, analysis of the data, corrective and preventive actions and management review using the PDCA cycle or the Deming cycle.

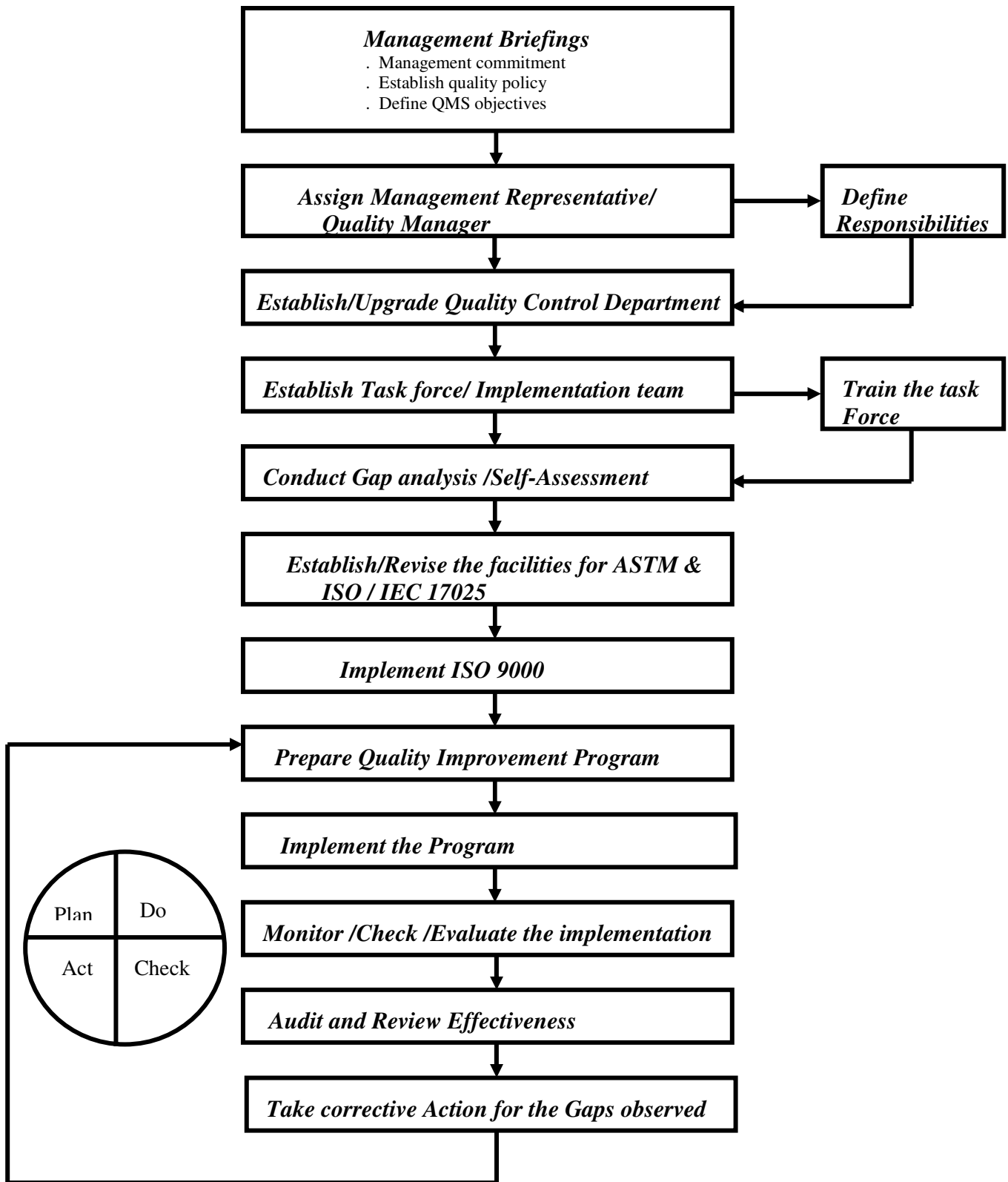


Figure 5.7 QMS-Implementation Model for Ethiopian Textile Industries [18, 25, 41]

CHAPTER 6 QMS – IMPLEMENTATION CASE STUDIES

So far, the main components of quality management system have been discussed in the previous chapters. The implementation guide of quality management system in Ethiopian textile industries has also discussed in chapter 5. Furthermore, to observe its practical implementation and to see its effects, two case studies (Bahirdar Textile Share Company and Akaki Textile Share Company) have been done.

6.1 QMS-IMPLEMENTATION MODEL FOR BDTSC

6.1.1 Profile of Bahirdar textile Share Company

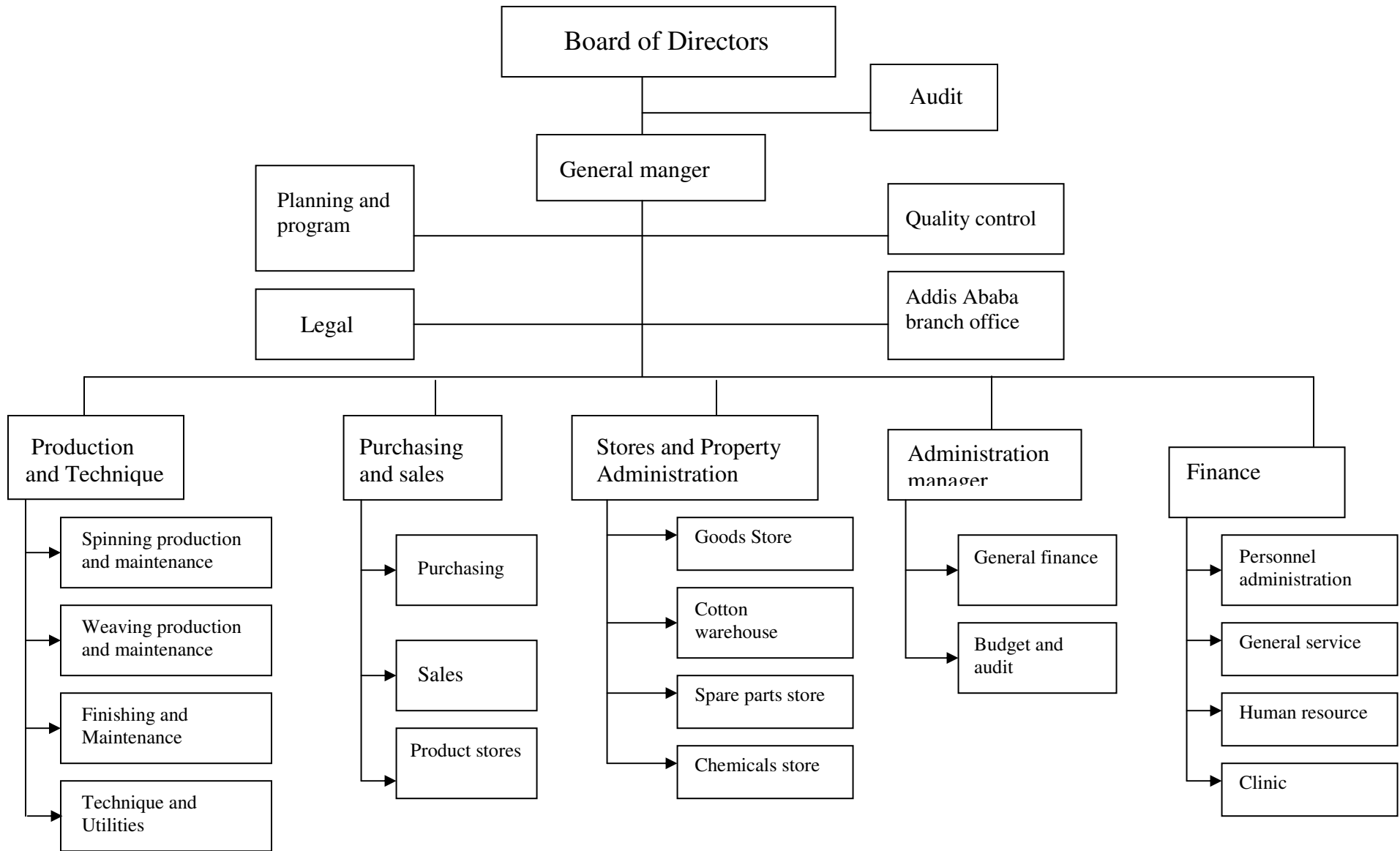
Bahr Dar Textile Company was established in 1961 in the town of Bahr Dar, 570km north of Addis Ababa. It is an integrated company, manufacturing 100 % woven cotton fabrics. In 1989 the factory modernized its spinning and weaving departments, in the process replacing most of the machinery. The company consists of 40,000m² of buildings within a large compound. The major part of the company's production is sold locally through trading houses. The major raw material, cotton, is locally available. The company is situated 160 Km from its main supplier, Gondar ginnery. This handles all the cotton grown in the area. Other raw materials such as chemical, dyestuffs and spare parts are imported.

a) Organizational structure of BDTSC

Currently, Bahirdar textile Share Company has a total of 1677 employees out of which 638 are females. Only 15 employees have first B.A/B.Sc degree and above. The highest number of employees i.e 1239 (73.9 % of the total employees) is less than grade 12. This indicates that the company should give an attention for education and training program to implement the quality management system.

The company is organized into five sections. The production and technique department, quality control service, planning and programming department, administration division, and finance department are independently accountable to the general manager. And the general manager is accountable to the board of directors. The organizational structure is shown on figure 6.1 below.

Figure 6.1 Organizational structure of Bahirdar Textile Share Company



b) Productivity at BDTSC

Before we come to the assessment of production and productivity at BDTSC, let us define each to avoid confusion. Production is a sequence of technical processes requiring either directly or indirectly the mental and physical skill of craftsman and consists of changing the shape, size and properties of materials, and ultimately converting them into more useful articles. In general it can be defined as an organized activity of transforming raw materials into finished products. The method of production applied at BDTSC is mass production. This method of production is a large-scale production and is a continuous production. Mass production does not have any non-producing time. Productivity is nothing but the reduction in wastage of resources. The resources may be men, machines, materials, power, space, time, building and so on. Productivity is the ratio of output value to input value.

The researcher has compared designed and actual production of Bahirdar textile share company for the years 1996 and 1997 E.C. There is a big deviation between the designed and the actual production capacity of this company. According to the company's annual report, the planned and actual production capacity of the company is shown on table 6.1 below

Table 6.1 Comparing of production rate at BDTSC for the years 1996 and 1997 E.C

<i>Production section</i>	<i>Unit</i>	<i>For year 1997 E.C</i>		<i>Efficiency</i> <i>%</i>	<i>For year</i> <i>1996 E.C</i>	<i>Difference</i> <i>By %</i>
		<i>Planned</i>	<i>Actual</i>			
Spinning plant	Kg	2294798	1927963	84 %	1922537	0.3 %
Weaving plant	Meter	9566433	7149599	75 %	7287176	2 %
Finishing plant	m ²	14,031,654	10114946	72 %	9679870	4.5 %
Warp & weft yarn	Kg	441720	399777	91%	501241	20.2 %
Mattress	Piece	10101	8645	86 %	10773	20 %
Pillow	Piece	1199	522	44 %	595	12%
Sheeting for export	Meter	2581428	1393987	54 %	1721625	19 %

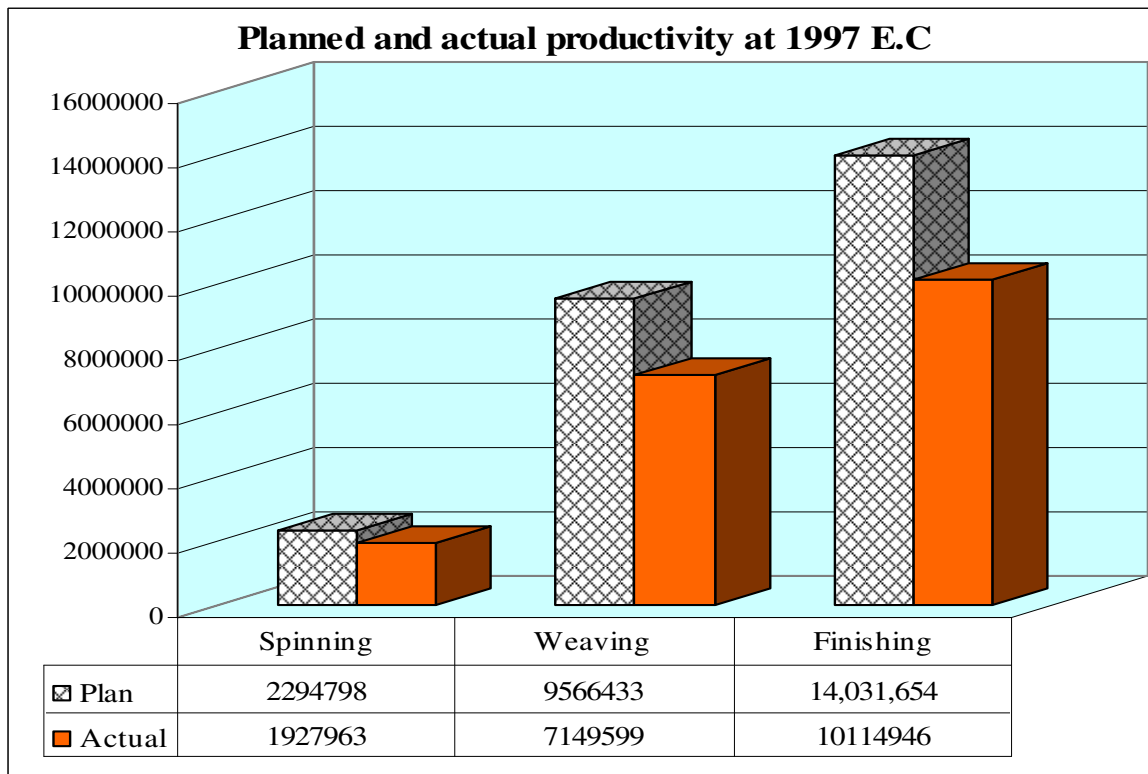


Figure 6.2 Planned and actual productivity at BDTSC for fiscal year 1997 E.C

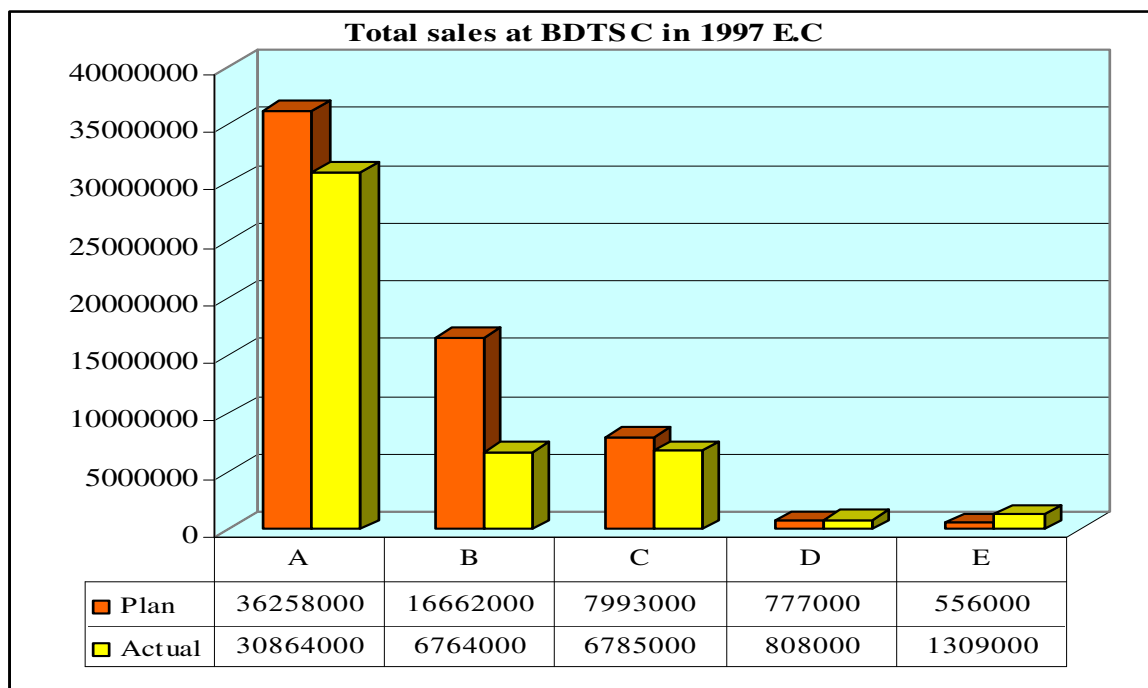


Figure 6.3 Planned and actual sales at BDTSC in fiscal year 1997 E.C

Key

A = Fabrics B = Sheeting for Export C = Yarn D = Mattress & pillow E = Others

The cost of production at Bahirdar textile Share Company for fiscal year 2004/05 is shown on table 6.2 below.

Table 6.2 Total cost of production at BDTSC in 1997 E.C

<i>S.No</i>	<i>Types of cost</i>	<i>Total cost (Birr)</i>	<i>Percent of cost</i>
1	Raw materials cost	20144580.28	54.33 %
2	Overhead cost	5037774.37	13.60 %
3	Labor cost	5913795.60	15.95 %
4	Maintenance cost	1799304.50	4.85 %
5	Depreciation cost	2548961.45	6.86 %
6	Excise tax expense	1562452.89	4.21 %
7	Other cost	66398.00	0.18 %
	Total production cost	37073267.09	100 %

c) Machine down time at BDTSC for fiscal Year 1997 E.C

Currently, BDTSC faces many problems that affect its production capacity. One of these problems observed in production year of 1997 E.C was absence of workers. According to the annual report of the company, in spinning plant 247.3 hours was the idle time due to the absence of the workers from the total 7019.68 working hours for this production year. Therefore, the spinning plant lost 18.86 percent of its production time. Totally, the spinning plant lost 1311.58 hours due to different problems such as electrical interruption, machine breakdown, absence of workers, and shortage of spare parts of machines. The total loss of production in this plant is about 428768 kg of yarn for the same.

When we look the production capacity of weaving plant for the same year, the time lost due to different problems was about 1508.36 hours (21.4 percent) from the total 7019.68 working hours. Due to the loss of this time about 2055514 meters of fabric was not produced. On the same way, the finishing plant also lost 2371.53 hours from total 7019.68 working hours, which is about 4740457 square meter of fabric.

In general, the causes for lower productivity of the machines in the company are: low quality of raw materials, sudden breakdown of the machines, stoppage of machines such as carding machine due to the shortage of the spare parts, interruption of the electrical power, absence of the workers, and others. Total idle time and loss of production is shown on table 6.3 below.

Table 6.3 Total idle time and loss of production at BDTSC in fiscal year 2004/05

<i>S.No</i>	<i>Main causes or Problems</i>	<i>spinning</i>	<i>Percentage</i>	<i>Weaving</i>	<i>Percentage</i>	<i>Finishing</i>	<i>Percentage</i>
A	Machine breakdown	134.38	10.25	329.61	21.9	-	-
B	Due Shortage of spare parts and others	345.55	26.35	225.11	14.95	-	-
C	Power interruption	70.83	5.40	70.83	4.70		
D	Absence of workers	247.30	18.86	406.54	27.00		
E	Others	513.54	39.15	465.96	30.95	2371.53	100
	Total time lost	1311.58	100	1508.36	100	2371.53	100
	Product quantity lost	428768 Kg		2055514 m		4740457 m²	

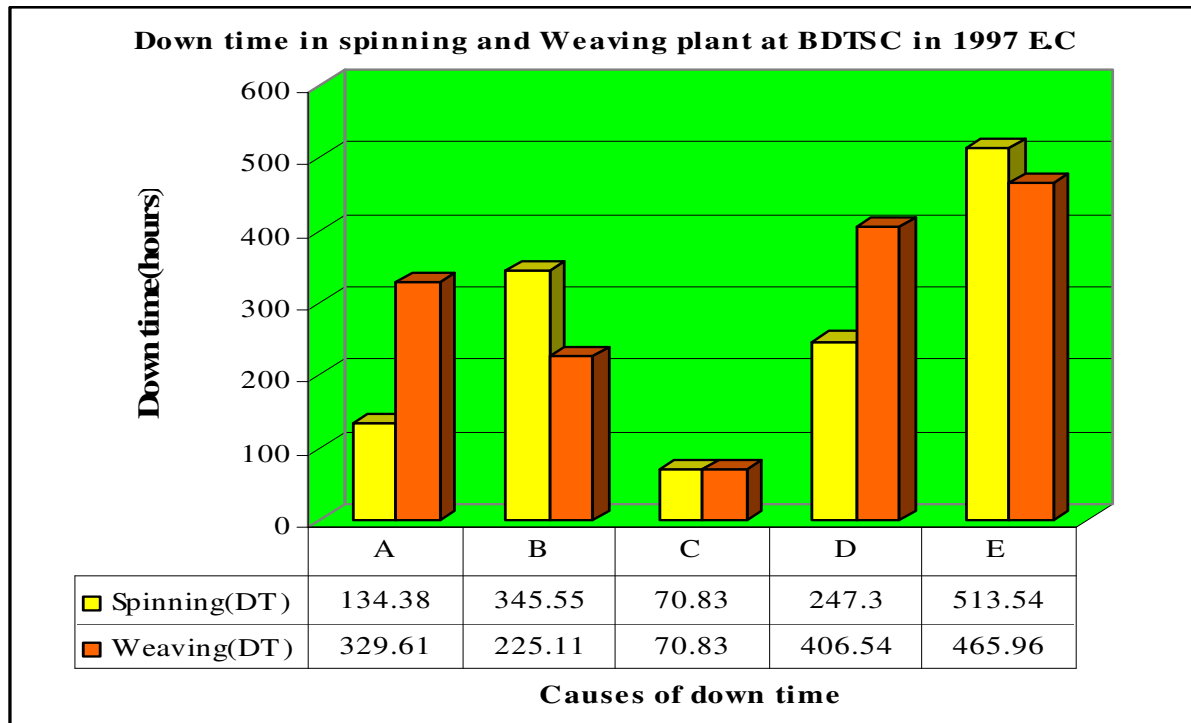


Figure 6.4 Down time in spinning and weaving plant at BDTSC for fiscal year 1997 E.C

d) Spinning, Weaving, and Finishing Processes at BDTSC

i) Spinning Process at BDTSC

The spinning process (yarn production) starts with the inspection and acquisition of the raw material (cotton fiber). When cotton bales arrive at the company, they are highly compressed and have been ginned to remove seeds and some of the impurities present. On removing the cotton from the bales, the cotton is opened up, blended and mixed with cotton from other bales manually. During the opening and blending process, the fibers are separated and loosened from each other, trash is removed from the fibers, and the fibers are more randomly mixed to assure greater uniformity. Finally the fibers are formed into a thin partially oriented continuous web of intertwined fibers called chute. The chute in turn undergoes carding process to remove short fibers and remaining trash and to provide additional orientation to the fibers. Carding involves pulling, separating, and orienting the fibers by passing the chute between successive cylinders moving at different speeds and containing fine bent wire bristles that catch the fibers. The carded lap is removed by doffer cylinder in the form of sliver (a rope-like fiber mass) and coiled into a rotating can.

The drawing and spinning process involves passing the sliver between and through a series of rollers moving at progressively higher speeds to draw the sliver to a finer, more oriented, and uniform structure followed by twisting as the sliver is played onto a turning spindle. The drawing portion of the operation is referred to as the drafting process. In the initial stage where little twist is present in the drawn sliver, the sliver is fed through a tube and onto the spindle. This process is called roving. Subsequent drawing and high speed with twisting is carried out by ring spinning in which the drafted, lightly twisted sliver (roving) is fed from the drafting unit onto a high speeded spindle via a traveler holding the spun yarn to a ring surrounding the reciprocating spindle. The traveler can move easily around the ring and provides a slight drag on the yarn as it is fed onto the spindle. Ring spinning proceeds at 5000 to 10,000 revolutions per minute.

Mapping of Spinning Process at Bahirdar Textile Share Company

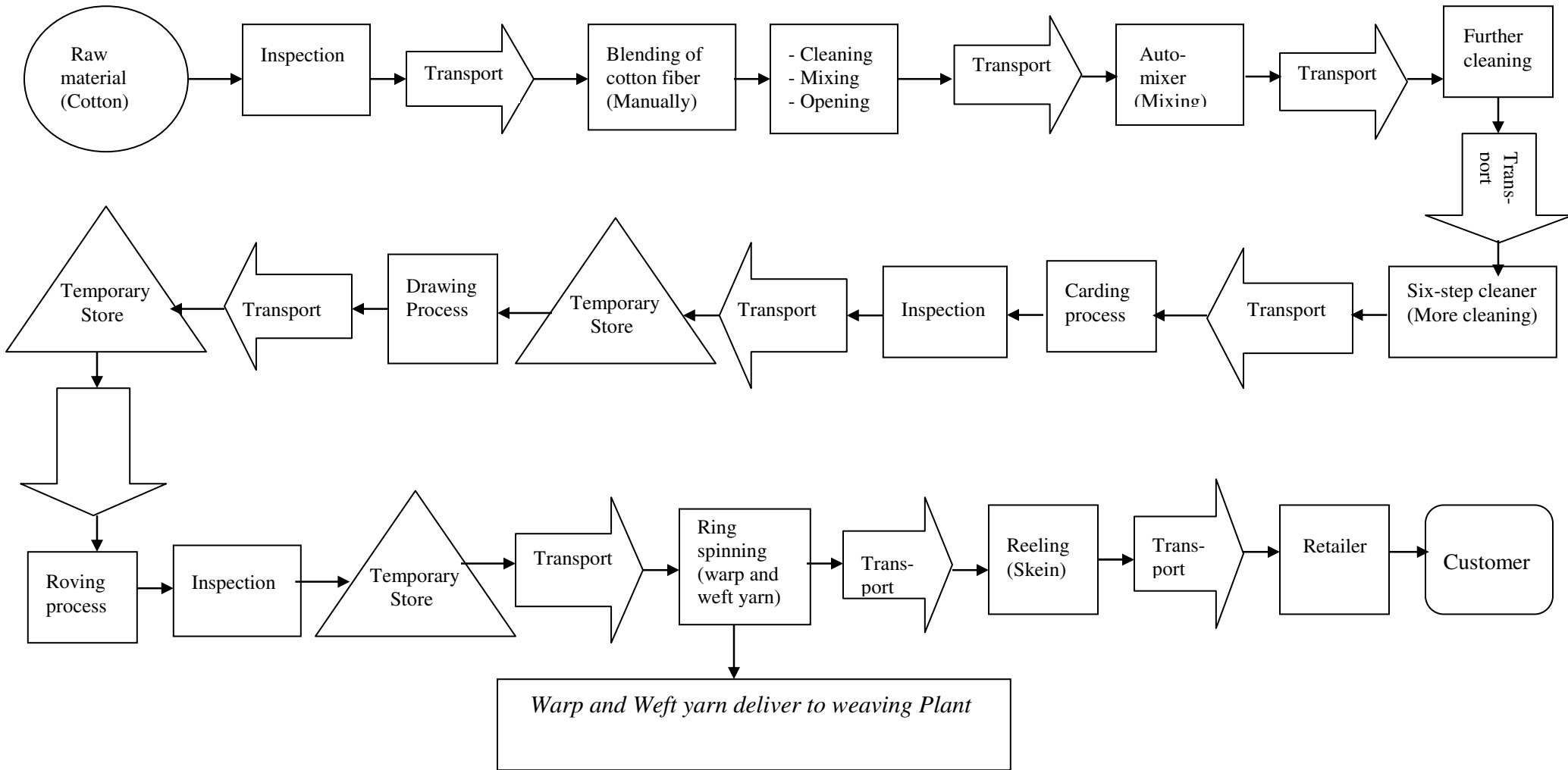


Figure 6.5 Yarn manufacturing process at Bahirdar Textile Share Company

ii) Weaving Process at BDTSC

The weaving plant at BDTSC includes three main departments: yarn preparatory department, weaving process (looms), and grey fabric inspection process. In the preparatory department the warp and weft yarns are prepared into different packages such as cone and beams that will be suitable for the next process (fabric formation process). The physical and mechanical properties of the yarn also improved in this department. In the weaving department, fabric formation is take place by using weaving machines. The grey fabric is also inspected for its defects in the inspection department.

Winding process is the first process in the warp yarn preparation. This process involves movement of yarn from one package to another and often conversion of the overall size, shape and tightness of the packages. These processes also serve other important functions. Winding allows clearing of the yarn to eliminate thin places, thick places, knots and other imperfections, and makes it possible to regulate tension within the package, combine or segment yarn packages, and prepare packages for dyeing prior to substrate formation. In shuttle weaving, it is necessary to prepare small packages referred to as quills or pirns that fit within the shuttle. The yarn is wound onto the pirn sequentially in such a way to assure steady and even release of yarn from the pirn during the weaving process.

A specialized type of package formation is involved in preparing warp beams for weaving. A high degree of tension is placed on the warp during these processes, therefore the yarns must be lubricated (sizing process) to make yarn smooth and minimize friction between yarn and machine parts and adhesive must be applied to the yarn to strengthen and reduce the hairness of the yarn. Warping involves winding yarns from several thousand packages placed on creels onto a flanged beam passing through a reed (a comb like device). The reed maintains the yarns parallel to one another as they are wrapped onto the warping beam under as even a tension as possible. After warp beams are prepared, the warp yarns must be drawn through certain element in the loom (passing the yarn through eye let of drop wires, eye let of harness and finally through the reed). This process in the past was carried out by hand using a special hooked wire to draw each warp yarn through the elements of the loom following hand

Mapping of weaving process at Bahirdar Textile Share Company

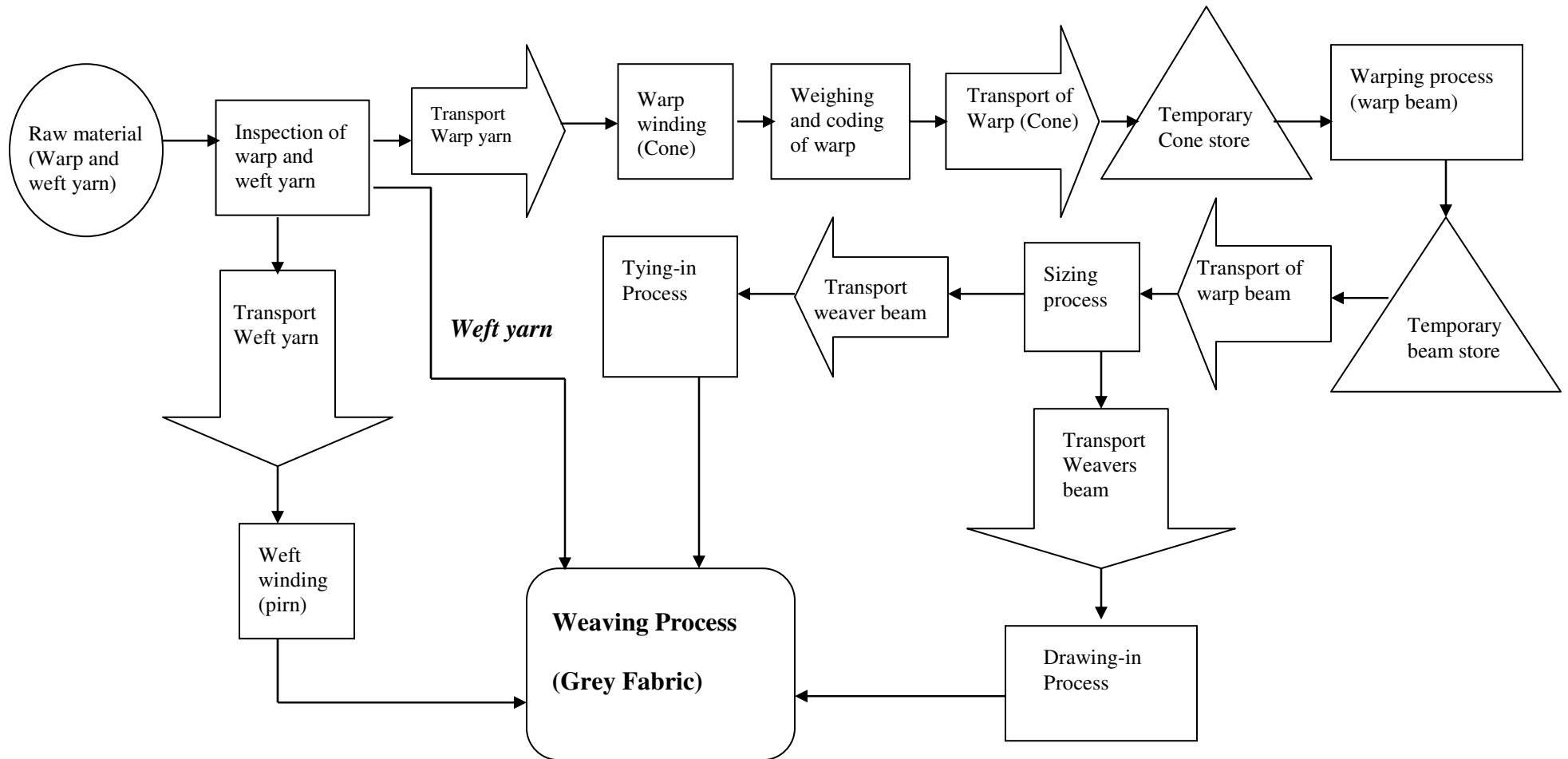


Figure 6.6 Fabric manufacturing process at Bahirdar Textile share company.

knotting of the yarn to the corresponding yarn on the take up warp beam. Currently, BDTSC uses tying-in machine for tying the two ends of yarn; but drawing –in process is takes place manually.

Weaving is the process of forming or producing fabric by interlacing two systems of yarns (warp yarn and weft yarn) disposed in mutually perpendicular directions. Weaving has been used more widely than any other methods of fabric production and gives a tremendous range of fabric character. The product of weaving is grey fabric in the case of Bahirdar Textile Share Company. Weaving is takes place on looms (weaving machines). Generally there are two types of weaving machines or looms: shuttle loom and shuttleless loom. In this company there are: 45 Galileo looms, 48 Ruti-looms and 134 Rapier looms.

iii) Finishing plant at BDTSC

Finishing is the final plant which bleaching, dyeing, coating, and printing processes are performed using different machines. The inspected grey fabric is delivering to the batching machine under which batching and stitching operations are performed. The grey fabric could also be deliver to the mercerizing process. This process imparts luster for the grey fabric. The techniques basically involve flattening or smoothening of the yarn surface using pressure. Beating of the fabric surface or passing the fabric between hard calendaring rolls under pressure and with some friction will tend to flatten out the yarns and lower light scattering by the fabric surface, thereby improving reflectance and luster. During calendaring or beating of a fabric interaction between individual fibers within yarns may be lessened and the fabric structure softened. Also, when a smooth fabric structure free of raised surface fibers or hairness is desired, the fabric is sheared by passing it over sharp moving cutting blade or by passing the fabric over a series of small gas jets that singe and burn raised fibers (singeing Process).

Then the singed fabric is fed into the desizing machine. The desizing machine washes the fabric and removes the size material from the fabric. This is to create suitable conditions for dyeing or

Mapping of fabric finishing at Bahirdar Textile Share Company

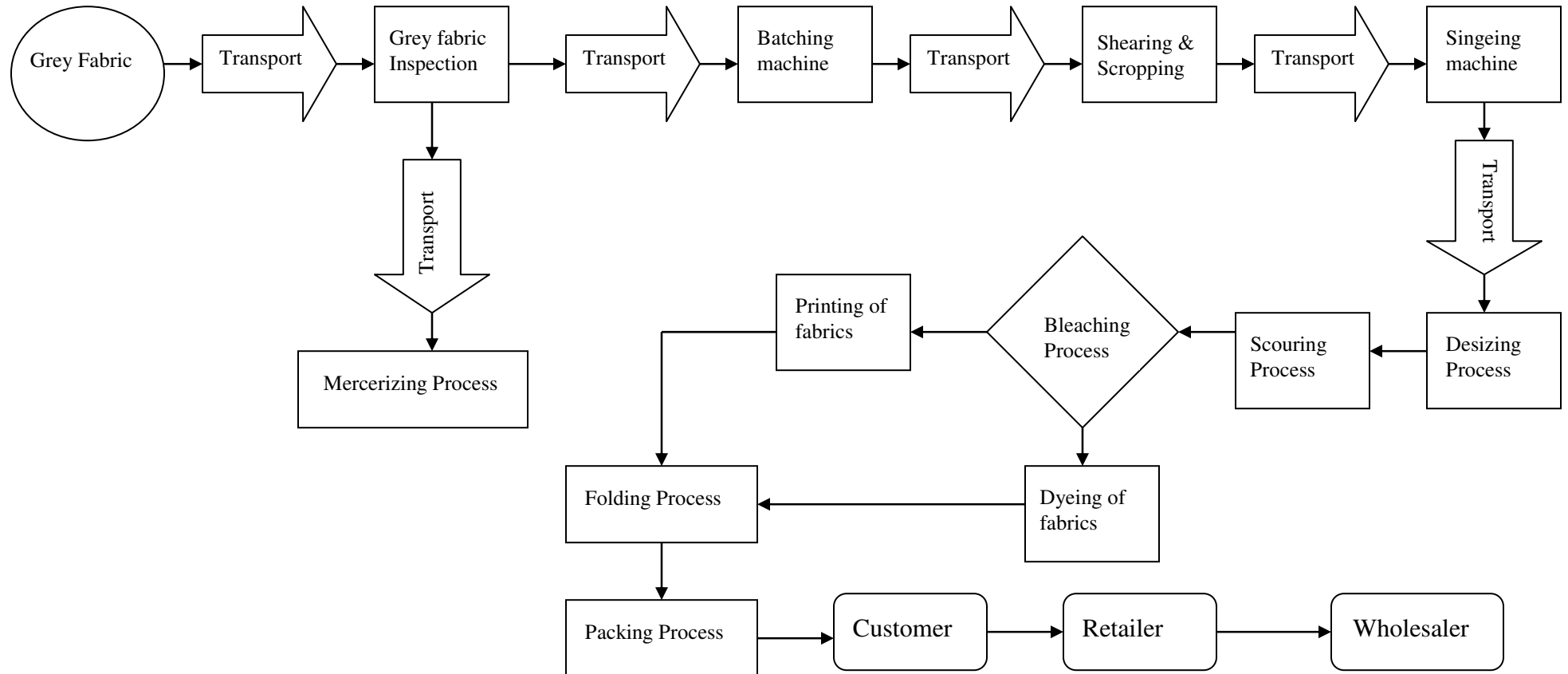


Figure 6.7 Fabric finishing process at Bahirdar Textile Share Company

for increasing the dye ability of the fabric. The desized fabric is delivered to the scouring process. In this process, washing of fabric using soap and other chemicals is performed. Bleaching is the next process by which the fabric exposed for bleaching (making white colour) by using hydrogen per oxide and chlorine.

The bleached fabric could be deliver either to the dyeing process or printing process which depends on the end use of the fabric. The Jigger dyeing machine performs dyeing. Finally the finished fabric is delivered to the folding machine (to fold on the required size) and pack for sale.

6.1.2 QMS - Assessment at Bahirdar textile share company.

The quality concept and activities in BDTSC has assessed through interviews and questionnaires prepared before hand (Appendix-I). The questionnaire includes: quality, management commitment and leadership, organization, decision making, customer focus, communication, causes of poor quality in the company, training, supplier's relationship, quality planning, quality control, quality design and development, quality improvement, cost of quality and others.

i- Quality awareness at BDTSC

The researcher's observation and the result of questionnaires on quality awareness in BDTSC indicate that the awareness level is low. In general, the understanding of quality concept in the company is higher at the top of the organization and gets lesser as one goes down. The role and participation of individual employees in quality activities is lower. Most employees believe that quality is the responsibility of quality control department only. The company does not understand customer's definition of quality and hence does not achieve it. Currently there is a high pressure of market both locally and internationally. Because of this pressure and the push from the government side, the leadership is trying to give attention to quality. But they did not move to practical work and it is a paper work only.

ii- Management commitment, Leadership, and organization

There is no clearly defined quality vision, mission or policy in BDTSC. One can easily observe that there is a huge gap with what is regarded as quality-oriented leadership. In this company, the general manager and middle managers are responsible for preparing and communicating the quality policy and the importance of meeting customer as well as statutory and regulatory requirements to employees within their organization.

Depending on the questionnaire assessment result, the top management (general manager or chief executive in the case of BDTSC) is not committed to quality initiatives. From the assessment 76.7 % of the respondents agree on that the top management is not committed to quality. And the rest 23.5 % agree that the top management is committed to quality. From this result, one can understand that the top management does not demonstrate its commitment and a determination to implement a quality management system in the company. The researcher also interviews some employees in the company concerning the commitment of top and middle management to quality. The interviewees said that, there is a talk about quality but not more than a talk in this company. The researcher has remembered Juran's word that says, "Senior management should be obsessional, not lip service". Hence, the word quality is lip –service only in this company.

There is no any effort done for the quality improvement in the company by the leadership. Quality activities are inspection-based and no efforts are made to go to the prevention-based quality approaches. Mostly, communication is made through the informal boss-subordinate relationship. One can easily observe that there is a huge gap with what is regarded as quality-oriented leadership.

The responsibilities and authorities of all the company staff are not well defined. The general manager does not provide feedback to the employees of the company about his work regularly. Currently, there is no trust between the managers and the work force in this company. Most interviewees agree on that the management of this company does not encourage new ideas and suggestions. Moreover, the management does not identify the constraints of employees to their

performance. The other big problem of the leadership in the company is that it does not evaluate its overall activities specially related to the quality problems.

In BDTSC; there is no organization, which creates quality awareness of the employees. And no body takes the responsibility to implement quality concept in this company and department for developing quality systems and approaches. As shown in the figure 6.1 above, the organizational structure of the company is more centralized. And a limited authority for decision-making has been given to different departments especially to quality control. Hence there is very little participation of employees especially in making important decision related to their activities.

iii- Decision making

Based on the assessment of questionnaires and interviews, the management of Bahirdar textile Share Company does not empower its employees specially low-ranking staff to participate in decision making process. About 82 % of the respondents of this company agree on that the extent of shop floor level employees' involvement in decision-making is none. The involvement of superiors and shift leaders in decision making is also none as indicated by the respondents, which is 47 % and 41.2 % respectively. The participation of the department heads in decision-making process is moderate. While the production head is highly involved in the decision-making. In general, the involvement of employees and sections lowers as one go down in the hierarchy.

iv- Customer satisfaction

The observations through the questionnaires show that company has less attention for its customers. Of course 52.9 percent of the respondents in the company believed that the company has identified customer requirements. They said that, particularly for export market, the company focuses on the customer requirements and specifications of the product and evaluate its products as per the customers required specifications. The rest 47.1 percent of the respondents believes that the company has not yet identified the customer requirements. The other question which is included in the questionnaire concerning the customer is," how often the company measure the customers' needs and satisfaction". More than 15 out of 17 respondents (which is 88.23 %) agreed on that the company does not regularly measure its

customers' needs and satisfaction. There is no also formal regular communication between the company and its customers. The customers of Bahirdar textile Share Company (for periods of 1994 - 1997 E.C) are shown on table 6.4 below.

Table 6.4 Customers of BDTSC for years 1994 -1997 E.C

<i>S.No</i>	<i>Product</i>	<i>Name of customers</i>	<i>Sales in Percent</i>
1	Fabric (drill, poplin, etc)	Matyas P.L.C	38.14 %
2	Sheet	Sayt P.L.C	39 %
3	Warp and weft yarn	Getaneh Trading P.L.C	16 %
4	Mattress and pillow	W/ro Yitemegn	1 %
5	Sheeting for export	Export house, Woinu Trading	3.86 %
6	Others	Some other customers	2 %

Most of the company's employees are not aware of internal customer. They did not know the difference between internal and external customers. The company does not handle customer complaints quickly and positively. Sometimes the customers of this company do not fully describe their requirements. The objectives of the company do not much with the customer needs and expectations. The company does not recognize, throughout its ranks, that the purpose of all work and all efforts to make improvements is to serve the customer better. This means that the company does not know how well its outputs are performing, in the eyes of the customer, through measurement and feedback.

v- Communication

Lines of communication among all members of the staff do not clearly define in this company. There is a difficulty to Communicate upward (with the boss). It is like boss-subordinate relationship which the boss considers the lower workers like goods. Lateral communication is easier than upward communication in this company. There is no clear inter- departmental relationship. The respondents' response indicates that the inter-departmental relationship is not smooth. There is an insufficient collaboration and communication among the departments. The relationship is friend based (not led by rules and regulations of the company).

vi- Causes of poor quality at BDTSC

Three questions are put into the questionnaires concerning the assessment of the causes for poor quality of products in the company: Which division(s) is/are responsible for quality? What are the obstacles for improvement in quality area and what are the causes of poor quality products? The respondents' result is shown on table 6.5 below.

Table 6.5 Responsibility for quality at BDTSC

<i>Responsibility for quality at BDTSC</i>	<i>Frequency</i>	<i>Percentage</i>
Production and technical section.	2	11.76 %
Quality control service	7	41.21 %
Quality control service & Production and technical section.	5	29.41 %
Top management (General manager).	2	11.76 %
All the departments in the company	1	5.88 %
Total	17	100 %

From the table 6.5 above, one can see that the highest frequency percentage is 41.21 % that indicates the most responsible section of quality at Bahirdar textile Share Company. According to the respondents, the lowest percentage that is 5.88 % shows that all departments in the company do take responsibility of quality.

Table 6.6 Obstacles for quality improvement at BDTSC

<i>Obstacles for quality improvement at BDTSC</i>	<i>Frequency</i>	<i>Percentage</i>
The system (policy, rules, procedures, etc)	6	42.86 %
The working environment	1	7.14 %
Lack of consistency in the action being taken.	1	7.14 %
The management	4	28.57 %
Lack of the required knowledge	2	14.29 %

As the respondents' response indicates, the first obstacle (42.86 percent) for the quality concept development and improvement is the absence of the quality system in the company. The second obstacle (28.57 %) is the management of the company. The third obstacle (14.29%) for quality improvement is lack of the required knowledge.

Table 6.7 Causes of poor quality products at BDTSC

<i>Causes of poor quality products at BDTSC</i>	<i>Frequency</i>	<i>Percentage</i>
Defective raw materials delivered from suppliers.	14	82.35 %
Inadequate training of workers in the company.	10	58.82 %
Due to poor maintenance of machines in the company.	15	88.23 %
Lack of top management commitment to quality.	12	70.58 %
Low quality awareness of workers in the company.	9	52.94 %
Due to many vendors of raw materials.	4	23.53 %
Due to carelessness of the workers in the company.	5	29.41 %

The researcher has prepared seven questions (as shown in table 6.7 above) which are targeted to assess the causes of poor quality in this company. According to the respondents' response, the big cause of poor quality in this company is due to poor maintenance of machines (88.23 percent). About Eighty two percent of the respondents think that defective raw materials delivered from the suppliers is the second main cause of poor quality textile products.

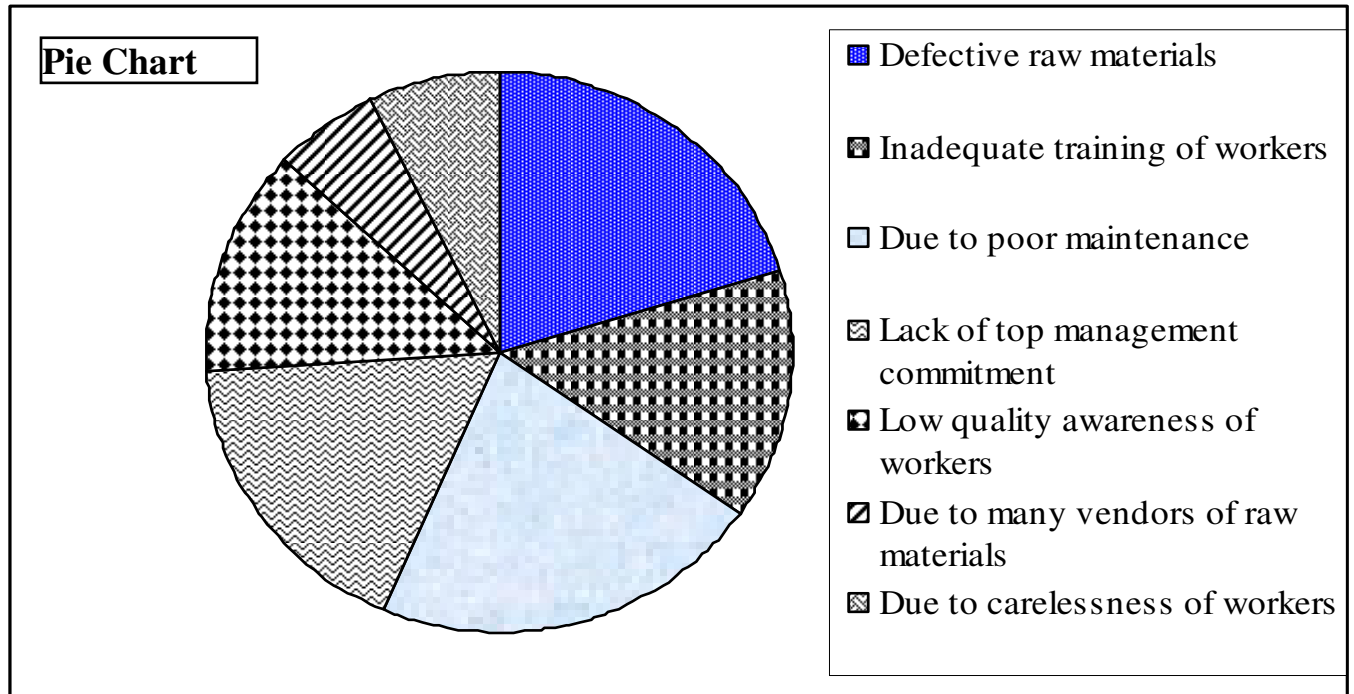


Figure 6.8 Causes of poor quality products at BDTSC (source: respondents result)

vii- Training at BDTSC

The company has a training program. But the training program is not targeted to the improvement of quality control. About 76.5 percent of the respondents agree on that the training requirements of the company do not identified properly. This training section also does not provide appropriate training. The training provided does not evaluate for its efficiency. The personnel carrying out activities affecting quality do not take training.

Some of the respondents comment that the basis for selecting personnel for training is based on skill ness, service years and on the direct work contact. Others suggested that it is based on the personal approach. The trainee is selected if he has more close relation with the managers not for the required work that he will going to do. Some of the courses which are given for training in this company are: training of machine operators, machine maintenance, and basic computer program, trainees of trainers, statistical quality control, and quality control. Few persons including the quality control department head have taken quality and quality management system courses given by the Quality and Standards Authority of Ethiopia.

viii- Supplier's relationship.

The main raw material (cotton fiber) for Bahirdar textile Share Company supplied by the ginning factories locally. There is a minimum flow of information and cooperation towards achieving a common goal between this company and its suppliers.

About sixty five percent of the respondents agree on that the company does not have a formal procedure for evaluating subcontractor or vendors. Moreover, it does not establish the criteria for removing suppliers (vendors) in case of unsatisfactory performance.

The suppliers of the main raw material (cotton fiber) for Bahirdar textile Share Company are: Gondar ginning factory, Des ginning factory, Middle Awash agricultural development enterprise, Tendaho ginning. Procurement of cotton fiber mainly involves the top management who decide the suppliers and the quantity purchased. Since there is a great fluctuation in the quality of cotton fiber, acquisition of the right lint cotton is heavily dependent on the supply in the market. Mostly the cotton growing farmers and state farms sell the cotton fiber to ginning

factories, which separates cotton fiber from its seed and produce the lint cotton. The type of cotton produced by the cotton farms and the ginneries determines the quality of the purchased lint cotton. This will have a direct impact on the type and quality of cotton product. The market fluctuation makes having a few suppliers difficult for this company. Therefore setting a single standard approach for selection of either supplier or raw material is difficult. There are also no efforts to improve the performance of supplier. Therefore, this Company has no constant supplier for lint cotton.

The simple supply chain of Bahirdar textile Share Company is shown figure 6.9 below.

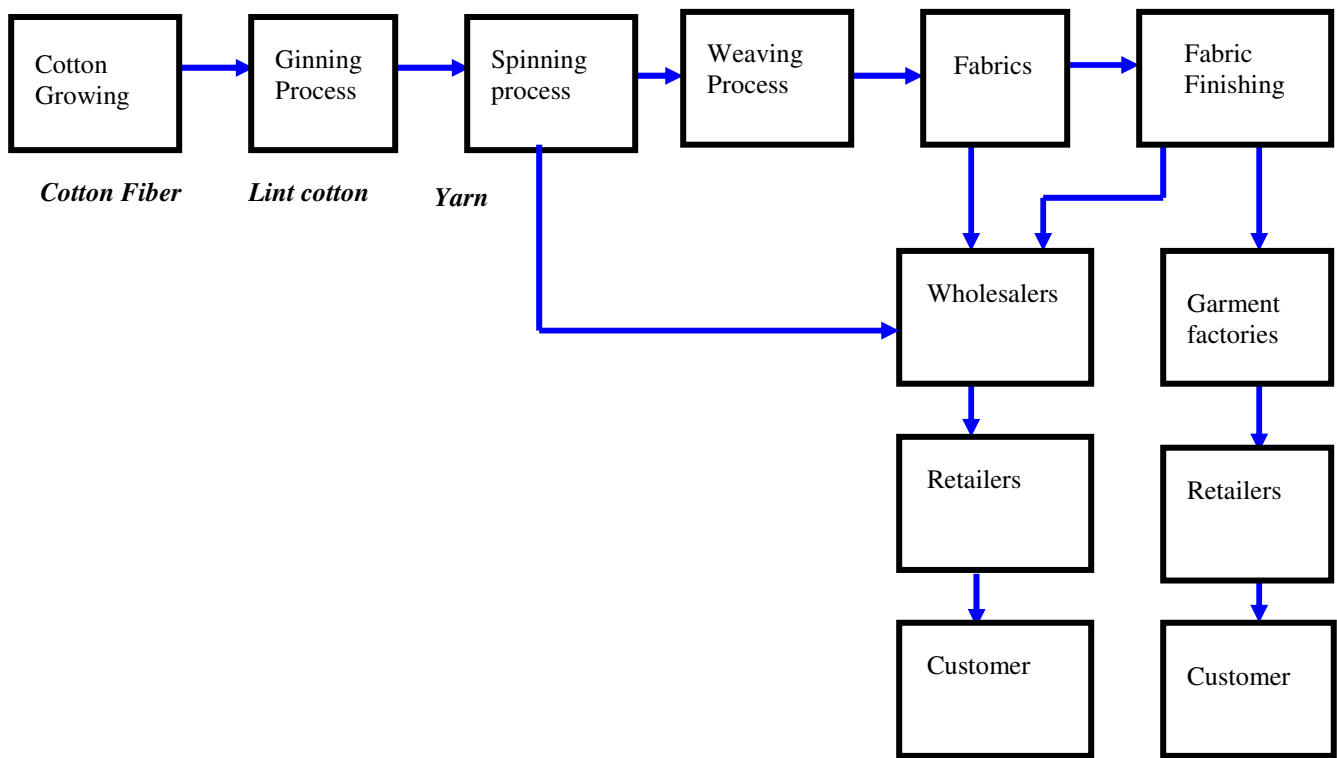


Figure 6.9 Supplier- customer relationships at Bahirdar Textile Share Company

ix- Quality planning

No more talk about quality planning at Bahirdar Textile Share Company. Because most respondents agree on that there is no any quality planning (planning which concerns quality). About sixty five percent of the respondents of the company agreed that the company does not plan for quality.

x- Quality design and Development

Quality design and development process of this company has assessed through questions. The researcher has also interviewed the production heads of spinning, waving and finishing plants. The result shows that there is no formal written procedure for designing process on spinning, weaving and finishing process. On the designing process of textile products, the production heads and quality control workers involve. The interviewees said that during designing process the customers' specification of products is taken into consideration.

Like other manufacturing industries, the types and design of textile products are changing fast. Therefore, the designers for textile products should assess the current market needs continuously and develop new product as required by the customers. But, there is no emphasis for new product development at Bahirdar textile Share Company. The design process of textile products performed traditionally without consideration and evaluation of customer or market needs. The interviewees comment that there is no assessment for new product opportunity.

xi-Quality Control

The company has a quality control department that is responsible for the general manager. The main functions of this department are: to test and inspect the incoming raw materials such as cotton fiber and other chemicals, to inspect and control in-process products (intermediate products such as carded sliver, drawing silver, roving and others), and to inspect and grade the final product such as yarn and fabric before deliver to sales.

The quality control system is traditional type quality control that is focused on inspection. In this company, the only department responsible for quality control is the quality control department. This department gives much attention for detecting the defects rather than preventing the defects.

xii- Common Defects of textile products at BDTSC

A defect is any state of unfitness for use or nonconformance to specification [15]. Defect is any form of deviation of the product's characteristic from the specification (standards) set up by the manufacturing process. It can be caused by a single source or the cumulative effect of several factors, which may arise at any stage of the processing. Generally, defects could be classified into three categories: critical defects, major defects, and minor defects. Critical defect is a defect

which renders the use hazardous and which does not allow the proper performance of the product when in use. Major defect is a defect that could result in the failure of the product or materially affects its usability, operation or performance. The third defect category called minor defect is a defect, which does not materially affect the usability, operation or performance of the product.

Defects in grey fabric could be classified into two: major defect and minor defect. Major defect is a defect that cannot be repaired in the grey so that it would not be obvious in the finished fabric. Minor defect is a defect that can be corrected in the grey or will be covered in finishing so that it will not be detected in the finished fabric. And defects in finished fabrics classified into four: Sub-minor defect, Minor defect, major defect, and critical defect. A minor defect is a defect, which is not obvious and may not be noticeable at first glance. Major defect is an obvious or very obvious defect that can easily be seen from a considerable distance and would most likely cause a defective garment. Critical defect is a classification used for defects of such severity that would cause a garment not to be saleable even as a second grade.

The causes or sources of defects in textile products at Bahirdar textile Share Company are due to: raw materials (textile fibers such as cotton fiber, chemicals, and dye stuff), machines, employees, and due to processing problems. The lower quality of those raw materials is also being the main cause to produce the defective textile product. Lacks of attention, poor handling or sabotage by employee are some of the factors that easily result in defective textile products. In textile products, defects due to processing include, poor understanding of the processing method, use of inadequate or old machines, lack of trained staff, machine break down, and inappropriate working environments.

There are no sufficient facilities and testing equipment for inspection and process control in this company. Some testing and inspection of the incoming material (cotton fiber) such as trash content of cotton fiber, maturity of cotton fiber, etc are done at Bahirdar university Engineering faculty through cooperation. Most of the respondents agreed on that from seven main statistical process control tools, only the check sheet is used in this company. Sometimes the quality control supervisors try to use control charts especially on inspection of twist and evenness of yarns. The company does not perform the calibration process for its instruments and devices.

xiii- Wastages at BDTSC

The researcher has assessed the total wastages for year 1997 E.C in three plants (spinning, Weaving, and finishing plant). The company classifies the wastes into two major categories: usable waste and non-usable waste.

Table 6.8 Amount of waste at BDTSC in year 1997 E.C

S.No	Machine/ Section/department	Amount of waste (kg)		Total waste (kg)
		Usable waste	None-usable waste	
1	Blowing section	-	63867.10	63867.10
2	Carding machine	-	68478.40	68478.40
3	Drawing frame	17108.05	2259.55	19367.60
4	Roving frame	4223.58	2824.02	7047.60
5	Ring spinning machine	48656.40	17516.30	66172.70
6	Weaving preparatory department	-	39549.42	39549.42
7	Weaving room	-	28249.58	28249.58
8	Finishing plant	-	193801.80	193801.80
9	Others	-	5533.60	5533.60

xiv- Quality improvement

To assess the quality improvement effort in Ethiopian textile industries including Bahirdar textile share company, four basic questions are prepared (refer to Appendix-I, question number 72 to 74). Fifty eight percent of the respondents have agreed that the company has no any documented procedure to enable preventive action to be taken to eliminate the causes of potential non-conformities and prevent occurrence. The quality control is inspection based and there is no attention for preventive based quality system in the company.

6.1.3 Proposed QMS- implementation model at BDTSC

The above nine main components of QMS have been also used for its implementation process at Bahirdar textile Share Company. Before modeling the quality management system for the company, we shall see each component briefly with the current situation of company as follows.

A) Management Responsibilities at BDTSC

Under management responsibilities, the management commitment and leadership, quality planning, quality manual preparation and customer satisfaction shall be included in the quality management system of this company. Quality management in this company should start by clearly defining customer requirements of the textile products. Quality statements (visions, mission and policy) must be properly set. This has to be based on its targeted customer's need. The definition must be put in witting and understood by all members of the company. And every body must be held responsible for its implementation. Quality control department should not be the only responsible for quality of a product.

Quality policies and quality objectives need to be established in order to provide a general focus for the company. The company's policies and objectives must determine the intended results and assist the company in applying its resources to achieve these results. The first step that the company must take is to define and document its quality management policy. That is, produce a mission statement that covers the organization's objectives for quality and its commitment to quality. This quality policy must be relevant to the company's organizational goals and take into account the expectations and needs of the customer. The company then needs to ensure that its quality management policy is understood and implemented by all staff members and use it to provide confidence that the application of management is efficient, comprehensive and effective in ensuring that the company delivers the right product: on time, to the agreed specifications, and within the budget.

The management must prepare plan with a special attention given to the quality strategy in the long and short run. The quality plan must address the position of the company with regards to customers, venders, employees, the community, the environment & the business itself. The company must exploit its past experience in the business and consult its employee when developing these quality concepts. Once developed, the management must be obsessively

committed to these concepts. Regular assessment of the company's position can help to amend these concepts and their implementation. The objectives (goals) should also be revised now and then, as there will be changes in the market.

A more diverging organizational structure (less centralized) must be used in company so that important decisions are made at all levels. This will improve employee's participation, which is a vital component of any quality concept development process. Proper education and training must be given before distributing any power to employees and low-level management bodies. There should also be a facilitator who is responsible for coordinating the quality activities in the company. Any further organization for quality may be formed depending up on the need. The facilitator may be selected from the management team (preferably the head of quality control department). With an increase in quality activities, the quality control department may have to be restructured as a quality department.

B) Resource management at BDTSC

This companies need to identify and make available all the resources (such as raw materials, information, infrastructure, people, work environment, finance, and support) required to implement and improve their quality management system and its associated quality processes. The organization is responsible for ensuring that all personnel are trained and experienced to the extent necessary to undertake their assigned activities and responsibilities effectively.

i- Suppliers of cotton fiber

One of the sources of problems for poor quality in Bahirdar textile Share Company is the quality of the raw materials. The major raw material (cotton fiber) supplied by the ginning factories locally. There is a big gap between the company and ginning factories. There is a minimum flow of information and cooperation towards achieving a common goal.

The quality requirements of cotton fiber must be properly defined and documented. Based on these requirements wholesalers (ginning factories) can supply the cotton fiber. To ensure traceability and quality of this fiber, selecting few suppliers is one of the best ways. But the current vendors situation of the country may not allow this kind of customer-supplier relationship. But the company must start and take this approach as a long-term target and work towards it.

Venturing into the investment of cotton farming can help the company in the procurement of cotton of high quality and acceptable trace-ability. The company explains that one of the causes for the losses is the high price of cotton fiber.

C) Textile (Spinning, Weaving and finishing) Process Design

The quality of a product depends first and foremost upon its design. Unless quality is designed into a product, it cannot be achieved during manufacture. The primary aim is to create a product that will fully satisfy the customers' needs and that can be manufactured at a cost enabling it to be marketed at a competitive price. Designing is a process where a product and/or its processing methods are planned.

The company produces yarns with different counts as well as fabrics of different type. Therefore, the company should have a documented process design and the product development cycle. The product development cycle must start with an assessment of customers; needs and ends when the design is released for bulk production. The main steps in the development cycle are: analysis of customer (or market) requirements to arrive at a thorough understanding of these requirements, formulation of design specifications converting customer or market requirements into quality parameters expressed in quantified technical terms as far as possible, modification of design on the basis of the design review and production of one or more prototypes, testing and evaluation of the prototype(s), modification of design if required, and production and testing of modified prototype(s), and finalization of design documents and preparation of complete product specifications including a test schedule incorporating conformity criteria.

D) Textile quality and Process control

There are two views of quality control: traditional quality control and modern view of quality control. Traditional quality control focused on inspection. In Bahirdar textile Share Company, the only department responsible for quality control is the quality control department. Much attention is given on detecting the defects. In modern view of quality control, high quality is achieved by a combination of good management and good technology. The two factors must be integrated to achieve an effective quality system in an organization. This company should avoid the traditional quality control system i.e it should transfer from inspection based quality control system to preventive based quality control system.

E) Textile quality improvement

Quality improvement refers to all efforts directed to increase effectiveness and efficiency in meeting accepted customer requirements. It is a continuous process to achieve a better understanding of the market; to innovate products and processes; to manage and distribute material and products; and to provide service to customers. The success of quality improvement is based on the understanding of every member of the organization concerning the needs of their customers (internal and external).

F) Quality assurance

Quality assurance involves prevention of quality problems through planning and systematic action. It takes a wider view than quality control. Quality should not be about fixing a problem but preventing it. Quality assurance, therefore, includes the whole production and distribution system starting from the supply of raw materials through the internal management to the customer. The current process should be revised with reference to international standards and local regulations. The company should implement ASTM and ISO/IEC 17025 standards. This will help the company to fulfill the international standard facilities and compete in the international market for its products. The next step is to target to ISO 9000 QMS.

G) Quality auditing and Review

When developing QMS, the company must develop a systematic audit of all quality related activities to ascertain whether quality procedures and instructions meet the requirements of the standard. Quality audits and reviews are fundamental for any quality management system to function properly. Quality reviews are systematic and periodical activities carried out to check whether the system achieved the required effect. And quality auditing is an official examination of the functions in an organization against a standard or document. Review must use audit findings and ultimately lead to system improvement. Quality management system review must be conducted at least once a year on all levels. It should show any defect or potential danger in the system and indicate possible corrective action.

H) Quality system documentation

After developing the quality management system, the company must establish and maintain a documented quality system as a means of ensuring that product conforms to specified

requirements”. In effect, it implies an overall scheme of quality assurance institutionalized in documentation issued in the form of manuals, procedures and instructions. Documentation is one of the main areas that the company must focus. There are no properly prepared manuals to assist employees in their day-to-day activities. This has limited the quality of work and any future effort to improve the process in the company. It also reduces the efficiency of the company.

1) Cost of quality

Cost of quality elements have been identified in section 5.4.9 above. Bahirdar textile Share Company does not calculate the cost of quality. The researcher has estimated the cost of quality for this company based on **Annual report** for fiscal year 2004/2005 [2] and through the analysis of the overall quality control activities. The **norm** for frequency of testing & inspection in textile industries has also taken into consideration for determining cost of quality [29].

1- Prevention cost:

A) Process control (in-process inspection): This is the cost incurred for the materials due to destructive test during in-process inspection and testing. It includes: carded sliver, drawn sliver, roving, yarn and grey fabric (weaving product) testing as shown below.

I. Carded sliver (sliver count, neps) = 13 kg x 9 Birr/kg(cost of cotton) = Birr 117

II. Drawn sliver (count, regularity) = 79.7 kg x 9 Birr/kg (cost of sliver) = Birr 717

III. Roving (count, regularity, package size) = 7.25 x 9 Birr/kg = Birr 65

IV. Yarn (count, twist, strength evenness, package size) = total Birr 10,651

V. Weaving : taking 0.5m of each kind of fabric for five tests (such as EPC, PPC, GSM) and 12 types of fabric, cost = 0.5 x 5 x 12 x 6 Birr/meter x 42 week/year = Birr 7560.

Therefore, total expense for process control = 117 + 717 + 65 + 10,651 + 7560 = **Birr 19,110**

B) Quality related training: For the fiscal year 2004/05, the company incurred about Birr 50,349. But, to train the staff of quality control, production and other sections, this cost shall increase. On the average for training 300 employees per year for ten days (70 Birr/day) the cost estimated as Birr **210,000**.

C) Education cost: The Company does not incur cost for education before this time. But it is necessary to give attention for education and the researcher has believed on that at least one person shall get the chance once a year. Taking the average expense as 900 for educating one person per month, the annual total expense will be estimated as Birr **10,800**.

D) *Cost for preparing specifications:* The Company does not consider this cost until now. This is the cost incurred for setting the specifications for yarn, grey fabric, and finished fabric. It is estimated based on the quantity and variety of the products. Assigning 3 persons (with salary of Birr 700/ person/ month) for each product, it is estimated as Birr **25,200**.

E) *Preventive maintenance cost:* This cost includes the labor cost for maintenance and the lubricants expense for the same. There are 22 persons for maintaining equipments. Taking the average salary of each as Birr 300/month, then total expense per year = $12 \times 300 \times 22$ = Birr 79200. And the lubricants expense = Birr 126,956. Therefore, the total expense for the preventive maintenance = $126,956 + 79200$ = Birr **205,956**.

2- Appraisal cost:

A) *Quality assurance:* The Company incurred 0.3 % of its cost of production to QSAE. The cost of production for fiscal year 2004/2005 was Birr 37073267 mentioned above. And the cost for quality assurance is $0.3 \% \times 37073267$ = Birr **111,219**.

B) *Incoming inspection and test:* (staple length, maturity, fineness, strength, waste content, sugar content, moisture content) of cotton fiber 100 g. Total amount of lint cotton lost for those testing estimated as 400 kg per year and current price of lint cotton is 9 Birr/kg. Hence, the expense = $400 \text{ kg} \times 9 \text{ Birr/kg}$ = Birr 3600. Moreover, two testers and one inspector for each plant (spinning weaving, and finishing) is required which costs about Birr 70,200 taking the average salary of Birr 650 for the above nine persons. Total cost = Birr **73,800**.

C) *Quality audit cost:* the company incurred about Birr **38,248**/year for auditing its activities.

D) *Cost of final inspection & test:* it is the testing of finished fabric for testing (tensile strength, tearing strength, and abrasion, color fastness due to washing, color fastness due to rubbing, stiffness, wrinkle, and stiffness). Taking 0.5 meter for each eight tests of twelve kinds of fabrics estimated as: $0.5 \times 12 \times 12 \times 8 \times 42 \text{ week/year}$ = Birr **24,192**.

3- Internal failure cost:

A) *Waste:* The Company determines the amount of wastes for spinning, weaving and finishing plants for this fiscal year. The costs incurred for spinning, weaving and finishing wastes are: Birr 1394500, Birr 406794, and Birr 562,782 respectively. Total cost = Birr **2,364,076**

B) *Rework cost:* it is the cost of re-processing of the usable cotton waste collected from carding room, ring spinning room and other sections. Taking the working process norm as 0.5 Birr/kg and the total usable waste given (69988 kg) the cost is Birr **34,994**.

C) *Machine down time*: According to the companies annual (fiscal year 2004/05) report, the production lost due to down time of the spinning, weaving and finishing are: 428768 kg of yarn, 2055514 m of grey fabrics and 4 740457 m² of finished fabrics respectively. Depending on these results, the company incurred about Birr **3,858,912** taking the average cost of yarn as 9 Birr/kg. This is too much loss and the efficiency of spinning, weaving and finishing plant should increase.

D) *Failure analysis cost*: The Company does not calculate this cost. Assigning two persons in each plant (spinning, waving and finishing), and taking the average salary as 700 Birr/month, then the cost incurred will be Birr **50,400**.

4- External failure cost

A) *Loss of Good will*: company lost many customers due to low quality and quantity of its products.

B) *Returns*: According to the annual reports of the company, 222652 meters of export sheeting fabrics has returned due to low quality. Hence, taking the average cost of the fabric as 6 Birr/m, the cost incurred is about Birr **1,335,912**. This should be minimized and gradually avoided when implementing QMS in the company.

The total cost of quality incurred at Bahirdar textile Share Company for the year 2004/05 has shown on table 6.9 below.

Table 6.9 Total estimated cost of quality for fiscal year 2004/05 at BDTSC

<i>S.N</i>	<i>Quality cost element</i>	<i>Total cost (Birr)</i>	<i>Percentage</i>
1	Prevention cost	259,534	3.19 %
2	Appraisal cost	223,267	2.75 %
3	Internal failure	6,308,382	77.62 %
4	External failure	1,335,912	16.44 %
	Total cost of quality	8,127,095	100 %

Comparing this amount of total cost of quality with the total sales and total production cost of the company for fiscal year 2004/05 (i.e, birr 46530000 and birr 37073267 respectively), the quality cost percentage of sales is 17.47 % and quality cost percentage of production cost is 21.92 %.

The estimated cost of quality for implementing proposed quality management system at Bahirdar textile Share Company is shown on table 6.10 below.

Table 6.10 Estimated cost of quality for QMS-implementation at BDTSC

<i>S.N</i>	<i>Quality cost element</i>	<i>Total cost (Birr)</i>	<i>Percentage</i>	<i>Remark</i>
1	Prevention cost	471,066	5.63 %	<i>This cost increase as quality level increase</i>
2	Appraisal cost	247,459	2.96 %	<i>This cost increase as quality level increase</i>
3	Internal failure	6,308,382	75.43 %	<i>This cost reduce as quality level increase</i>
4	External failure	1,335,912	15.97%	<i>This cost reduce as quality level increase</i>
	Total cost of quality	8,362,819	100 %	

The difference between the cot of quality incurred for the fiscal year 2004/05 at BDTSC and the proposed estimated cost of quality for QMS implementation is Birr 235,724.

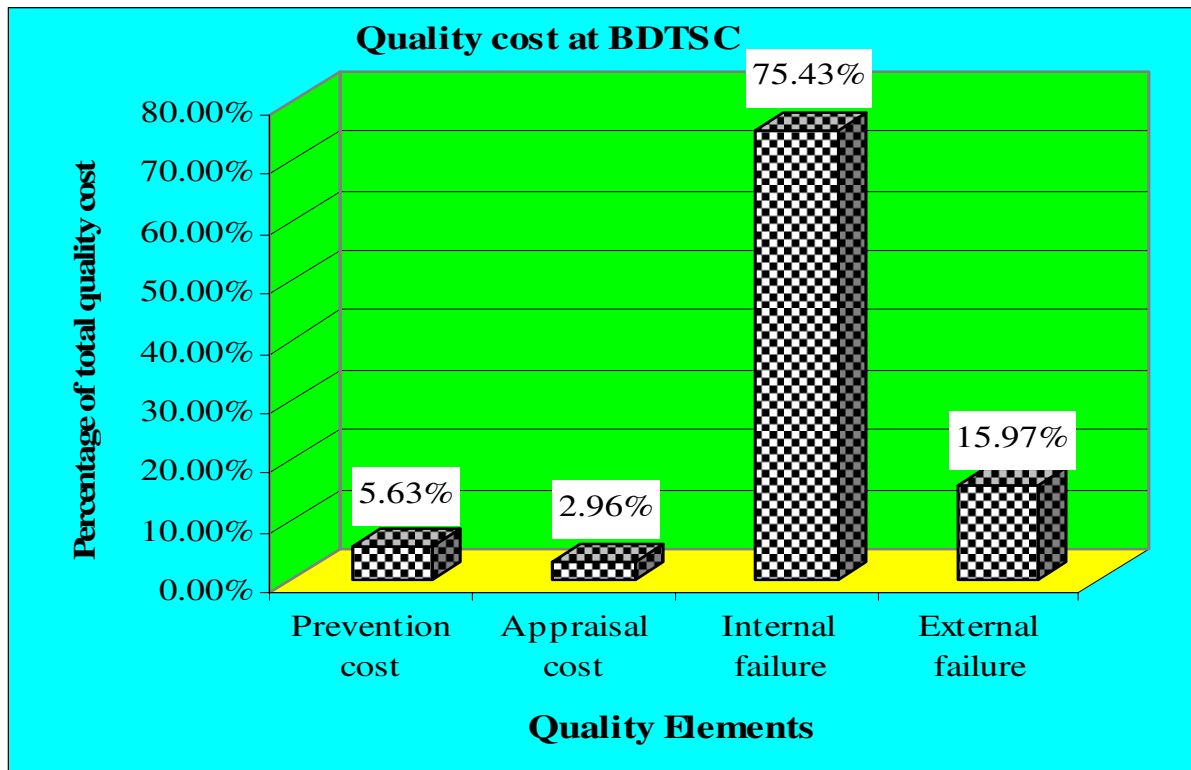


Figure 6.10 Percentages of quality cost elements

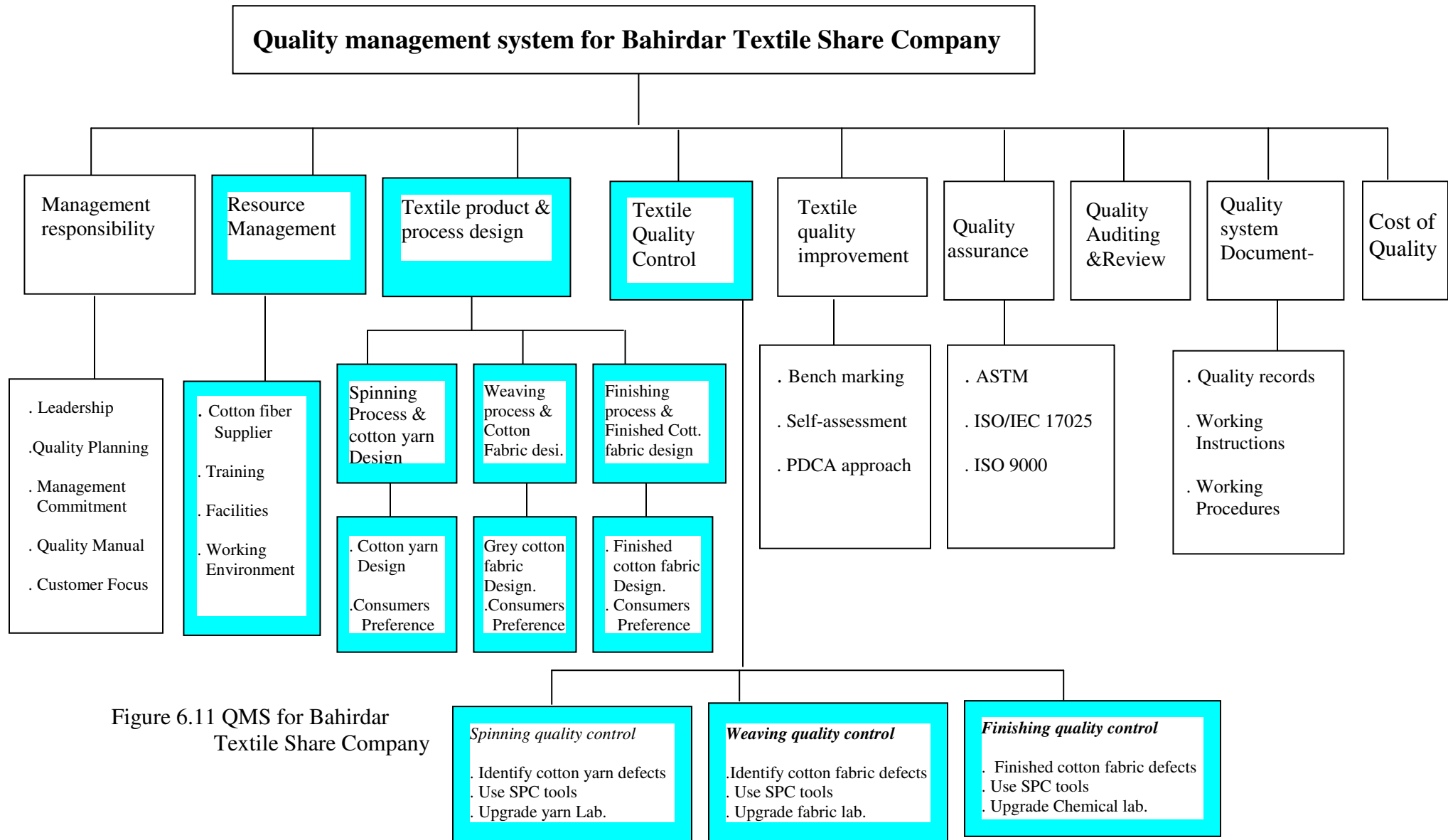


Figure 6.11 QMS for Bahirdar Textile Share Company

The implementation steps of quality management system for Ethiopian textile industries have been discussed in section 5.4 above. Accordingly, those steps could be applied for any textile industries (for those who have started implementing of quality management system and those who are on the way to implement it in the future). Bahirdar textile Share Company does not implement the quality management system and currently it is on the way to implement it. The quality management system implementation steps for Bahirdar textile Share Company have twelve steps.

The management commitment to quality should be demonstrated by establishing the quality policy and quality objectives of the company. This is the first step to implement quality management system. The second step is to assign the quality manager or management representative who takes the responsibilities of the QMS-implementation. The quality control head of this company may be the appropriate person for this position. As the respondents' response indicated in this company the responsibilities and authorities of all staffs are not well defined. So, this has to be done beforehand. The quality control service should be also upgrade to department level and the title of the head shall be named as quality manager. Then, the implementation team or the task force should be established to perform overall quality related activities. For instance, this team prepares the QMS-implementation plan. The company shall conduct the gap –analysis or self-assessment to define and express itself in what position it is as compared to ISO 9000 quality management system. The sixth and seventh steps are to revise their facilities to perform the standards such as ASTM and ISO/IEC 17025 and then implementing ISO 9000 QMS.

The eighth step is to prepare the quality improvement program. There has to be an owner for the quality improvement activities – usually the quality manager shall take. This plan has to be implemented and monitor the implementation process. The audit and review process is used to check its effectiveness. Corrective actions should be taken for nonconformities. The quality improvement process is a continuous process that the Deming cycle or PDCA cycle should be applied.

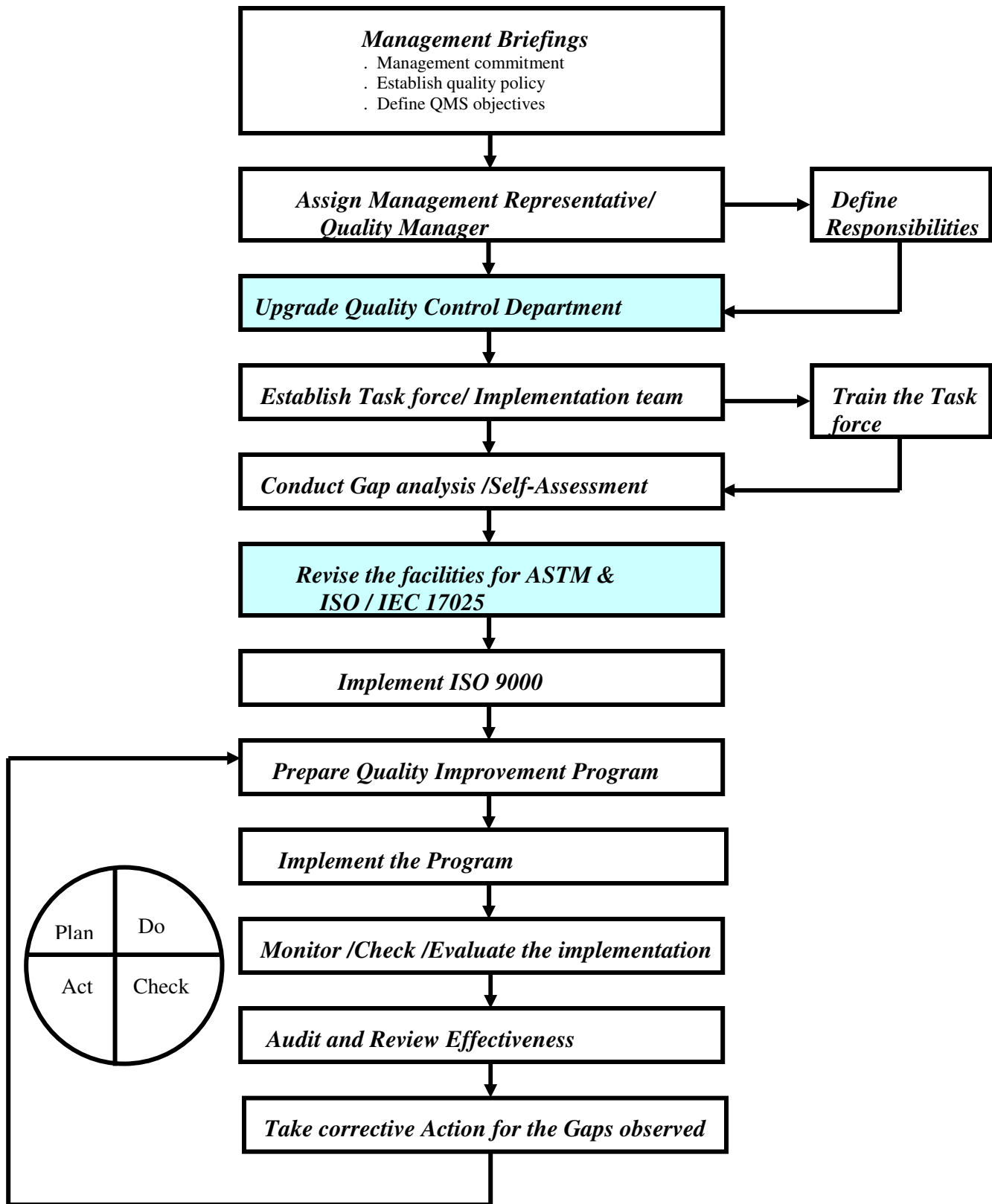


Figure 6.12 QMS-Implementation Model for Bahirdar Textile Share Company [18, 25, 41]

6.1.4 Recommendation.

The results of the questionnaires distributed and the researcher's observation indicates that Bahirdar textile Share Company is too back to implement the quality management system. This company will start from the initial of the QMS implementation steps. This company still follows the traditional management system. The traditional management system does not give attention for the employees rather consider them as goods.

The top management of Bahirdar textile Share Company should wake up and assess overall activities of the company genuinely. The quality related problems discussed above through the study of this thesis and other obstacles that expose the company for loss should be eliminated from their origin. There is no question to apply the quality concepts and its principles in this company, since it is a question of survival.

It will be simpler to implement quality improvement processes on project basis. Projects also clearly define the resource requirements, the time span and objectives to be attained. And this makes the control and evaluation of the improvement process easy. A larger project can be set up for the implementation of the QMS in which smaller projects are prepared to execute the different components of the system. At the end, the project can be phased out and the normal activities of the mill take on. Specific assessment to determine the initial and running costs of the QMS need to be made before embarking onto other activities.

The proposed QMS gives a quality framework for this company. It only guides the activities of the company towards achieving better quality in its yarn and fabric products. The main problems of the company have been identified in this study. Hence, the company shall focus on those problems elimination. This study will also help this company to avoid unnecessary wastages and it could reduce the costs incurred on unnecessary activities. Generally, the company will come to a better position and become competitive in the national and international market, if it implements this model genuinely.

6.2 QMS-IMPLEMENTATION MODEL FOR ATSC

6.2.1 Profile of Akaki Textile Share Company

Akaki textile Share Company was established on April, 1960 with a capital of birr 4,500,000 in Addis Ababa. Its name was “INDO-ETHIOPIA TEXTILE SHARE COMPANY”. When the company starts, it was with 500 workers producing Abugedid, drill, and different warp and weft yarns. The company is 20 km south east of Addis Ababa on the Debre-zeit road adjacent to river Akaki. It occupies 315,485 meter square of land out of which 52,874 meter square is covered by building. In 1974, the Ethiopian government declares that the textile industries will be under the control of the government and this company became the property of the government. In 1991, the company again privatized. The designed and attainable production capacity of Akaki textile Share Company is shown on table 6.11 below. Currently, the productivity of this company is decreasing and it is on the way to stop production because of two big problems: the shortage of working capital and the outdated machines.

Table 6.11 Designed and Actual capacity of production at ATSC

<i>Product</i>	<i>Unit</i>	<i>Designed capacity</i>		<i>Attainable Qty.</i>
		<i>Qty.</i>	<i>No. Shifts</i>	
Yarn	Kg.	1,959,376	3	1,394,032
Fabrics	M ²	131663349	3	24,909,564

Currently, Akaki textile Share Company has a total of 1852 employees out of which 551 are females. Only 14 employees have first B.A/B.Sc degree and above. About 70 percent of the total employees is grade six and below. This indicates that the company should give an attention for education and training program to implement the quality management system.

The company is organized into seven departments: Production and technical, quality control, administration, finance, purchasing and store, legal service, and audit service. Quality control, internal audit, legal service, and planning and management are directly responsible to the general manger of the company. And the general manager is accountable to the directors of board. The organizational structure is given on figure 6.13 below.

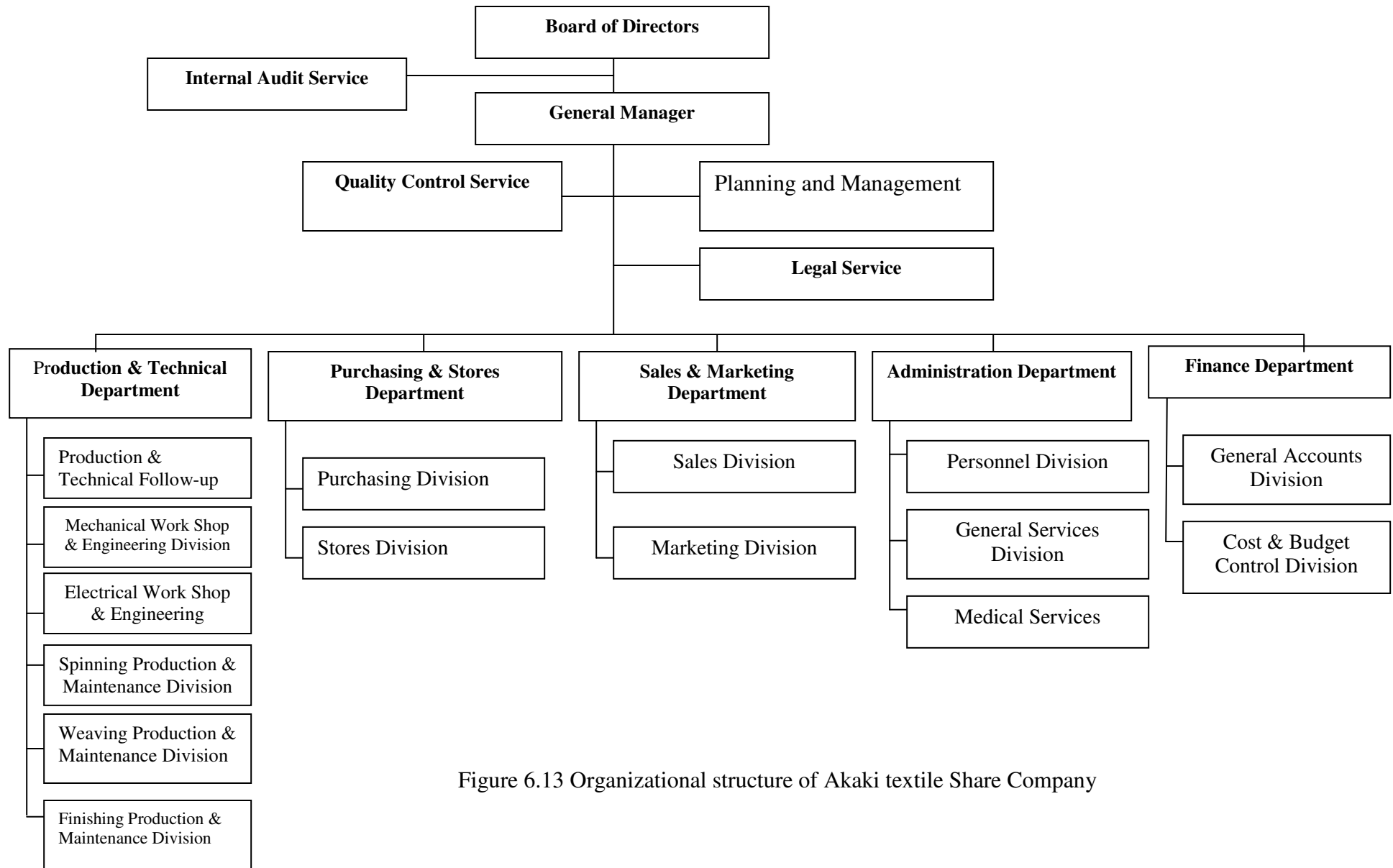


Figure 6.13 Organizational structure of Akaki textile Share Company

a) Spinning Process at ATSC

In a similar way, the spinning process at Akaki textile Share Company starts by receiving the raw lint cotton from its suppliers. The raw cotton is inspected for its conformance to the specification of the company. The lint cotton delivers to the blending feeder for its opening, mixing and cleaning process. Then, the tuft will process in the six-step cleaner, vertical opener and automixer for further opening, cleaning and mixing. The final output of the blowing room that is called Lap is then feed to the carding process for cleaning and parallelizing process. The carded sliver feed to the drawing process to produce the drawn sliver. The drawn sliver could be deliver either to the pre-drawing or directly to the roving process. If it delivers to the roving process the final output is the carded yarn. But if it is delivering to the pre-drawing and combing process then the final output will be the combed yarn. The drawing portion of the operation is referred to as the drafting process. The degree of twist will depend on the speed of the turning spindle with each complete turn of the spindle providing a single complete twist in the yarn. In the initial stage where little twist is present in the drawn sliver, the sliver is fed through a tube and onto the spindle. This process is called roving. Subsequent drawing and high speed with twisting is carried out by ring spinning in which the drafted, lightly twisted sliver (roving) is fed from the drafting unit onto a high speeded spindle via a traveler holding the spun yarn to a ring surrounding the reciprocating spindle. The traveler can move easily around the ring and provides a slight drag on the yarn as it is fed onto the spindle. Ring spinning proceeds at 5000 to 10,000 revolutions per minute.

The final products of the spinning plant in ATSC are carded yarn and combed yarn. A certain amount of yarn delivers to the reeling process to manufacture the hank or skein for sale. The warp and weft yarns deliver to the weaving plant to manufacture fabric. Therefore, the spinning plant is a customer to weaving plant that supplies different kinds of yarns. The quality characteristic of fabrics depends on the quality characteristics of the yarn.

Input = Cotton fiber
Output = Carded and combed yarn

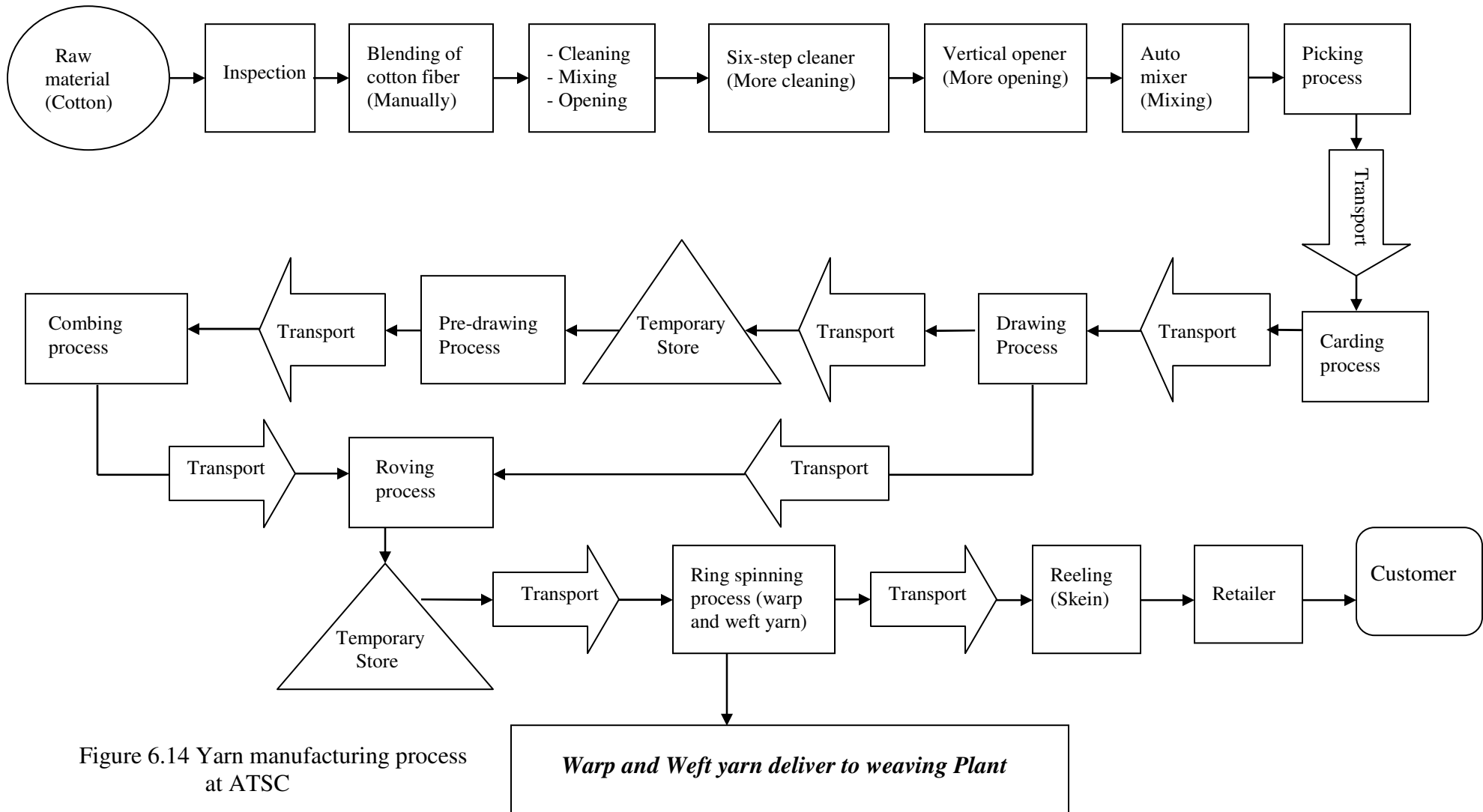


Figure 6.14 Yarn manufacturing process at ATSC

b) Weaving Process at ATSC

The weaving plant at Akaki textile Share Company includes three main departments: yarn preparatory department, weaving process (looms), and grey fabric inspection process. In the preparatory department the warp and weft yarns are prepared into different packages such as cone and beams, which will be suitable for the next process (fabric formation process). The physical and mechanical properties of the yarn also improved in this department. In the weaving department, fabric formation is take place by using weaving machines. The grey fabric is also inspected for its defects in the inspection department.

Winding process is the first process in the warp yarn preparation. This process involves changing of yarn from one package to another and often conversion of the overall size, shape and tightness of the packages. These processes also serve other important functions. Winding allows clearing of the yarn to eliminate thin places, thick places, knots and other imperfections, and makes it possible to regulate tension within the package, combine or segment yarn packages, and prepare packages for dyeing prior to substrate formation. In Akaki textile Share Company, the looms are the outdated shuttle looms and its productivity is very less as compare to shuttleless loom in Bahirdar textile Share Company. Therefore, it is necessary to prepare small packages referred to as quills or pirns that fit within the shuttle for the shuttle loom. The yarn is wound onto the pirn sequentially in such a way to assure steady and even release of yarn from the pirn during the weaving process. The weaving process in Akaki textile share Company is shown on figure 6.15 below. This process is almost similar to the weaving process in BDTSC except that the machines are very old. Further more, the weaving machines of Akaki textile share Company receives weft yarn in the form of pirn only.

Input = Warp and weft yarn
Output = Grey Fabric

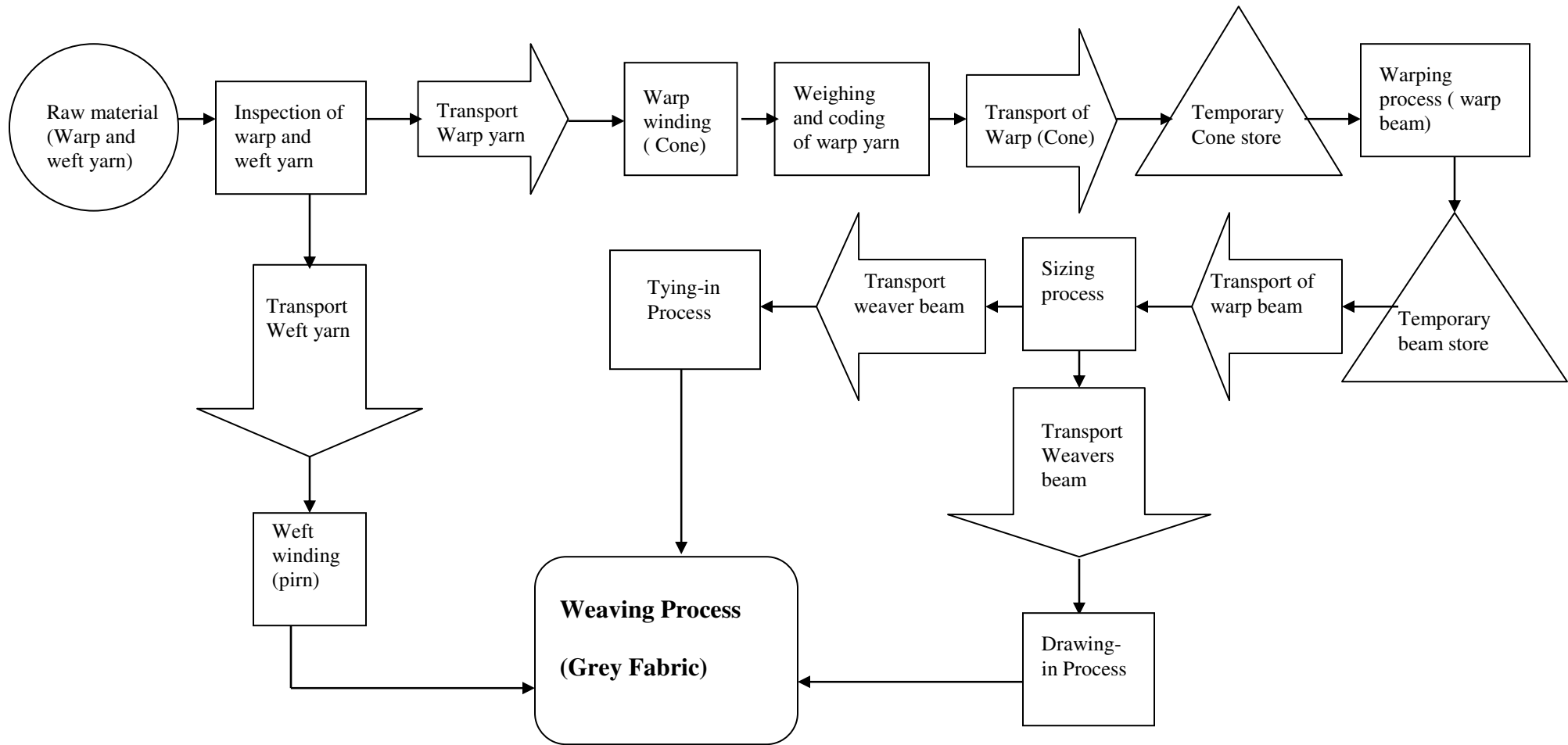


Figure 6.15 Fabric manufacturing process at ATSC

c) Fabric Finishing Process at ATSC

The raw material for the finishing plant is the grey fabric. After inspection is takes place, the grey fabric will feed to grey folding to make batching as required and stitching using stitching machine. The operations performed are: bleaching (half bleaching or full bleaching), dyeing using the Jigger or padding machine, coating, and printing processes. The grey fabric could also deliver to the mercerizing process. This process imparts luster for the grey fabric. The techniques basically involve flattening or smoothening of the yarn surface using pressure. The mercerized fabrics then deliver to the Kier bleaching.

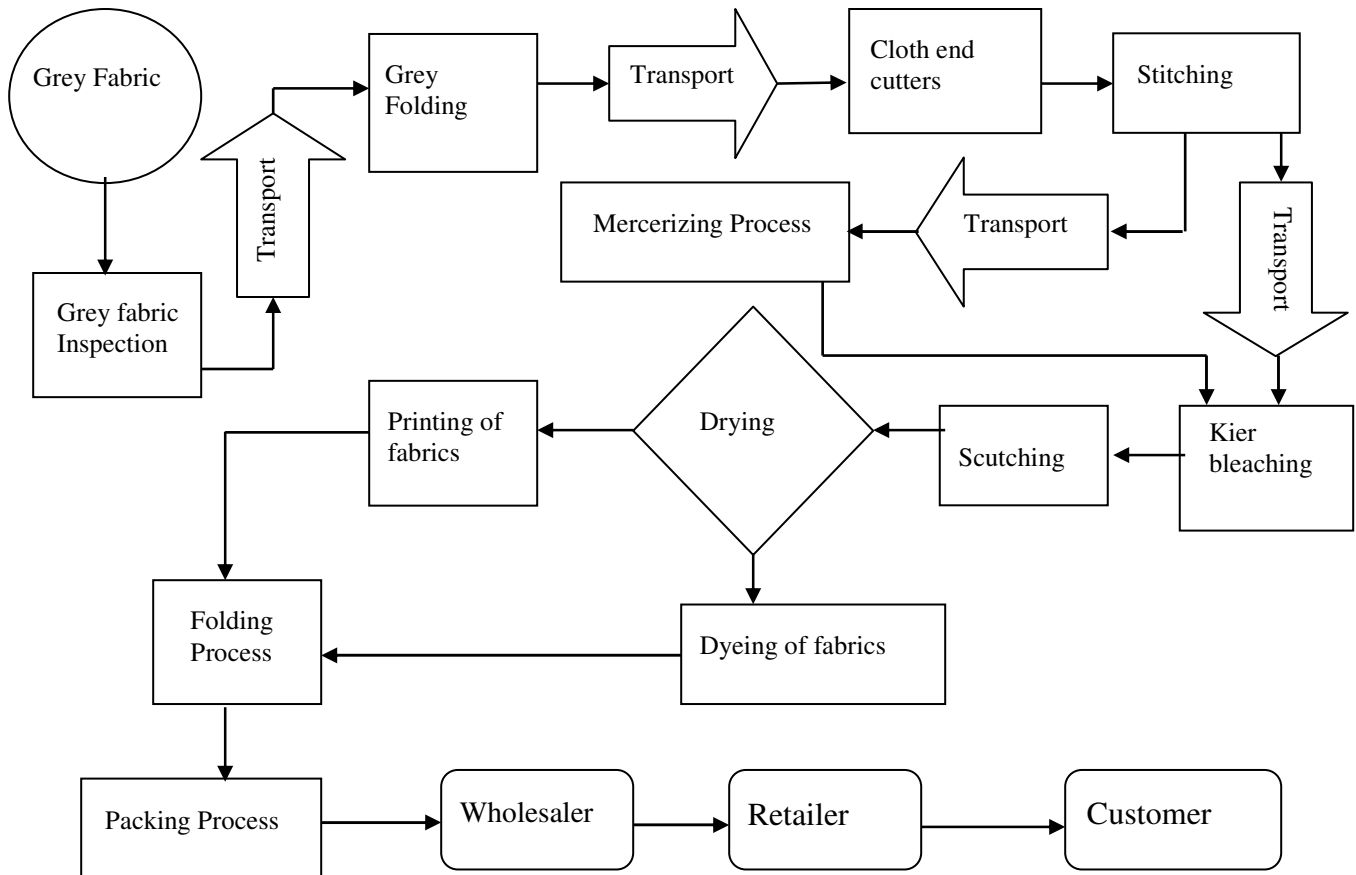


Figure 6.16 Cotton fabric finishing process at ATSC

After drying process the fabric deliver to either dyeing process or printing process which depends on the end use of the finished fabric. Then the printed or dyed fabric delivers to the folding and packing machines. Finally, the finished fabric goes to the customer through the wholesaler and retailer.

6.2.2 QMS -Assessment at Akaki Textile Share Company

In a similar way, the quality concept and activities in Akaki textile Share Company has assessed through interviews and questionnaires prepared before hand (Appendix-I).

i- Quality awareness at ATSC

As compared to Bahirdar textile Share Company, the quality awareness level of Akaki textile Share Company is better. The result of the survey indicates that the participation of the employees in quality related activities is better at this company as compare to BDTSC. The researcher's observation shows that the understanding of quality concept in the company is higher at the top of the organization and gets lesser as one goes down. Most of the respondents (86.67 %) agree on that quality is the responsibility of every body in the company. Sixty percent of the respondents agree on that the company's understanding of customer's definition of quality is better.

ii- Management commitment and, Leadership at ATSC

Akaki textile Share Company does not have the quality policy manual and quality procedure manual. In a similar way, the quality activities are performed traditionally. There is no also clearly defined quality vision, mission or policy. Depending on the survey result (over 60 % of this company's respondents) the top management is committed to quality. But according to the interviewees' result that is made by the researcher the top management is not committed to quality. Its commitment did not demonstrated practically. According to the result of assessment, the responsibilities and authorities of all the company staff are defined. But the general manager does not provide feedback to the employees of the company about his work regularly. Most interviewees agree on that the management of this company does not encourage new ideas and suggestions. Moreover, the management does not identify the constraints of employees to their performance.

iii- Organization and decision making at ATSC

This company has no organization that creates quality awareness of the employees in the company. As shown in figure 6.13 above, the organizational structure of Akaki textile Share Company is more centralized. A limited authority for decision-making has been given to

different departments. Based on the survey of questionnaires (80 % of the respondents), the management of Akaki textile Share Company does not empower its employees specially low-ranking staff to participate in decision making process. The result of the survey of employees' participation on decision making at different level is shown on table 6.12 below.

Table 6.12 Results of Respondents on decision making at ATSC

<i>Questions</i>	<i>Rating results</i>				
	<i>High</i>	<i>Moderate</i>	<i>Little</i>	<i>Low</i>	<i>None</i>
To what extent are employees at different level getting involved in decision making?					
f) shop floor level	-	2	6	2	5
g) Supervisors	-	3	6	5	1
h) Shift leaders	-	3	7	5	-
i) Department heads	2	6	5	2	-
j) Production and technique head	3	5	3	2	1

As shown above, the extent of employees' participation in decision-making processes increases as one goes from the shop floor level to the middle managers. The involvement of the employees in the product /service improvement process is also less. The participation of the department heads in decision-making process is low. Middle managers have a better involvement in decision-making as compare to the department heads and the supervisors.

iv- Customer focus at ATSC

Fifty four percent of the respondents' result shows the company does not regularly measure its customers' needs and satisfaction. The formal communication between the company and its customers is somewhat poor. The awareness level and knowledge of the company's employees on internal and external customer has also assessed. And the result shows that only few employees could identify the difference between internal and external customers. On the other hand, few customers only fully describe their requirements.

v- Communication in ATSC

In this company, the results show that lines of communication among all members of the staff are good. There is no much difficulty to communicate upward (with the boss). But still lateral communication is easier than upward communication. The response indicates that the inter-departmental relationship is smooth and there is sufficient collaboration and communication among the departments.

vi- Causes of poor quality at ATSC

About forty seven percent of the total 15 respondents in the company believed that the only responsible department for quality in the company is quality control department. The results of the respondents' response are shown on table 6.13 below.

Table 6.13 Obstacles for quality improvement at ATSC

<i>Obstacles for quality improvement at BDTSC</i>	<i>Frequency</i>	<i>Percentage</i>
The system (policy, rules, procedures, etc)	4	26.67 %
The working environment	5	33.33 %
Lack of consistency in the action being taken.	2	13.33 %
The management	3	20.00 %
Lack of the required knowledge	1	6.67 %

As the respondents' response indicates, the first obstacle (33.33 percent) for the quality concept development and improvement is the problem of working environment in the company. The second obstacle (26.67 percent) is the absence of quality system. The third obstacle (20.00 percent) for quality improvement that is suggested by the respondents is the management of the company. The fourth and the fifth obstacles of quality mentioned by the respondents are: lack of consistency in the action being taken (13.33 percent) and lack of the required knowledge (6.67 percent) respectively.

Table 6.14 Causes of poor quality products at ATSC

	<i>Causes of poor quality products at BDTSC</i>	<i>Frequency</i>	<i>Percentage</i>
A	Defective raw materials delivered from suppliers.	12	80.00 %
B	Inadequate training of workers in the company.	13	86.67 %
C	Due to poor maintenance of machines in the company.	14	93.33 %
D	Lack of top management commitment to quality.	11	73.33 %
E	Low quality awareness of workers in the company.	12	80.00 %
F	Due to many vendors of raw materials.	8	53.33 %
G	Due to carelessness of the workers in the company.	11	73.33 %

According to the respondents' response, the main cause of poor quality in this company is due to poor maintenance of machines (93.33 percent). Inadequate training of the company's workers is the second big problem that is commented by the respondents. Eighty percent of the respondents think that defective raw materials delivered from the suppliers and low quality awareness in the company are the third main causes of poor quality textile products. The percentage share of each causes of poor quality is shown in figure 6.17 below.

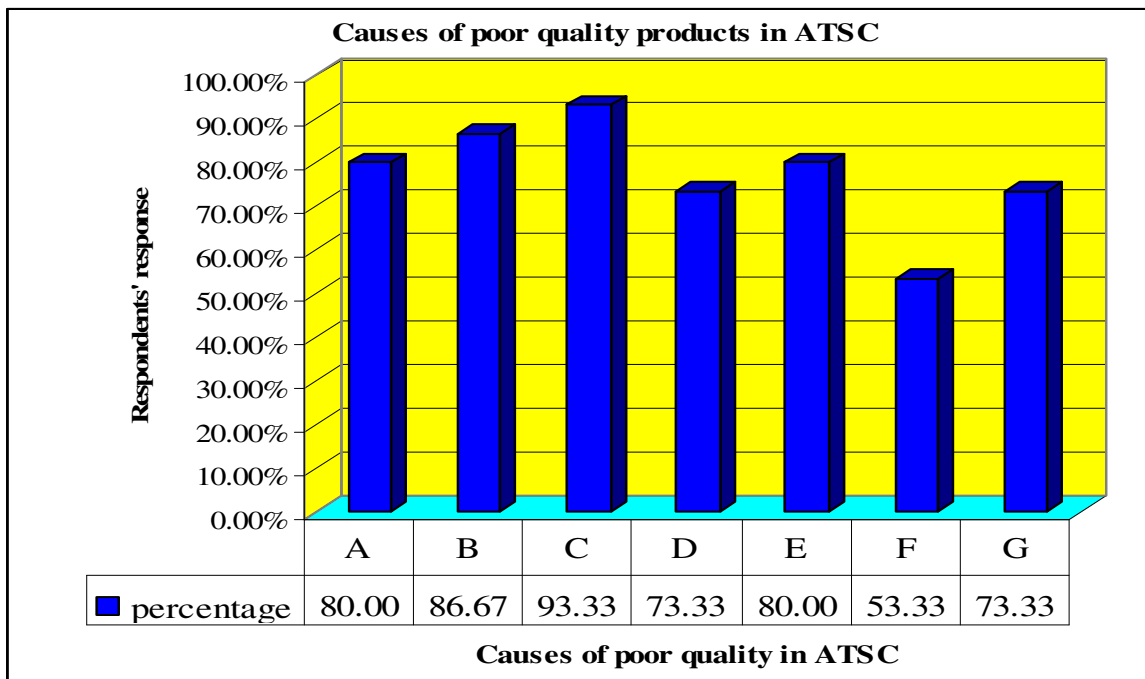


Figure 6.17 Causes of poor quality products in ATSC

vii- Training at ATSC

The comments given by ATSC and BDTSC are the same concerning training. This company has a training program, but the training program does not targeted to the improvement of quality control. Eighty percent of the respondents agree on that the training requirements of the company do not identified properly. This training section also does not provide appropriate training (as the respondents' comments). The training provided does not evaluate its efficiency. The personnel carrying out activities affecting quality do not take training.

viii- Supplier's relationship

The main raw material (cotton fiber) for ATSC supplied by the ginning factories locally. The suppliers of the cotton fiber for Akaki textile Share Company are: Middle Awash agricultural development enterprise, Biralie agricultural development, Gondar ginning factory, Des ginning factory, and Tendaho ginning. Procurement of cotton fiber mainly involves the top management who decide the suppliers and the quantity purchased. Since there is a great fluctuation in the quality of cotton fiber, acquisition of the right lint cotton is heavily dependent on the supply in the market. The market fluctuation makes having a few suppliers difficult for this company. Therefore setting a single standard approach for selection of either supplier or raw material is difficult.

ix- Quality planning

The respondents of ATSC, concerning quality planning, give two contradictory opinions. The question was 'does the company plan for quality "? About sixty seven percent of the respondents answered "yes". The next question was "does the company's quality planning documented? They answered "No". But the researcher has proved through interviews and the results indicate that there is no quality planning in this company.

x- Quality design and Development at ATSC

The interviewees agreed on that during designing process, the customers' quality requirements are taken into consideration. About sixty seven percent of the respondents agreed on the presence of procedures for quality and process design in the company. But, the researcher has also interviewed the production heads of spinning, waving and finishing plants and the result shows that there is no formal written procedure for designing process on spinning, weaving and finishing process.

xi- Quality Control at ATSC

Similarly, at this company, there is a quality control department, which is responsible for the general manager. This department is confined only on three functions: to test and inspect the incoming raw materials such as cotton fiber and other chemicals visually, to inspect and control in-process products (intermediate products such as carded sliver, drawing silver, roving and others), and to inspect and grade the final product such as yarn and fabric before deliver to sales. It is focused on inspection. Its attention is high for detecting defects rather than preventing it.

xii- Quality improvement at ATSC

In a similar way, there is no any effort done for the quality improvement in this company by the leadership. Quality activities are performed as usual traditionally and it is inspection-based. The respondents underline that the company does not have any documented procedure to enable preventive action to be taken to eliminate the causes of potential non-conformities and prevent occurrence. Moreover, the managers do not take the lead and demonstrate their desires for quality improvement.

6.2.3 Proposed QMS- implementation model at ATSC

Similarly, the above nine components of quality management system has discussed for Akaki textile share company. The objective is to see its further application and to observe the difference (if exists). The current trends of the quality and quality management system in this company has assessed and discussed in the above topics. Depending on this result, a short description of each component of quality management system for the company has given below.

A) Management Responsibilities at ATSC

The top management of Akaki textile Share Company should always try to create an environment where people are fully involved and in which their quality management system can operate effectively. The management should demonstrate their commitment to developing and improving their quality management system by: conducting regular management reviews, establishing organizational objectives and its quality policies, ensuring the availability of necessary resources, ensuring everyone is aware of the importance of meeting customer, regulatory and legal requirements.

This company should also make the gap analysis to identify itself where it is as compare to its competitors both locally and internationally. Furthermore, the quality policies and quality objectives need to be established in order to provide a general focus for the company. The company must define and document its quality management policy. It is also necessary to set the company's vision and mission statements that cover the company's objectives for quality and its commitment to quality. This quality policy must be relevant to the company's organizational goals and take into account the expectations and needs of the customer. The company should consider the requirements of the customers during setting its quality policy and quality objectives.

Quality planning is another issue, which should be prepared in the company. After defining its overall business objectives, the company is then in a position to define its quality objectives and to plan the resources that they will need to meet these objectives. The overall quality objectives of the company need to be firmly established during the planning stage and then circulated to all personnel involved so that they can easily translate them into individual (and achievable) contributions. Then, quality management system planning is required: to meet QMS requirements, to define QMS processes and identify the resources necessary, to meet requirements for continual improvement.

To satisfy customer requirements, the company must fully understand the customer's current (and future) needs and expectations. Akaki textile Share Company should start by clearly defining customer requirements of the textile products. It should: identify its customers (including potential customers), identify and assess market competitions, identify opportunities and weakness, define financial and future competitive advantages and identify the benefits to be achieved from exceeding compliance.

There are a lot of issues that the management should address to improve quality performance. To start with, it must improve its relationship with employees. There should also be communication with all members of the company. Incentives, motivational mechanisms, recognitions and rewards are very important in the implementation quality concept. These are tools for making employees put their maximum efforts and ways of acknowledging their effort.

B) Resource management at ATSC

In a similar way, Akaki textile share company need to identify and make available all the resources (such as raw materials, information, infrastructure, people, work environment, finance, and support) required to implement and improve their quality management system. The company is responsible for ensuring that all personnel are trained and experienced to the extent necessary to undertake their assigned activities and responsibilities effectively.

The major raw material (cotton fiber) for this company supplied by the ginning factories locally. Until now, the company does not have a single supplier for cotton fiber. The company buys cotton fibers through bidding process and procurement process will be performed for the one who delivers at lower prices. They do not consider the quality of cotton fiber. But, this has to be changed and the quality of cotton fiber should be considered. Moreover, the company's quality requirements of cotton fiber must be properly defined and documented. And it should try to have a single cotton fiber supplier as much as possible.

Training is a very important issue, which should get attention from such a company. As it is mentioned earlier, most of textile industries in Ethiopia do not have a skilled manpower. More than 86 percent of this company's employees are Grade 12 and below. This indicates that unless education and training is encouraged, the company could not implement quality management system. Akaki textile Share Company has a training program. But it is not well organized and its objectives do not clearly define. The training should emphasize the importance of meeting requirements and the needs of customers and other interested parties the relevant courses that coincide with the quality objectives of the company should be selected. The outputs of the training should be evaluated regularly for its effectiveness.

Currently, this company faced a great problem of facilities. All the machines and equipments, used in this company are outdated. Therefore, one of the big problems of the company is the technology backwardness. For sure, this company could not compete in the local and international market using those outdated machines. Therefore, the company must replace those machines and equipments by the new appropriate technology machines to survive in this intensive competition.

Working environment should also get attention in this company. The current situations of this company are not suitable for working because of the obsolescence machines and equipments. Some of the machines have a high noise. The others are not safe which the employees are exposing for danger. The temperature of the production rooms is very hot which is not controlled. All of these factors affect and influence the motivation of employees to their work, feeling dissatisfaction and poor performance as well.

C) Textile (Spinning, Weaving and finishing) Process Design at ATSC

The designing process of textile products (yarn, grey fabric, finished fabric), has discussed in the previous case study (BDTSC). The product and process design of this company is also similar to BDTSC. Both of them are producing 100 percent cotton yarns and fabrics.

The company should have a documented product and process design for: yarn and spinning process, grey cotton fabric and weaving process, and finished cotton fabric and finishing process. For spinning plant, the yarn designing must start with an assessment of customers' needs and ends when the designed yarn is released for mass production. Similarly, the weaving and finishing process and their products should assess and analysis the customer (or market) requirements to arrive at a through understanding of these requirements, formulation of design specifications converting customer or market requirements into quality parameters expressed in quantified technical terms as far as possible.

Regular updating of the design of the textile products is required. This is done after the assessment of the market and customer needs. The textile product design input and output should be defined earlier. The design inputs include: the products' functional and performance requirements, regulatory and legal requirements. The design output should also ensure: design output meets design input requirements, sufficient information is available for production, product acceptance criteria have been met, and the characteristics of the product have been defined.

D) Textile quality and Process control

The traditional quality control system of this company should be replaced by the modern quality control system, which focuses on defect prevention. The company should control the

spinning, weaving and finishing process for the conformance of the products to the designed specification and take corrective action for any deviation observed immediately.

Inspection and testing is required for the incoming major raw material (cotton fiber) to check the conformance of the material to the specification designed by the company. It is of course the vendors' responsibility to ensure that inspection and tests are always performed on all incoming goods and that no incoming materials used or processed until it has been inspected or otherwise verified to confirm that it is up to the specific requirements.

E) Textile quality improvement

Quality improvement is a continuous process that makes overall efforts of the company to increase effectiveness and efficiency in meeting accepted customer requirements. Most common problems observed in Akiaki textile Share Company is lack of consistency in taking actions. Quality improvement of this company should focus: on early detection of the problems, identification of opportunities, establishment of a conducive decision-making team, comprehensive evaluation of the procedures, establishment of long-term improvement goals.

F) Quality assurance

Quality assurance (QA) must be one of the components of quality management system in this company. Quality assurance focused on providing confidence that quality requirements are fulfilled. The main purpose of quality assurance is to provide assurance to a customer that the standards of workmanship within the company is of the highest level and that all products leaving this company are above a certain fixed minimum level of specification and to ensure that production standards are uniform between divisions/sections and despite changes in personnel.

As mentioned above, the existing situation of this company (very poor facilities) could not allow giving confidence for its customers on its products. Therefore, the current process should be completely replaced by the new process and technology to be quality assured. Then, the company shall exercise and implement the standards such as ASTM and ISO/IEC 17025. The next step is to implement to ISO 9000 quality management system.

G) Quality auditing and Review

There are two types of auditing systems: internal audit and external audit. This company should make an internal auditing at least four times in a year. And the main purpose of internal audit is to identify potential danger spots, eliminate wastage and verify that corrective action has been successfully achieved. To be effective an internal audit must be completed by trained personnel and where possible by members of the quality control staff –provided, that is that they are not responsible for the quality of that particular product. The audit should be capable of identifying such things a non-compliance with previously issued instructions and deficiencies is within the QMS. The audit should recommend any corrective actions that can be achieved to improve the system. It is essential that management shall take timely corrective action on all deficiencies found during audit. The company should also conduct management review to ensure the suitability and continuity of the quality management system using feedback of information from the QMS, including audit findings and customer complaints.

H) Quality system documentation

Akaki textile share company is one of the huge manufacturing textile industries which has a complex processes. Therefore, the quality management system documentation is relatively needs a big attention in this company. The following documents shall be included in the documentation system: documented statement of quality policy indicating the overall intensions and directions of the company related to quality, documented statement of quality objectives that establish what the company wants to achieve based on its quality policy, a quality manual that provides overview of quality management system of the company, system level procedures, records required by the standard and others

I) ***Cost of quality:*** This Company operates at 20 to 30 percent of its capacity and it is on the way to stop production as explained above. Hence, the company does not have an initial data to calculate cost of quality. The quality cost elements are identified in section 5.4.9 above.

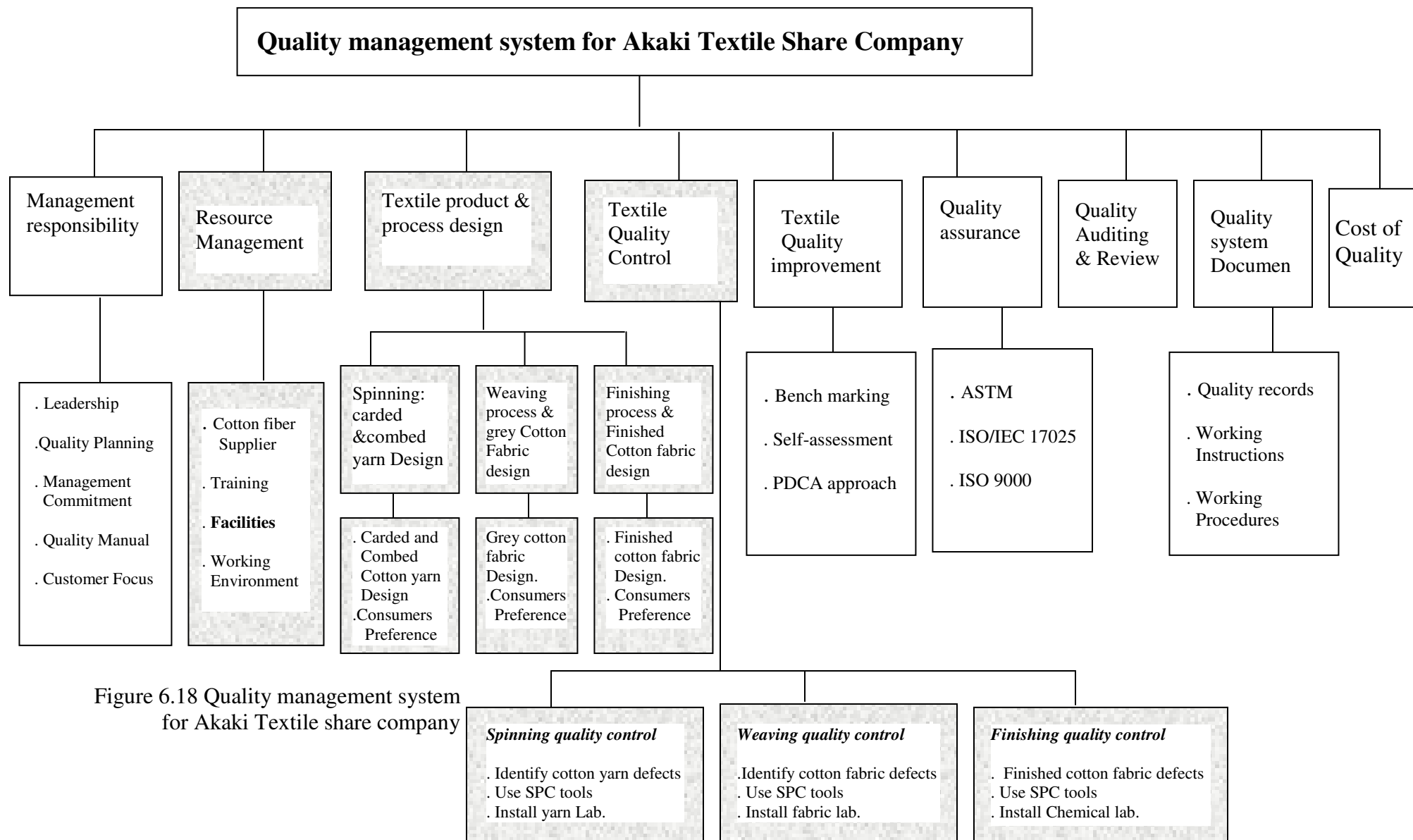


Figure 6.18 Quality management system for Akaki Textile share company

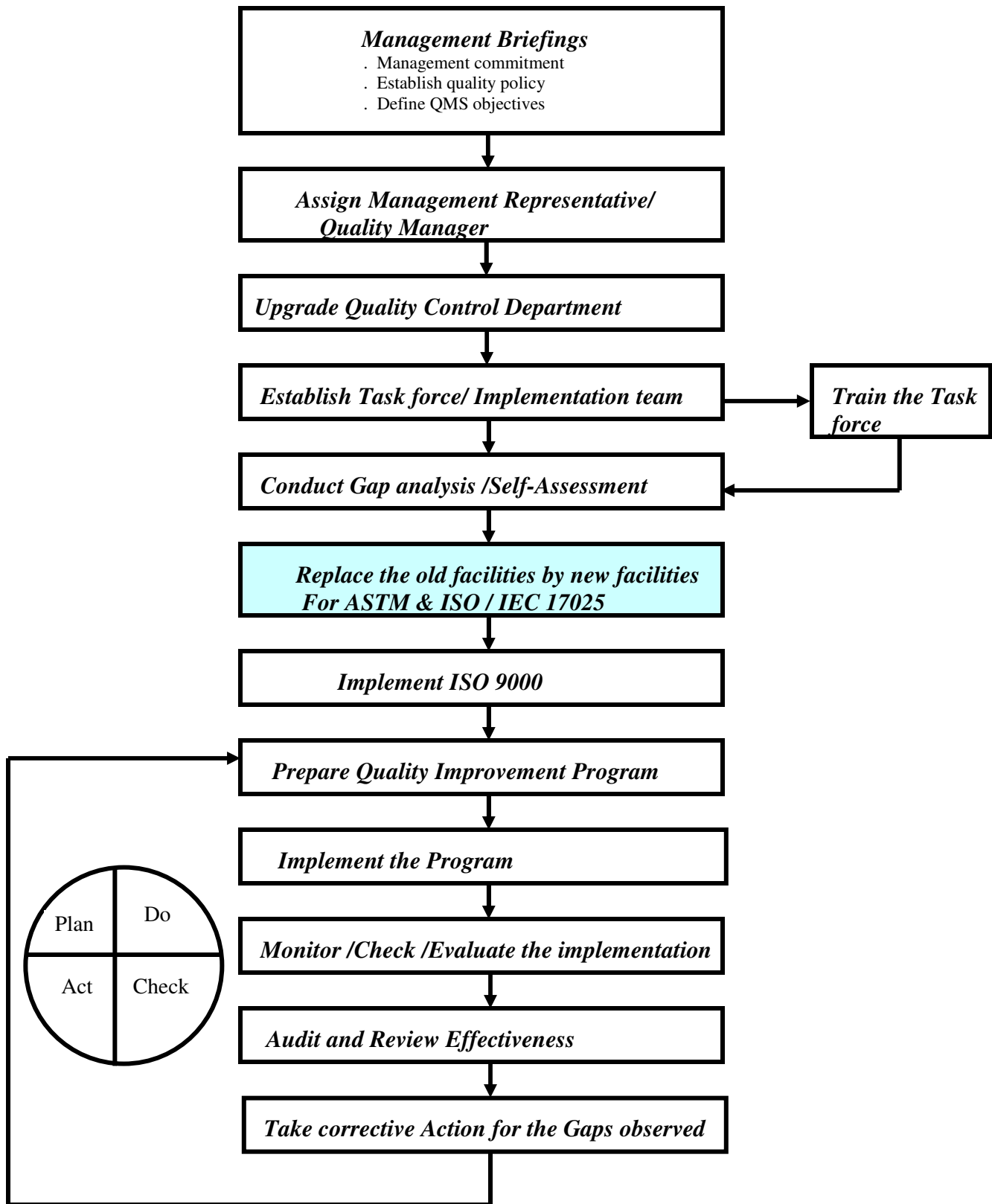


Figure 6.19 QMS-Implementation model for ATSC [18, 25, 41]

The implementation steps of quality management system for Bahirdar textile Share Company have been discussed in section 6.1.3 above. Accordingly, those steps could be applied in Akaki textile Share Company except step six and some other detail points. Those two companies did not apply quality management system before (they are beginners for QMS implementation) and secondly the manufacturing process and their products are similar (products only from cotton fiber).

The first difference is that in Akaki textile Share Company, the responsibilities and authorities of the staff and sections are clearly defined. The second is ATSC has very old machineries and equipments that pull it back to apply the quality management system. Hence, complete establishment of facilities is required for this company to implement QMS.

6.2.4 Recommendation

Two critical problems are strongly pulling this company backward. All machines (spinning, weaving and finishing machines) and equipments are too old which are incapable to produce the yarn and fabrics at the required quality level. The second problem is the shortage of working capital. Currently, the company is under question for its survival because of those problems.

Therefore, the current situation of this company does not allow implementing quality management system. The modern machines should replace the obsolete machines step by step. For instance, first change the spinning plant machines at a certain period of time. And then come to weaving and finishing pant machineries.

CHAPTER 7 CONCLUSIONS AND RECOMMENDATIONS

7.1 CONCLUSION

Based on a survey result (Chapter 4), the thesis addresses the current situation of quality management in Ethiopian textile industries. The survey has indicated that quality related problems are a serious deal to the survival of textile industries. A market is one area that has been affected by these problems. Low market share has been resulted due to poor product quality. Poor performance of products in the world/local market, decline in competitiveness, and under utilization of capacity are good examples to manifest quality related problems. Moreover, quality problems include poor leadership, lack of top management commitment to quality, low quality awareness of the workers, inadequate training of workers, poor quality supplies of raw materials, poor relationship with customers and suppliers, poor product design and absence of team work. In this research work, the implementation model of textile quality management system has been proposed as a solution for these problems. The quality management system consists of nine components, which are strongly interrelated with each other. Those components addresses the areas pertinent to quality in manufacturing process such as management, customers' and suppliers' relationship, textile product and process design, textile quality control, textile quality standards, quality system documentation and cost of quality.

Globalization has become the order of the day that the organization has to live with. The fierce competition has demanded a new way of doing things that optimality utilizes its resources, the biggest resources to make a difference being the employee. The organization has to device a change for maximum 'exploitation' of its employee by empowerment, development, participation, and having their commitment for continuous improvement at all times.

Currently, some textile industries have decided to implement the QMS. This should be encouraged. All other textile industries must also be engaged in the implementation of the QMS as soon as possible. The implementation process could be in a project approach. The implementation process may be long and the result may not observe immediately. The QMS requires a general culture change. It requires intensive training of the employees, involvement of experts and professionals from different field of study and a considerable amount of investment. A strong top management commitment and organizational culture (change of the attitudes of the

staff) with the measurement of customer satisfaction and controlled feedback mechanism will ensure the effective implementation of QMS. With hard working and continuous effort, an achievement can be attained. This includes: improve product quality, increased market share, improve productivity and efficiency, improve customer satisfaction, better utilization of the resources, and development of reliable and good supply of raw materials.

7.2 RECOMMENDATION

Textile industry is an industry with many work procedures, manual operations, and employees. The saying of “30 % of technique and 70 % of management” indicates that technique is the foundation for the product to enter into the market and management is the guarantee for the product to enter into the market. Those industries should stick to the increase of product quality, and enhance the management of the companies to increase its operational capacity [4].

The textile companies should improve: machine/equipment management, air conditioning and dust filtering equipment management, spare materials and parts management, and equipment maintenance management. Through the establishment of the regular repair and maintenance system for machines, the companies can enhance technical reform and maintenance for the machine and increase the efficiency of the machines. It is necessary to enhance quality management system and pay attention to the on-line examination and control of the product quality, in order to continuously improve the quality of the product. Establish “cost priority” management mechanism, determine the competitive price of certain product according to market, and analyze all sections in the production area of the company which cause the rise of cost, adopt powerful measures to lower consumption, increase efficiency, and minimize production cost.

Governmental and non-governmental organizations play an important role in the implementation process of QMS. Governmental bodies such as Ministry of Trade and Industry, Ministry of Agriculture, Textile and Garment Industry Support Institute (TGISI), Bahirdar University Engineering Faculty (BDUEF), QSAE, are vital in coordinating activities such as raw martial (cotton fiber) supply, development of the textile quality standards and implementation of these standards and regulations. TGISI supports textile industries in training and other technical work.

Furthermore, in order to adopt the proposed QMS the following comments shall be considered.

- In Ethiopian textile industries, the education of operational personnel is low, which makes it difficult to execute the company's product quality management, machine maintenance management. Develop a training program on the topics, which helps to implement QMS and related to the objectives of the company. Fully mobilize textile workers' enthusiasm in valuing quality, saving raw materials, improving technique, increasing production.
- Establish textile association: Generally, Ethiopian textile industries have not formed a complete industry system, and companies exist as individual, with no comprehensive administration institution to manage the industry as whole. Thus, it is necessary to establish a comprehensive industry development program to form the association.
- Improve textile quality standards: It is necessary to enhance textile standardizing work, and establish and complete textile standards system in the country. Measures should be taken to accelerate the implementation process of international standards and foreign advanced standard, establish product standards, which conform to the international practices.
- Develop a quality policy (vision, mission, objectives) of the company. Management should show commitment to quality. Leadership by examples is very important to get employees commitment. Involve employees in objective setting and decision-making.
- Identify customer requirements or needs through continuous assessment. Focus on customer satisfaction and target for better customer satisfaction.
- Develop a means of communication such as a quality newsletter to address the quality issues to all staff in the companies.
- Assessment should be carried out on the processes, employees and customer satisfaction continuously in a certain period of time. Develop knowledge of quality improvement tools and techniques and recognize teamwork. Use tools and techniques to identify root cause of quality problems. Concentrate on vital few problems.
- Every body in the company has to be given orientation of quality awareness. QMS could be effective if and only if every body in the company involves for its implementation consistently.

REFERENCES

1. Adedeji B.Badiru, **“Practitioner’s guide to Quality and process improvement”**
Chapman &Hall, Great Britain, 1993.
2. Bahirdar Textile Share Company, **“Annual report (for fiscal year 2004/05) of Bahirdar Textile Share Company”**, Unpublished document.
3. Barrier Dale and John Okaland, **“quality improvement through standards “**, second edition, Stanley throne, 1994.
4. Bruce Brocka, **“Quality management, implementing the best ideas of the masters.”**
McGraw-Hill ,USA , 1992.
5. China Textile Planning Institute of Construction, **“Study Report on the development Strategy of Ethiopian Cotton/Textile/Garment sub-sectors, (Draft)”**, Beijing, 2003.
6. CSA, **“Report on Cottage/Handicraft and Small Scale Manufacturing Industries Survey”**, Addis Ababa, September 2003.
7. Dennis F. Kehoe, **“The Fundamentals of Quality Management “**, Chapman & Hall, London, 1996.
8. Douglas C. Montgomery **“Introduction to Statistical quality control”** New Delhi, 1997.
9. Dr. Brijendra Singh, **“Quality control & Reliability Analysis “**, Khanna Publishers, 2003.
10. D. Sarkar, **“Hand book for Total Quality Management”**, Infinity books, Delhi India, 2000.
11. Elliot B. Grover **“Hand book of textile testing and quality control”** New York, 1993.
12. Ezra Tsegay, **“Quality management system in Ethiopian Food Processing Industries”**
AAU, Technology faculty, thesis, 2004.
13. Fasika Bete, **“Quality Management: Efforts and Problems in Ethiopian industries”**, AAU, Technology faculty, thesis, 2003.
14. Gebeyaw Damte **“Implementing TQM in the technical service of Ethiopian airlines”**, AAU, Technology faculty,2001
15. Histoshi Kume ‘’ **Statistical methods for quality improvement “**, seventh edition, 3A corporation, Japan, 1992.
16. International Trade Center, **“ISO 9000 QUALITY MANAGEMENT SYSTEMS Guidelines for enterprises in developing countries”**, Geneva, 1993.
17. John Oakland, **“Total Quality Management Text with Cases “**, Butterworth-Heine, 2000.

18. John Oakland, **“Total Quality Management: the route to improving performance”**, 2nd Edition, Butterworth- Heinemann, 1999.
19. John Pike & Richard Barnes, **“TQM in action”**, second edition, 1996.
20. Joseph M. Juran, **“Juran’s Quality Hand book”**, 5th Ed, R.R Donnelly & Sons Co, 1999.
21. Kaoru Ishikawa, **“Introduction to quality controls”** Chapman & Hall, 1994.
22. K.C. Arora **“Total quality management”** Kumar Kataria, Delhi 2002.
23. Kit Sadgrove, **“Making TQM work”**, Great Britain, 1995.
24. Peters Mears, **“Quality improvement tools and techniques”** Mc Graw-Hill, Inc, 1995.
25. QSAE, **“Training material for Quality management system development and implementation Based on ISO 9001:2000”**, QSAE, 2004.
26. QSAE. **Training material for Statistical process control (SPC tools)**, QSAE, 2004.
27. QSAE **“1st DRAFT for TESTING Instructor Training Manual for Quality control and inspection in Garment Manufacturing”**, QSAE, 2005.
28. Ray Tricker, **“ISO 9001:2000 for small business”** Butterworth Heinemann, 2nd Ed, 2001.
29. Textile & Clothing consultant **“Quality management”**, TC-consultants, 1997.
30. T.R. Banaga S.C. Sharma, **Industrial Organization and Engineering Economy**, 23rd Edition, Hindustan offset press, Naraina, Delhi, 2000.
31. [http: www.itl.gov](http://www.itl.gov) **“ Engineering Statistics handbooks ”**
32. <http://www.epa.gov/glnpo/qmp>
33. <http://www.tycoelectronics.com/quality>
34. <http://www.bds-ethiopia.net/textile/index.html>
35. <http://www.businessballs.com/dtiresources/total-quality-management>
36. <http://www.epubl.luth.se/1402-1544/2003/07/LTU-07-SE.pdf>
37. <http://www.westinghousenuclear.com/pdf/E6-qms.pdf>
38. http://www.ahca.org/quality/qf=qms_guidelines.pdf
39. <http://www.wmo.ch/web/www/BAS/MG2/DOC-2-6-Richer.pdf>
40. <http://www.mampu.gov.my/mampu/bi/program/circulers/DACO192>
41. <http://www.iso.ch/iso/en/iso9001-14000/understand/qmp/html>
42. <http://isotc.iso.org/li velink/3553384/8>
43. <http://www.national.com/quqlity/files>
44. <http://www.qsae.org/web-en>

APPENDIX-I
QUESTIONNAIRE FOR SURVEY

Addis Ababa University
School of graduate studies
Faculty of technology, Department of Mechanical Engineering
Graduate program in Industrial Engineering



QUALITY MANAGEMENT SYSTEM SURVEY IN ETHIOPIAN TEXTILE INDUSTRIES

Your personal data (it is not necessary to write your Name!)

Position (like manager, quality control head, foreman, shift leader, supervisor, etc)

Service year -----

Gender -----

Rate the following questionnaires as follows (where applicable in your company)

5 = Excellent / High

4 = Very good / Moderate

3 = Good / Little

2 = Fair / Low

1 = Poor / none

Give short or brief answer for subjective questions.

QUALITY	5	4	3	2	1
1- What is the quality awareness level in the company?	☐	☐	☐	☐	☐
2- How high is your role and participation in quality activities?	☐	☐	☐	☐	☐
3- How is quality defined in the company?					

4- Quality is a responsibility of everyone in your company. Do you agree?	yes ☐	No ☐			
5- Does the company understand the customer's definition of quality and try to achieve it?	☐	☐	☐	☐	☐
6- Does the company have quality objectives?	☐	☐	☐	☐	☐
7- Does the company recognize and solve the quality related problems?	☐	☐	☐	☐	☐

MANAGEMENT COMMITMENT AND LEADERSHIP

- 8- Is the top management committed to the QMS initiative? Yes ☐ No ☐
- 9- Does the company have a quality policy manual? Yes ☐ No ☐
- 10- Does the company have a quality procedures manual? yes ☐ No ☐
- 11- Are the functions and inter-relationships of all the company staff defined? yes ☐ No ☐
- 12- Are the responsibilities and authorities of all the company staff defined? yes ☐ No ☐
- 13- How often managers provide feedback to employees about their work? ☐ ☐ ☐ ☐ ☐
- 14- Does the management listen to employees? ☐ ☐ ☐ ☐ ☐
- 15- Is there trust between managers and workforce? ☐ ☐ ☐ ☐ ☐
- 16- Does the management encourage ideas and suggestions? ☐ ☐ ☐ ☐ ☐
- 17- Does the company evaluate its activities? yes ☐ No ☐
- 18- Does the management identify the constraints of employees to their performance? yes ☐ No ☐

DECISION MAKING

- 19- Is all employees specially low-ranking staff empowered to take decisions? yes ☐ No ☐
- 20- Are the employees motivated? yes ☐ No ☐
- 21- Does the company guide its employees' careers? yes ☐ No ☐
- 22- To what extents are employees at different level get involve in decision-making?
- a- Shop floor level ☐ ☐ ☐ ☐ ☐
- b- Supervisors ☐ ☐ ☐ ☐ ☐
- c- Shift leaders ☐ ☐ ☐ ☐ ☐
- d- Department heads ☐ ☐ ☐ ☐ ☐
- e- Production and technique heads ☐ ☐ ☐ ☐ ☐
- 23- To what extent are employees participate in the products/ service improvement process? ☐ ☐ ☐ ☐ ☐
- 24- Has this participation valued and used in the future improvement? yes ☐ No ☐

ORGANIZATION

- 25- Has the company an organizational structure? List out the main departments/sections?

- 26- Does the organizational structure create suitable working environment? ☐ ☐ ☐ ☐ ☐

- 27- What is the objectives and mission of the company?

- 28- Does the company set its goals and targets? yes ☐ No ☐
- 29- Does the company establish its clear vision of the future? yes ☐ No ☐

COMMUNICATION

- 30- Does organization ensure the lines of communication between all members of staff? yes ☐ No ☐
- 31- How easy is it to communicate lateral (with your colleagues)? ☐ ☐ ☐ ☐ ☐
- 32- How is it to communicate upward (with your supervisor)? ☐ ☐ ☐ ☐ ☐
- 33- How smooth is the inter- departmental relationship? ☐ ☐ ☐ ☐ ☐
- 34- Is there sufficient collaboration and communication among departments? ☐ ☐ ☐ ☐ ☐

CAUSES OF POOR QUALITY IN THE COMPANY

- 35- Which division(s)/department(s) is/are responsible for quality? (Mark all that are applicable).
- a) Production and technical section. ☐
 - b) Quality control service. ☐
 - c) Quality control service & Production and technical section. ☐
 - d) Top management (General Manager). ☐
 - e) All departments in the company. ☐
- 36- What are the obstacles for improvement in the quality area? (Mark all that are applicable).
- a) The system (policy, rules, procedures, etc) ☐ d) The management ☐
 - b) The working environment. ☐ e) Lack of the required knowledge ☐
 - c) Lack of consistency in the action being taken. ☐
- 37- What are the causes of poor quality products? (Mark all that are applicable).
- a) Defective raw materials delivered from suppliers. ☐
 - b) Inadequate training of workers in the company. ☐
 - c) Due to poor maintenance of machines in the company. ☐
 - d) Lack of top management commitment to quality. ☐
 - e) Low quality awareness of workers in the company. ☐
 - f) Due to many vendors of raw materials. ☐
 - g) Due to carelessness of the workers in the company. ☐

TRAINING

- 38- Does the company have a training program? Yes ☐ No ☐
- 39- Does the company :
- a- Identify training requirements? Yes ☐ No ☐
 - b- Provide appropriate training? Yes ☐ No ☐
 - c- Evaluate the training provided? Yes ☐ No ☐

40- Have all personnel carrying out activities affecting quality been properly trained? Yes ☐ No ☐

41- What is the basis for selecting personnel for training?

42- Do all personnel receive appropriate training? Yes ☐ No ☐

43- What are the training courses given for the trainee?

1) -----

3) -----

2) -----

4) -----

44- Who gave (Quality and standard authority of Ethiopia, Ethiopian management institute, etc) the training courses? 1) ----- 3) -----

2) -----

4) -----

45- Has a quality management course been identified? Yes ☐ No ☐

46- Have all managers attended the quality management courses? Yes ☐ No ☐

CUSTOMER FOCUS

47- Does the company identified customer requirements? If yes what are they?

48- Does the company regularly measure customers' needs & satisfaction? Yes ☐ No ☐

49- How often the company communicate with the customers? ☐ ☐ ☐ ☐ ☐

50- Are customer complaints handled quickly and positively? ☐ ☐ ☐ ☐ ☐

51- Are the company staffs aware of internal customers? ☐ ☐ ☐ ☐ ☐

52- Do customers fully describe their requirements? ☐ ☐ ☐ ☐ ☐

53- Are objectives of the company linked to customer needs and expectations? Yes ☐ No ☐

SUPPLIER'S RELATIONSHIP

54- Does the company have a procedure for evaluating subcontractors or vendors? Yes ☐ No ☐

55- Has the company established criteria for removing vendors in case of unsatisfactory performance?
Yes ☐ No ☐

56- If materials coming in are inspected :

a) Do test equipment and facilities available in the company? ☐ ☐ ☐ ☐ ☐

b) Does the company get assistance from external agencies? Yes ☐ No ☐

c) What types of tests are performed? -----

57- Who are the suppliers of raw materials?

QUALITY PLANNING

58- Does the company plan for quality? Yes ☐ No ☐

59- Is the company's quality planning documented? Yes ☐ No ☐

60- Does the company's quality planning cover:

a- The process required for quality management? yes ☐ No ☐

b- The requirements for continual improvement? Yes ☐ No ☐

c- The requirements for change control? Yes ☐ No ☐

QUALITY DESIGN AND DEVELOPMENT

61- Is there a procedure for product / process design? Yes ☐ No ☐

62- Does the company define product requirements inputs and outputs? yes ☐ No ☐

63- Who are participant in the designing process (from employees and customers)?

64- Does the specification defined understand by the shop floor staff? yes ☐ No ☐

QUALITY CONTROL

65- Are there inspection & tests for incoming, in-process and final products? ☐ ☐ ☐ ☐ ☐

66- Are there procedures for inspection? Yes ☐ No ☐

67- How are processes planned and controlled to assure quality? ☐ ☐ ☐ ☐ ☐

68- Are there procedures for identifying & segregating non-conforming products? Yes ☐ No ☐

69- Are there procedures for corrective action? Yes ☐ No ☐

70- Indicate the statistical process control (SPC) used in the company to monitor , inspect, and control the process :

a- Histogram ☐ e- cause and effect diagram ☐

b- Pareto analysis ☐ f- Defect concentration diagram ☐

c- Scatter diagram ☐ g- Control charts ☐

d- Check sheet ☐

71- Does the company calibrate the testing instruments? yes ☐ No ☐

QUALITY IMPROVEMENT

72- Has the company a documented procedure to enable preventive action to be taken to eliminate the causes of potential non-conformities and prevent occurrence? Yes ☐ No ☐

73- Does the company have procedures available for :

a- Planning continual improvement? Yes ☐ No ☐

b- Preventive action? Yes ☐ No ☐

74- Do the managers take the lead and demonstrate their desire for improvement? yes ☐ No ☐

75- Does the right person be placed in the right job? yes ☐ No ☐

QUALITY ASSURANCE

76- How often calibration of instruments takes place? ☐ ☐ ☐ ☐ ☐

77- What international and national standards need to be observed?

78- Are all measuring equipment in a known state of calibration? yes ☐ No ☐

QUALITY AUDIT AND REVIEW

79- Does the company audit (internal, external) its overall activities? yes ☐ No ☐

80- Does the company has a documented procedure for audits that include :

a- The responsibilities & requirements for conducting audits? Yes ☐ No ☐

b- The methods for recording the results? Yes ☐ No ☐

c- The method for reporting to management? Yes ☐ No ☐

81- Does the management take timely corrective action on deficiencies found during an audit ? Yes ☐ No ☐

QUALITY DOCUMENTS

82- Does the company have any quality records? yes ☐ No ☐

83- Are those quality records properly filed and easily retrievable? yes ☐ No ☐

QUALITY COST

84- Does the company calculate the cost of quality? Yes ☐ No ☐

85- How the information obtained utilized to calculate cost of quality? ☐ ☐ ☐ ☐ ☐

86- Which functions are involved for cost calculation? -----

TEAM WORK

87- Is there quality circle in the company? If yes who are the members? What are the functions performed by them? -----

88- Is there any other team (quality council, quality steering committee, etc) in the company?

89 -Is there sense of good teamwork in the company? ☐ ☐ ☐ ☐ ☐

90 - Is there trust and loyalty in the group? ☐ ☐ ☐ ☐ ☐

APPENDIX – II
EMPLOYEES SURVEY RESPONSE TO QUESTIONNAIRES

Addis Ababa University
School of graduate studies
Faculty of technology, Department of Mechanical Engineering
Graduate program in Industrial Engineering



RESULTS OF QUALITY MANAGEMENT SYSTEM SURVEY FOR ETHIOPIAN TEXTILE INDUSTRIES

Meaning of Rating is as Follows:

- 5 = Excellent / High**
- 4 = Very good / Moderate**
- 3 = Good / Little**
- 2 = Fair / Low**
- 1 = Poor / none**

General Information

<i>Total number of questionnaires distributed</i>	100
<i>Number of respondents</i>	52
<i>Respondents in percent</i>	52 %
<i>Nationality of Respondent</i>	
Ethiopian	52
Foreigner	-
<i>Ownership</i>	
Public	42
Private	10
<i>Composition of position</i>	Division mangers, Supervisors, Foreman, production heads, shift leaders, Engineers.

Employees Survey Response to rating questions at four textile companies

Q.No	Questions	Response rate				
		5	4	3	2	1
QUALITY						
1	What is the quality awareness level in the company?	3	12	23	12	-
2	How high is your role and participation in quality activities?	2	16	13	16	2
3						
4	Quality is a responsibility of everyone in your company. Do you agree?	Yes = 16 / 48% No = 17/ 52%				
5	Does the company understand the customer's definition of quality and try to achieve it?	3	18	26	10	2
6	Does the company have quality objectives?	8	10	12	15	7
7	Does the company recognize and solve the quality related problems?	2	18	14	15	3
MANAGEMENT COMMITMENT AND LEADERSHIP						
8	Is the top management committed to the QMS initiative?	Yes = 25/ 48% No = 27/ 52%				
9	Does the company has a quality policy manual?	Yes =13/ 27% No = 35/ 73%				
10	Does the company have a quality procedures manual?	Yes = 19/ 37% No = 32/ 63%				
11	Are the functions and inter-relationships of all the company staff defined?	Yes = 20/ 44% No = 25/ 56%				
12	Are the responsibilities and authorities of all the company staff defined?	Yes = 25/ 51% No = 24/ 49%				
13	How often managers provide feedback to employees about their work?	2	7	24	11	6
14	Does the management listen to employees?	2	9	15	16	10
15	Is there trust between managers and workforce?	1	9	21	12	9
16	Does the management encourage ideas and suggestions?	3	7	17	12	11
17	Does the company Evaluate its activities?	Yes = 23/ 44% No = 29/ 56%				
18	Does the management identify the constraints of employees to their performance?	Yes = 20/ 40% No = 30/ 60%				
DECISION MAKING						
19	Are all employees specially low-ranking staff empowered to take decisions	Yes = 7/ 14% No = 42/ 86%				
20	Are the employees motivated?	Yes = 12/ 24% No = 39/ 76%				
21	Does the company guide its employees' careers?	Yes = 15/ 31% No = 33/ 69%				
22	To what extents are employees at different level get involve in decision-making? a- Shop floor level b- Supervisors c- Shift leaders d- Department heads e- Production and technique heads					
		1	6	6	9	29
		-	6	14	20	10
		-	7	26	11	6
		5	19	22	3	-
		17	16	8	3	4
23	To what extent are employees participating in the products/ service improvement process?	6	7	15	16	5
24	Has this participation valued & used in future improvement?	Yes = 22/ 45% No = 27/ 55%				

ORGANIZATION						
25						
26	Does the organizational structure create suitable working environment?	1	15	11	11	8
27						
28	Does the company set its goals and targets?	Yes = 26/ 52%		No = 24/ 48%		
29	Does the company establish its clear vision of the future?	Yes = 25/ 49%		No = 26/ 51%		
COMMUNICATION						
30	Does organization ensure the lines of communication between all members of staff?	Yes =25/ 51%		No = 24/ 49%		
31	How easy is it to communicate lateral (with your colleagues)?	1	14	15	11	9
32	How is it to communicate upward (with your supervisor)?	1	15	18	9	2
33	How smooth is the inter- departmental relationship?	1	16	15	10	9
34	Is there sufficient collaboration and communication among departments?	1	11	21	8	9
CAUSES OF POOR QUALITY IN THE COMPANY						
35	Which division(s)/department(s) is/are responsible for quality? (Mark all that are applicable). a) Production and technical section. b) Quality control service. c) Quality control & Production and technical section. d) Top management (General Manager). e) All departments in the company.	Frequency				
		16				
		27				
		20				
		14				
		25				
36	What are the obstacles for improvement in the quality area? (Mark all that are applicable). d) The system (policy, rules, procedures, etc) e) The management f) The working environment. g) Lack of the required knowledge e) Lack of consistency in the action being taken.	Frequency				
		16				
		6				
		2				
		8				
		1				
37	What are the causes of poor quality products? (Mark all that are applicable). a) Defective raw materials delivered from suppliers. b) Inadequate training of workers in the company. c) Due to poor maintenance of machines in company d) Lack of top management commitment to quality. e) Low quality awareness of workers in the company. f) Due to many vendors of raw materials. g) Due to carelessness of the workers in the company.	Frequency				
		39				
		37				
		41				
		33				
		29				
		21				
		27				
TRAINING						
38	Does the company have a training program?	Yes = 17/ 37%		No = 29/ 63%		
39	89- Does the company : a- Identify training requirements? b- Provide appropriate training?					
		Yes = 9/ 18%		No = 41/ 82%		
		Yes = 6/ 12%		No = 43/ 88%		

	c- Evaluate the training provided?	Yes = 10/ 19% No = 42/ 81%				
40	Have all personnel carrying out activities affecting quality been properly trained?	Yes = 9/ 20% No = 36/ 80%				
41						
42	Do all personnel receive appropriate training?	Yes = 5/ 11% No = 39/ 89%				
43						
44						
45	Has a quality management course been identified?	Yes = 14/ 30% No = 32/ 70%				
46	Have all managers attended the quality management courses?	Yes = 13/ 30% No = 30/ 70%				
CUSTOMER FOCUS						
47						
48	Does the company regularly measure customers' needs & satisfaction?	Yes = 11/ 24% No = 35/ 76%				
49	How often the company communicate with the customers?	-	12	16	9	5
50	Are customer complaints handled quickly and positively?	4	10	17	12	3
51	Are the company staffs aware of internal customers?	2	12	15	11	6
52	Do customers fully describe their requirements?	3	14	11	10	6
53	Are objectives of the company linked to customer needs and expectations?	Yes = 17/ 38% No = 28/ 62%				
SUPPLIER'S RELATIONSHIP						
54	Does the company has a procedure for evaluating subcontractors or vendors?	Yes = 22/ 48% No = 24/ 52%				
55	Has the company established criteria for removing vendors in case of unsatisfactory performance?	Yes = 21/ 48% No = 23/ 52%				
56	If materials coming in are inspected :					
	a) Do test equipment and facilities available in the company?	3	6	15	18	6
	b) Does the company get assistance from external agencies?	Yes = 13/ 30% No = 31/ 70%				
	c) What type of tests are performed?					
57						
QUALITY PLANNING						
58	Does the company plan for quality?	Yes = 19/ 40% No = 28/ 60%				
59	Is the company's quality planning documented?	Yes = 16/ 34% No = 31/ 66%				
60	90- Does the company's quality planning cover:					
	a-The process required for quality management?	Yes = 14/ 30% No = 33/ 70%				
	b- The requirements for continual improvement?	Yes = 13/ 28% No = 34/ 72%				
	c-The requirements for change control?	Yes = 14/ 30% No = 32/ 70%				
QUALITY DESIGN AND DEVELOPMENT						
61	Is there a procedure for product / process design?	Yes = 17/ 39% No = 27/ 61%				
62	Does the company define product requirements inputs and outputs?	Yes = 32/ 73% No = 12/ 27%				
63						
64	Does the specification understand by the shop floor staff?	Yes = 15/ 31% No = 33/ 69%				

QUALITY CONTROL						
65	Are there inspection & tests for incoming, in-process and final products?	7	11	17	9	2
66	Are there procedures for inspection?	Yes = 18/ 47% No = 20/ 53%				
67	How are processes planned and controlled to assure quality?	3	11	19	10	3
68	Are there procedures for identifying & segregating non-conforming products?	Yes = 18/ 41% No = 26/ 59%				
69	Are there procedures for corrective action?	Yes = 18/ 38% No = 29/ 62%				
70	Indicate the statistical process control (SPC) used in the company to monitor , inspect, and control the process : a- Histogram b- Pareto analysis c- Scatter diagram d- Check sheet e-Cause and effect diagram f-Defect concentration diagram g- Control charts	Frequency				
		4				
		4				
		2				
		33				
		3				
		4				
		17				
71	Does the company calibrate the testing instruments?	Yes = 16/ 36% No = 29/ 64%				
QUALITY IMPROVEMENT						
72	Has the company a documented procedure to enable preventive action to be taken to eliminate the causes of potential non-conformities and prevent occurrence?	Yes = 19/ 40% No = 28/ 60%				
73	Does the company have procedures available for : a- planning continual improvement? b- Preventive action?					
		Yes = 15/ 33% No = 31/ 67%				
		Yes = 20/ 41% No = 29/ 59%				
74	Do the managers take the lead and demonstrate their desire for improvement?	Yes = 14/ 30% No = 33/ 70%				
75	Does the right person be placed in the right job?	Yes = 18/ 38% No = 30/ 62%				
QUALITY ASSURANCE						
76	How often calibration of instruments takes place?	4	3	8	16	14
77						
78	Are all measuring equipment in a known state of calibration?	Yes = 12/ 26% No = 35/ 74%				
QUALITY AUDIT AND REVIEW						
79	Does the company audit (internal, external) its overall activities?	Yes = 23/ 55% No = 19/ 45%				
80	Does the company has a documented procedure for audits that include : a- The responsibilities & requirements for conducting audits? b-The methods for recording the results? c- The method for reporting to management?					
		Yes = 22/ 46% No = 26/ 54%				
		Yes = 19/ 40% No = 28/ 60%				
		Yes = 22/ 48% No = 24/ 52%				
81	Does the management take timely corrective action on deficiencies found during an audit?	Yes = 17/38% No = 28/ 62%				

QUALITY DOCUMENTS						
82	Does the company have any quality records?	Yes = 28/ 58% No = 20/ 42%				
83	Are those quality records properly filed and easily retrievable?	Yes = 20/ 44% No = 26/ 56%				
QUALITY COST						
84	Does the company calculate the cost of quality?	Yes = 9/ 20% No = 37/ 80%				
85	How the information obtained utilized to calculate cost of quality?	-	3	6	17	18
86						
TEAM WORK						
87						
88						
89	Is there sense of good teamwork in the company?	-	4	11	22	10
90	Is there trust and loyalty in the group?	1	3	12	21	10

EMPLOYEE SURVEY RESPONSE TO SUBJECTIVE QUESTIONS

1- How is quality defined in the company?

- Degree of achievement as compared to the standard.
- The degree to which the product comes up to the expectation of customer.
- Protecting the product from defects that can create customer complaints.
- Quality is defined as a simple inspection in the textile companies.
- Quality is conformance to requirements.

2 – Has the company an organizational structure? List out the main departments/sections?

- Yes, it has. Administrative, Planning and program, production and technique, quality control, marketing and sales, finance, personnel.

3- What is the objectives and mission of the company?

- To be competent in the local and international market and get profit.
- To produce a competent quality product in the world market.
- To produce the quality product on required quantity and on time.

4- What is the basis for selecting personnel for training?

- Based on skill ness, service year, job title.
- Some respondents commented that the selection is based on personal approach to managers.

5- What are the training courses given for the trainee?

- a) Total quality management, Marketing, Production management.
- b) Maintenance, productivity improvement (spinning, weaving, and finishing).

- 6- Who gave (QSAE, Ethiopian management institute, etc) the training courses?
- Quality and Standards authority of Ethiopia (QSAE).
 - Ethiopian management institute
 - Bahirdar University Engineering faculty (textile engineering department).
- 7- Does the company identified customer requirements? If yes what are they?
- Yes, especially for export products, the companies consider the specifications given by the customer for specific product such as yarn and fabric.
 - Yes, quality products, on time delivery, and optimum costs, etc.
- 8- What types of tests are performed?
- Incoming material test (such as cotton fiber strength, trash content, length, etc).
 - Testing of different chemicals and dyestuffs.
 - Final product test to check its conformance.
- 9- Who are the suppliers of raw materials?
- All ginning factories in Ethiopia (Gondar ginning, Middle Awash agricultural development enterprise, Biralie agricultural development enterprise and others) supply cotton fiber.
 - Belgium, UK, France and other supply acrylic fibers.
- 10- Who are participant in the designing process (from employees and customers)?
- Quality control department.
 - Production heads (spinning, weaving, finishing). Sometimes external customers involved.
- 11- What international and national standards need to be observed?
- Quality and standards authority of Ethiopia has prepared standards for textile products.
 - ISO 9001
- 12- Which functions are involved for cost calculation?
- All companies do not calculate cost of quality.
- 13- Is there quality circle in the company? If yes who are the members?
- Some companies have quality circle but it does not work at all. The members are quality control head, production heads (spinning, weaving, and finishing), supervisors, foremen.
- 14- Is there any other team (quality council, quality steering committee, etc) in the company?
- The respondents approved that there is no any other kinds of quality committee for solving the quality related problems.