

**ADDIS ABABA UNIVERSITY
SCHOOL OF GRADUATE STUDIES
DEPARTMENT OF MECHANICAL ENGINEERING**

**Master's Thesis
On
QUALITY MANAGEMENT SYSTEM IN ETHIOPIAN
FOOD PROCSSING INDUSTRIES
A Case Study at D.H. GEDA P.L.C. & ELFORA
Agro-Industries**

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of
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ABSTRACT

Like most industries in Ethiopia, the food processing industries are suffering from quality related problems. These problems include poor performance of products in the export market, low quality and insufficient raw material supply, low product confidence due to lack of quality assurance systems and increased pressure from high quality and competitive products in the local market. The proposed solution is to implement a properly developed Quality Management System (QMS) in the industry.

Based on the assessment of two cases in the food processing industries (D.H.GEDA & ELFORA Agro-Industries) and other information, seven main components and three minor elements have been identified for this QMS. The first deals with the role of managers and owners, which includes leadership, decision-making and organization related to quality. Quality issues related to raw material and inputs are addressed in the supplier-relationship. Quality design is where customer based products are developed. Quality improvement is the general approach that must be adopted to improve processes and product. Quality control activities are carried out to minimize defect during processing. Quality assurance deals with meeting internationally recognized system to assure product/process quality. To improve the QMS quality review and audits are used. Although they are partially discussed in the main components, elements such as quality manuals, cost of quality, and customers need more focus.

This QMS can alleviate a considerable proportion of problems in the industry. As the food processing industry dominates the manufacturing industry, such exertion will have tremendous impact on the overall performance of the economy.

CHAPTER ONE: BACK GROUND

The term 'Food' is understood in a different context from place to place. For example in USA, it is any substance consumed either by human or animal [28]. This includes all those item that are taken in for their flavors such as chewing gum and additive. In Germany, the term includes those items that are not exactly defined as food stuffs such Tobacco. In Australia, the term includes all substances that are consumed by human but excludes those items used for therapeutic purposes. In general, the term 'Food' should be expressed based on the nutritional function of the substance upon consumption. Codex Alimentarius Commission (a commission jointly established by Food and Agriculture Organization/World Health Organization (FAO/WHO) to ensure food safety and international trade) has given a formal definition of the expression 'Food' as [28]:

"Any substances whether processed, semi-processed or raw, which is intended for human consumption, and includes drinks, chewing gums and any substance which has been used in the manufacture, preparation or treatment of 'food' but does not include cosmetics or tobacco or substances used only as drugs."

Most food products used for the consumption of human and domestic animals are farm products. But there are also items, such as forest coffee and different species of fish from ocean, sea, lake or river, which are harvested from the wild. These food are consumed either raw or after being processed. Food processing can take place at a household level or on industrial scale. The dietary culture (habit) and stage of development of the society significantly influence the preference of consuming raw food products, house processed or industrial processed. For example, there is a relatively low consumption of industrial processed food products in developing countries where house-cooked meals are cheaper.

At the beginning, food was processed at a retailer level for the local consumption. But with the advent of large-scale manufacturing, food processing became industrialized enabling mass production of food items. Nowadays, it has grown to be a multi-billion dollar business involving equally both the developed and developing countries.

Food processing can be defined as the conversion process of food raw material into an improved consumer product. In food industries, it is a general term used to describe all the manufacturing activities of food or drinks for human consumption. These activities include cooking, baking, heating, drying, mixing, grinding, extracting, cutting, dicing, freezing and churning. Any enclosing of food in a container including packing and canning and transportation of raw as well as finished product are also considered as food processing activities. Activities such as sorting, cleaning or water rising are not regarded as food processing.

Generally processing food has a number of advantages for consumers such as:

- Improve physical characters like taste, appearance and texture of the food products;
- Enable food to be preserved for a long period of time;
- Improve food safety;
- Improve the nutritional value of food items;
- Ease the storage and transportation of food products.

Quite a large number of new enterprises have joined the food manufacturing world through time providing either new or already existing products. This gave consumers a wide variety of products to select from and as a result forcing manufactures resort to production system that

focus on the customer's requirements. Meeting customer's requirements is referred as quality. From the 20th century on wards, different approaches to quality have sprung up and become a management strategy tool to secure a competitive advantage in the market. In the beginning, these quality approaches were a bit sluggish in their adaptation by the food processing industry. But it quickly caught up the leading industries (such as Automotive industries) and nowadays it is one of the main constituents in the management of food industries. The implementation of quality in the industry must be properly managed and systematic. To this regard, The development of a quality management system specifically to the food processing industry is of great importance and this will be the core subject matter of the of the thesis.

The thesis consists of seven chapters. The first chapter is an introductory chapter where general information, significance, objective, scope and limitation and methodologies of the study are presented. Problem identification is the second chapter in which major food quality problems are exposed. In the third chapter, background information on food quality is discussed. This includes what quality is, its historical development and the specific quality characteristics of food. An attempt was made in the fourth chapter to identify and discuss the main components of a Quality Management System (QMS) in the food processing industries. The manager and owner's contribution, design, improvement, control, assurance, planning, reviews and auditing aspects of quality are dealt in a more detailed manner. Other narrower topics such as quality manual preparation, quality cost calculation methods and customer-related topics are described in the last section of the chapter.

The fifth chapter looks into the practical aspect of the QMS taking into account two case studies: D.H. GEDA P.L.C. and ELFORA Agro-Industries. The existing situation of each

organization is first assessed and based on the assessment and the theoretical concepts discussed in the fourth chapters, a QMS is proposed for the respective cases. Chapter six tries to investigate the overall QMS of the food processing industries in Ethiopia. It starts by tracing the quality development history of the food industry. Then based on the facts and principles discussed in the preceding chapters, a general QMS for food industries in Ethiopia is put forth. In the last chapter, a conclusion and recommendation are presented.

1.1 Objectives

Having a food quality management system development in mind, a set of objectives has been aimed at in this thesis paper. And these objectives have been grouped in two major class: General and Specific objectives.

The *General* objectives are

- To identify the main components of food quality management system (QMS);
- To identify what quality strategy and standards (the dominant ones) exist internationally and which ones (combination) will best suit our country's food processing industries without compromising their acceptability to the international market;
- To propose general QMS for any food processing industry in Ethiopia.

The *Specific* objectives of the study

- To define different internationally accepted quality strategies and standards, food safety standards, quality management activities and manufacturing practices specifically important to the food industries.
- To formulate food quality management system from the pre-defined standards, strategies

and practices to suit the local conditions.

- To test the practical aspect of the food Quality Management System on two selected food-processing plants that is ELFORA Agro Industry for canned meat and D.H.GEDA P.L.C. (the flour mill section) for wheat flour.
- To identify customer complaints and requirements on the products of the case studies.
- To formulate and propose a Food Quality Management System for any food processing industry in the country.

1.2 Significance of the Study

As a research thesis, the primary merits of the study goes to the university academics. Since there are few and shallow studies in the area, it will give a comprehensive starting point for more specific quality researches for Ethiopian Food Processing Industries. Organizations, which are taken up as a case study, will get at least some idea on the development of a quality management system for their respective company. Hopeful, this will motivate them to improve their quality perception and activities. Government bodies such as Quality Standard Authority of Ethiopia (QSAE), Ministry of Trade and Industry (MoTI), and other interested offices get important concepts on the overall quality management system and specific quality conditions in the food processing industries. Finally, anybody who is interested in quality especially in processed food products can get good ideas from this thesis.

1.3 Scope and Limitations

Because of the available time and space, the scope of thesis is limited to the overall system of quality management. Each component of the quality management system is a good subject for a book. And the thesis only touches those parts that are pertinent for the implementation of the

management system in the food processing industries. Quality systems that are specific only to the food industries are also included in the thesis to make the system complete. The proposed QMS will only serve as starting point for those who try to implement it. Thus it requires regular updating based upon the situation on the ground. Minor adjustments must be made to accommodate the type, size and technology employed in the industry being under consideration.

The two case studies may not represent the food processing industries nature in the country completely. But they exemplify the size and product complexity range in which the industries are. D.H.GEDA represents smaller industries processing relatively simpler product - wheat flour while ELFORA represents large processing industries with more complex product - meat. This will help organization to develop a QMS by approximating their respective level of processing and product complexity to the nearest case scenario discussed in the thesis.

Quality concepts have developed to be multi-disciplinary activities. Doing any kind of study only from the point-view of one field of study will result in a limited scope of the very wide knowledge of quality. It will also lead to professional biasness. Field of studies such as Health, Engineering, Food Technology, and Management are all directly involved. Further more, the lack of experience of the researcher in the food processing industries may have some negative impacts on the overall work. Through consultation with experts from different fields of study, attempts have been made to minimize these problems.

The main problem encountered in the thesis preparation is the lack of information specific to the food processing industries in Ethiopia. There is poor documentation and record of activities in most industries. Modern quality concepts are just beginning to take off and as a result quality

related information specific to the food processing are not available adequately.

1.4 Methodology

Different methodologies have been employed for the preparation of this thesis paper. The main sources of information especially for compiling the theoretical background are different reliable books and Internet websites. One good local source of information used by the study is the work of past graduates of Post-graduate program of the University. Different printed materials including brochures, achievement reports, strategic plans etc. have also been used.

Interviews and discussion with individuals actively involved in the topic area of the thesis is the other methodology used to gather information. Discussion on the actual practices of quality in the country, international quality standards and quality concepts in food industries are made with different experts in the field. Interviews on the processes employed by the case companies have been conducted with those employees responsible for the respective process.

The involvement of employees in quality activities of any organization is of paramount importance. To understand and assess the attitude of employees towards their company and quality, a survey has been made on each case study. Questionnaires that are considered to be helpful in revealing employee's attitudes have been distributed and the answers acquired have been analyzed to give bases for the recommendations put forward.

To have a thorough understanding of the process for the manufacturing of the respective food items, a number of field visits have been made to the case studies. These visits have helped in obtaining information on the physical conditions of processing plants as well as their surroundings and in conducting a face-to-face discussion with shop floor employees.

CHAPTER TWO: PROBLEM STATEMENT

The economy of Ethiopia is in abysmal condition for the past three decades. There are a number of causes for this condition including recurring draught, long-lasting war and poor economic policies and strategies. Whatever the case, the country needs to make serious effort to pull itself out of the situation it is currently in. To this effect, all section of the economy must score significant growth.

Being an agrarian country, Ethiopia's economy is heavily dependent on agriculture and agro-based industries such as food, beverage and tobacco processing industries, leather industry, forest-related industry and textile industry. Agriculture contributes 45.1% of the nation's total Gross Domestic Product (GDP) [3]. In the manufacturing industries, agro-based industries make up about 50% of large and medium-scale manufacturing establishments. And from the total manufacturing enterprises, 31.02% are food and beverage producing establishments [2]. In the cottage/handicraft and small-scale manufacturing, agro-based establishment add up to be 87% of the total count and about 53% of the overall establishments are related to food and beverage production [4]. Agro-based industries are also the largest employers of the workforce and value adders in the economy. Thus, one can easily observe that agro-based industries, more specifically, the food & beverage industries, play significant role in the economy of Ethiopia.

The food processing industries are able to dominate the economy mainly due to the very high demand for their products in the local market. Consumers have limited awareness of quality (if not limited choice) and take whatever they find in the market with out making any fuss. This has created a considerable gap between the demand and supply side of processed food products. Supply deficit is slowly disappearing nowadays as more products are getting into the market.

And this phenomenon is gradually building up a competitive market in the country. The best examples of such trend in the food processing industries are observed in wheat flour, spaghetti and macaroni, soft drinks and beer markets. Competition in the market is forcing manufacturers to look for ways to adapt to this new market condition. As the international experience proves it, implementing quality concepts is the only solution for these kinds of situations.

Although competition is the main driving force, there are additional problems that necessitate the implementation quality concepts in the industry. Export oriented economic strategy is one of the economic policies perused by the incumbent government of the country. Manufacturers are encouraged to produce items of international standard in order to be competitive in the global market. To participate in any global trading, one has to meet certain international requirements. In processed food markets, there are mandatory and voluntary requirements. Mandatory requirements, for instance include World Trade Organization's agreements (Sanitary and Phyto-sanitary Measures (SPS) and Technical Barriers to Trade (TBT)), WHO/FAO guidelines (Guidelines for Hygienic Practices) and safety management systems such as HACCP. ISO standards are good examples of voluntary requirement. These requirements are additional to the ones set by the importing country and some times national requirement are tougher than their international counter parts. To meet these requirements and standards, a well-established quality management system (QMS), without any doubt, is vital.

Organizations that produce for domestic market may feel no need for any QMS, as there is no pressure for quality product. But pressures are recently building up from several fronts. The first source of the pressure is the free market policy of the government. The liberalization of trade and opening up of domestic markets to the international competition has made local industries

no longer be protected from these foreign competitions. A good example for this is the reduction of tariffs for imported products from a maximum of 80% to 50%: the average rate being 24.5% in 1998 [26]. There is also a plan to reduce the average even further to 19.5%. With such trend in the economic strategy and the creation of free trade zones such as COMESA (Common Market for Eastern and Southern Africa) the local markets that have been considered to be a safe backyard may no longer continue to be so [14].

The other source of pressure is coming from the manufacturers themselves. The total number of industries is increasing, even though the rate of increases varies for different types of food processing industries. For example, if the total number of establishment for large and medium scale manufacturing industries is considered, the number of food processing industries has increased by 47 establishments (about 20%) between the years 1999/2000 and 2001/2002 [4 & 3]. This growth has been observed for the past few years and may lead to over crowding in a number of sub-sectors in the near future. To keep its slice of the market, each manufacturer has to implement quality in all their manufacturing processes.

Another serious difficulty in food processing is the supply of good quality raw material. In order to produce high quality product, all the stages in the food chain must produce/supply high quality good (starting with the farmer right up to the consumer). If a farmer cultivates a poor quality crop, the processing industry taking up this product cannot manufacture a good quality food item. 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.

Most food processing industries are operating under their attainable production capacity in the country though the level may vary from one factory to another. This has resulted mainly from the combined effect of the quality problems described above (market and raw material). Under utilization of capacity will lead to loss in profit and ultimately to bankruptcy and closure. The urgency of quality concept implementation to most of these industries is apparent.

Ethiopia's potential for manufacturing export standard processed food products is immense. As the country is endowed with natural conditions for agriculture, there is adequate supply of raw materials for these industries. The availability of ample labor force at cheaper prices adds to the competitive advantage of these industries. Since it requires less capital, both local and foreign entrepreneurs can invest in this business and become successful. But the only draw back may be the lack of quality concept and culture in the country and among its people. Developing and implementing such system will help the country exploit its resources and add valuable points to its image as a potential opportunity for investment.

There are major efforts that are being made by different government bodies to set up local standards. Almost all of these standards are adopted from international standard and safety management systems. International standards are mainly based on quality concepts. Therefore, to meet local standards manufacturers has to implement quality in their production processes. Local standards are mandatory in order to manufacture in any country.

There are also problems that have entangled the manufacturing process in the industry that could be alleviated through the selection of the right quality concepts. Product and process development for manufactured food items and related difficulties are some examples where

quality can provide solutions. Continual up grading of skills of employees and smooth information flow with suppliers and consumers can be attained with such concepts. Appropriate facilities especially laboratories can also be established and maintained. In general, most of the problems faced by the industry can directly be solved or at least significantly minimized.

Some important reasons for employing quality in the food processing industries have been discussed above. And to actually implement it effectively and efficiently, properly prepared QMS is crucial. Since no study has been made in the area, manufacturers may face some difficulties even if they decide to implement some quality concept. Of course, there are international standards and approaches that can be directly copied down. But as the local manufacturing and marketing environments are quite different from those found elsewhere, the success of such grafting may not be guaranteed. Therefore, the best way to implement a QMS in Ethiopian food processing industries is to develop one tailored just for its local conditions.

The QMS developed must address some basic issues regarding the implementation of quality. First, it must show where the country's quality concepts are compared with the international situation. It must also show how the gaps are met in order to make the food 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 country. Developing a blanket management system may not be logical as there are different processing industries in terms of size, type of product, processing technology, stage of quality development etc. But a general QMS can be formulated where each industry can modify it to accommodate its specific local conditions. And such system will encourage, simplify, and facilitate quality implementation in the industries.

CHAPTER THREE: FOOD QUALITY

3.1 Quality

Quality connotes different meaning to different people. Its concept may be easy to grasp but formulating a universal definition is difficult. Several quality authorities have defined quality in various ways considering different attributes of a product. Some definitions are [10, 25, & 5]

Juran: "Fitness for purpose" or "Quality is customer satisfaction."

Deming: "Quality should be aimed at the needs of customer, present and future."

Crosby: "Conformance to requirement"

Feigenbaum: "Total composite product and service characteristics of marketing, engineering, manufacture and maintenance through which the product and service in use will meet the expectations of the customer."

Taguchi: "The loss impart to the society from the time a product is shipped."

ISO 9000:2000: "The degree to which a set of inherent characteristics fulfills requirements."

Others define quality to be the consistency in meeting the user's requirements. When the expected sensory attributes are observed persistently, the food item is considered to be of good quality. And when these attributes are missing or non-uniformly/non-consistently exist in a food item, it is judged to be of low quality.

The quality of a food item can also be evaluated based on its ability to fit the intended purpose, provided that it is supplied at the right time and price. People buy items simply because they have use for them. And manufacturers produce these items just because of their demands.

Quality of a commodity is a composition of attributes that determine its acceptability to the customers. For food items, most attributes are based on the sensory assessment of the product.

Usually the selection of a product is narrowed down to one or two important sensory attributes usually common to majority of customers. To give an example, the crispness of a potato chip is more important than its color or flavor [27]. Food safety is another important attribute. In most instances, it is considered as a basic requirement and is not subjected to negotiation. There are cases where safety is the only criteria for defining the quality of a food product.

Quality is measured in terms of customer satisfaction. The degree of satisfaction depends on the manufacturer's ability to meet customer's needs and keep on meeting. In a competitive market repeated purchase can be taken as a good indicator of the satisfaction level. With time customers will gain confidence on the product & its manufacturer and attach quality to the brand name.

3.2 Quality Characteristics of Food

There are a number of food quality characteristics where the measurement technique for each varies. These characteristics are broadly classified into two [27]:

1. Physical Characteristics
2. Hidden Characteristics

1) Physical characteristics: - are those characteristics that can be defined and perceived by the human senses. They are also called Qualitative or Sensory Qualities. These characteristics are easier to identify and measure. Physical characteristics can be categorized into three: *Appearance Characteristics* include color, size, shape and physical defects; *Kinesthetic Characteristics* are texture, viscosity, consistency, finger feel and mouth feel; and *Flavor (Sensations) Characteristics* are the combination of odor and taste [27]. Faced with new product, a person will first make a visual/appearance (i.e. the color, size, shape, etc) assessment of the food. He then takes it into his hands and feels the texture of the food. He finally checks

the aroma and puts it in his mouth and tastes the texture, palatability and flavor of the food.

2) ***Hidden characteristics***: - are those characteristics that can't be identified by human sensors and are only revealed through standard chemical or microbiological procedures. This includes nutritional content, chemical composition and food hazards. Chemical or microbiological tests require different instruments/equipment, chemicals, laboratories and well-trained technicians. This makes defining hidden characters more complex and expensive.

Another type of classification for quality characteristics of food products is based on the economic theories: Search, Experience and Credence characteristics [19].

1. ***Search Characteristics***, like that of the size of eggs or the color of meat, can be ensured before any purchase is made. These characteristics are based on perfect information that can be obtained beforehand.

2. ***Experience Characteristics***, such as taste, are characteristics that can be established after only experiencing the food item.

3. ***Credence Characteristics*** are attributes of manufactured products that cannot be found out either before or after the purchase of the item. For instance, determining whether a vegetable is organically produced or not or whether a coffee powder is produced according to Max Havelaar regulations. Credence Characteristics are not visible and very difficult to validate by an outsider. Thus these characteristics are a matter of credibility and trust. And they are becoming more important requirements of customers nowadays.

3.3 Historical Development of Food Quality System

a) Food Quality

At the beginning, quality concepts were mainly based on the individual's perception. As

governments started to play essential role in assuring the integrity of food supplier, food quality concepts became organized. Regulatory functions focusing on food supply were set up. These regulatory functions were used as a means of protection against fraud in the market place. The concept expanded into a mechanism for preventing the sale of unsafe food and as the science of nutrition developed, it further incorporated the nutritional integrity of food supply. Some efforts in food regulation can be sited in the ancient Greek and Roman eras. For example Theophrastus (370-285 B.C), a Greek botanist, reported on the use of artificial flavors in the food supply [16]. The Roman's were more of practical people like Pliny the Elder (23-79 A.D) who described adulteration of bread with chalk, vegetable meal and cattle fodder and M. Porcius Cato who recommended a method to determine whether water has been added into a wine or not.

Food laws were another means used by societies to define the 'accepted' concepts of food quality. For instance, the Egyptian, the Jewish, Christian and Islam have grouped animal into edible and non-edible [13]. Further more, they have set standard practice (mostly religious) for the preparation of meat from edible animals. In addition to the regulatory function, governments have also adopted food laws mainly to punish perpetrators of fraud in the quality of food. Deliberate adulteration like stone grinding in flour, water in wine, beer or milk and sale of margarine for butter are some examples of fraud dealt by these laws, which usually punish offenders by amputation or death. Food laws and regulation were used to perpetuate the concept of food quality which most of the time dominated by the safety aspect. The enforcement of these laws and regulation is directly related to the strength of the government at the time.

In the 18th and 19th century industrial revolution and advancement in scientific knowledge in the fields like Management, Food Processing and Medicine brought about a new approach to food

processing industries. The inception and growth of large-scale food processing industries like bakeries and breweries resulted in mass production of food products for consumption. This mass production made the fraud committed much worst. In addition, significant advancement in health sciences made people more wary about food safety. These conditions put strong pressures on governments to pass and enforce tougher laws with regards to adulteration and safety of consumer foods. Some good examples of such laws are passed in 1800's in Britain, 'The Bread Act' (1834) and 'The Margarine Act' (1893) in Australia and 'The 1906 pure food and drug act' of the United States [13].

Since most deliberate threats to public safety were eliminated with better knowledge of science and improved food laws, government's and industry's philosophies centered on the containment of defective products through end-product inspection. Manufacturers viewed the occurrence of defective products as an inevitable part of processing and thus would accept the losses due to rework or discard of defective products.

This end-product inspection became unacceptable approach to quality as modern quality concepts grew. Walter A. Shewart and some of his associates like W. Edwards Deming and Joseph M. Juran and later on Philip B. Crosby pioneered the modern time quality concepts. The modern quality concepts went through three clearly defined stages of developments: the Quality Control Stage, the Quality Assurance Stage and the Total Quality Management Stage.

During the quality control stage of development, product testing and documented control became a way for ensuring greater process control and lower number of non-conformance. While working at AT&T Bell in the 1920's, Shewart observed that no two parts are likely to be

manufactured precisely to the same specification. He recognized that this variability was a fact of industrial life and it could be understood by the use of probability and statistical principles. Through the use of past experience one can predict the variations in the future. And for this, he developed “Control Charts” to track the manufacturing process over time there by providing workers with the ability to monitor their work and predict when they are about to exceed limits and possibly producing scrap. The other critical element of this stage is the development of sampling techniques. Sampling is a technique for checking limited number of items from a lot and making decision about the lot based on the items checked.

The quality assurance stage brought the change from product focus to a system focus quality approach. Quality became a prevention based rather than inspection based which was the case in quality control stage. Concepts like quantifying the cost of quality, total quality control, reliability engineering and zero defects were developed at this stage. Organizations set up controlling systems for all activities and auditing the system, either by a second or third party, in order to assess their efficiency. Some of the characteristics of this stage are the use of quality manuals, procedures, work instruction, quality planning etc.

The latest stage, Total Quality Management (TQM), involves the application of quality management principles to all aspects of the business. At this stage, managers view quality as an aggressive competitive weapon. They linked quality with profitability as it affects market share and required its inclusion in the strategic planning process. Product liability, foreign competition, pressure from government etc have also forced into existence this strategic approach. In the 1980's TQM grew to be very popular and there were great promotion for its implementation in all types of organization. But the enthusiasm dropped down significantly in

1990's. This popularity slump resulted from the controversies that arise from the surveys that have been conducted in the early 1990's. In general, these surveys were more of opinions, perceptions and impressions of different people about the value of TQM. Thus, they didn't present any objective data. As most organizations fail to successfully implement TQM the result of the survey were negative. Further more, the response given by organizations that benefited from the implementation of TQM to these allegations were also not based on tangible data. In the late 1990's, different studies based on data collected from organizations, which successfully implemented TQM, verified that TQM indeed pays off and was resorted to its past glory [20].

b) International Standards and Food Safety Systems

Standards are measuring or testing tool for different characteristics that determine quality. As trade increases the need for a recognized standards become imperative to communicate product characters with in a country as well as on an international scale. The US Military developed the first standard, which described and recognized quality, in 1963 [13]. NASA (National Aeronautics and Space Administration, USA) was the first to set procedures, specification and requirements as space programs require highly reliable equipments. These standards that later on named as US military specification (Mil Specs) were mandatory for suppliers of equipments and materials to the space program. Because of the American's influence, NATO (North Atlantic Treaty Organization) started to use similar requirements. And from NATO came the British Standards, which is called the Defense Standards (DEF STAN) 05 series.

Realizing the benefits, the British Standard Institutes adopted the DEF STAN 05 for civilian use into a document called BS 5750. Other countries have also developed their own standards such as CZ299 of Canada, AS3900 of Australia and NZS5600 of New Zealand [13]. Merging two or

more standards to formulate a common standard among countries was one approach used for creating an international standard. One example of such merger was that of the Australian and New Zealand standards which was used in both countries. Successful international standards were developed by organizations like that of the International Organization for Standards (ISO).

International Electro-technical Commission (IEC), which developed standards in the electro-technical field, set the first International Standard in 1906 [21]. The International Federation of the National Standardizing Association (ISA) was the pioneer organization in other fields and was active from 1926-1942. ISO officially began operation on the 23rd of February 1947 with an objective of facilitating the international coordination and unification of industrial standards. It started with 25 countries as members and currently has 148 countries on one-member one-country bases. Between its establishment in 1947 and now, ISO has published more than 13700 international standards. Among these standards, the ISO 9000 and ISO 14000 families are the two most widely known and successful standards. ISO 9000 provides a framework for quality management throughout the process of producing and delivering products/services for the customer. ISO 14000 is an environmental management system to help organizations improve their environmental performance.

ISO 9000 (ISO 9000: 1987 sets of standards) was first established in 1987 and was very heavily based on the BS5750 parts 1,2 and 3 [34]. It was ratified and republished by British Standard Institutes (BSI) as BS5750: 1987. The technical Board of the European Committee for standardization later on approved and accepted as the European Standard EN 29000:1987. As it can be seen, the same document was referred by different names, which created confusion. To avoid this problem, the ISO republished after making some modification to the ISO 9000: 1987

as ISO 9000: 1994 which was accepted by all members with its name. The next revision of the standard was made in 2000 producing the latest version of the standard: ISO 9000: 2000 series.

Quality system and standards used for general industrial application may not necessarily address the food industry's unique requirements for food safety standard. These requirements arise from the fact that a large number of people are reported dead or ill from the food processed by the industry from time to time. Out of the fear of astronauts getting sick in space, Pillsbury Company together with the National Aeronautics and Space Administration (NASA) and the US Army Natick Research and Development Laboratories developed the most popular management system for food safety called Hazard Analysis Critical Control Point (HACCP) in the 1960's [13]. HACCP was established to monitor and control each steps of food processing so that a preventive rather than an inspection oriented system was adapted to the process. This was compatible with the modern quality concept. Although HACCP is in use since the 1960's, the Pillsbury Company formally presented it to the general public in 1971. Consideration for the broad application of the system in the food industries was started in 1985. In 1993, recognizing the importance and usefulness to quality control in the food manufacturing process, HACCP guidelines were recommended to food industries by Codex Alimentarius Commission (CAC).

3.4 Quality Gurus and Their Contribution

There are a number of quality writers who have made immense contribution to the development of quality management concepts, as we know it today. Although there are differences in their philosophies, these quality gurus provided a good base for the identification of the primary elements necessary for the successful implementation of Total Quality Management (TQM). A limited account of their philosophies and contributions has been discussed below.

1. W. Edward Deming

Deming is regarded as the father of TQM. He is also one of the masters who developed Japanese's success in quality concepts. He emphasized that the management is the key for quality problem in any organization. He assigned 85% of the problems to the system, which directly related to the management and the rest 15% to employees. He argued that management blames workers for things that are beyond their control. Workers, having better understanding about the process, can contribute much for the continuous improvement of the process. The old management style, which limits the employee's role, should be replaced with a management philosophy, which encourages the participations of workers. Deming tried to list some of the obstacles for effective management, which include thinking their problems are different by the management; reliance on quality control department; quality by inspection approach; blaming the workforce; and inadequate testing of new product [10].

Being the disciple and co-worker of Shewart, Deming has also contributed in the development of statistical process control (SPC). The heart of any quality strategy is SPC, which identifies the special and common causes of variation in products. And these statistical tools are used to communicate quality and encourage quality control efforts through out the organization. Deming has successfully, implemented the SPC techniques in his native country, USA, and Japan where he received so many awards for his contribution.

Deming has summarized his quality philosophies into 14 steps and these are [10 & 25]:

1. Create a constancy of purpose to improve products and services aiming at becoming more competitive to stay in business - through long term planning and constant improvement by means of innovation, research and education, and maintenance of equipment and plan;

2. Adopt the new philosophy - the need for higher quality by promoting constant improvement;
3. Cease dependence on mass inspection but improve process on statistical evidence to achieve quality;
4. End the practice of awarding businesses on the basis of price tag alone - fewer suppliers who understand specification, use of material and other inputs;
5. Improve constantly and forever the system searching continually processes for problems;
6. Institute modern methods of training and education on the job including the management to make the best use of every body;
7. Adopt and institute modern leadership where managers focus on quality culture;
8. Drive out fear so that people work more effectively;
9. Breakdown barriers between departments to create a team spirit in tackling problems;
10. Eliminate slogans, exhortation, and numerical goal (targets) and make reasonable requests of the workforce. These only cause adversarial relationships;
11. Eliminate work standards and numerical quotas and focus on quality and providing support;
12. Remove barriers that rob workers of pride in their work like annual rating or merit system;
13. Institute a vigor program of education and training for continual updating and improvement;
14. Work towards accomplishing the transformations given in the 13 points above.

2. Joseph M. Juran

Juran's idea of meeting customer's needs was based on five quality characteristics: Technological (strength); Psychological (beauty); Time oriented (reliability); Contractual (guarantee); and Ethical (sales staff courtesy) [35].

Quality management according to Juran consisted of three basic processes (Juran Trilogy) [5]:

- (1) *Quality Planning*: - a process, which identifies the customers, their needs, product service features, and the process that will deliver all the right attributes and then facilitate this knowledge through out the organization.
- (2) *Quality control*: - a process where products are examined and evaluated against the original requirements of the customer. And then any corrections needed are made.
- (3) *Quality Improvement*: - a process in which a sustaining mechanism for continuous quality improvement are placed. It involves the establishment of permanent structure to pursue quality and maintain the gains already secured. He also recommended a project-by-project approach for any improvement process, and the selection of project should be based on their estimated return on investment.

Juran was the first to recognize that there are two types of customers in an organization: Internal and external. Internal customers are those that receive products/service with in the organization. External (final, existing) customers are the final consumer of the product/service that is offered by the organization. Internal and external customers are important to the organization and any improvement process must take into account both.

Like Deming, Juran put the cause for any quality problems to management rather than to employees. He also laid out two types of problems, Sporadic and Chronic, and each should be dealt differently. Chronic problems need more of 'breakthrough' principles while Sporadic problems need a 'Control' principles. He has elaborated the activities for each.

He has formulated a ten steps quality improvement approach, which are summarized [10 & 35]:

1. Build awareness and conducive environment for change and improvement;

2. Set improvement goals and decide control points;
3. Organize to reach goals - forming diagnostic groups to identify and prioritize goals;
4. Provide training to create understanding of the systematic approach to quality improvement;
5. Carryout problem solving projects - steering council should guide and track the effects;
6. Report progress - diagnostic group should analyze problems, propose solution and report progress;
7. Give recognition - public recognition like certificate & plaques;
8. Communicate results in terms of cost of quality;
9. Keep score of the improvements made;
10. Maintain momentum by making annual improvement efforts as part of the regular systems and process of the company.

3. Philip B. Crosby

Unlike Deming and Juran, Crosby didn't have to go out of the USA to make his impact on quality. By linking quality to cost, he developed a quality message that appealed to the leaders of US corporations. Crosby argued that the optimal investment in quality practices for an organization is zero as it cut re-work costs. This monetary language caught the attention of many US corporations and was able to pull in the USA into the quality revolution.

Crosby defined the cost of quality to be of two types: Cost of Conformance and Cost of Non-conformance. Cost of Conformance is the cost of doing it right the first while the Cost of Non-conformance is the cost of doing it wrong and correcting to make it right.

Crosby attributes 80% of quality problems to management and hence building management's

capacity through training and education and keeping management's integrity intact is the main ingredient for reducing these problems. The management must also be committed to implement the absolutes of quality and permanently set their minds to quality improvements.

Crosby has also developed fourteen steps to quality, which are given below [5 & 10]: -

- 1) Management commitment - management must make clear where it stands on quality;
- 2) Quality improvement team - set up high level and cross-functional team to implement the quality improvement program;
- 3) Quality measurement - to overcome waste in the process, identify the potential non-conformance problem, measure the current status and develop quality program;
- 4) Cost of quality - define the components of quality cost to create awareness of the situation;
- 5) Quality Awareness -it provides a method for raising interest about quality among all workers. The awareness programs can be carried out in two parts: the regular meetings between workers & management and the communication of any quality program and related initiatives;
- 6) Corrective action - a systematic method for solving identified problems;
- 7) Zero defects (ZD) - action a preparatory activities (including the planning) for ZD program launching;
- 8) Supervisors training - for supervisors to carry out their task and responsibility, training is important. The type and extent of training should be defined depending on the situation;
- 9) ZD day - a day for reviewing achievements and making future commitment and understanding quality;
- 10) Goal setting – employees set goals and commit themselves;
- 11) Removal of causes of Error - a communication method between management and employees

must be developed for removal of error- causes;

- 12) Recognition of good works of employees in the quality process;
- 13) Quality councils - professional quality staff are meet on for a regular and planned bases;
- 14) Do it over again - emphasize that quality improvement is a continuous and never ending process demanding constant effort.

Crosby classified causes of mistakes into two factors: lack of knowledge and lack of attention. Lack of knowledge can be eliminated through education and training while lack of attention can be cured through commitment to excellence and attention to details.

4. Armand V. Feigenbaum

Feigenbaum argues that quality management covers the full life cycle of the product/service starting from inception, through production and customer service. All functional activities, such as marketing, designing, engineering, purchasing, manufacturing, inspection, shipping, accounting, installation, service, etc are involved and responsible for quality. And for any effective quality control, the integration of these functions is very important. Further coordinating the action of people, machine and information is pertinent. He suggested a system-approach to quality. This Feigenbaum's approach has been developed and became to be known as Total Quality Control (TQC). TQC consists four steps, which are setting quality standard; using these standard for appraising and conformance; acting when standards are not met; and preparing plans for the improvement of the standards [25].

Feigenbaum has also listed ten principles to quality which are summarized as follows [5]:

1. Genuine management involvement;

2. Serious consideration of any employee's ideas;
3. Continuity for long-term;
4. Involvement of everybody including factory and office employees;
5. Clear and simple program organization;
6. Initial preparation must be made carefully;
7. Purposeful involvement session;
8. Incorporate fresh and relevant ideas;
9. Line operation leadership;
10. Implementing quality control on company-wide scale.

5. David A. Garvin

Garvin identified several approaches to quality, each with different implications for quality control and improvement. These various approaches resulted in multiple definitions of quality, which are a function of purpose, stage of product development, type of product or processes, and company strategy. Garvin has categorized his approaches into five [5]:

- *Transcendental approach* - Quality is defined in terms of innate excellence, which may be attained through learning or experience. Transcendent is a concept taken from Plato's discussion of beauty. It is neither mind nor matter.
- *Product - based approach* - quality is precise, measurable, and can be ranked on various attributes, which are inherent part of the product.
- *User - based approach* - quality is reflected on consumer/demand curves or the ideal combination of attributes for maximizing consumer satisfaction.
- *Manufacturing - based Approach* - quality is conformance to specification, which reduces cost by reducing deviation. It is common among engineers and manufacturers.

- *Value - based Approach* - Quality is performance or conformance to an acceptable cost or the notion of "affordable excellence".

The multiple definitions of quality can produce conflicts and communication breakdown. Garvin recommends shift of the quality approach as the product moves from design to manufacturing and to marketplace to avoid any confusion that may arise.

The other major contribution of Garvin is the 'Eight Dimensions of Quality', which he related it with the 'Five Approaches'. These dimension are [10 & 5]

- *Performance* - refers to the primary operating characteristics. It combines product and user-based approach. The relationship between performance and quality reflects the reaction of customers to objective characteristics.
- *Features* - are secondary characteristics that supplement the basic functioning of product and less central to users. Product - based approach is used.
- *Reliability* - is the probability of a product/service to serve the intended purpose with out failure for the intended period of time. It's relevant to durable goods. Product - base approach is also used.
- *Conformance* - is the degree a design and operating characteristics match those specifications that have been laid down. It can be measured in two ways: conformance to specification (Western approach) and degree of variability from the target (Japanese approach). Manufacturing - based approach is used here.
- *Durability* - is the measure of product life. The technical definition is the amount of use before the product deteriorates. Economically, it is the repair cost, or the trade off between repair and replacement due to changing fashions, obsolescence, personal valuations of time and inconveniences and other associated costs.

- *Serviceability* - is the ease with which a defective product is repaired to action. Together with durability it is the most subjectively argued up on dimensions. Most customers consider rapid repair as high quality.
- *Aesthetics* - is personal assessment of product's look, feel, taste, sound or smell and reflecting individual's preferences. User - based approach is used.
- *Perceived Quality* - includes images, brand name, and reputation, which are indirect measures of quality. It gives perception rather than the reality. Here also user-based approaches are used.

6. Kaoru Ishikawa

Ishikawa believes that quality control should be extended beyond the product and include after-sales service, quality management, individual's and company's quality perception. Also this control should be company wide (i.e. TQC). TQC should be every employee's responsibility. Ishikawa has also been associated with the development of the seven quality control tools.

The other contribution that Ishikawa made is the introduction of quality circle concept. He argued that neither workers nor managers know the correct solution to a problem. But by working together they would have a better capacity to solve any problem that may arise. This would also enhance the participation of all employees in quality improvement activities.

Ishikawa's view of quality can be summarized as follow [10]:

1. Quality Control (QC) is the responsibility of every body in the company. It is a discipline that combines knowledge with action.
2. Management should put quality at the top of its list, plan for long term benefit and stamp out

any sectionalism.

3. TQC management is teams work not an individual act.
4. TQC fails if there is no cooperation among all employees from president to line worker.
5. TQC is a company wide activity and also based on respect for humanity.
6. Middle management will be the focus point in TQC and thus subjected to frequent involvement and criticism.
7. Care should be taken not to confuse objective with means.
8. QC circle activities are part of TQC.

7. Genichi Taguchi

Taguchi approached quality from the engineering aspect. He emphasized the production of goods with a minimum performance variation against the targeted goals or requirements. He called these variations as “noise”. The objective of any quality system is to minimize this noise, which is contrary to the traditional quality management (accept if the specification are met).

Taguchi developed the “loss function” where he calculates the loss a product imparts to the society as a function of the distance from the target value of the product. It includes all costs like warranty cost, dissatisfied customers, and performance failure costs. It is given by [10]:

$$L = k (X-T)^2$$

Where L= Loss in terms of money; k = Cost coefficient

X= Value of quality characteristics; T = Target value

The loss function relates economics (cost) to variability. Variation from target is waste and cost. It is important to concentrate on reducing the total cost of the process rather than on reducing variation.

CHAPTER FOUR: QUALITY MANAGMENT SYSTEM OF FOOD PROCESSING INDUSTRIES

The main purpose of quality in any manufacturing process is to enable manufacturers produce items that meet their customer's requirements the first time and all the time. A well-established management system for quality will make the implementation effort efficient, effective and company-wide so that the organization will benefit to the maximum. Oakland has defined quality management system (QMS) as [30],

"An assembly of components, such as the organizational structure, responsibilities, processes and resources for implementing Total Quality Management."

In general QMS identifies the different components for quality implementation process. For the food industry seven components are identified: Manager's and Owner's Contribution to quality, Quality Design, Quality Assurance, Quality Control, Quality Improvement, Quality Planning and Quality Auditing/review. Additional elements that are especially important for the implementation of these components but have not been touched in the main components are also addressed in the last section. There is always an interaction among these components and hence the system must take into account this interaction when trying to implement it. And when considering implementing any management system, one must start on food safety and then expand to other aspects of quality.

4.1 Management and Owner's Contributions

Managers and owners of the industries make most of the major decisions and hence make vital contribution to quality. Management concepts ensure that all resources (human, finance, raw material etc) are effectively utilized through planning, organizing, leading, controlling and

personnel (Function of Management). The latest management thoughts have borrowed quality concepts to ensure competitive edge in the market.

There are four basic managerial skills that will help managers (including quality managers) do their daily activities: Technical, Human, Conceptual and Administrative skill [32]. Technical Skill is performance skill on specific task where as Human Skill is performance skill on society and people. Conceptual Skill is analyzing and evaluating skill of a situation and Administrative Skill, which may be related to Conceptual, is regulation skill of activities. The depth of each skill type required varies with the level of management (i.e. top, middle, or lower) under consideration. Managers are also expected to play interpersonal, informational and decisional role. Interpersonal roles include figure head leading and liaison functions; Informational roles include monitoring, dissemination of information and spokes person functions; and Decisional roles include entrepreneur, disturbance handler, resource allocate and negotiation functions [32]. The management must also focus on the long-term success of the company. It must strive to achieve a better, cheaper, and quicker product. The management must not only demand better quality but also show its commitment through appropriate support and resource allocation. In this section, those quality management activities that are not properly dealt as a component of QMS are discussed in a more detailed manner.

4.1.1 Leadership

Attributes such as trustworthiness, integrity and fairness usually encourage people to follow and be committed to the strategies and direction set. But on an organizational level the success of any quality plan depends on the effectiveness of the leadership. Like any manufacturing industries, effective leadership facilitates the quality implementation process. There are five

main requirements for an effective leadership and these are [30]:

- 1) *Preparing a clearly documented corporate beliefs and objectives*: -Executives must develop a clear vision for the company and the specific objectives for the organization to achieve. The belief and objectives must include definitions of the business; the commitment to effective leadership and quality; target sectors, customer relationships, and market/service position; the role of the organization or units; the distinctive competence of the organization; indication of future direction; the commitment in monitoring performance.
- 2) *Preparing a clear and effective strategy and supporting plans*: - Although senior managers develop strategies and plans, employee's participation must be encouraged to enrich it.
- 3) *Identifying the critical factors & processes*: - Important sub-goal and processes for the successful accomplishment of the mission of the organization are identified at this stage.
- 4) *Reviewing the management structure*: - effective organizational structure with clear definition of responsibility and operational procedure to carry out quality activity.
- 5) *Effective Communication*: - it is vital to have a strong communication line with employees, customers as well as suppliers. Especially employees must be encouraged to make effective participation- mainly through empowerment and involvement.

4.1.2 Decision-making

Decision-making is one important function of the management in which food business managers spend a lot of time. It is heavily dependent on the availability and quality of information. Quality management requires decision-making at different level and an appropriate approach for making correct decisions. One such approach is Problem-solving (Scientific) approach [30].

The first few phases of Scientific method for problem solving provide good steps for decisions

making. The method starts by identifying opportunities. This includes identifying the problem, forming a team, and defining the scope. Then comes analyzing the existing situation which includes activities like the development of process diagram, determination of customer satisfaction and measurements needed, data gathering and root cause identification. The main objective here is to understand the process and how it is operating. When trying to understand the process, one must note the process boundaries, the process flow and the relation between outputs & customers as well as inputs & suppliers. Finally, optimal solution is prepared. If more than one solution is proposed, selection can be made based on the result of evaluation and/or testing. The criteria for selection include cost, feasibility, effectiveness, resistance to change, consequences and training requirements. Once a decision is made, it is implemented; results are analyzed; and plans for future action are made. This scientific method can easily be integrated into PDCA quality improvement approach.

4.1.3 Organization

Organizational structures for quality are important in food manufacturing industries. The different quality activities are coordinated towards achieving the objective/goals set in the organization. Further more proper organization is a pre-requisite for any effectively operating QMS. The type and width of the structure may vary depending upon the quality target, size of the food manufacturing industry, type of product to be processed, skill and educational level of employees available and other factors.

At the top are quality managers who over look all activities in the organization. Quality managers must disengage themselves from line activities, and disperse responsibilities throughout the appropriate operating departments. They should help those who control the

means for implementing quality in the organization to believe that quality should be an integral part of the organization's activities. Generally, a quality manager needs to be persuader, philosopher, teacher, adviser, facilitator, reporter and motivator.

Although organizations can make adjustments, Oakland has developed the three-tier approach to create organizational structure for quality. Each level is discussed below [30]:

- i) *Quality Council*: - It is made up of the top management and chairman of site steering committees or process quality team. The chief executive, who must attend every meeting taking place at least once a month, chairs the council. The council's objective includes providing strategic direction to the organization, preparing plan for each site, setting up and review the process quality teams (PQT) for key business processes, and reviewing and revising quality plan for implementation.
- ii) *The process quality team (PQT) and site steering committees*: - The size of the organization determines whether a team or committee should be set up. All senior managers must be involved in each team who meet monthly. This enables the top management communicate their commitment to quality. The responsibility of these groups are selecting projects for quality improvement teams (QIT), providing an outline and scope for these projects, appointing team leader and members, and monitoring and reviewing the progress and results of these projects. The PQT should be given responsibility and authority so that the team will gain recognition and respect with regard to their process.
- iii) *Quality improvement teams/quality circle*: - QIT is a group of people with the appropriate knowledge, skills and experience. It is made up of cross functional group and often of multi-discipline setup to solve a single problem on a project basis. They differ from task force in that they involve the entire production operation. Factors that need to be considered before

setting up these teams are selection and leadership of the team, objective of the team, team meetings, team dynamics & result and review of the teams. Quality circle was originally developed in Japan in order to motivate workers and get them involve in the day-to-day activities of organization [5]. It is defined as a group of people (three to fifteen) doing similar job. They meet (usually weekly) voluntarily and regularly during working hours with their supervisors to identify, analyze and solve problems, and recommend solution to the management. To accomplish their tasks, training is vital for the quality circle. On subjects that need consultation, experts in the particular field must be made available to the group.

4.2 Quality Design

Regardless its size, product design determines the long-term survival of any food processing industry. The main purpose of processing food is to add value to the product and making it more profitable. Designing is a process where a product and/or its processing methods are planned. For designing (developing) a food product either a step-wise or a team-based approach can be used. Even though it is simpler and cheaper, step-wise (sequential) approach is inferior on the design information incorporated compared with that of a team-based approach [30]. In general, for any successful product development good market and consumer knowledge and retailers involvement are vital.

Innovation is one important component of any product designing process. In food processing industries, innovation is a very risky undertaking. It may bring a significant reward or a severe penalty to a company. Although there is a common argument that a substantial profit can be made from the launch of new food items, the probability of success for a new product is less than 28% [17]. It is equally difficult to proof a product to be a genuine invention. 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, they must use innovative and recently developed techniques, materials or components to avoid stagnation of the designing process.

One recently adopted model for food product development is Quality Function Deployment (QFD). QFD is a structured approach to designing a product where customer's needs/requirements are translated into specific plans for the manufacturing of goods. The activities in QFD includes market research, basic research, invention, concept design, sample and final product/service testing and after sales assessment [30]. To exercise QFD, a cross functional QFD team is formed to determine who the customers are, what their needs are and how these needs are met. Here customer's requirements, being stated or not, are the bases for designing a product. These customer's requirements (sometimes referred as "voice of the customer") can be collected using various methods including direct discussion or interviews, surveys, focus groups, customer specifications, observation, warranty data, and field reports [24]. The voice of customers are very diverse and must be properly considered, reconciled and balanced for any successful product design process. Using a multi column priority rating for all needs may help to pick out those basic needs of the customers. People involved in the product development process must be sure that they have truly understood the requirements and if not, must strive until they do so. The singled out basic requirements are then transcribed on cards using brief statements. The cards are grouped into logical grouping in order to easily avoid redundancy. Unstated/unspoken requirements may not be included in data collection but must be considered in the product design as customers assume them to be. Once the information is summarized, it then translated into a product requirements or technical characteristics using product planning

matrix or "House of Quality"(HOQ). HOQ provides a means for designing a product through inter-departmental or inter-functional planning and communication.

HOQ got its name from the shape similarity to that of a house when all the components are fitted together. HOQ starts with the identification of customer requirements (the 'What') and placing it at the left central relationship matrix. Then customers rate the importance of each requirement entered and these are placed on the right side. The rating could be based on the organization's performance against competitors. The technical design requirements are placed on the top and bottom of the central relationship matrix. The top is filled with the identification of each requirements (the 'How') and the roof with the comparison of 'How's. The bottoms are requirement including cost, ratings and target values of the technical characteristics. And the central relationship matrix is the core where the 'What's are matched with the 'How's. It is important to limit the amount of information in each HOQ to a manageable number. If complex products are to be designed, a hierarchical matrix can be used to define the requirements.

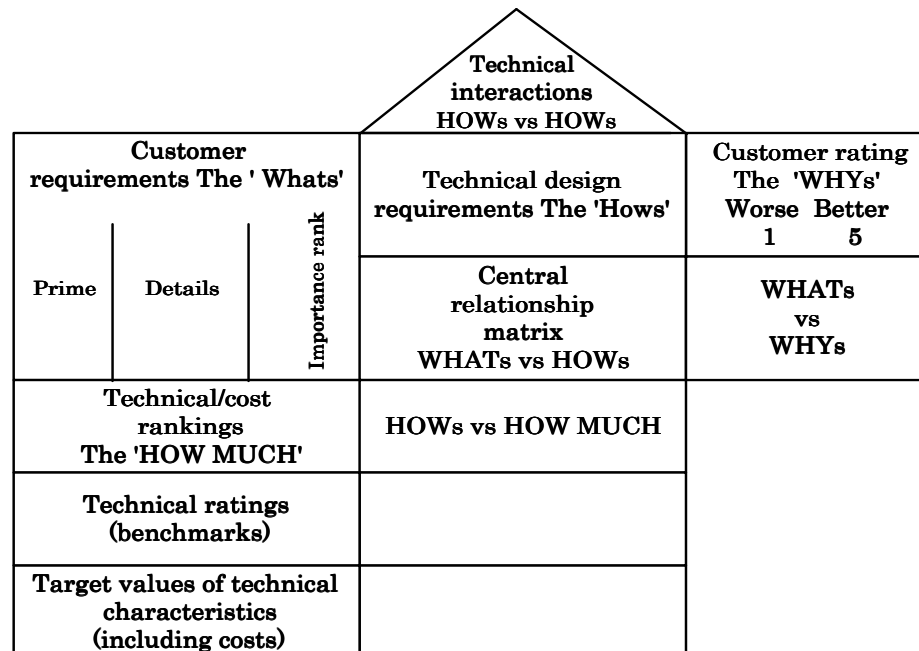


Figure 1 House of Quality [30]

After the product planning is prepared, product concept is developed using the product requirements and specification. Product concept should include the customer's need that is going to be met, the reason why the need is satisfied and a description of the key elements that will give a good picture of the product. Concepts can be generated through benchmarking, brainstorming and research and development. Usually a number of concepts are endorsed and selection matrix is used to select the best one. This matrix enables the evaluation of each concept based on the criteria, which is technical characteristics or product requirements. Cost and trade studies commence once product concepts are developed, analyzed and evaluated. And for this, concept selection matrix can also be used [24].

The next step is to design the manufacturing process. This is usually an evaluation process for the selection of a superior manufacturing process using a concept selection matrix. One important criterion for the selection manufacturing process should be the process's capacity to meet the consumer's requirements. Recently, different technologies have been developed which have created some controversies among consumers. A good example will be Biotechnologies such as Genetic Modification. The process design must also address process control, quality control, setup, equipment maintenance and testing and training requirements of the manufacturing process [24].

Using a QFD team helps develop a well-designed product and there will not be any change to the design mid-way the production. If systematically implemented, QFD provide a structure for information, and a framework for sensitivity and documentation. Further more, it provides an increase in customer satisfaction and loyalty.

Like any other activities, the designing process must be controlled. But care must be taken not to

stifle the creativity of the designers. Design control must be there especially for the cost and time to be within the organization's budget. The designing process must also integrate the activities of the different functions of the organization. Quality design must address all aspects of the customer's needs including, cost, production, safety and ease of consumption. To do so, quality designing must incorporate activities such as identification of needs, developing product/service that satisfies these needs and finally ensuring that these needs are satisfied in a sustainable way.

4.3 Quality Improvement

Quality improvement is all about 'not being satisfied' at the existing state no matter how good it is. There is always a gap for improvement though it may appear to have reached the limit. Quality improvement must have long-term goals and should be embodied into the business strategies. Small improvements made here and there, in time, will lead to a big gain.

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 business 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 business further. Vendor-producer relationship is one component for quality improvement since vendors provide the raw material. A solid relation with suppliers ensures 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. There are a number of motivational theories among which Maslow's 'hierarchy of needs' and Herzberg's 'hygiene factors and motivations' are the most popular.

Assigning workers responsibility for design and performance of a task helps quality improvement process in an organization. It will make workers feel more like part of the team rather than an automaton. Obviously, there must be proper controlling mechanism to prevent any abuse. Cutting corners must also be discouraged when it comes to quality.

Gaps for improvement can be identified using different approaches where one of them is Benchmarking. Benchmarking is a continuous search and application of better practices of organizations with superior competitive advantages [5]. It involves identifying, understanding and adopting outstanding processes and practices. Benchmarking reveals the existing gaps in numerical specification including dimensions, weight, extent of defects and portion of reject for products. It also gives the difference in method and workflow for processes.

Instigating quality concepts like that of Total Quality Management, which advocates a continuous improvement for both the product and process, can also be used to identify gaps. Continuous Process Improvement (CPI) is a steady and uninterrupted process of improvement for different aspects of the organization [1]. This approach is applicable to any goal-oriented process including business, management, or technical processes. Unlike CPI approach, Traditional improvement approaches have a number of rises and falls before the target point is achieved. This has many disadvantages including high cost, process disruptions, negative effect on employees and loss of customer trust. But in continuous improvement, although the rate varies, there is always improvement. Comparison of the two approaches is given on figure 2.

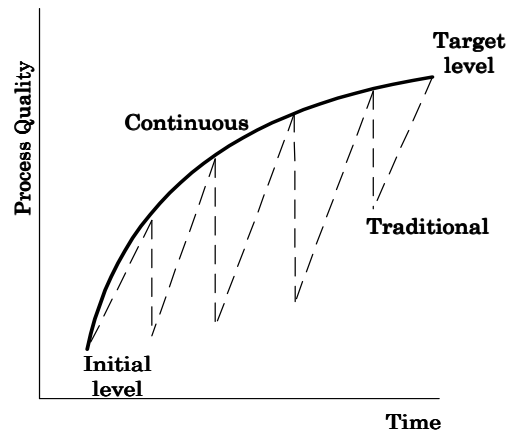


Figure 2 Comparisons of Traditional and Continuous Improvement [1]

In food industries, Consumer Tests are one indicator for measuring consumer's reaction towards a product, which provides a platform for building a quality improvement process. The two common tests are Preference Test and Acceptability Test. Preference Tests are tests conducted to determine a product sample that is preferred by the members of a panel. Acceptance tests are conducted only to determine whether the product is liked or disliked by the panel. In addition to Consumer Tests, experiments can be designed to test any gap for quality improvement [27].

Once the gap is identified, different Statistical Process Control tools are used to identify and monitor areas for improvement. Some of these tools include Pareto analysis, cause-and-effect diagram and control charts. Finally, process improvement commences using PDCA approach. PDCA (Plan, Do, Check, Act) is an effective technique for quality improvement process implementation, which was developed first by Shewart [6]. The first step in PDCA is the Planning stage where plans are made using data collected regarding the gap for improvement. The plan identifies problem, defines tools and techniques to be used and revise past cycle's activities. The next is the Do-stage, which involves the actual implementation of the plan. The implementation depends on the type of process implementation strategies selected: Parallel, Phased, Pilot and Direct [9]. Then comes checking whether the implementation are carried out

according to the plan. And also problems and other opportunity observed on the previous stage are analyzed. Any condition for continuous implementation, correction and standardization of the plan are finalized in the last stage of the cycle, Act. Then the next and relatively higher stage of PDCA cycle takes on.

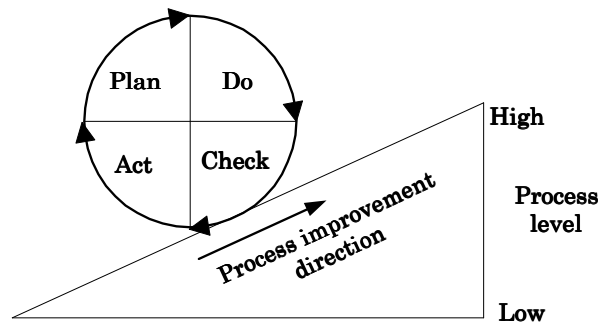


Figure 3 PDCA cycle

4.4 Quality Control

Quality control refers to all activities (processes) and techniques that are used to achieve or maintain the quality of a product or service. It includes finding and eliminating source of defects and monitoring the manufacturing process. The main purpose of quality control is to ensure that the requirements (specifications) of the customers are met when manufacturing the product. Quality control activities are most of the time in-processing activities that are used to guarantee manufacturing specification are met.

4.4.1 Defects in food

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. Some of the sources of defects in food processing industries include [27]:

- *Raw materials:* - raw materials for food processing usually deteriorate in time or become

defective by the packaging material or added ingredients. Since they are biological system, food raw materials can easily get spoiled.

- *Employees:* - Lack of attention, poor handling or sabotage by employee can easily result in defective products and further more serious risk to human life.
- *Processing Problem* – Defects due to processing include, poor understanding of the processing method, use of inadequate machines, lack of trained staff, machine break down, and inappropriate working environments.

Pursuing the philosophy of prevention of defects is the most suitable approach to quality in food processing industries. It saves organizations from a lot of problems including financial, legislative and consumer's complaints. When a successful defect prevention programs are implemented, a well-established quality control for raw materials, reduction in processing loss and drop in the volume of rejects are clearly observed [27].

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 [27]. 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. These standards should consist confirmed information on the requirements; proven products and processing specifications; maintenance of

controllable quality characteristics (at a reasonable cost); and measurable implementation procedure for equipments and methods [27]. It may take at least three years before these standards are fully developed. When adequate defect control is implemented, strict compliance to specification, proper identification and acceptance of raw material and finished products, good relationship with vendors and customers, and effective recording and reporting system of can be observed.

4.4.2 Quality Control Activities

All in-coming materials must pass through a series of steps before they are accepted into the processing [27]. A technician will take a sample, inspect and label as soon as the materials are received. Sampling should be done according to the sampling plan prepared beforehand. The container must be tagged with all the necessary information after sampling. Each lot and batch must be recorded into a master ledger. Dispositions are made based on the result of the analyses of the samples taken. The material is retagged in accordance with the decision of the disposition. In the processing stage, quality characteristics are checked against the design of the process. Defective materials at any stage of the process are removed. Sampling and analysis tests are made on the finished product before it is packed, labeled and transferred to the warehouse.

Both types of quality attributes (Physical and Hidden) should be properly identified and measured. The measurement of Hidden attributes requires complex equipments and procedures (such as micro-analytical and microbiological tests). Customers usually test food products for its sensory attributes and measurement of this attribute is of paramount importance. Either a jury of people or a set of instruments can be used to conduct sensory tests. There are two types of jury testing [27]: Difference Test & Acceptability Test. Difference Tests are used to identify

detectable differences between samples where as Acceptability Tests are used to identify the level of like or dislike for a given product. Sensory attributes can also be measured using instruments such as seed displacement, Penetrometer, Vacuum gauge etc. Chemical and Physico-chemical tests are used to identify attribute such as moisture, fat, protein, carbohydrate, acidity etc.

4.4.3 Statistical Process Control (SPC)

Statistical Process Control (SPC) techniques have proven to be an essential ingredient for success. The major uses of SPC in the food industry are [27]:

- To help understand variation (both assignable and random) in quality characteristics;
- To help identify assignable causes and set control limits for product specification;
- To determine the quality level of a process through time.

It is important that manufacturers understood and convinced of the benefits of SPC before any effort is initiated for its implementation.

Samples are used when 100% inspections are uneconomical or impossible. Some of the advantages of sampling are low cost, less time, less risk of handling damage, less inspection error, need of fewer staff, and forces organizations prepare quality control plan and take preventive measures. Sample inspection can be based on either Attributes or Variables [8]. In sampling by attribute, items are classified as non-defective or defective according to one or more characteristics. It is carried out using a sampling plan. There are several sampling plans: single, double, and multiple sampling plans. In a single sampling plan samples are taken only once to check the number of defects (for double - twice and multiple - more than two). The ability of sampling plan to isolate defective item is given by Operating Characteristic Curve.

ISO has developed a sampling system. This standard contains general level (I, II, III) and special level (S-1, S-2, S-3, S-4). These levels are determined based on the characteristics of the sample to be taken, which include defect risk, cost and type of variation to be measured. Two tables are used to select the level and acceptable defects.

In sampling by variables, measurements of characteristics are made and statistical techniques are used to determine acceptable level. The condition for use of this method is the characteristic to be measured must be normally distributed and no 100% inspection is made before sampling. There is also an ISO standard system for variable sampling. It contains five inspection levels and three possible acceptance procedures. There are two approaches: $\bar{x}$ method (standard deviation of the lot is known) and $\bar{x}$ or R method (estimated standard deviation used) [8].

Different Quality Control Tools have been developed and can be implemented in the food processing industries [5]. **Cause and Effect diagrams** (Fish-bone diagram or Ishikawa diagram) used to associate multiple possible causes with a single effect. Given a particular effect, the diagram is constructed to identify and organize possible causes for it. **Pareto Chart** is used to identify those factors that have the greatest cumulative effect on the system. This allows the user to focus attention on a few important factors in a process. **Check Sheet** are tools for presenting information in an efficient graphical format. **Histogram** provides the easiest way to evaluate the distribution of data. It is a simple, graphical view of accumulated data, including its dispersion and central tendency. The data obtained from a sample serves as basis for a decision on the population. **Scatter Diagram** is a graphical tool that attempts to depict the information that one variable has on another. **Flow Chart** (Defect Concentration Diagram) is useful in identifying where errors are likely to be found in the system. It is a pictorial representation of a process.

Control Charts indicates the range of variables that is built into a system. It helps to determine whether or not a process is operating consistently or if a special cause has occurred to change the process. There are many types of control charts for controlling different quality attributes. Each has its own merit and demerits. Control Charts are commonly categorized in to two: those used for Continuous (variable) Data and Discrete (attribute) Data. Continuous Control Chart includes X-R charts used for average and ranges and X charts used for average measured value. Discrete Control Charts are P, Pn, C, & U charts used for fraction defectives, number of defective units, number of defects and number of defects/unit respectively.

4.5 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. Quality assurance system must be documented to clearly show who is responsible for doing what and when. Employees must be motivated and well trained to carry out the quality assurance activities. A two-way communication must also be there to facilitate the quality effort in the organization. Quality assurance system need not be complex and should be continuously improved and refined.

Different international standards have been developed to give the basic requirements for a quality system and a framework against which companies gauge their quality achievements. Two such standards applicable to the food processing industries are HACCP and ISO 9000. Another standard for food processing industries is packaging and labeling standards. This

standard set the labels per-packaged food products. The main sections considered include name of the food, list of ingredients, net contents and drained weight, name and address of manufacturer (packer or distributor), and lot identification.

4.5.1 Hazard Analysis Critical Control Point (HACCP)

HACCP is a management system for food safety. Like the latest quality approaches, HACCP is a preventive rather than an inspection based approaches to food safety. HACCP system is in conformity with the manufacture-base approach of Garvin (quality guru). WTO (World Trade Organization) has made HACCP mandatory for trade between its member states. The USA and European countries have even adopted it into their food laws, which sometimes used as a non-tariff trade barrier for exporters into their country.

HACCP has the following benefits [22]:

- 1) *Customer Confidence*: -Standardized and certified system like that of HACCP provides customers confidence on the product's safety of the organization.
- 2) *Access to Markets*: -Both companies and governments are demanding suppliers of food products with a documented quality system that has been audited by a third party.
- 3) *Defining processes*: -HACCP system clearly defines and documents processes, which give stability and consistency to the overall production. It also helps in training and standardizing methods thus reducing chance for error.
- 4) *Save money*: -Recognizing and concentrating on potential risks can reduce the reject at the end production. When problems arise, it provides quick and easy methods for pinpointing the sources, thus saving money as well as time.
- 5) *Base for improvement*: -Since HACCP system monitor, control and document the

process, it provides good base for process improvement.

a) Definition

The definition of HACCP consists of three components, which are given below [22]:

Hazards: -It refers to any part of the food production chain that is not accepted because it has the potential to cause food safety problems. Hazards can be of three types: Biological, Chemical or Physical.

Analysis: -It is the identification and assessment of the seriousness and likelihood of occurrence of the hazards in raw materials, processing, storage or distribution of the product, which will cause it to be unsafe for consumption.

Critical Control Point (CCP): -It is a point, step, or procedure at which control can be applied so that hazards in food can be prevented, eliminated or reduced to an acceptable level.

Therefore, the HACCP concept is a detailed approach for the identification and assessment of hazards and risks in food manufacturing, distribution and consumption.

b) Implementation plan for HACCP

The first step in the implementation of HACCP is preparing the plan. But the existence of HACCP plan doesn't necessarily make a manufacturing facility an operational HACCP system. It requires an effective implementation and maintenance plan for an operational HACCP system in an organization [18 & 22]. There are 12 main steps for the implementation of a HACCP plan (sometime the first five are called 'Preliminary Steps' and the rest 'The 7 Principles of HACCP'):

1. *Assemble the HACCP Team:* -After securing the full commitment and involvement of the management, a HACCP coordinator and team should be appointed. The team may include production personnel, microbiologists, food technologists, maintenance personnel, engineers, veterinarians, agronomists and/or medical experts depending upon the complexity

of processing.

2. *Describe the product:* -The HACCP team should describe the product. The description includes name and composition of the product, the shelf life, packaging requirements, labeled instructions, sales information, method of storage, handling & distribution etc.
3. *Identify the intend use:* - the team should describe what the purpose/use of the product is.
4. *Develop a process flow diagram:* - to prepare process flow diagram, all the manufacturing steps must be listed. Then itemize all the individual processing steps in order, starting from reception to the final dispatch. Finally add a symbol to present each step as an operation, transportation, inspection and delay/storage, and then give number to each step.
5. *Check the flow diagram:* -the team checks whether the process-flow developed is congruent with the existing establishment. It should also check that regulatory sanitation requirements and Good Manufacturing Practices (GMP) concerning operating procedures and equipment maintenance are in place.
6. *Conduct Hazard Analysis:* -The HACCP team identifies the potential hazards at each step and considers any controlling measures for these hazards.
7. *Identify critical control points:* - a CCP decision tree is used to determine whether each step in the process is a critical control point (see Figure 4). The team could write down the hazards, the preventive measures available, and the CCP using this decision tree.
8. *Set Critical limits for preventive measures associated with each CCP:* -critical limits are set to delineate the maximum and minimum values in which all types of hazards can be controlled at CCP to prevent, eliminate or reduce an identified safety hazard to an acceptable level. The HACCP team has to come up with the limits consulting existing regulatory requirements, scientific literature, experimental studies and/or expert opinion and then prepare a control chart for monitoring it. Parameters used as bases for CCP include

time/temperature, humidity, water activity, p^H level, salt concentration, chlorine level etc.

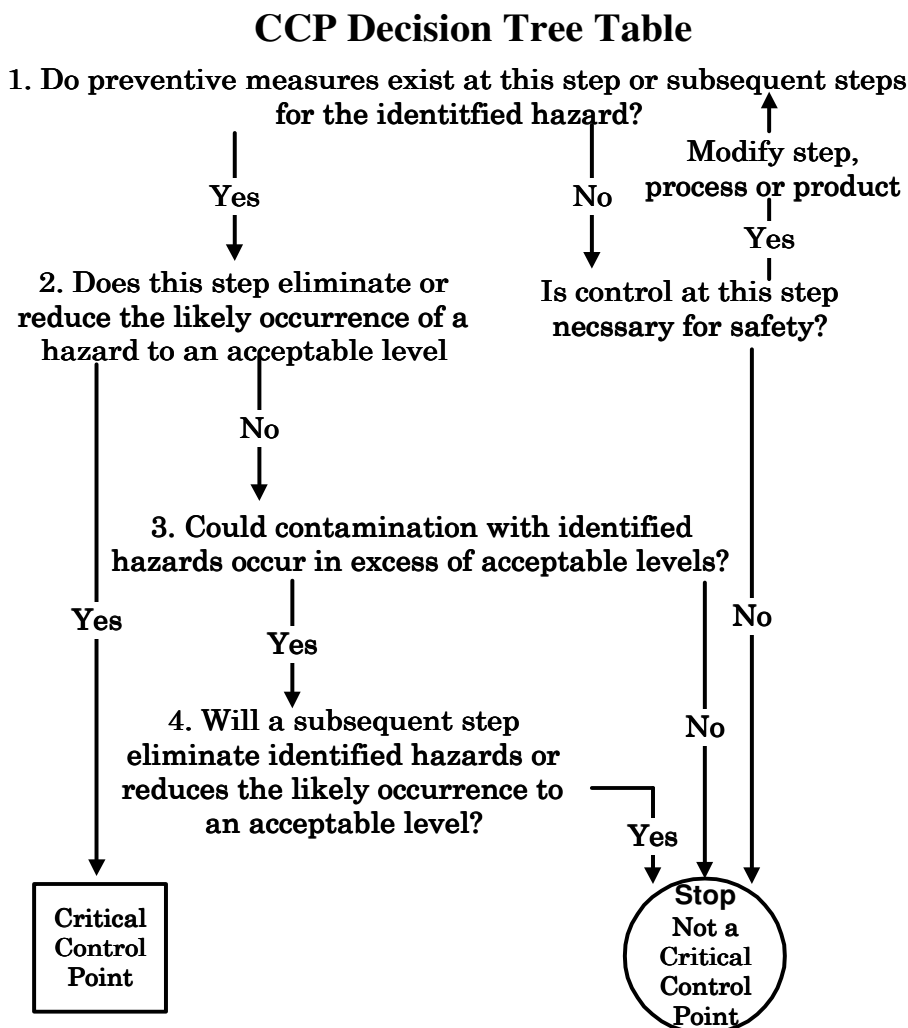


Figure 4 Decision Tree for CCP [18]

9. *Establish a monitoring system for each CCP:* -Monitoring produces records for future use and verification. It also gives signal whether the system is under control or not. It can be continuous or discrete. For discrete monitoring, the team must give the frequency of monitoring, randomness of the control and the process for statistically based sampling wherever used. The team has to identify the person responsible for monitoring and make sure that he/she is aware of the importance of the monitoring.
10. *Establish corrective actions:* -corrective actions are procedures to be followed when critical

limits are breached. The team should determine, in advance, what to do when critical limits are not met at CCP. A clear corrective action must be prepared for implementation. Employees must be trained to take timely action when failure occurs and they should fill and sign the corrective action document. Unlisted corrective action should be incorporated in the document for corrective actions not anticipated. The corrective action must include decisions on disposal of non-complying material and correcting the cause of deviation.

11. *Establish record keeping and documentation:* - Accurate record keeping is vital for a HACCP system. The record must have title and date of record, product identification, critical limits, and the time of observation. It has to be signed by the employee who made the monitoring and by reviewer for accountability. Keeping accurate records helps to trace the history of an ingredient, product or process if problem arise and serves as a source document for HACCP compliance and evidence against lawsuits.
12. *Verification and Validation of the system:* -Once the plan is laid, the HACCP team must verify that the plan has been implemented as it was expected to. The team should check the calibration of the monitoring instruments. It must also make sure that employees are keeping specific, accurate and timely records and norms set in the plan. Internal auditing must be made every six months. External auditing by a certifying body has to be made before and after the completion of the implementation. Once a satisfactory result from the external auditor is obtained, the organization is issued with a certification for HACCP. And the certifier will keep on auditing the organization every six months there on.

c) Good Practices

Good Practices (GP) are the base for any HACCP implementation. GP can be taken as the 'Hardware' and HACCP system as the 'Software' for any food safety system implementation.

There are a number of GP developed by international organization for industries involved especially in food and pharmaceutical products. To list some these Good Practices in food processing industries - Good Manufacturing Practice (GMP), Good Hygienic Practices (GHP), Good Agricultural Practice (GAP), Good Handling Practices (GHaP), and Good Laboratory Practice (GLP). Due to their relevance to the subject under discussion GMP & GHP are discussed further more below.

Good Manufacturing Practice (GMP) is one component of HACCP. It prescribes sanitation and hygienic practices for people in direct contact with food, surface in contact with food and packing materials. Once an incoming raw material is inspected and tested for all necessary quality and safety, it proceeds to the processing area. Food can easily be contaminated and become unfit at any stage right up to the consumption. Therefore, it is vital to implement safe practices in the processing, storage & transportation of food items. One good reference standard of GMP is the U.S. Federal Government's Food and Drug Administration's (FDA) current Good Manufacturing Practices (cGMP) and its main components are briefly discussed below [12]:

1. *Personnel*: - It deals with employees that are working in close contact with the food item processed. Any sickness, lesion or abnormality can be source of contamination. So continuous and thorough medical examination should be made. Personal hygiene can also be the source for contamination. This includes clothing, personal cleanliness, jewelry, and hair. The packing materials can also cause contamination. Training and education on the danger of personal hygiene and unsanitary practices can enhance the overall practice of employees.
2. *Building and Facilities*: The building's layout must be properly designed to avoid any contamination of food. This includes removing all sources of hazards, proper waste disposal, sanitized facility, equipments and utensils, effective pest and animal control etc.

3. *Warehousing and Distribution*: the storage and transportation of appropriate design for stores, pallet, bins, containers and other storage materials. Transport vehicles must be properly equipped and maintained to prevent any contamination of the food items.

Codex Alimentarius Commission has proposed one Good Hygienic Practice in 1997 entitled 'Recommended International Code of Practice: General Principles of Food Hygiene' [23]. This proposal, which has further been amended in 1999, provides information on the necessary hygienic conditions for producing food, which is safe and suitable for consumption. Food hygiene must be applied at all levels of the food chain starting from primary production to the final consumption. When looking at the manufacturing section, it is more similar to what discussed in the GMP. GHP takes a wider view of the hygiene, which is important in controlling or tracing sources of hazards. This proposal also tries to define the role of government bodies, industries and consumers in the implementation of this hygiene practice.

4.5.2 ISO 9000: 2000

From the time it was first released in 1987, ISO 9000 has gone through a number of improvement and revisions. The first revision was in 1994 and removed many problems that exist in the earlier versions. And as many organization started to implement the ISO 9000:1994 version its shortcomings became more apparent. Some of them include bias to manufacturing industries, repetition of requirements, inflexibility, lack of base for continuous improvement. So the next revision took place in 2000 releasing the ISO 9000:2000 series. The some of the key changes made in ISO 9000:2000 are the merger of ISO 9001, 9002, & 9003 into one ISO 9001:2000, dropping out the term 'Quality Assurance', reduction of elements to only four major sections, inclusion of means for excluding non-applicable clauses, better harmonization with

other standards, and provision of generic product categories [34].

The 2000 ISO revision doesn't require the rewriting of the already existing quality management system documentation of an organization [34]. But the updating process burdens organizations registered for ISO 9002: 1994 and 9003:1994 with extra documentation for demonstrating the reasons for permissible exclusion of standard. Those that have certified for ISO 9001:2000 will have a fairly easy task during updating. The ISO 9000:2000 consists of four standards [34]:

- 1) *ISO 9000:2000 Quality Management Systems - Fundamentals and vocabulary*: -It describes the fundamentals and specifies the terminologies for the system. It provides formal approach to the definitions of terms and assists those who want to assess or audit their system, enhance their understandings, give advice on standards and develop related standards.
- 2) *ISO 9001:2000 Quality Management Systems - Requirements*: -It is the single quality management 'requirements' standard that is used by all organization's products and service. It is also the only standard used for certification. It has adopted a process management approach and satisfies the quality management requirements of an organization to demonstrate its capability to meet customer's requirements. The ISO 9001:2000 has integrated the main points of the ISO 9001:1994 standard into four major generic business processes. These are:
 - Management responsibility – includes policy, objective, planning, system review
 - Resource management – includes human resources information, facilities
 - Product realization – includes customer, design, purchasing production calibration
 - Measurement, analysis and improvement – includes audits, process control improvement
- 3) *ISO 9004:2000 Quality Management Systems -guidelines for performance Improvement*: -It provides guidance in all aspects of quality management for continual satisfaction of

customers. It is a generic standard applicable to all organizations, regardless of type, size and product provided. ISO 9004:2000 go beyond meeting requirement and provide organizations with guidelines to improve performance through sustained customer satisfaction. It lays the stepping-stones on the path to Total Quality Management. It should be noted that ISO 9004:2000 is not a guideline for implementation ISO 9001:2000 and not intended for certification, regulatory or contractual use.

- 4) *ISO 19011 Guidelines on auditing Quality and Environmental Management Systems*: -It provides guidance on managing and conducting environmental and quality audits.

a) Certification for ISO 9001: 2000

A third party is usually used to certify an organization for ISO 9001:2000 compliance. Companies like BSI & Yarsley SGS are good examples of a certifying party. The selection of a certifying company depends on the location of the organization's main market. The main requirement for certification is a fully documented and auditable quality management system. The system must have the top management's backing and must already been implemented in the organization. It must contain [34]:

- 1) A Quality Manual: describing how the organization meets ISO requirements;
- 2) Process: describing all activities involved in project management;
- 3) Quality Processors: describing process management methods;
- 4) Work instruction: describing the way each tasks (activities) are carried out.

There should be a 'Quality Manager' post either on a full time or part time basis depending on the size and stage of QMS development. A full time manger is needed if the organization is large or it is actively involved in setting up a QMS. Part time managers are used when the

organization is small or less involved. The quality manager should be approachable and have the ability to establish good communications with all levels of the company.

b) ISO 15161:2001 (Guide lines on the application of ISO 9001:2000 for the Food and Drink Industry)

ISO has released a standard called ISO 15161:2000 specifically suitable for food and drink processing industries and these industries need to implement only this standard. It is based on the four sections of the ISO 9001:2000 that have already been discussed. This standard is complementary to the requirements of a product. Both internal and external functions can use it. The ISO standards encourage process approach in the development, implementation and improvement of a QMS. This process approach may include identification, defining the nature and interaction of the processes. A good model for this process approach is PDCA approach.

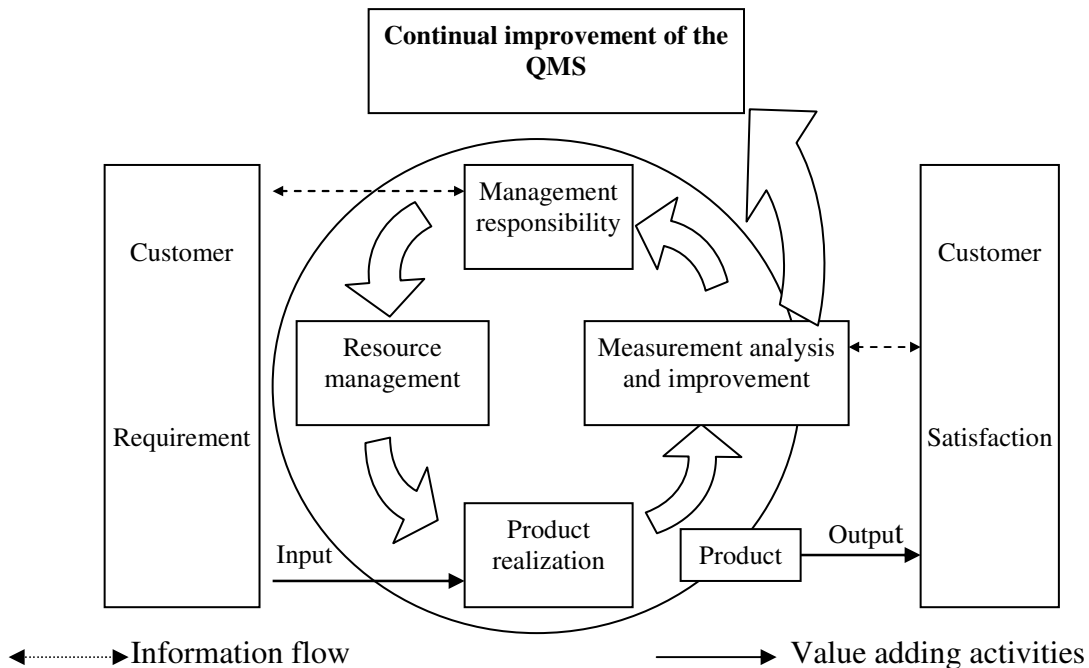


Figure 5 Model of a process-based Quality Management System [34]

The ISO standards give guidance on all aspects of the food and drink industry. These industries

include all those that are involved in sourcing, processing and packing food and drinks. To address safety aspect of food and drink product, the ISO has adopted HACCP into ISO 15161:2001. This doesn't mean that ISO is the sole standard that an organization should adopt. The ISO standard clearly states the possibility of implementing other standard (regarding safety or otherwise) with its standards. ISO selected HACCP for integration with its own standard mainly because of its popularity. The implementation of this combined HACCP/ISO system is more effective in meeting customer's requirements than either of them implemented alone (Figure 6). For example, the identification of hazards can be made using HACCP and controls are prepared using ISO quality planning and prevention system. Once the critical control points are identified using HACCP, ISO 9001 can be used to control and monitor them [21].

The fact that most countries adopting HACCP as their national food law has made organization to be reluctant about implementing ISO 9000. They think that as long as they implement the Codex Recommendations and HACCP systems, quality of their products is guaranteed. But food quality is more than food safety. Other aspect such as nutrition, biological and hedonic value, consistency of the quality must also be considered in order to win customers. No matter how safe food item is no one will buy it unless it appears, tastes, and/or odors right.

4.6 Quality Planning and TQM

4.6.1 Quality Planning

For an effective quality management system planning is a basic requirement. Oakland has defined quality plan as [30]:

"Quality plan is a document which is specific to each product, activity or service or group that sets out the necessary quality related activities."

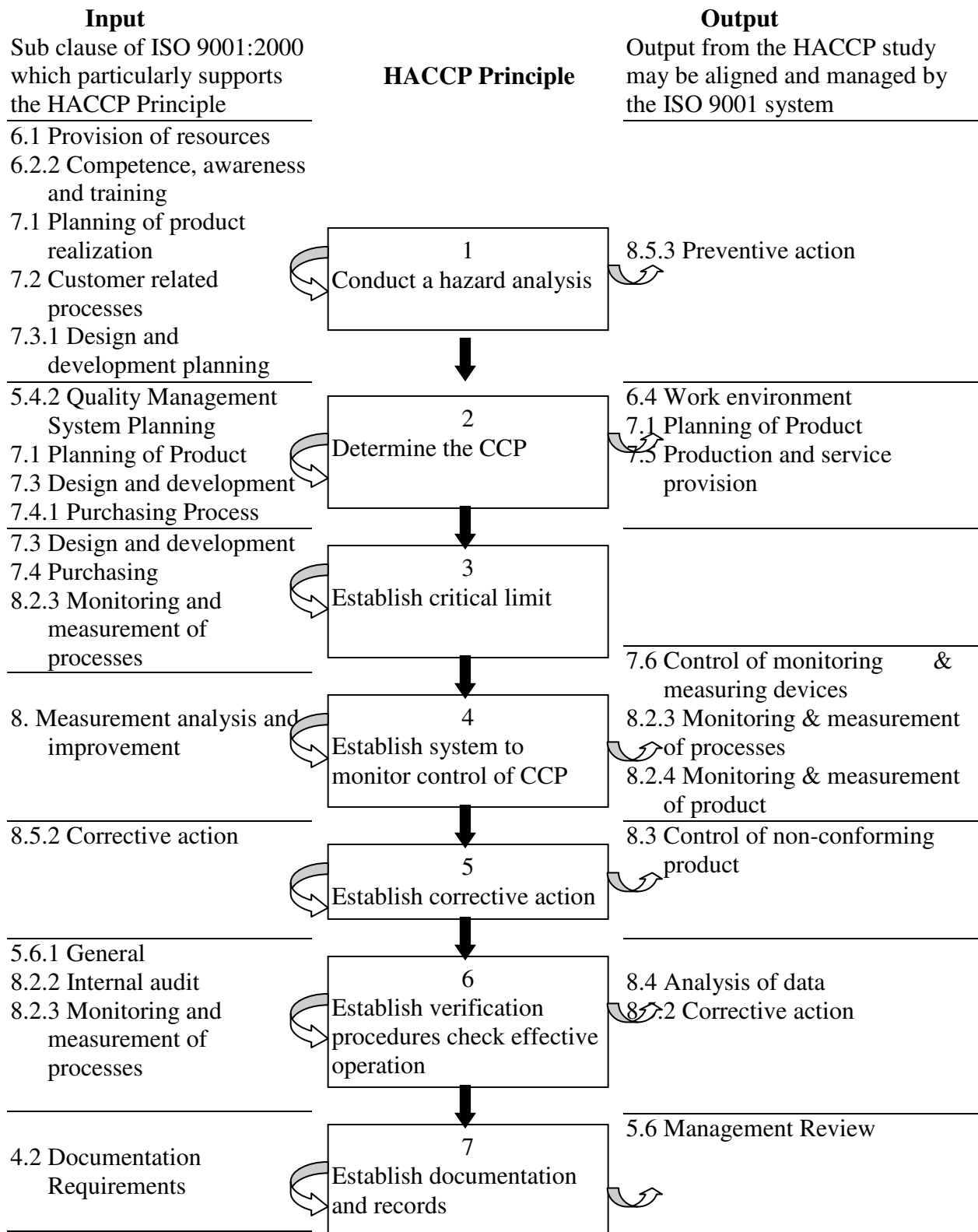


Figure 6 Linkages between the HACCP method and the ISO 9001 system [21]

Quality plan must start by setting 'Zero Defect' through continuous improvement as its objective. Planning facilitates decision-making and enables the organization to be proactive where future problems are anticipated and the necessary actions are taken in advance. Continuous review of the plan is an important activity in developing more suitable plan to the current situation.

A preliminary analysis of the aspired quality level, the existing organizational structure and the available resource in order to carry out the assignment must be made. Reviewing the existing program in an organization is important in any quality planning. And comparing this review with the preliminary analysis gives a base for appraisal of the strength and weakness of the quality system in the organization. This helps in defining the required systems and programs in terms of detailed operating plans, procedures and techniques.

Quality management system should start by establishing quality polices and objects (goal). Then comes creating the organizational structures and defining responsibility. After establishing quality system, problem areas are identified to prepare improvement programs. The programs developed are then implemented and their progresses are monitored regularly. The system's effectiveness is finally evaluated through auditing and reviews and adjustments are made to the quality system and the rest of the steps are carried out again [30].

Quality plan should avoid wastage of cash and if this is not the case, the plan should be revised. The plan has to be prepared in such a way that it will function irrespective of management or personnel change. In general, quality management system must be planned and developed taking into account all function such as design, development, production/operation,

subcontracting, installation, maintenance and so on. The plan should include purchase material/service specifications, procedures for quality system, product formulation, service type, specification for packaging and distribution, procedures for sampling and inspection, and process control [30].

There are three types of quality planning: Strategic plans, Tactical plans and Operation plans. *Strategic planning* is a general, long-term and prescriptive plan, which describes the vision, mission, policies, objectives and goals of the organization. *Operation planning* is short-term plan focusing on specific areas of the organization. It deals with the actual activities under taken and their efficiency. *Tactical planning* is in between the two. It is more detailed than strategic but less focused than operation for specific areas such as marketing, design and production. Some writers try to categorize tactical planning into either strategic or operation planning depending on its proximity.

Strategic planning starts with the quality statements i.e. vision, mission and quality policy statements. Vision statement is a written statement of what the organization would look like in the future (usually five to ten years). It must paint a realistic picture that is shared by everyone in the organization. Mission statement is description of what the organization is, its activities and who its customers are. Quality Policy statement is a guiding statement for an organization on how to deliver product (service) to the customer. The Chief Executive Officer (CEO) writes it with feedbacks from all other employees.

Strategies set the culture in an organization. Organizational culture is the philosophies, ideologies, values, assumptions, beliefs, expectation, attitude and norm that tie together the

whole organization [5]. Strategies also define the relation of a company with its partners and suppliers. It gives the short and long term objectives and goals of the organization. Goals and objective refer the same thing except that goals are for long period while objectives are for short period planning. They state what to be achieved or attained with the efforts over the given period. Goals must be measurable, definitive, specific, understandable, use concrete results and for specific frame of time [6].

Preparing the strategic planning of any organization is a tedious and time-consuming activity. But once this is accomplished linking the other planning activities are relatively easy. The latest quality approach, TQM, advocates that quality should be integrated with the strategy of the organization. TQM is being implemented in different section of the food processing industries all over the world. In addition to TQM integration, the never-ending planning process has made the preparation of strategic plan a complex process.

4.6.2 TQM

John S. Oakland, a famous 'quality' writer defined TQM as [30]:

"TQM is a comprehensive approach to improving competitiveness, effectiveness and flexibility through planning, organizing and understanding each activity and involving each individual at each level. It is useful in all types of organization."

As Oakland tried to put it, TQM assigns quality to be the responsibility of everybody in all aspects of the organization and in all their activities. TQM involves a continuous improvement of process or product/service seeking that perfect or zero-defect product. It also centers on identifying customer's requirements and surpassing them. TQM also encourages employee's participation and empowerment as employees contribute significantly to any quality related

endeavors. Some of the reasons for adapting TQM include [31]:

- Customers are becoming sophisticated and knowledgeable and they are demanding more from an organization. If their demands are not met they go to the competitors.
- Nowadays, competitions are getting stiffer and worldwide creating a dynamic environment. Approaches such as TQM are ideal for coping up with rapid changes.
- TQM is the latest approach in managing quality.
- Legislations are becoming tight making organizations more wary about the environment, health and safety. For this, they need heedful, motivated and knowledgeable employees and TQM can help in developing such employees.

There are a number of ways to implement TQM in an organization. Some of them are [25]:

- Direct application of the approaches proposed by the quality gurus;
- Use of models developed from well known quality awards;
- Developing and implementing tailored model for the organization.

Each method has its own pros and cons. Quality guru's approach basically defines what broadly needed together with the techniques for the implementation of TQM. These gurus give little guidance of the implementation on specific areas of the organization. They also don't give any conceptual framework and instructional methodology to help organizations. Quality awards such as Deming Prize in Japan, the European Quality Award in Europe and the Malcolm Baldrige National Quality Award in the USA have developed perceived model of TQM. Based on these models, they award organizations with superior performance. These models provide organizations with the information about their strength and weakness measured against a universally accepted set of criteria. These models are concerned only about factors affecting TQM and not the overall management activity of the organization. Thus organizations face

problems in developing their quality management practices.

The other method is to develop appropriate model for the organization. To develop a model, a thorough understanding of the elements TQM and the organization is vital. This is a time taking process. It is also open for various interpretation and non-uniformity. Different authors have tried to list these elements of TQM in a different manner though the concepts are similar.

a) Elements of TQM

When an organization attempts to implement TQM, the environment in which it is operating affects its efforts. This environment can be divided into external and internal, from the viewpoint of the organization. The organization has very limited influence over the external environment. It can adjust itself to accommodate those factors in the external environment through the manipulation of the internal environment, which are at its disposal.

External Environment

The external environment is composed of four sub-environments. These are [25]:

- 1) *Social environments*: - includes factors like personal value system, ethical consideration, social responsibility, taste and behavior patterns, immediate community and greater community influence;
- 2) *Legal-political environments*: - includes regulatory agencies, national laws, local ordinance, restrictions, international considerations, tax considerations, consumers legislation union agreements;
- 3) *Technological environment*: - includes factors like basic and applied research results, engineering & management knowledge, material-equipment innovation, process & product

innovation;

- 4) *Economic environments*: - includes conditions like the general economic, labor & vender market, consumer (international competitive) market, and inflation.

Internal Environment

The internal environment includes factors that are with in the sphere of influence and control of the organization. These elements have been classified into eleven parts, which are [25]:

- 1) *Leadership*: -Top management's leadership role starts with creating the goals, values, organizational culture and system for quality. Quality gurus like Deming, Crosby, and Juran have made the top management responsible for most of the quality problem that arise in an organization. The other important input for any quality improvement activity is the top management's commitment. Commitment is more of personal rather than mandated or imposed attribute. The top management should demonstrate their commitment through action. Most of the time, people watch action more than they listen to what is preached. Lack of genuine top management commitment is cited as one of the causes of failure for most TQM implementation activities.
- 2) *Supplier Quality Management*: - Selecting fewer suppliers and working together to improve quality will reduce the overall cost of an organization. Organizations may feel vulnerable, as suppliers will take advantages of the situation and raise price indiscriminately. On the other hand suppliers fear losing their whole business by teaming up with one buyer rather than what they traditionally loss (a small portion that goes with the specific company). Thus there is a risk for both sides and the development of such kind of customer-supplier relationship is difficult and time taking. It also requires mutual trust and ability to work together as a unit.
- 3) *Vision and Plan Statement*: -there should be proper definition of quality statements &

planning. Participation of employees in the preparation of quality statement and planning is also vital as it makes the implementation process smoother.

- 4) *Process Control and process improvement*: - Process is a method for doing work which result from a unique combination of machines, tools, methods, materials and people with the intention to produce some item. Variation reduction or process maintenance activities are installed in order to keep variation of products to an acceptable level. A good process management defines and documents clearly each steps of the process. This reduces possible operator's errors and increases the flexibility of the worker to perform a variety of processes. It also simplifies the process improvement activities. A process should be managed in such a way that it operates as expected, without any breakdowns, workforce variability and missing material, fixtures, tools and so on.
- 5) *Evaluation*: - is a good source of information for any quality improvement practice. Evaluations are made through measurements of changes. It shows the specific areas in need of attention and the size of attention required. Evaluating activities may include strategic evaluation, cost of quality, quality audit, diagnostic survey, department evaluation, employee's performance & satisfaction evaluation, and team project evaluation.
- 6) *Product design*: - Product design is one of the key links for any production/service activity. Most of the quality problem can easily be tackled at this stage of production. Superior product design lead to products that meet customer's requirements, which will ultimately affect the market share and profitability of an organization.
- 7) *Quality System Improvement*: - Quality system is organizational structure, procedures, processes and resources required for the implementation of quality management [25 & 34]. Guidelines for quality system improvements can be obtained from different quality management approaches (ISO 9000 standard and TQM). Documentation of the quality

system makes the management processes more consistent. The improvement must be in a well-structured manner for all areas of the business and with an intention of attaining better customer satisfaction and reduced production cost.

- 8) *Employee Participation*: -Participation is one of the principles for any behavioral and attitude change that is needed for quality improvement process. Through participation, employees acquire new knowledge, improve their personal capabilities, increase self-respects, change personality traits, obtain a sense of self-accomplishment, develop positive attitudes, and reduce conflict stemming in the working process. It also increases management's respect for employees and the understanding between the two. Organizing different type of teams is one way of ensuring the participation of employees. Quality circle, focus teams, steering committee, and quality council are some examples.
- 9) *Recognition and Reward*: - Recognition is a public acknowledgment of individual or team's superior performance on specific activity. It can be verbal or written praise with symbolic items such as certificates. Reward is more tangible thing like salary increase, bonus and promotion, which are conferred for superior performance. The reward and recognition system in an organization should encourage and motivate employees to perform in certain desired ways. In TQM implementation, these desired ways are quality improvement and customer satisfaction. To effectively support quality efforts, any compensation system that the organization implements must strongly be linked with quality and customer satisfaction.
- 10) *Education and Training*: -A systematic and continuous education and trainings are vital for any successful implementation of TQM. Training and education provide knowledge and skill to employees. Organization should be willing and ready to invest in training and education of their employees as well as management members. The merits of training and education should be acceptable by all management, supervisors and employees. Knowledge

helps people deliver better quality work.

- 11) *Customer focus*: -Any quality concept begins and ends with the customer. What so ever the definition or approach used, the ultimate goal of quality is to supply what a customer need. Therefore, any production process must identify what the customer wants and delivering these requirements. For this customer must be made the center of all activities.

4.6.3 Harmonizing ISO 9000 and TQM Implementation

ISO 9000 standard provide a documented system that depicts the activities in an organization, which can provide a base for TQM program. ISO 9000:2000 has taken into consideration TQM and even laid down some pointers for those organizations who want to implement TQM. In order to help link ISO 9000 with TQM, employees must be encouraged to write procedures and convinced of the benefit of the quality system [31]. ISO 9000 standards must be set in such a way to maximize customer satisfaction and bias towards action rather than to bureaucratic procedures.

There are four approaches to fit an ISO 9000 standard into a TQM quality approach [9]:

- a) *Step Theory*: It advocates a stepwise approach where ISO 9000 standards are fully implemented followed by TQM implementation.
- b) *Drive Theory*: It is an approach where successful implementation of ISO 9000 standard pushes organizations to implement TQM. The basic elements in ISO 9000, if properly implemented can drive the organization ultimately into TQM.
- c) *Foundation Theory*: It is a theory, which compares ISO 9000 with a foundation of a house. A strong foundation of ISO 9000 provides a strong framework for a roof of TQM.
- d) *Element Theory*: This theory defines, ISO 9000 to be part of TQM. Therefore, in the process

of TQM implementation, ISO 9000 is part of the implementation process.

ISO 9000 has the advantage of providing a well-controlled paper work, which defines tasks and record system. It facilitates any auditing and quality control activities. It also helps organization allocate responsibilities. But if it is not properly implemented, it may lead to bureaucracy, which will choke the life out any smooth workflow in the organization. It is also internally focused excluding the impact of external factor that an organization must adjust itself. Some companies may not have the money to pay the high certification fee for ISO 9001. Most of the down sides of ISO 9000 can easily be compensated by TQM.

Although it complements ISO 9000, TQM is not perfect. The most serious disadvantage of TQM is, it takes a long time, dedication and effort for implementation. Most organization look for the short and easy way of implementing and when they are faced with this kind of challenges, they easily give up. It also requires thorough understanding of the concept of quality and for these and other reasons organizations are reluctant to implement it. But it has been proved, beyond reasonable doubt that TQM worth all the pain (example Xerox & Jaguar).

4.7 Quality Auditing and Review

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 [7]. 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.

Quality audits are made to gather objective and factual information for specific purpose. It can be conducted by anybody including the management and customers. Quality audits can be made to test the level of conformance to a system (compliance auditing), review the effectiveness of a system or meet legislative requirement to make one (mandatory audits) [7].

There are different types of quality audits including product audit, supplier assessment/audit and performance audit. It can also be categorized as internal or external auditing and first, second or third party auditing. *Internal Auditing* is where an organization audits itself or employ other qualified auditing body to make the audit. Here the client/auditee is the organization and the auditing body can be itself or a sub-contracted party. When the organization audits itself, it is called First Party Auditing and when a subcontracted body is used, it is called Second Party Auditing. In the first party auditing the auditing body can be drawn from either the area to be audited (True Internal Auditing) or from other sections of the organization for obtaining fresh and objective view. When another organization requests the auditing of an organization, it is called *External Auditing*. Here, the client is the organization initiating/requesting the auditing, the auditee is the organization being audited, and the auditing body is the one carrying out the auditing. When an external auditing is made by a subcontracted organization, it is called a Third Party Auditing.

Before beginning any quality auditing, the scope of the audit has to be defined. This is important because of resource constraints. Simply, one can't have the resources (budget, time, manpower, skill, and facility) to audit every thing in the organization. Therefore, boundaries have to be set for the audit. The objective of an audit is the first boundary. The objectives determine what information is needed or the reasons for making the audit. The next is to define the system or

element of the system to be reviewed and decide against what measures that the quality audit is going to be compared with. Then comes enumerating the areas, functions and operations of the organization that are going to be audited. This should cover location of each function. Finally resource requirements have to be prepared including budget, time, manpower & skill needed and any special requirements for the audit.

Looking at the overall auditing process, the planning is the first activity in line. The content of plan should include audit type, objective, scope, audit language, members of the audit team, representatives of the client, documents (information) required, audit areas, functions of the organization to be audited, timetable, resources and facilities required, method of communication and problem resolution methods. Preparing this plan should involve the client, audit team and auditee. Once the plan is prepared, gathering and analyzing data using different working methods commences. Check lists and different working documents can be used to guide the auditing activities. In-process reporting can be used to communicate between the audit team and auditee. But final findings are reported using standard formats and depending on the agreement with the client, proposal for corrective action can also be included. There should be proper presentation (verbal or otherwise), documentation and record for any future reference.

The activities of quality auditing can be classified into two: those that are performed by the head of the audit team and those by all members of the team. The head auditor starts the auditing activity by selecting the team members for the auditing team and focal person in the organization to be audited. This is the preparation phase. He has to make sure that the members understand the objective and standards for the auditing. The next phase, the data collection, is the most common and visible activity. All auditors have to collect data by means of interviews,

examination of documents, interrogation of data records and other means. In addition to these, the head auditor has to manage the day to-day activity. Then the initial review phase follows where the data collected are reviewed and analyzed starting the process of identifying non-conformities and conformities. But the main purpose, at this stage is to show the real picture of the organization. Auditors have to support their arguments with facts (evidence). Finally, the reporting phase where the head auditor takes the responsibility of deciding the content and issue of the audit report. But the team has to agree on the draft of the report.

The size of the auditing team may vary from a single individual to a number of people depending on the type and scope of the audit. Although solo auditing is possible, it is advantageous to audit in pairs. But increasing the auditing team more than two members will have a diminishing return. The team could be made-up of lead auditor, auditors, trainee auditors, experts, and observers. It is also pertinent to consider the qualifications of the auditors including education, training, auditing skill, technical skill, work-experience, language skill and auditing experience. Also the human nature of the auditor like fairness, honesty, awareness, sensitivity, tenacity, behavior under pressure, and analysis and decision making capacity are vital for making a successful auditing [7].

ISO has developed a standard approach (ISO 19011), which can be adopted especially for carrying out internal auditing. Also criteria of quality awards like that of Malcolm Bridge National Award and European Quality Award can be used for making self-auditing.

4.8 Other Components

Elements that need special attention during QMS development are discussed briefly below.

4.8.1 Quality Manual

Quality management manual is a document consisting of the general quality policies, procedures and practices of an organization. It may be difficult and inconvenient to prepare a comprehensive manual, which presents all activities for large organizations. In such cases, only the location and contents of other manuals detailing the procedures and practices for specific areas can be given in the quality management manual. Most food processing companies fear preparing and documenting their product design and specification. Because in doing so, they feel that they would reveal their business secrets. Keeping secrets must not be at the expense quality. Quality management manual (also referred as Quality Manual) can be divided into three parts: namely Quality Policy Manual, Quality Procedure Manual and Work Instruction [29].

In theory, quality management manuals should be written after all decision-making, resource allocation, policy formulation and agreement on procedure are complete [29]. Thus, making quality manual writing just a matter of structuring and recording of decisions. But in reality, manuals and management system are prepared simultaneously. That means writing down when each decision is made and revisiting and revising them as it becomes necessary. The structure of the quality manual ensures no part is missed in the development of the management system.

Good quality manual design helps users to easily find, read and understand, information from the manual [29]. The design starts with the format and binding of the manual. It is common to use ring binders for the manual, as it is cheaper and easy to make changes or photocopy. Access features such as covers, content lists, section starts, heading, running heads, page numbers and indexes must be carefully designed since these parts are most often read. Design techniques for organizing information, making the information legible, and laying out pages, tables and

diagrams should be used in the quality manual's preparation.

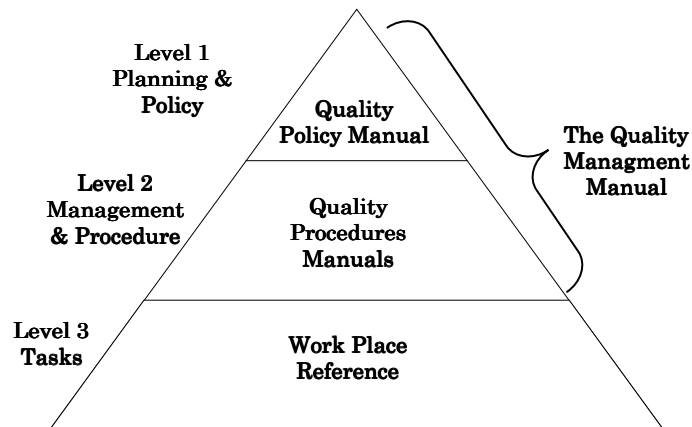


Figure 7 Quality Management Levels and Manual [29]

i) **Quality Policy Manual**

A quality policy manual identifies the primary functions of the organization and how these functions are managed and controlled. It consists of six main components including [29]:

- a) *Introduction*: - covering what quality management standards are used, how the quality manual is organized and controlled and the people who are implementing it.
- b) *Policy statement*: - includes quality mission and policy statement of the organization and the signature of Chief Executive Officer at the end of the policy statement.
- c) *Organizational structure*: -description of organizational structure, usually using charts.
- d) *Management responsibility and authority*: -gives the responsibilities and reporting relationship for all functions in the organizational structures.
- e) *Management review*: -it is a regular evaluation of all aspects of the quality management system and includes who leads it, how often it's held, what the objectives are, what information source will be used and how the findings are presented.
- f) *The Quality Management System and its conformance with ISO 9000 requirements* (any other standards): - covers the scope of the QMS and its conformance with the ISO 9000 requirements using charts, list, or separate sections to show.

ii) Quality Procedure Manual

Quality procedure manual deals with tactical aspects of the quality management system. It defines the practices and operational details of the organization. It must

- a) Define the quality management processes;
- b) Describe the procedures for smooth and uniform process work.

Quality procedure manual must be styled to suit middle managers who use it frequently. Procedures are vital for successful implementation of the quality management system and therefore must carefully be prepared.

Management processes such as sales and marketing, accounting and finance, and quality assurance are common to all organization and hence easily adopted. But processes such as operations management, infrastructure management and project management are specific to an organization and need to be prepared locally. Quality management processes start by identifying who the customers are, what the products/service are and what functions exist in the organization. Standards such as that of ISO 9000 provide guidance and models for management processes. Once the processes are defined, proper presentation is important in order to communicate it with users (usually using listing or diagrams).

In the preparation of the procedure manual, writing down the procedures succeeds the management process identification. The procedure manual should give information on [29]:

- a) How the management processes are carried out;
- b) Who will carryout these processes using job title to describe them;
- c) How these processes are documented;
- d) Which work instructions are going to be needed?

Good procedure preparation takes time and effort. It should also be tested before its submission as a final version.

iii) Work Instructions

Work instructions have other names such as workplace instruction, third level documentation, support documentation, and workplace instruction. It is a material that employees refer to perform their day-to-day activities properly. It is also a large quantity document, which includes forms, technical manuals, drawings, instructions and standard methodologies for testing reference and research materials. Workplace references play an important role in an organization's quality system. Since employees constantly refer these materials, they directly influence the way employees do their jobs. They are also used as a base line for any quality improvement process undertaken by an organization.

4.8.2 Cost of Quality

The first questions that managers raise when considering implementing quality improvement activities are the cost of these activities and their returns. If closely assessed, it is observed that the investments on the quality improvement activities are returned through the reduction in operating cost. That is why Crosby argued that 'Quality is Free'. There are two approaches for collecting and presenting cost of quality: Prevention, Appraisal and Failure (PAF) costing & Process Cost Modeling [8].

Prevention cost is the costs producing defect free products. These costs include cost of developing a product design and specifications, preparing and maintaining purchasing procedures, setting up quality planning and administration structure, training, and carrying out a

quality audit. Appraisal cost is the cost of all those processes that assure quality is part of the product. It includes process testing, preventive maintenance, supplier's assessment and finished products testing. Cost of Failure can be classified in two: Internal and External. Internal Failure Costs are costs incurred when products fail to meet specification or quality requirements while they are in the organization's premises. Some examples are non-crisp potato chips, fermentation-tasting canned mango, pulp and bulging cans and other packaging and processing defect. External failure costs are costs that arise due to failure of the product after it has left the organization.

The PAF approach has a number of drawbacks. In reality, every thing that a well-managed organization does can be considered as prevention. And separating preventive activities from other activities becomes difficult. It is also difficult and in some case not necessary to classify costs into these categories. Investing in the prevention activities decreases the total cost to a certain optimum point and any further investment will actually increase the total cost. The PAF approach doesn't consider this fact, which seriously handicaps the quality costing process. Thus, the process cost modeling is more preferred.

The process cost modeling approach classifies the cost of quality into two: the Cost of Conformance and the Cost of Non-Conformance. Cost of Conformance is the cost of producing an item exactly to the requirements, the first time and every time. It is approximated by sum of the cost of prevention and appraisal. Cost of Non-conformance is the cost of failing to produce to the requirements or variable products. It is more or less similar to the cost of failure. The sum of these two costs gives the Total Cost of Quality.

Although the reporting formats and frequency are specific to organizations, few common approaches have emerged through time. These are [8]:

- Sales Ratio = $\frac{\text{Total Quality Cost}}{\text{Net Sales}}$
- Unit Ratio = $\frac{\text{Total Quality Cost}}{\text{Unit Produced}}$
- Cost Ratio = $\frac{\text{Total Quality Cost}}{\text{Cost of Operation}}$
- Labor Ratio = $\frac{\text{Total Quality Cost}}{\text{Direct Labor Cost}}$

4.8.3 Customer Satisfaction

Any organization has some form of idea who its customers are. The main purpose of this section is to create a common understanding about the concepts around customers. A customer is any one who receives and uses what an organization or individual offers. As discussed above, there are two types of customers: Internal and External. If an organization wants stay successful in the market, the satisfaction of both type of customers is equally important.

Only when customers are involved in the food processing that customer satisfaction can be attained. The satisfaction level may vary on the type requirement (Basic, Performance and Delight) met by the product [5]. The involvement must be from the product design to the final delivery and consumption of the food product. In processed food products external customers are not only final consumers but also retailer. Retailers assume some risk in the distribution of the final product. They also have first hand information about consumer's quality characteristics requirements. Food research institutes and government regulatory bodies must also be consider as customer. Thus, broader view must taken when inputs from customers is involved.

In any food processing industry, there must be a positive working environment. Food products are especially susceptible to any sabotage and product spoilage. Therefore, employee's

satisfaction in the work condition is crucial. This is achieved through employee's involvement and empowerment. Once employees are adequately trained, involved and empowered in the manufacturing processes and acknowledged for their effort, they start to see their organization in a positive prospect. The main objective here is to create a feeling of ownership by the employees. To this effect, different method can be used including providing financial interest, ensuring job security, creating suitable organizational structure, and implementing different motivation schemes.

4.8.4 Supplier's Relationships

Raw materials and parts purchased can become a source for quality problem in an organization. Quality management employed by suppliers is, therefore, very important for an organization. Traditionally, customer-supplier relationships were adversarial in nature where one is suspicious of the other. There was minimum flow of information and cooperation towards achieving a common goal. Modern approaches of quality condone such 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.

Food production and supply consists of a value adding chain starting from the farm right up to the consumer. Some examples of food chain are given on the table below. The quality of food items can easily deteriorate at any stage of the chain. Therefore, to deliver quality to the final consumer each member in chain is equally important must be given equal attention.

Farmers Consumers	Farmers Middleman Consumers	Farmers Wholesalers Retailers Consumers	Farmers Wholesalers Industries Retailers Consumers
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Table1 Example of food chain

In food processing raw material are purchased from suppliers for processing. There must be a properly outlined manual for the purchasing of raw materials. It must clearly define [30]:

1. The responsibilities of different parties with in the purchasing function.
2. The manner in which suppliers are selected, to ensure continual supply of raw materials.
3. The requirement for purchasing activities such as written orders, specifications, etc. which preferably in document form.

Suppliers of raw materials are expected to meet some basic requirement which include consistent (low variability) products, meeting targeted requirements, implementation of process evaluation and development, reduction of variability continuously, correct delivery performance, the right speed of response and an appropriate QMS [30].

Many organizations, especially in the manufacturing industries, have adopted an inspection oriented quality system for incoming materials. This kind of approach has a number of disadvantages. It is expensive, imprecise and impossible to apply equally to all material that is brought in. And all these will lead to variability in the cost as well as quality of the end product. Hence, teaming up with suppliers is the best solution for these problems.

CHAPTER FIVE: FOOD QUALITY MANAGEMENT SYSTEM (FQMS)

IMPLEMENTATION CASE STUDIES

Components of Food Quality Management System have been discussed in the previous section. For further analysis of the components, two case studies have been used (D.H. GEDA Wheat Flour Factory and ELFORA Agro-Industries). But before going into the analysis, a brief account of the overall environment of the respective case and its product is given below.

The annual flour production of the country by large and medium scale manufacturers ranges between 100,000 tons to 190,000 tons. There are currently about 6 privately and 8 publicly owned flour-producing enterprises in the country. The growth rates of the industry for the three years (1997/98, 1998/99 & 2000/01) were -25%, 60% and -11% respectively depicting a wide fluctuation [36]. The main flour type produced by most of these industries is wheat flour, which has a relatively high demand. Wheat flour is usually prepared at home or imported from abroad and these industries compete for the remaining demand. Thus, creating a very tight competition in the market.

In meat processing, except for the abattoirs, ELFORA Agro-Industries owns most of the industries that produce canned meat, sausage, and mortodela. Most of the major cities have local (municipality) abattoirs, which supply small butcher shop with fresh meat of cattle, sheep and goats. Although the country has one of the largest populations of livestock in the world, it has not exploited this resource. After the lifting of the trade ban by countries in Middle East, the export market has significantly grown. There is very limited domestic market for processed meat products mainly due to the dietary habit of the people. In general, the market for meat products is not steady for different reason (war, draught, disease, safety & health).

5.1 FQMS Case Study at D.H. GEDA P.L.C

D.H. GEDA is a privately owned organization actively engaged in different types of businesses in Ethiopia. It was established in 1993 as a commercial business enterprise and later on expanded into the manufacturing sector. It has set up five factories, which are involved in Wheat Flour Milling, Galvanized Corrugated Sheet Metal production, Wool-blanket production, Paint production, and Dry Cell Battery production in the industrial sector. The Commercial division of the organization is active in the marketing of finished products and other imported items. It has set up branches all over the country including Dese, Tigray, Bahire Dare, Gondar, Shashemena, Jima, and Harer. The Board of Directors, whose members are mainly the owners, is the highest body of management. A Managing Director is accountable to the Board of Directors and is also responsible for the overall activity of the organization. There are a number of sections including the industrial sections under which the flourmill factory is structured.

5.1.1 D.H.GEDA Wheat Flour Mill

General background

One of the factories in the manufacturing section of D.H. GEDA P.L.C. is the wheat flourmill located in Addis Ababa at a place commonly known as 'Gergi'. It shares the location with another factory of organization - D.H. GEDA Galvanized Sheet Metal Factory. The feasibility study for the establishment of the mill was completed in 1995. Construction and machine erection of the factory were finished in April 1997 and the plant started milling at full capacity in May 1997. The factory has a capacity of milling 1250 quintals/day and 375,000 quintals/year. Its current capital is estimated to be about 10 million Birr. The main objectives of the Mill include:

- To produce high quality wheat flour in order to alleviate the shortage of flour in the country.

- To produce standard wheat flour for public consumption like Biscuits, Bread, and Macaroni.

Although the main product of the factory is wheat flour used for bread making, it is also capable of producing wheat flour suitable for biscuit, macaroni and pasta making. As a by-product of the milling, it also produces bran and pollard, which are used for animal feed. The flour produced is packed in 100kg jute bags, 50 kg PPC bags or cellophane bags ranging from 1 to 5 kg. The packing materials are all imported. Though the flour is mainly produced for bakeries, there are also household consumers buying the product from retailer shops.

The factory can operate on three shifts depending on the market demand. It is current utilizing on average about 66% of its total capacity. The main problems of the factory include the shortage of good quality of raw material (wheat) and market as a result of the tight competition. The factory is organized into six sections with a manager and deputy manager. The organizational structure is given on figure 8. The departments are responsible for marketing, production, quality control, finance and administration with respect to their title while technical department is responsible for maintenance activities. The manager directly reports to the head of Industrial department of the mother organization. Each section has its own department head. All the administrative and production units are found at the same vicinity with that of the plant.

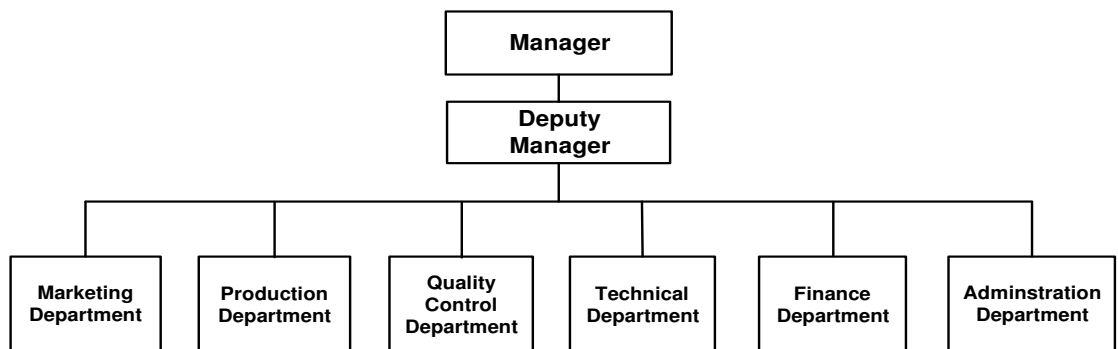


Figure 8 Organization structure of D.H.GEDA Wheat Flour Mill Factory

There are a total of 56 full time employees currently working only at the mill factory. But there are employees who work for both the mill and the corrugated sheet factory because of the close proximity. There are also seasonal workers who are employed depending up on the workload of the mill factory. Most department heads and some professional employees are at least bachelor degree holders. Mid-level employees are either high school graduates or graduates of vocational training and there are also employees with lower education background.

Milling Process

The wheat milling process starts with the inspection and acquisition of the raw material. About 0.5kg of wheat sample is taken from each truck (containing about 50-120 quintals) coming into the plant. The sample is tested for different characteristics, which include hectoliter weight, moisture content, impurities and hardness. Once the sample proves to have met the required characteristics, wheat acquired will be stored for about 15 days, which will help it to mature properly. It will then be transferred to the milling sections.

Cleaning is the initial process that the wheat under goes in milling section. Big foreign materials and fibrous materials are removed by the first activity of the cleaning process - separation. Then a gravity de-stoner is used to separate high-density materials from the wheat. The wheat is then cleaned of any foreign material that may have been adhered on to the grains using dry scrubbers. Conditioning is the next process where the wheat is soaked in water for 8-16 hours depending on the type of the wheat and then dried. It helps the wheat attain the required moisture level and make the cover more elastic so that the scrubber can scrape off the cover and any foreign materials attached to the wheat kernel.

Then the wheat is fed into the grinding process in a batch of 25kg. There are three main types of machines in the grinding process: Breaker, Reducers, Fine-grinder (Scratchier). The wheat goes first into a breaker and three items i.e. flour, partially milled flour (crude flour) and bran are produced. The three are separated using different sized sieves. The flour is extracted, the crude flour is transferred to the next breaker and the bran is first passed through the reducer where some amount of flour is extracted and then to the scratchier where further extraction of flour takes place. As the process repeats the bran and pollard become finer and contain lesser flour in the mixture. There are a total of five breakers, four reducers and seven scratchier that are interconnected through different types of sieves combination to direct the right materials to the right milling machine. After the grinding is over, the flour is temporarily stored in a flour-bin until it is finally packed to the required size. The flour is left to mature for 15 days where it will bleach (become white) and improve its protein contents. And finally it is shipped out to customers. By products are also packed and sold to animal farms.

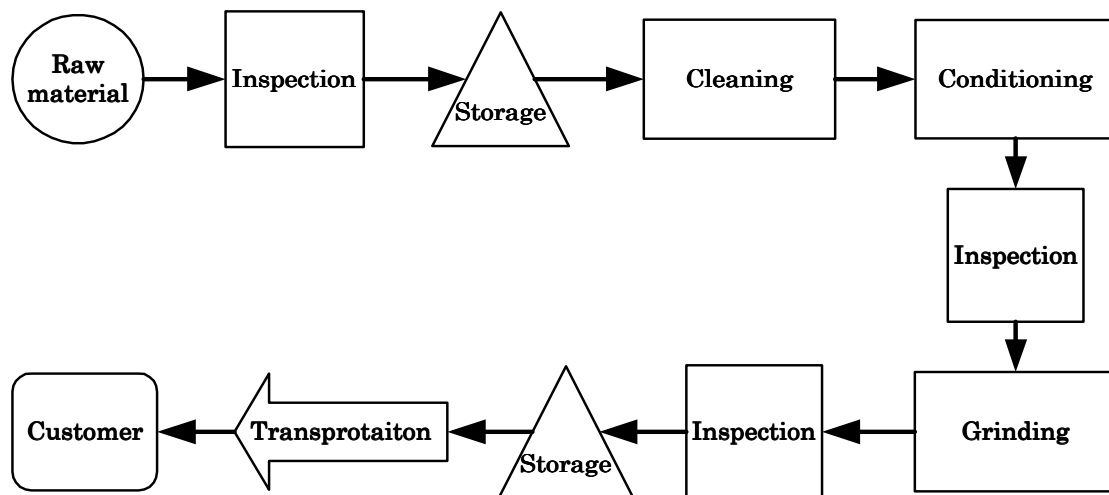


Figure 9 Wheat flour milling process

In-mill and final flour are sampled and tested for quality at different stages of processing. In-mill samples are taken continuously during milling and the total sample amounts to 0.25kg every 30 minutes. Then the sample is tasted for appropriate mix ratio, conditioning level and

sieving. A larger sample of 1kg is taken from the final flour product and a number of tests are conducted. Some of the tests are impurities test, different types granulation tests, ash analysis, gluten tests, different food composition (protein, maltose and starch) tests, farinograph test and extensograph test. Sample bread is baked from this sample and later on (after 15 days) from a new sample taken at the time to actually inspect the flour quality.

The plant use medium hard wheat (about 60-70% hardness) for the production of bread-flour. This wheat hardness is achieved through mixing of soft and hard wheat in the appropriate ratio. The mill's efficiency can be described in two ways. The milling efficiency (Output/Cleaned material) is about 75% while the commercial efficiency (Output/Raw material) ranges 70-72%.

5.1.2 Quality Management System Assessment

The quality concept and activities in D.H.GEDA Wheat Flour Mill is assessed through interviews and questionnaires prepared before hand (see Appendix A). The questionnaires are based on the components that have been discussed in the literature survey sections of the thesis.

Quality Leadership and Organization

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. Because of the pressure from the market, the leadership is giving serious thought to quality. They have identified the most commonly demanded quality characteristic from their product, which include color (white), high water absorbing nature and of course price. Quality activities are inspection-based and no efforts are made to go to the prevention-based quality approaches. Except for the weekly meeting between the manager and marketing department, the only communication is made through the informal

boss-subordinate relationship. There is no clearly defined quality vision, mission or policy in the factory. One can easily observe that there is a huge gap with what is regarded as quality-oriented leadership.

There is no organization for the quality concept implementation and department for developing quality systems and approaches in the factory. As a whole, there is a more centralized organizational structure. But 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.

Quality activities in the milling processes

Procurement of wheat mainly involves the top management who decide the suppliers and the quantity purchased. Since there is a great fluctuation in the quality of wheat, acquisition of the right wheat is heavily dependent on the supply in the market. Wheat farmers sell their products to intermediate venders who collect, store and sell it back to factories that process it. The type of wheat produced by the farmers determines the purchased wheat. This will have a direct impact on the type of flour produced. The market fluctuation makes having a few suppliers difficult, as most of these suppliers are region specific and small in capacity. Therefore setting a single standard approach for selection of either supplier or raw material is difficult. There are also no efforts to improve or trace the performance of supplier. The factory has no constant supplier.

Product improvement is mainly aimed at minimizing complaint from their customers and exceeding rival flour products. Although there are plans to expand the products of the factory, there is no documented approach to improve the overall quality concept of the flour. The gaps in

quality of flour are usually identified using bench marking. Sample flour products from different manufacturers and importers are collected and compared with that of the factory's product. The gap identified from the samples provides the base for improvement of product quality.

The technical department of the factory carries out maintenance of the different milling machineries. No preventive maintenance, a documented procedure for maintenance and regularly interval calibration is found in the company. Procedures for operating the milling machines and controlling milling processes are mainly based on experience of the respective employee. Recently there are some efforts to make operations in the mill formal but these efforts are not supported with the appropriate manual.

Two separate storage facilities are found in the factory. One is used for temporary storage of wheat while the other is used to store flour. And the two are a good distance apart. No evaluations of the quality of the store, the mill factory and other surrounding environment using standards such as GMP and GHP have been made. This also holds true to the laboratory in regards to the GLP. Assessment of the impact of the near by sheet metal factory on flour need to be made to assure safety. The products meet the national packing and labeling standard.

Customer's satisfaction is a very important aspect of the mill factory. Sales personnel are given regular training and motivation to perform well. They have a direct contact with customers (mainly bakeries), thus obtaining first hand information of customer's reaction to the flour supplied. There is a weekly meeting between the manager and sales personnel to assess the market and problems related to their customer's satisfaction. When there is a complaint from customer, the quality control personnel launch an investigation to pinpoint the sources of

problems and take corrective measures. There are also scheduled visits of customers by the quality control personnel to evaluate the quality of flour supplied. Advices and fliers are distributed to consumers on basic bread making process so that consumers will get the maximum out of the flour they purchase. But there is no documented survey of the customer's satisfaction for the product.

There is no quality manuals used for carrying out most of the daily activities including quality in the factory. One exception is the quality standards set for laboratory testing of flour and wheat. Also some records are kept on the type of wheat available on the market in order to adjust the flour quality. The usual administrative and financial records are kept but these are not in accordance with the international standard such as the ISO.

The overall activities (performance) of the factory are evaluated in the reviews that are made regularly. But since there is no well-established quality system, the auditing or reviewing of quality system do not exist.

Quality Control

Quality control department is the most responsible party in maintaining quality of the flour processed. It is in charge of all the testing and making the appropriate adjustments. There is a laboratory where all testing are carried out. The tests performed are inferior to the standards of some of the wheat mills in the country mainly because the laboratory is ill equipped.

There is a documented set of standards for quality characteristics for both raw material and finished product. These standards are expressed as a test result carried out by the laboratory. But there are no documented procedures for sampling. These quality standards are the bases for

segregation of non-conforming products. Any corrective actions to be taken are determined by the quality control and production departments under the supervision of the management. The actions taken are mostly from the rich experiences that the employees possess. And there are no formal procedures for taking corrective action or record of action taken. No statistical techniques with formal procedures are used in the analysis of the quality of flour during and at the end of milling process.

Report on the employee's assessment

Using a survey (Appendix B) that has been conducted on 41 employees of the D.H.GEDA Wheat Flour Mill factory, the following evaluation is made about the employees. Most of the employees believe that the mill factory knows what its final consumers need from Wheat Flour. With the flour currently produced, about 56% think that it has satisfied its consumers where as 40% of them think otherwise. The majority believes that the quality of flour needs to be improved and the endeavors that are made to this effect are not sufficient. 56% of the employees think that the relationship between the management and employees is not smooth. Slightly over half of the employees questioned think the nature of the current organizational structure enables them to perform well. The vast majority (80%) believes that there are no incentives and motivation schemes in the factory. The same number of employees attests that the training in the mill factory is not adequate. 51% believe employees involve in the product improvement processes while 48.8% believe the opposite. About 56% of the employees think that they have no input in the development of product in factory. Although they have limited involvement in the product design, about 73% of the employees think that all employees are responsible for the quality of product. Employees believe that the quality control activities are not adequate (54%). In general, 71% of the employees don't believe that there is a conducive working environment.

About 56% of them don't feel secured with regard to their job and thus not proud of their factory. They also feel that there are unsafe working areas in the factory (63%).

5.1.3 Proposed Quality Management System

The proposed quality management system is formulated based on the literature review and the actual practice observed. The system consists of components pertinent to the mill.

Management's Responsibilities

Quality management in D.H. GEDA Wheat Flour Mill must start by clearly defining what it really expects from its flour. 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 writing and understood by all members of the organization. And every body must be held responsible for its implementation. Quality control department should not be the only one responsible for quality of a product.

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 organization with regards to customers, vendors, employees, the community, the environment & the business itself. The organization 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 organization's position can help amend these concepts and their implementation. The objectives (goals) should also be revised now and then, as there will be changes in the market. For example, setting an objective of meeting the shortage flour in country is not plausible as the market is nowadays flooded with the product.

A more diverging organizational structure (less centralized) must be used in the mill factory 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 focal person who is responsible for coordinating the quality activities in the factory. Any further organization for quality may be formed depending up on the need. The focal person 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.

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 factory. The simplest medium of communication can be to posting different messages on a notice for everybody to read. Fliers and formal meetings should be prepared. 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. With out the right training for employees, achieving quality is a futile exertion. Therefore, training must be given to make employees feel confident to produce the required quality and standard. To sum up, employees must feel safe about their work place (jobs) and part of the family and not an outsider.

Flour and milling process design

The mill produces only one type of food item and a formal design has to be made for it. A product development procedure must be put in place as the factory has planned to expand its

products in the future. The flour design must take the raw material (i.e. wheat) variation in the market into consideration. QFD model can be a good model for developing products in the mill factory. Product design and designing procedures and requirements must be properly documented for any future references. Once the milling processes are designed, it should be communicated to the shop floor employees in such a way that is easy to comprehend. Using Amharic language and descriptive pictures may facilitate the communication.

Wheat Supply

To expedite the wheat acquisition process from local markets, quality requirements of wheat must be properly defined and documented. Based on these requirements wholesalers and farmers can supply the raw materials. To ensure trace-ability and quality of wheat, selecting few suppliers is one of the best ways. The current vendors situation of the country may not allow this kind of customer-supplier relationship. But the mill must take this approach as a long-term target and work towards it. Venturing into the investment of wheat farming can help the mill in the procurement of wheat of high quality and acceptable trace-ability. It will also place the factory in close proximity with farmers, which will enable it to influence farmers to crop good quality wheat. Such proximity will help the mill develop supplier's relationship on a farmer level. An example of such relationship is observed in the sugar factories for sugar cane supply.

Quality control

Since the quality of wheat determines the quality of flour produced, the inspection of in-coming wheat is important. Accordingly, there is a reasonable quality inspection for incoming wheat at the mill factory. What it real lacks is formalization of the process. There must be a properly designed control process for taking samples, testing and documentation. With the current

capacity, single sampling plan may be suitable since it is cheap and easy. But with further quality improvement, double sampling can be used. ISO sampling systems should be used in order to ease the coordination with other standard activities. This sampling approach can be used to trace any defects in the flour during the milling process. The other main point that should be focused is the quality control capacity of the factory. Being poorly equipped, the quality tests conducted by the laboratory may not be sufficiently indicative for the quality level of flour aspired to be attained. The quality policies may have a significant impact on the quality level, control and approach that is aimed to be achieved. In any case, the quality control must be set up in such a way that it provides adequate information on quality characteristics of flour in line with the market requirement.

In-milling control system (including SPC) and non-conforming flour identification, segregation and correction systems must be formally prepared and documented before hand. After identifying those decisive quality attributes of flour, collecting and analysis of data has to be made using control charts. Collected data through such systems will help the factory develop milling processes based on hard and solid facts instead of intuition. There must also be a documented mechanism for disposition of unfit flour.

Quality Assurance

Revising the milling processes in terms of those international standards and local regulations is crucial. Meeting such requirements not only increase the factory's efficiency but also enables it to manufacture safe products. GMP is the first standard that the mill must strive to implement. Although it goes beyond the scope of the milling plant, hygienic practices recommended by CODEX can also be implemented in parallel with GMP. This will help the mill attain an

international standard milling facilities. Then ISO 15161 should be the target. If GMP & hygienic standards are properly accomplished, the implementation ISO 15161 (ISO/HACCP) is a relatively easy task. Finally, the factory can focus on the principles of TQM to make its milling process and products of the highest quality standard. Some of the principles of these approaches can improve the current situation of the mill and must be implemented with GMP.

Flour and milling process improvement

The quality implementation must be in a continuous manner. Care must be taken not to fall back once the improvement process started. To ensure continuity, approaches such as PDCA must be employed. Therefore, a thorough implementation plan and a good team spirit must be developed starting from the top management down to the shop floor employees and from marketing to administrative personnel. Proper introduction and consent of the changes to be under taken must be made with all employees in the factory in advance.

Quality auditing and reviewing

When developing the QMS, there must be a mechanism for auditing and reviewing it. The management may use an overall auditing and reviewing systems for all the operations in the mill. But review of each activity at all levels must be put in place to evaluate quality progress.

Others

One method to justify the implementation of quality concepts is the cost of quality. It can also be used to measure progress in quality. Cost of quality clearly indicates how much the mill is losing (gaining) from the quality improvement activities. Since no previous calculations of quality cost exist in the mill factory and to help any future computation, a table for calculating

quality cost has been proposed in Appendix C. This table can be used as starting point and improvement can be made as the experience and knowledge in the area expands.

During the implementation of quality concept, calculation of quality cost has to be made at a regular interval to measure the progress. Another indicator for progress in quality is communicating directly with customers. This can be done using questionnaire, which will make the communication more formal and documented for any future reference. Such surveys should be made at the beginning and on a regular bases during the implementation period.

Documentation is one of the main areas that the factory 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 milling process. It also reduces the efficiency of the mill factory. Employees working at each point of the processing can be used to prepare their own work instruction and procedure manual. In cases where help is required, professionals within or out side the mill factory may be called up on. After including a policy manual, which is developed by the top management, a quality manual is compiled by the focal person. This manual must be available for all employees at any time.

The implementation model (Figure 11) depicts the general approach to the implementation of the system in the mill factory. The system development must start with briefing and consent of the management. Building the required organizational structure and assigning a focal person who will be responsible for coordinating and controlling the quality activities is the next step. Then comes the adoption of international standard such as GMP, GHP and ISO 15161. Finally the continuous quality improvement process commences in which improvement plans are made,

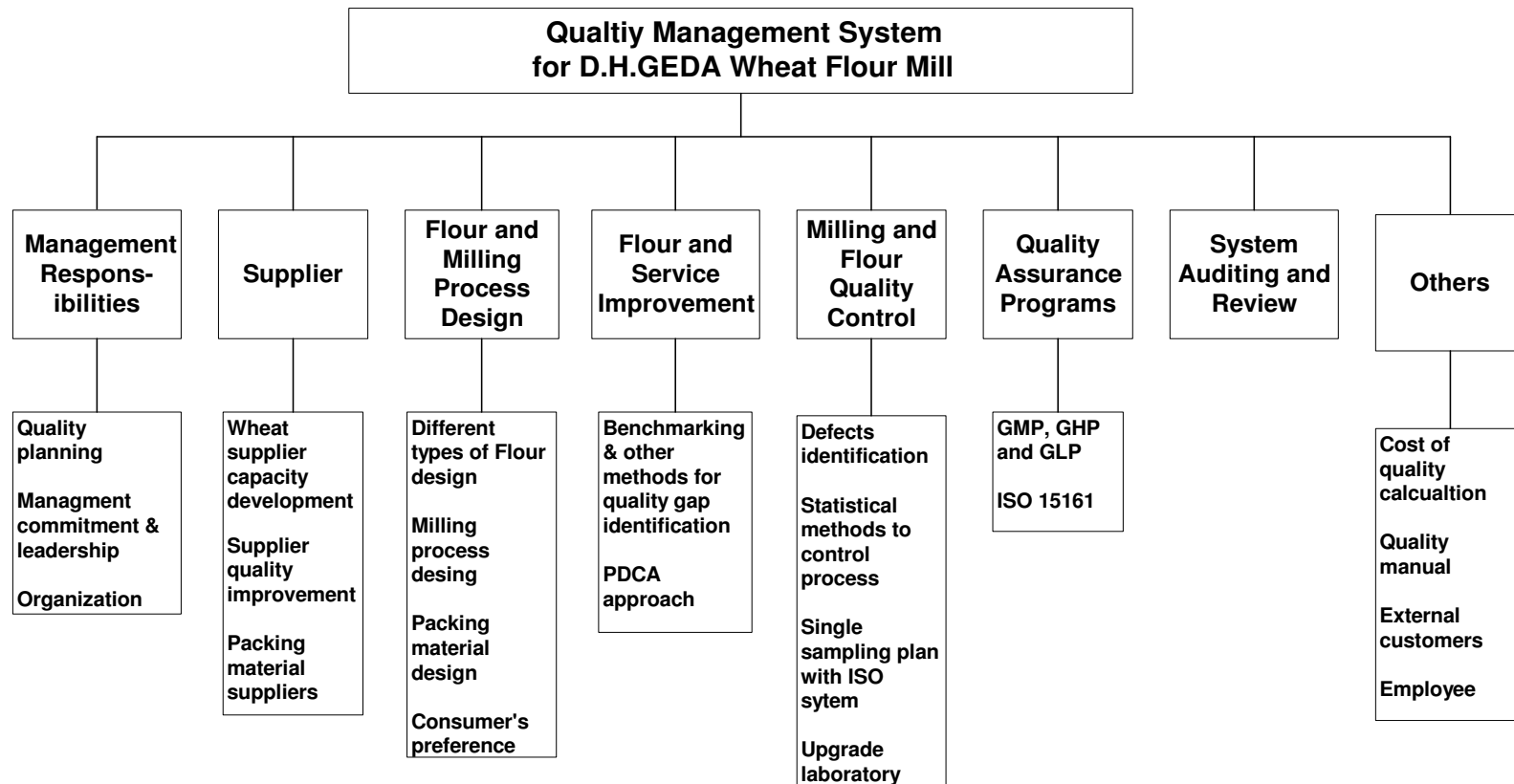


Figure 10 Quality Management Systems for D.H.GEDA Wheat Flour Mill

implemented and evaluated. And based on this, the next cycle of the implementation plan is prepared. Quality improvement processes are continuous and never ending as there is always opening for betterment.

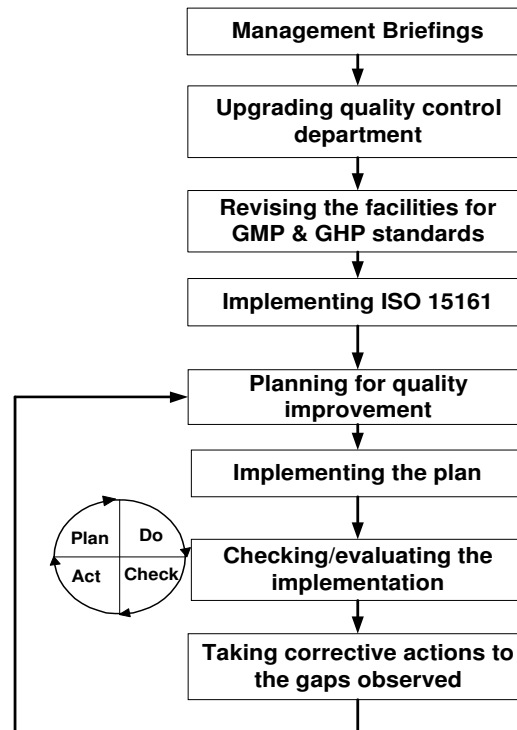


Figure 11 Implementation model for the quality management system (D.H.GEDA)

5.1.4 Recommendation

Evidently, it will be simpler to implement quality improvement processes on project basis. Project concepts are already well taken up in the country and hence are easier to prepare and carry out. 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. For this, the quality level that the mill aspires to achieve and financial resource invested are very

important. The major investment areas include consultation cost, training, new equipment & facilities, cost of managerial changes, and staff time in documenting the system. Definitely, there will be more quality improvement and short return period if more resources are invested in the implementation. The decisions are subjective and dependent on the commitment of the mill.

The proposed QMS gives a quality framework for the mill factory. It only guides the activities of the mill towards achieving better quality in its flour and other products (service). It will address the main problems of the mill (market & supply) thereby enabling it attain better operating capacity. It will also help the factory save cost in reworking of defective flour. Relation with customers, suppliers and employees can also be improved. Generally, with a genuine devotion to its implementation this QMS will make the mill more competitive.

5.2 FQMS case study at ELFORA Agro-Industry

5.2.1 General Background

ELFORA is one of the companies under the MIDROC Ethiopia consortium operating in agro-processing sector. It was established in December 1997 with the acquisition of eight Government owned enterprises as a package deal. The deal is worth about 55 million US dollars, of which 21.87 million (40%) was paid for. These acquired enterprises were active mainly in livestock and food processing, poultry production and crop production operations. The name "ELFORA", which stands for natural products, comes from two Oromiffa (Borena Oromo) words: "ELA" and "FORA". "ELA" means permanent water point and "FORA" means seasonal grazing land. When the two are combined they signify the high quality livestock products, which are produced under traditional pastoral system as well as modern ranching. The mandate (purpose) for its establishment is to produce and supply live animals, chilled and frozen

meat and canned foods; table eggs and broilers; cash and industrial crops (flowers, vegetables, pulses, cereals etc.); dairy products; and forage and fodder crops (alfalfa). But currently, its main products are carcasses and meat cuts, poultry products, live animals, different types of canned foods and by-products of different processes.

Its main office is located in Addis Ababa (near "Tele-Medhanyalem") and currently administrated by newly organized chief executive officer of MIDROC Ethiopia. It has eight agro-industries operating units, seven ranches, five holding grounds, three feedlots and one quarantine. It has created employment for over 3000 people. The company covers the complete chain of livestock facilities starting from purchasing of the animals, holding ranches, vaccination and quarantine, slaughtering and processing, poultry and crop farms.

Concentrating on meat processing, ELFORA has five abattoirs and food canning plants in regions where favorable raw material supplies are located. These plants are Melge Wondo, Kombolcha, Dire Dawa, Gondar, and Kaliti including the DebreZeite slaughterhouse. Meat products are mainly supplied to hotels and institutes (Sheraton Addis, Hilton, Supermarkets, Universities), households and government organizations in the domestic market and countries such as Saudi Arabia, United Arab Emirates, Yemen and Djibouti in the export market. The specific meat products processed by the company are carcass (chilled/frozen beef, veal, mutton and goat meat); meat cuts (chilled/frozen beef prime cuts, lamb racks/roll, goulash and goat racks) and canned meat products (corned beef, beef in jelly, beef stock, minchet abish, cooked meat, veal/beef sausage, veal/beef mortodela, and veal/beef ham).

After the end of the Ethio-Eritrea war, the domestic market for canned meat has sharply

declined, as the army was the main consumer of these products. This has forced most of the plants to stop operation. DebreZeite, Melge Wondo and Kaliti are the only plants that are currently operating to some extent. Kaliti processes canned meat products in addition to other meat products. DebreZeite exports carcass of an internationally accepted standard. Due to the limited time available, the restriction of the objective to meat canning processing and easy access, two plants of ELFORA are assessed: DebreZeite Abattoir and Kaliti Meat Concentrate. These two plants give all the processing steps in the production of canned meat. There are two distinct processes in the manufacturing of Canned Meat: the Abattoir & Meat Processing operation. The Abattoir operations are the slaughtering of animals and preparing the carcass whereas the actual processing and canning of the meat takes place subsequently.

DebreZeite Abattoir

DebreZeite abattoir was first set up by FAO in 1973 mainly for training animal health assistants at the DebreZeite Veterinary College. In addition, the abattoir was to supply the town of DebreZeite with fresh carcass and meat-cut. Ministry of Agriculture administered the abattoir until ELFORA Agro-Industry acquired it. Although it can slaughter and process carcasses and meat cuts of all livestock, currently it focuses on goat and sheep slaughters. It is one of the five plants licensed to export carcass to the Middle East countries. It has a capacity of 1000 sheep and goat/shift (1 shift = 8 hours). It has different facilities including chillers/freezers, cold rooms, boilers, stand by generator, loading/unloading docks and reject pits & incinerator.

There is one manager under which six departments are organized. The organizational structure is given on figure 12. The abattoir reports to Food Processing and Livestock Operations section of ELFORA. There are about 115 employees currently working at the abattoir with varying

educational background. Most of them are below a high school diploma level but there are also professionals with one food technology master and a number of diplomas.

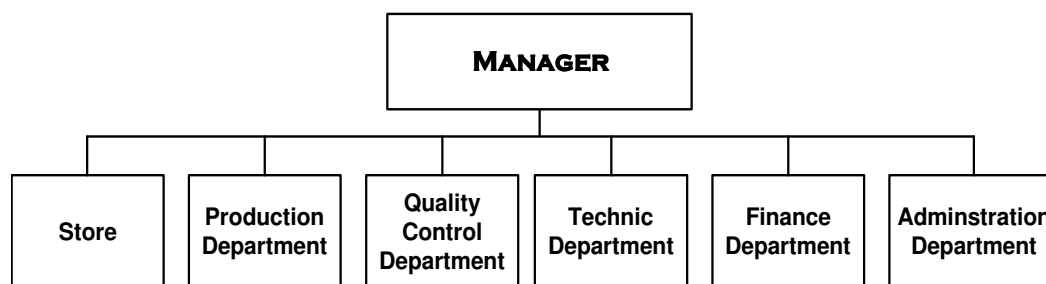


Figure 12 Organizational structure of DebreZeite Abattoir

The abattoir operations start with the purchase of the raw materials - live animals like sheep, goats, calves and cattle. The animals are collected from different parts of the country and are held in the ranches. There is also a quarantine station where healthy animals are kept for about 21 days before they are slaughtered. Then the animals are transported to the abattoir facilities using special trucks designed for the transportation of livestock. This will keep the animals from losing too much weight while walking. They are held in the 'holding pen' for 2 to 3 days being provided with feed and water. This will help the animals to rest from the long journey they have made. Then they are transferred into the lairage where they are supplied with only drinking water and kept for up to 24 hours. Here the animals will starve. This reduces the unnecessary feed expense and the amount of waste material taken out during slaughtering process. Then they are transferred into the slaughterhouse where a number of processes are carried out. The animals are weighed and killed first. Then the dressing process commences where the skin & outer non-edible parts are removed. A special sternum saw is used to split the breast of the cleaned animal in order to open it (Breast-splitting process). The inner non-edible part and offal's are removed. Then comes carcass-splitting process where the beef carcass is split into two parts. It is further cut in to smaller pieces (meat cut product). If carcass is the final product, the two splits are cleaned and allowed drip the water in them before standardizing and storing them in the cold

rooms. Depending on the temperature, the carcass is chilled or froze. Freezing reduces the temperature of the carcass up to -18°C to -20°C and up to -2°C to 2°C for chilling temperature. Frozen carcasses are usually exported. The carcass is transported using refrigerated trucks, which will keep the meat at the required temperature and then flown to the destined country. If the carcasses are produced for the domestic market, the meat is distributed to retailers & hotels.

Quality control activities are geared to ensure the quality (usually safety) of meat. Health inspection starts when the live animal is purchased. The animals are checked by a qualified doctor and quarantined for a number of days as required. Veterinary doctors from the Ministry of Agriculture (MoA) and quality controllers of the company also check the animal before killing (injures, diseases, pest etc). When the offal is taken out visual inspections are made especially on the liver and lungs to see symptoms for any diseases. If any symptom is observed the carcass first detained for further inspection and if it is found not wholesome at the subsequent inspection, the carcass is condemned. There is also inspection of the carcass at this stage. The final inspection of the carcass is made before it is transferred into the cold store. Condemned carcass at any stage of the inspection is either burned or buried.

Samples are also taken using swab from specific areas of the carcass: the front leg, hind leg and intestine. The samples are examined for bacteria population, which determines the shelf life of the meat product. The uniform size of samples (in cm²) is regularly taken per production batch but the rate varies depending on the need and availability of resources. For conducting complex analyses, laboratories at the National Veterinary Institute and Veterinary Faculty near by are used. Other test including acidity test, glycogen test are also made. The water used in the facility is also tested. It is pumped out from the ground but sometimes municipality water supply is

used. It is also tested for pot-ability (chlorine content) and hardness both at the plant and Ethiopian Health and Nutrition Research Institute (EHNRI).

Kaliti Meat Processing Plant

Kaliti Meat concentrate was established in 1976 mainly to process livestock products for export market. It was set up as the processing extension to the DebreZeite abattoir, which supplies the carcass. It has a capacity of processing 30,000 canned meat products (240 gm-can) per single shift (8hrs). Because of the market problem in the country nowadays, the plant processes only mortodella, sausage and on a limited amount of canned meat for the consumption of the nationals and foreigners residing in the big cities. Packing materials are the other inputs for the processing activity. The major machineries in the plant include can-reformer (rollers, flanges and seams), steam cookers, canning and dozing machine, boilers, autoclaves, compressors, incubators, raw material preparing equipment (mincing, mixing and slicing).

There are four departments in the plant headed by a manager reporting to Food Processing and Livestock Operation department of ELFORA (See figure 13). Currently there are 56 employees with an educational background ranging from Bachelor Degree to elementary school.

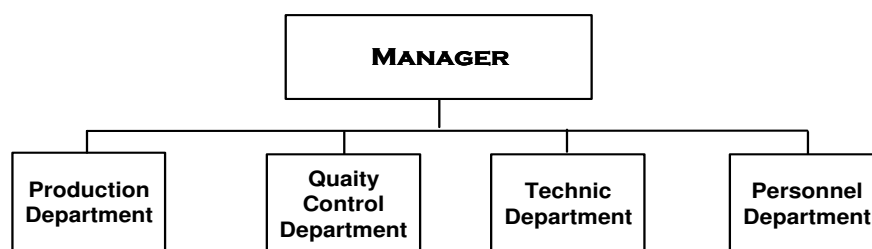


Figure 13 Organizational structure of Kaliti Meat Concentrate

The carcasses from the chiller room (DebreZeite) are transported to Kaliti for the subsequent processing. The first step is to separate the meat from the bone (de-boning) and either cut or

minced to produce Goulash or Minchet Abish respectively. The next process would be cooking (boiling) process. The required ingredients are mixed and cooked according to the recipes that have been designed before hand. Boilers are used to cook the meat mixtures. Examples of these recipes include Minchet abish (minced meat stew) and Goulash. The cans that are going to be used for packing are reformed for filling the processed product. After filling (usually called Dosing) the cans, the top is seamed. The filled cans are then sterilized. This is done by placing them in autoclaves for 45 minuets at a temperature of 120°c and pressure of 1 atmosphere. After being kept for 15 days at different temperatures and found to be safe for consumption the cans are labeled (for none lithographed), packed in cartoons, dispatched to retailers and sold.

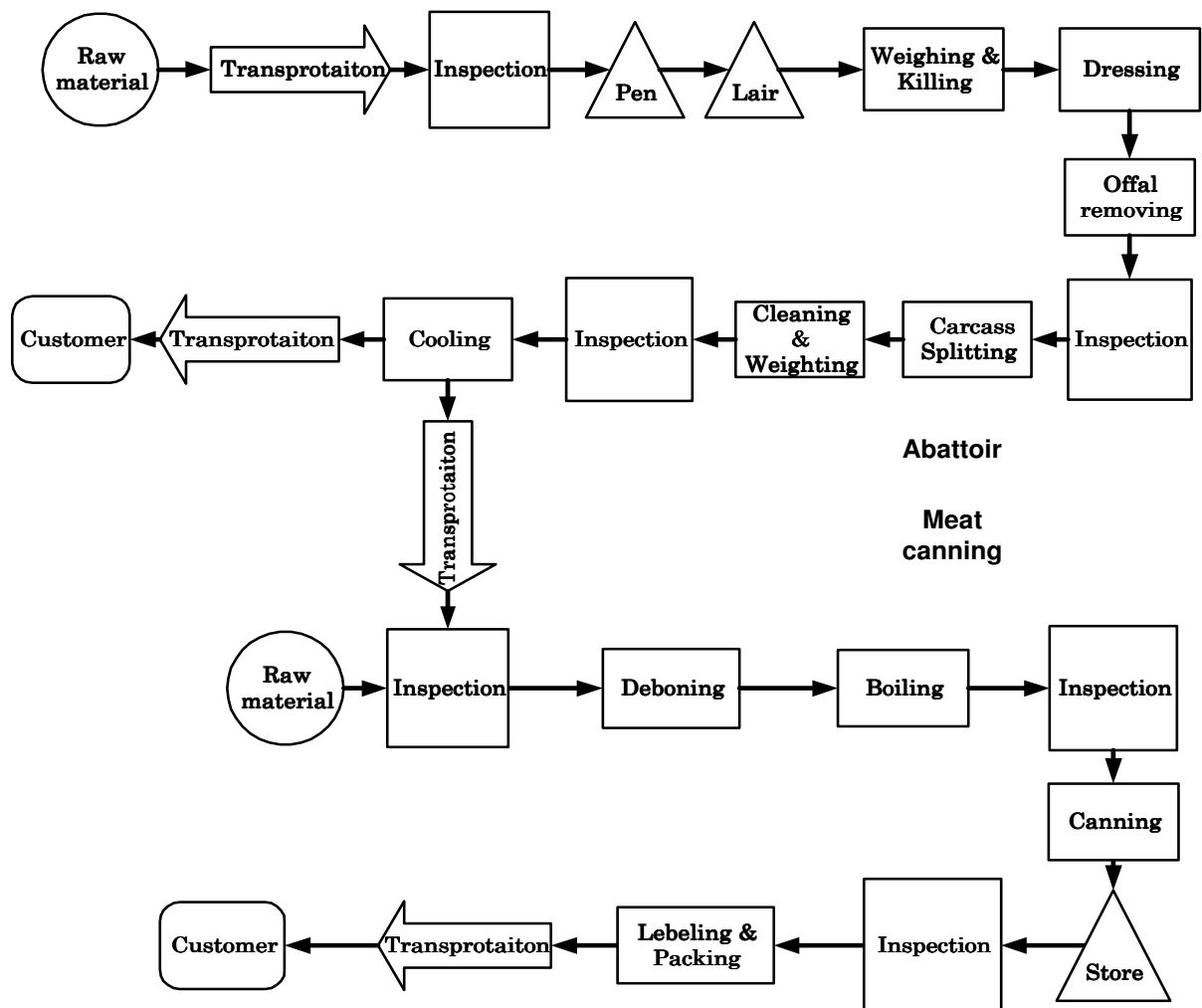


Figure 14 Canned Meat Processing at ELFORA Agro-Industry

Here also, experts from MoA and quality controller of the plant carry out the quality control activities. There are inspections of the raw materials on arrival (especially meat products). The first thing checked is the certification of the meat issued by meat inspectors of the MoA. Microbiological analyses also are made at the plant level. Inspections for proper mixing of ingredients are made during processing. Samples are taken before dosing on an hourly bases and tested for nutritional content, safety and ingredients. Data such as gross and net weight of the can are also taken to ensure the filling processes are correctly executed. Another samples, 3 cans per basket (900 or 700 cans), are taken from the batch and kept for 15 days at a temperature of 37 & 55°C. This helps to identify any defects when the product is exposed to abnormal environmental conditions. Different tests are conducted including an organoleptic test by panel of experts, physical test, seam test, and microbiological & chemical tests. Based on the result of the test, a decision is made to accept or reject the batch. The physical and seam defects on the can are tested using instruments and inspections. Bacteriological and hard metals (example Tin and Lead) are conducted in the laboratory at the plant. Whenever suspicions arise or every three-month, samples are taken and sent to EHNRI or Quality and Standard Authority of Ethiopia (QSAE) laboratories for further analysis. The water used in the plant is pumped out from the ground and tests are also conducted on it. Similar tests to the ones at the abattoir are conducted.

5.2.2 Quality Management System Assessment

Generally the quality activities at ELFORA are focused on product safety. Health related issues especially with meat products are the major problems in the export market. Diseases like Foot & Mouth and Rift Valley Fever were causes for the recently lifted ban on the export of live animals and meat products. Thus, solving this difficulty has been set as the primary quality goal. Using questionnaires (Appendix A) the quality activities of the plants are assessed as follows.

Management's Contribution

As one of MIDROC companies, ELFORA also shares the vision and mission of its mother company. The vision and mission statements are well defined and posted together with the values of the organization at most of its plants and offices. This will make employees understand and strive towards achieving this vision and mission. These statements are:

Vision Statement: "Quality products and sustained service to every customer and user."

Mission Statement: "A multi sector organization with second to none leadership positions in each of our products and service there by exceeding the expectations of our customers, employees, share holders, and the community."

MIDROC has also a monthly newsletter to communicate with its employees. There are also meetings on different subjects including quality between plant managements and employees. There is good commitment by the management to assure products safety at all level.

There is an organizational structure for the implementation of HACCP safety management system (HACCP teams) at the main office and in most of the plants. The nature of this structure is more of centralized where the main ELFORA office carries out most of the major decision-making activities. In relation with the implementation of HACPP, the company covers health check-up cost of its employees. This is carried out every six month. On top this benefit there are bonus payment, occasional recognition and reward of outstanding performance and extra-payment systems as a motivational scheme.

Quality activities during the meat processing

As it has been discussed, HACCP is the main quality standard pursued by the company. Before going into HACCP, Good practices (Good Manufacturing Practices) have to be established.

Even though it varies from one plant to another, the employees, plant & its facilities, warehouse and transportation aspects of the practices have been implemented to some extent. The HACCP implementation document at ELFORA head office level has been developed. A more detailed document is to be developed at DebreZeite Abattoir plant. Most of the machineries at Kaliti are obsolete and updating them to meet the HACCP has not yet been financially feasible under the current market condition and hence there is no definite plan to implement the standard. This HACCP implementation plans are the only quality plan that exist in the company. There are reviews and audits on the implementation HACCP. In general, the concept of prevention of defects is well grasped with regards to safety by the company. And the implementation process has already started. There is very little effort with the implementation of other aspects of quality and quality systems such as ISO 15161 and TQM.

The other area of attempt for standardization is waste disposal. Though there are ISO standards for environment (ISO 14000), there is no activity that indicates the implementation this standard in the company. There is a close cooperation in waste management with a local organization called 'Ethiopian Cleaner Production Center' (ECPC) at the Science and Technology Commission of Ethiopia. Also local standards for packing and labeling which are set by QSAE have been adopted.

The company acknowledges the concept of continuous process improvement and its contribution to the success of a product. But there is no, as such, formally organized quality improvement processes. Benchmarking is used especially with processed meat products such as Mortodela and Sausage.

There are some work instructions for carrying out day-to-day activities related to food safety. There are also written procedures for testing different characteristics of products. But in general as a document there is no quality manual describing procedures and policies at all plants. There is also no cost of quality calculations to measure performance with respect to quality. External customers (retailers mainly) are assessed to gauge the performance of the company. There are face-to-face contact and promotional activities to meet product requirement and perception of customers. Usually, these are done for marketing purposes rather than for quality improvement.

There is good understanding of customers need from the manufactured goods in both plants. But there are no activities (projects) to develop these attributes that are important to consumers. Products are defined to the required level with a properly prepared quality design document including recipes for canned product, packing material, processing flow and labeling. Like most food processing industries there is a shortage of supply (particularly live animals). The animal market fluctuates significantly not only in supply & price but also in quality. To maintain stability, the company has established purchasing & holding centers at different locations. There are also attempts to keep close relationship with suppliers (local farmers and wholesalers). In collaboration with MoA, there are attempts to promote and develop market for the farmers and also financial assistance for farmers unions.

Quality Control

The company has a close cooperation with the MoA, the regulatory government body for animal and animal products. There are experts from the Ministry working with quality controllers of the organization to ensure the safety of the meat products. Most of the activities require 100% inspection since diseases are risky business to check by sampling. Sampling plans from the past

experience of the plants (especially in the canning process) were used for testing attributes. And no constant sampling plans exist. Carcasses are properly tagged and logged for tracing the product flow in the abattoir. There are also records of the employees working on the carcass.

Employees health are regularly checked and training are given especially in the abattoirs on personal hygiene and bio-security as a whole. If any symptoms are observed on an employee, he/she is suspended from work until such time that it is safe for he/she to work again. There are shower rooms, equipment sterilizing facilities, and hand washing tap, which are operated both by hand and knee. Employees and visitors wear clean cloths when entering the plants. There is also boot disinfections bath at each entrance of the plants. There is continuous flow of clean water to remove dirt and clean the meat while processing it.

Employee's Assessment Summary

Employees have been assessed using questionnaires on Appendix B. The majority of employees believe that the company understand what customer want and has met these needs (more than 80%). Even though the efforts are not adequate (68% think so) most employees believe that the quality of products needs to be improved (86%). Despite their low involvement in product design (56%), the actual quality improvement processes involve employees (68%). 76% of employees know the vision, mission, and polices of their company and 58% believe that there is good communication in the company. There is a doubt about the effectiveness of the organizational structure where equal percentages of employees believe on both side (48% each). 52% think that there is no incentive and motivational scheme in the company. And 66% believe they have good relation with management. 66% of employees think that the training in the company is not sufficient. 72% argue that the quality control activities are adequate. Only 44%

of the employees know any international standard suitable for the company. Even though there is work instruction (80% says so), only 52% of them use these manuals. According to 62% of employees, working environment currently existing in the company is not conducive. But 56% of them are still proud and secured about their job. And 72% of them believe the company is a safe place to work.

5.2.3 Proposed Quality Management System

Although ELFORA is in a better position than D.H.GEDA, it suffers from similar shortcomings. Therefore the components of the management system are similar expect for the details.

Management's Responsibilities

The first thing that the current management needs to do is to prepare a detailed quality plan to coordinate quality activities. Separate plans should be made for the two plants since both have different target customers. The plan should address all the sections of the manufacturing process that means total approach to quality must be employed. It must incorporate all quality characteristic required from each product. The already existing HACCP team can be expanded into a quality organization and thus no additional organizations are needed. But the team members must include all those who contribute to the improvement process.

Quality Design

There has to be a formal product development procedure and format especially for the processed meat products at Kaliti. Canned products need continuous improvement to meet the ever-changing consumer's quality requirements. And based on these procedures, products must be refined. Processed meat products are facing difficulties in most of the plants at ELFORA. The

local market is small. Therefore new product development and market has to be made to improve the situation. Developing a quality design model such as QFD will formalize and ease the improvement process and provide baseline information for any future activities.

Quality Improvement

There is a dynamic improvement with regard to product or process in the market. This change can effectively be accommodated to the manufacturing process through well-formulated improvement approach. The existing benchmark approach could help to some extent. But to be successful in the long run, continuous improvement should have to be applied. Gaps for improvement must be identified on a continuous base. PDCA approach will lead the improvement process to the vicious circle where it will continue forever.

Livestock Supply

There is a good mechanism already set in the company to address problems related to raw material supply. But the permanent solution is to develop a formally organized food chain that starts from the farmers right up to the industry. The company can motivate and lead farmers and wholesalers by creating a reliable market for their products. It can also help farmers & major wholesalers by providing information & training on quality. It must assist projects to solve problems like disease control and feed development for livestock. It must also initiate research and help the dissemination of viable research findings on the improvement of livestock productivity. Despite the population, the livestock in Ethiopia have very poor productivity.

Quality Control

Quality control activities are in a good condition in the company. The only activities that need to

be incorporated are statistical techniques for sampling and process control. Single sampling must be used to those activities that require sampling at the abattoir, as most of the tests are expensive. With regards to the meat processing, most of the time single sampling can be used but double sampling plans can be employed for those simpler tests such as seam test. Here also the sampling system of ISO must be adapted to coherence with other ISO standards. Both types control chart (Continuous and Discrete) must be used especially at the Meat Concentrate. Different attributes need to be measured during processing of meat products, which include defective cans, fill levels of cans, and seam defects etc. This may require training for employees.

Quality Assurance

The implementation of HACCP has already begun in the company. It only needs to be completed at all plants. Preliminary study on how to upgrade the HACCP into an ISO 15161 standard must be made and implementation has to be carried out. Adopting international standards will help the company penetrate new export markets, which will guarantee stable market. This is vital as most of plants are operating under their capacity. Depending on the benefits and the success with ISO and HACCP standards, the implementation of more advanced quality concepts like TQM must be considered. TQM can also perpetuate the implementation standards such as ISO 15161. It will also help ELFORA, as the company is export-focused.

Quality Auditing and Review

For the quality management system proposed, an auditing and review mechanism has to be set to monitor the performance of the system in the future. Review has to be made on a regular interval to check the system and make appropriate rectification as soon as the need arises. Audit (if possible by outsiders) has to be made to assure the respective consumers.

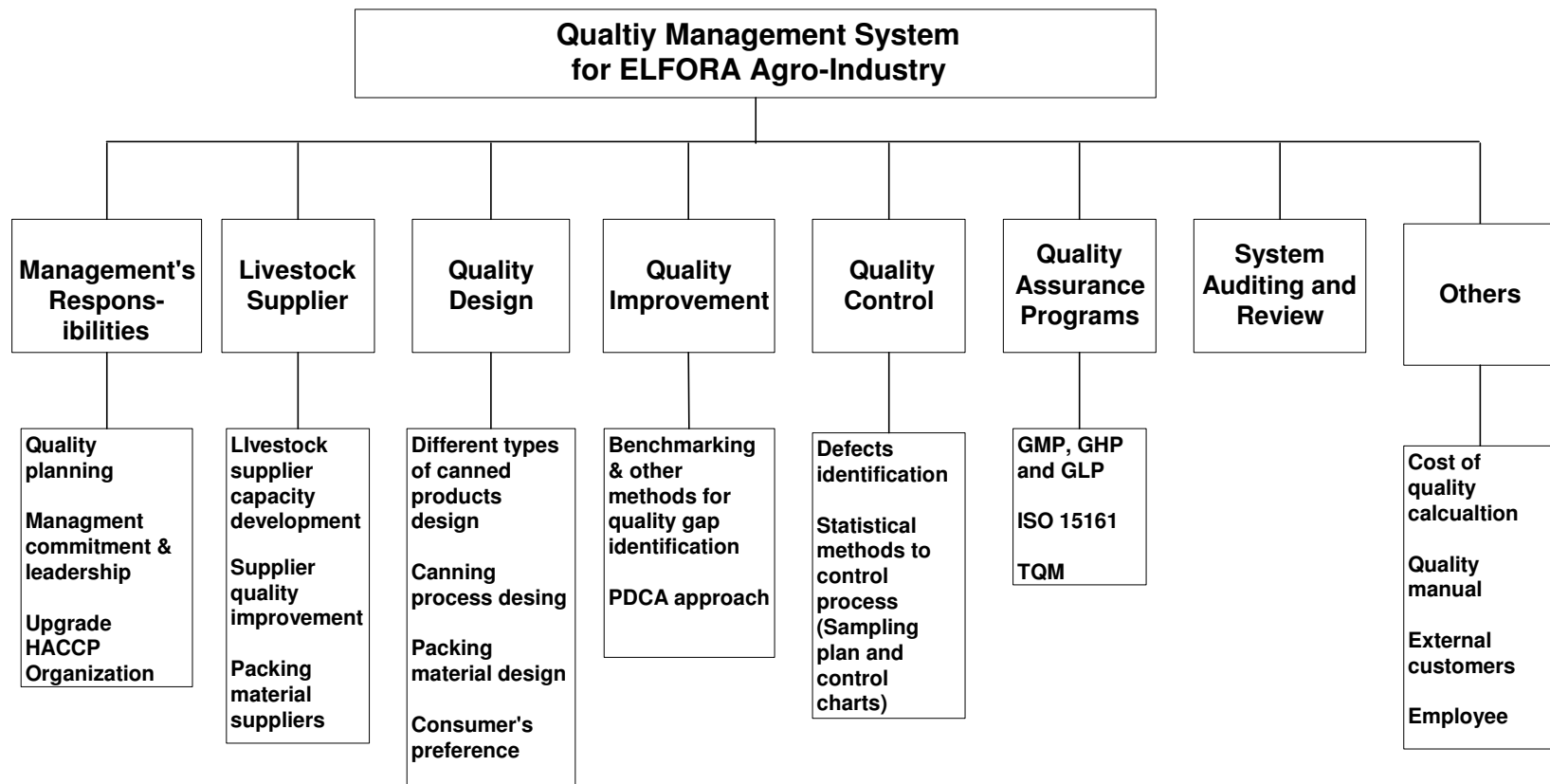


Figure 15 Quality Management System for ELFORA Agro-industries

Others

ELFORA has to calculate the cost of quality in order to justify the quality activities it is practicing and those that are going to be implemented. A general list of costs has been proposed on Appendix C. The specific cost of each component may require further simplification preferably by a team of professionals. Work instruction & manual need to be organized in to a standard format (ISO standards) and should be made available for all employees. Care must be taken with the language and descriptive pictures as most of the employees have low educational level. Training must include quality concepts in addition to the HACCP trainings that are being carried out currently. These concepts must include quality improvement, quality control tools like statistical process controls, sampling technique and quality standards. The training must also give the employees confidence on what they do. Motivational schemes need improvement making employees more quality oriented. Involvement of employees must cover all activities of the manufacturing process.

The implementation of the system starts by introducing the management with the new concept and its benefits (figure 16). Then revision and upgrading of the organization (HACCP team) in the company has to be made. The already started improvement process of GMP has to be finished at all plants in order to properly implement ISO 15161. The continuous improvement of quality starts after this preliminary steps. The improvement areas are given on the QMS.

5.2.4 Recommendation

ELFORA has taken the first step to quality and it only needs to broaden its view to include other aspects of quality like organoleptic tests (taste & appearance) and hedonic values. The company has a good understanding and experience of the benefits of quality concept implementation. This

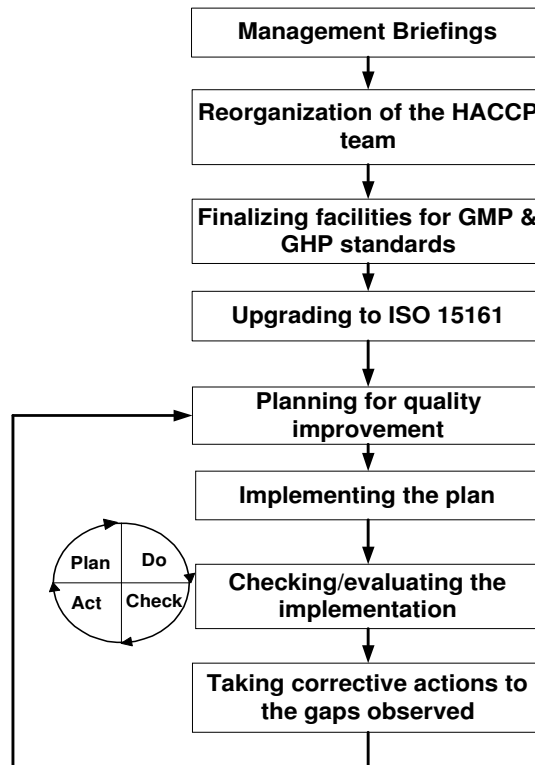


Figure 16 Implementation model for Quality Management System (ELFORA)

QMS will help the company by providing a framework for quality that goes far beyond safety. By pursuing this system, the company can lay a good foundation for a long-term quality improvement process. It will also save money on common activities such as training. Employee will have more time to acquaint themselves with modern quality concepts. The commitment to quality is genuinely measured by the amount of investments the company puts in to it.

Plants processing canned meat are in a very serious problem and one big portion of the solution is this system. Further more, the company can improve its relation with customer, save money and become more competitive in the international market. With regards to the implementation, project approach is also suitable here.

CHAPTER SIX: FOOD QUALITY MANAGEMENT SYSTEM FOR ETHIOPIA FOOD PROCESS INDUSTRIES

Modern quality concepts are just beginning to be adopted by the food processing industries in Ethiopia. Most of the implementation efforts are mainly centered on meeting standards. There is no properly prepared food quality management system and to some extent this has contributed to the narrow perception of quality observed in the industry. Currently there are some attempts to implement quality standards such ISO and HACCP. As it has been tried to show in the preceding chapters, quality is a complex and never ending process that needs a systematic approach. Quality goes far beyond meeting one or another standard. So all food processing industries must prepare its own QMS, which will address their particular quality problems. To assist the development this system, a general QMS for the food industries is proposed in this chapter. First, the main components of the system are assessed and then the QMS is formulated. To create a complete picture, the assessment starts with a brief historical development of quality in the country.

6.1 Historical Development of Food Quality in Ethiopia

Most food processing industries, all industries for that matter, sprung in the country after the end of the Italian occupation. At the beginning, the establishment and development food processing industries were relatively fast. After slowing down for some time, it is gaining some momentum recently. 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. And this, in return, had an impact on the development of quality concepts. Thus the development of quality concepts in the food

processing industries can easily be studied by classifying it into three periods: the Imperial, Derg and EPRDF periods.

The Imperial Period (before 1973): - most industries and those bodies that are directly involved in the promotion and regulation of food quality were established in this period [9]. Good examples of such bodies include the Quality & Standard Authority of Ethiopia (QSAE) and Ethiopian Health and Nutrition Research Institute (EHNRI). The industries had only a means for inspecting quality of a product and had no market situation that necessitates them to go beyond. And in food processing, safety was the primary quality requirements in most industries and in some cases the only requirements.

Food quality concepts in Ethiopian industries were conceived in order to deal with concern about the provision of safe and unadulterated food product to the consumers. For this, the largest laboratory in country for testing food hazards (especially microbiologic and chemical hazard) was established. Based on its analysis of samples supplied, legislative and administrative decisions are made on food product's safety countrywide. The laboratory was first set up during the Italian occupation under the name 'MINISTRO DELLA SANITA' and at the end of the occupation it was renamed as the "Imperial Medical Research Institute". In 1958, a bilateral agreement was made between the Imperial Ethiopia Government and the Institute Pasteur of Paris for the establishment of the "Institute Pasteur d' Ethiopie" after the dissolution of the Medical Research Institute. In addition to the researches and vaccination services, the institute renders a laboratory service especially for microbiological elements. With the termination of the bilateral agreement in 1972, the Ministry of Public Health took over the administration of the institute and renamed it as "Imperial Central Laboratory and Research Institute".

The development of quality concept in its modern sense can actually be related to the establishment of QSAE. Problems related with the standard of imported & exported products ignited the quality and standard development endeavors in country [35]. These problems were apparent from 1943 especially in agricultural and industrial products. In 1949, the first legislation, "The Grain Board Act", was passed to regulate the quality of exported agricultural products such as grains and flour. To address problems in the industrial sector, a department for standard was set up in the Ministry of Tourism and Industry in 1964. These problems include the lack of standards for electrical equipment and hygiene level of water supply, which mainly faced by Addis Ababa University and the lack of building code faced by the construction projects all over the country. As the need for standards increase due to the rise of product number and variety, the department of standard at the ministry was re-established on an organizational level under the name "Ethiopian Standardization Organization" (ESO) in 1970. Its objectives were

- To improve and regulate the quality of manufactured products and materials so that consumers are protected;
- To regulate the export of manufactured products.

In 1972, it published the first 108 standards, which included standards for measurement equipment's calibration, agricultural products (oil seed, grains, leather, coffee), cement, iron and steel products and paper. To secure the interest of the country, the Ethiopia Standard Organization became a member of ISO and TEC in 1972 and The International Organization for Legal Metrology in 1973.

The Derg period (1973 - 1991): - 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. Lack 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 of them 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 [9].

Although the establishment goes back to the imperial period, Ethiopian Nutritional Institute (ENI) has contributed to food quality development in terms of nutrition. It was set up in 1962 as Children's Nutritional Unit (CNU) and later renamed as ENI in 1968. It makes researches on nutritional problems of the country and promotes balance diet through books, posters, leaflets etc all over the country. To solve the malnutrition and famine problem, ENI played a vital role in formulating supplement food items that are manufactured on industrial scale. These include food items locally called "FAFA", "Dubei" and "Edget", which were famous since 1986.

Both "Imperial Central Laboratory and Research Institute" and ESO were reorganized and rename as National Research Institute of Health (NRIH) in 1985 and Ethiopian Standard Authority (ESA) in 1986. The role of the NRIH has grown from a simple laboratory service into the administration of quality control of food and beverages as well as biological and chemical preparation and supervision of public health Laboratories. And ESA was authorized to develop standards and regulate quality in both agricultural and industrial sectors. Ethiopia also became a member of African Regional Organization for Standardization in 1976.

The EPRDF period (Post 1991): -The current government, the 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 food processing industries started to make efforts to catch up with the latest quality concepts. One such effort is the projects for the implementation of HACCP at different factory. With the assistance of UNIDO (United Nations Industrial Development Organization), a number of food processing organizations have embarked on the implementation of HACCP in their plant. The list of organization includes Dire Dawa Food Complex, Mojo Oil Seed Mill, and ELFORA Agro-Industry. In most of these industries, the implementation is at its early stage of development. The most successful case (that of Dire Dawa Food Complex) was limited to only one type of product: spaghetti product.

There were also changes to the organizations directly involved in food 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 different ISO standard including the latest standard for food and drink processing industries (ISO 15161). Although the adoption and development of national standard is important, it is equally important to have a certifying body for the implementation these standards. Currently, there is no internationally accredited certifying body for any of the international standards in the country. Recently the two institutes, ENI and NHIR have merged

with another organization called Department of Traditional Medicine to form the Ethiopian Health and Nutrition Research Institute (EHNRI). And it is responsible for the regulation of laboratories and safety under the Ministry of Health.

There are also projects for creating a national council for food safety involving Ministries of Health, Agriculture, and Trade and Industry, QSAE, AAU, and UNIDO. This will ensure food safety starting from the primary production stage right up to the consumption. There are also projects to establish food safety assurance system, which meets the international standards. The Ministry of Trade and Industry is making efforts to establish Food Research Institute which primary focus is to assess and find out solutions to the problems faced by the food processing industries. In general, there are encouraging activities towards quality.

6.2 General Guideline of Food Quality Management System for Ethiopia Food Processing Industries

6.2.1 General Background

According to Central Statistic Authority (CSA) survey in 2000/01 there were 251 Large and Medium scale food-processing industries in Ethiopia. Most of these establishments were in the category of bakery products, which is followed by grain mills and edible oil factories respectively (see table 2) [35]. The major processed food products manufactured includes different types of juices, tomato paste, pasteurized milk, milk products, canned product, meat products, different type of flour and formula, macaroni & spaghetti, edible oil & oil cakes, biscuits, milled coffee, sugar, tea, sweets, beer, wines, liquor & Alcohol, soft drinks and mineral water.

	No. of establish ments	Total employ ment	Value added million Br	Total sale in million Br	Export in million Br	Share of imported raw material (%)
Food & Beverages	251	22726	1447	3271	206	19.3
Share of manufacturing sector	31.53%	30%	51%	41%	26.4%	
Processing of meat, fruits and vegetables	9	2888	63	126	0.601	15.3
Vegetable and animal oils and fats	27	1307	24	97	1.655	1.1
Dairy products	2	435	14	32	-	15.6
Grain mill products	55	3295	54	402	0.37	13.9
Prepared Animal feed	3	177	2	5	-	3.0
Bakery products	104	3509	72	233	-	19.8
Sugar and sugar confectionery	8	6113	685	1098	197.195	1.7
Macaroni and spaghetti	4	435	24	97	-	3.0
Food products (not elsewhere classified)	9	835	28	46	5.474	12.5
Distilling, rectifying and blending of spirits	11	1019	29	68	-	10.6
Wines	2	588	9	21	0.053	43.1
Malt liquor and malt	7	2784	301	654	0.585	50.9
Soft drinks and mineral water	10	3875	143	393	0.086	45.7

Table 2 Summary of facts for Food and Beverage Large and Medium Scale Industries (2000/01)

6.2.2 Food Quality Management System

Based on problems and assessment of the food processing industries, the following essential components have been identified for the general QMS. These components make up the main focus area although the details may vary to the specific cases.

Management's Responsibilities

Quality activities must start by convincing top manager and owners the benefits of quality and QMS. Argumentative facts to support the implementation of QMS can be obtained from cost of quality calculation, surveys made on customers, suppliers and employees, study of the market

trends, the international and national trade requirement and current technology trend. In a country where power is traditionally centralized, the role of management is vital in any activity. The management is responsible for setting & 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 roll for the success of quality activities. Planning determines what 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 it success or failure in the market.

The management needs to be obsessively committed to the implementation of quality. They must show their commitment through their day-to-day activities. They must also adopt proper leadership style to encourage and motivate employee.

Quality Assurance

International standards such as ISO 15161 and GP (GMP, GHP & GLP) are good starting point to improve the manufacturing process of a plant. This will not only help the industries to be efficient and competitive but also potential exporter. The upgrading and certification for standards may require funds sometime beyond the reach of an organization. Intervention by the government and international organization at this point is crucial. UNIDO & QSAE are making some efforts in this respect. But the industries must find ways to implement these standards in a cheap and suitable way. These standards don't only ensure an international recognition but also

products of consistent quality which most of the industries in the country lack.

Quality Control

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 industries. Control chart, especially, 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.

There is a serious problem of good standard laboratory facility in the industry. 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. To ease this problem, mechanisms must be developed to exploit the existing laboratories specially those that perform a wide range of tests. Such laboratories include the ENHRI and QSAE laboratories. Another approach to solve this laboratory problem is setting up a specialized central laboratory for food processing industries. This facility will provide additional testing capacity to those that already exist in the plants. It can also be used to solve arguments that may arise between suppliers and buyers. In general, it will safeguard the food standards set in the industry.

Suppliers

Shortage of quality raw material is a problem that is faced by almost all sub-sectors of food process industry. And the industry has to make the first initiative in fixing this problem. Like

customers, supplier's involvement in quality improvement is vital. There is no mechanism to communicate raw materials requirements to the farmers. The development of such mechanism must be a priority. As most of the farms have limited capacity, whenever possible, large-scale farming must be encouraged by the industry. Farmer's unions are another supply-partners for the industries. Providing attractive price to industrial raw material may persuade farmers to cultivate these products. The industry must assist in developing the capacity of suppliers. The few efforts made in this regard may have failed in the past. But this should not discourage further endeavors since the other alternative, importing raw material, will lead the industries ultimately into bankruptcy. Learning from the past and making efforts to improve is the path for success.

Quality Design

Once the basic facilities are in place, the next step is to make the processing activities customer focused. One of the problem areas in food processing industries is product design. Even though there are other related source including quality raw material and finance, the major difficulty with food products designing is applying the right approach and shortage of trained manpower. Customer focused product design (development) in food processing industries can be best implemented using QFD models. This model is a very convenient tool for product development, which can be implemented in the industry. But there has to be adequate training to experts directly involved. Similar effort has to be made to develop new or existing packing materials that can cheaply be produced locally.

Quality Improvement

There has to be a constant improvement of products as well as the manufacturing processes. By large, inconsistent improvement is one of the greatest weaknesses of food industries in the

country. Most of the time the improvement processes follows the traditional approach, which has so many negative impact. 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 be adopted by the food processing industries. Improvement process must be implemented in all aspects of the industry.

Quality Review and Auditing

System reviews and auditing must be incorporated in order to provide information for any future amendment to the quality management system. The activities of reviewing and auditing have developed well in the industries. What remains is consistently implementing them to quality.

Others

Customers are the center of any business and meeting their demands is the center of any quality activity. The two types of customers must be given equal attention in the food processing industries. When referring external customer, it must include final consumers, retailers, research institutes and regulator bodies. Consumer's related studies especially consumers preference must be made for local consumers and if possible for the international case. This will help industry to satisfy their consumer's requirements. There has to be a close relationship with all customers especially in the exchange of information as well as the actual implementation of quality. In most industries the contribution of the internal customer (employees) is very much demised. In food processing industries the role of employees is crucial as food products are delicate and require careful handling and processing procedures. The main focus areas regarding employees include training, involvement and empowerment, motivation and reward and recognition.

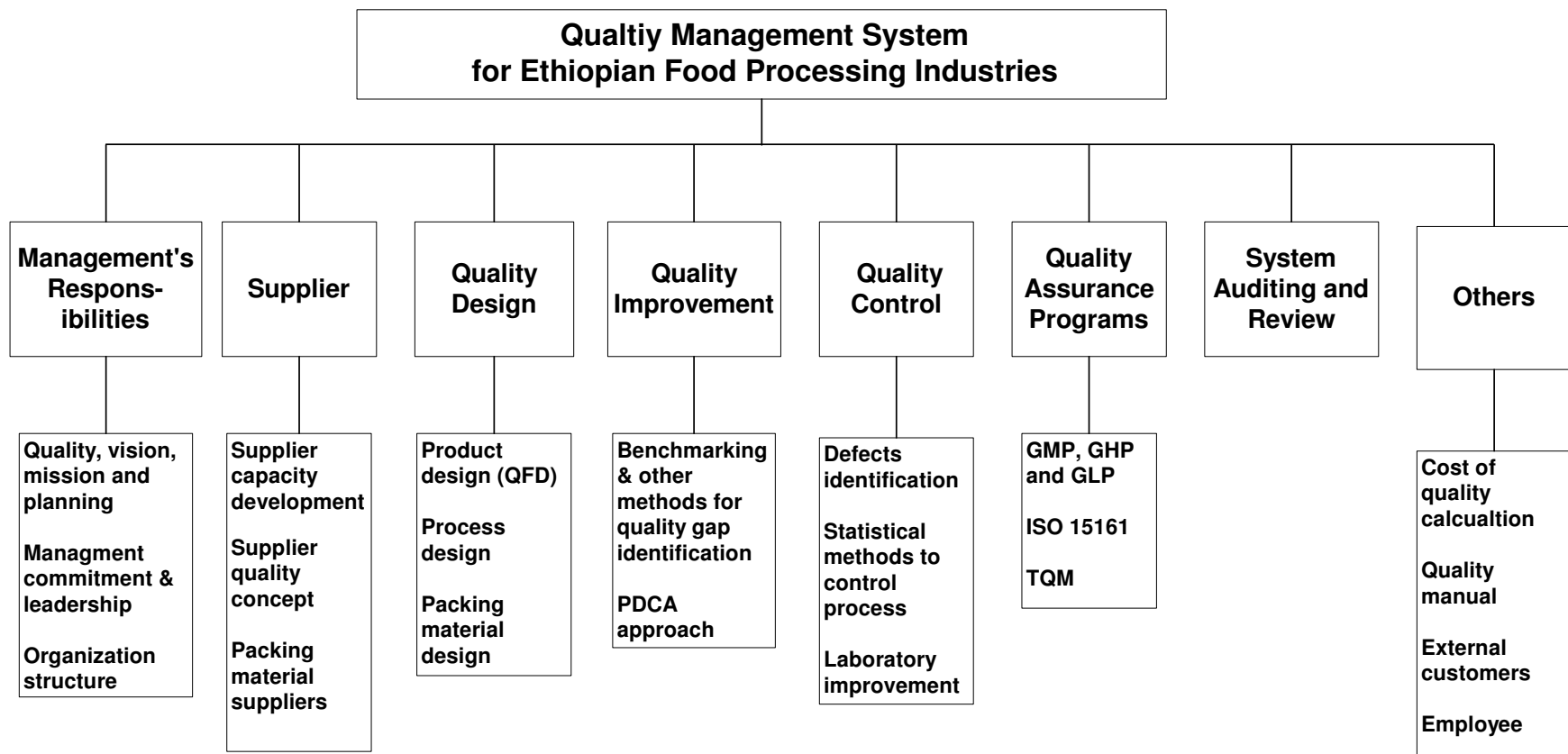


Figure 17 Quality Management System for food processing industries in Ethiopia

Documentation and manuals are the most important areas that need to be focused. Most industries lack properly prepared manuals to carry out their processing activities. Poor records of past experiences are kept in many industries. The decisions made regarding processing activities heavily dependent on the experience of those people on the job. All these make continuous quality improvement process a fantasy. So quality manuals and documentations are one main focus area for most industries. Keeping record may be considered as a liability by revealing business secrets to competitors. But one observable fact is that the world is changing at fast rate and these documentations and manuals are indispensable to cope up with the change.

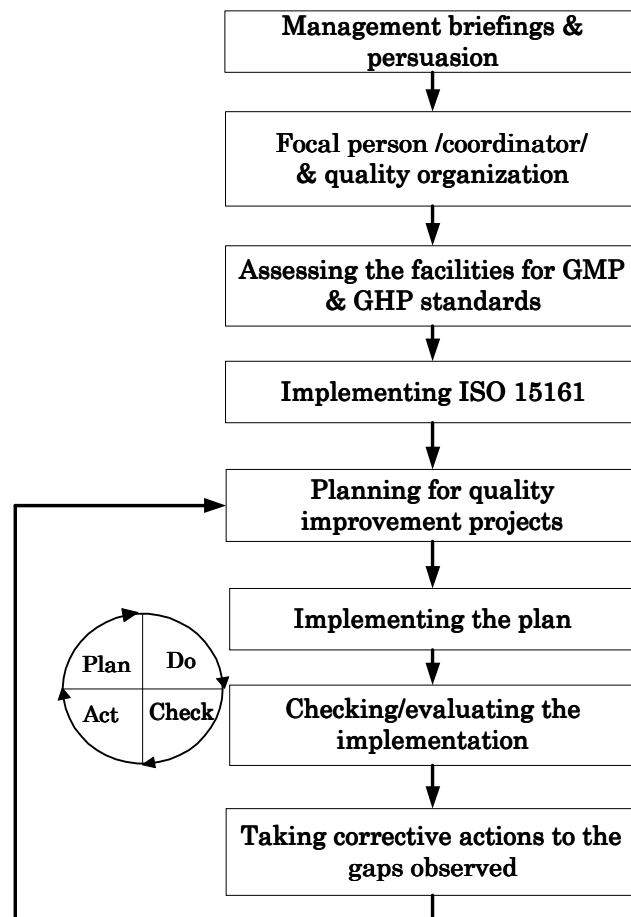


Figure 18 A general implementation model for the quality management system

The implementation of the QMS requires a step-wise approach. The starting point must be compelling the management to adopt quality concepts. There has to be an owner for the quality

improvement activities - usually a focal person or coordinator selected among the management. Depending on the size and complexity of the food processing, additional organizational structures can be formed. The next step is to evaluate the processing plants against internationally acknowledged quality standards and practices. This usually doesn't mean installing state-of-art machineries and processing technologies. It is just making the plant and its operation more quality conscious. Finally, the PDCA cycle are used to implement those components of the QMS, which are discoursed upon the previous sections. Projects need to be prepared to carry out these components. The priorities and nature of the projects may vary from one industry to another. Since the components are interrelated to each other, the project must be developed in such a way to get the maximum benefit.

CHAPTER SEVEN: CONCLUSION AND RECOMMENDATION

Quality related problems are a serious treat to the survival of the food industries. As the manufacturing sector is dominated by these industries addressing this problem will have a far-reaching impact on the whole economy of the country. Market is one area that has been affected by these problems. Poor performance of products in the international/local markets, decline in competitiveness, and under utilization of capacity are good examples where quality related market problems are manifested. Further more, quality problems include poor quality supplies of raw material, poor relationships with customers and suppliers, and poor product design. In this thesis, the implementation of food QMS has been proposed as a solution for these problems. The QMS consists about eight components, which are strongly interrelated with each other. The components address those areas pertinent to quality in the manufacturing processes such as management, process (product) design and control, international regulation, standards and practices, customer's and supplier's relationship and documentation.

All food processing industries must be engaged in the implementation of the QMS as soon as possible. A case-specific approach may be needed to each situation but a project approach will work in most cases. The implementation process is also long and result may not be observed immediately. It will require trainings, involvement of experts from different field of study and a considerable amount of investment. With hard and committed effort a profound achievement can be attained. This includes the reduction in cost of production, better relation with customers and suppliers, more committed and motivated workforce, internationally competitive products and manufacturing establishments, the development of reliable and good supply of raw material source, and better utilization of manufacturing capacity.

Government and non-government organizations play a pivotal role in the implementation process. Government bodies such as Ministries (Agriculture, Trade and Industry, Health), Research Centers, QSAE are vital in coordinating activities such as raw material supply, nutritional development of food items, food safety, and implementation of quality standards and regulations. These bodies can also be involved in setting up facilities that promote the implementation of quality like laboratories and research and training institutes. Non-government organizations have already started to be involved in this quality concept development process. HACCP implementation program of UNIDO is a good example. Other areas of intervention for these organizations include assisting farmers in producing high quality raw materials and creating the market for it. Non-government organization can also contribute a lot through the introduction of international market requirements and the technologies needed to meet these requirements.

The government, in-cooperation with other organizations, can be involved in two inter-related approaches to enhance quality and service excellence that will have a tremendous impact on the export market of the country [14]. The first is to establish a quality award program in the country. This will create a sense of competitiveness among the industries. The other is to expedite the condition for actively seeking and obtain international standards such as ISO and HACCP. Establishing a local certifying agent can be one way to accomplish this.

In general the implementation of quality requires a change in attitude of the society. This will take a long and frustrating journey. But at the end, the survival of the industries and betterment of the quality of live in the country are ensured.

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APPENDIX A

Questionnaire One

Quality

- How is quality defined in the organization (Written or perceived)?

- Does the company understand what customer's definition of quality and try to achieve it?

- Who is the most responsible for quality in the organization?

- What is the quality awareness level in the organization?

Leadership

- Does your company have a quality policy (vision, mission, long & short-term strategies, objective & goal)? Does it address company's position with regards to customers, suppliers, employees, community environment, & the business itself?

- How large resource do you allocate (including money) for quality compared to the total budget?
Large ☐ Medium ☐ Small ☐
- Does the management know where the organization is in the market (both local and international)?

- Is there communication with employees? How is it conducted? How is the communication evaluated?

Decision-making

- To what extents are employees participate in the product/service improvement process?
Poor ☐ Satisfactory ☐ Good ☐ Very Good ☐
- How is participation tracked and used for future improvement? (M)

- To what extents are employees at different level get involve in decision-making?

Shop floor level-	Poor ☐	Satisfactory ☐	Good ☐	Very Good ☐
Line manager-	Poor ☐	Satisfactory ☐	Good ☐	Very Good ☐
Middle manager-	Poor ☐	Satisfactory ☐	Good ☐	Very Good ☐

Organization

- What does the organizational structure looks like (diagrammatically)?

- What type of organizational structure is used (in terms of structural nature and authority)?

Quality Design

- What are the procedures for product/process design?
-
- Who are participant in the designing process (from employees & customers)?
-
- Do designs have plans and documentation for inputs, outputs, and verification?
-
- Are there procedures for design changes?
-
- Do design specification define in such a way that shop floor staff understand them?

Process and Quality improvement

- Do purchasing documents contain clear description?
-
- What methods of trace-ability are used for a purchased item?
-
- What are the criteria for selection of supplier's or sub-contractors? Who is involved in the decision of supplier selection?
-
- How is supplier performances determined and traced?
-
- What methods are used to improve supplier performance?
-
- How is customer's satisfaction determined and traced?
-
- How is the information on customer satisfaction used for future improvement?
-
- How does the company demonstrate its commitment to customers?
-
- Is competition in the market used as a basis for comparison? How?
-
- Is there training? Who receives training? Who determines who will be trained, in what, and the timetable? How is training's effectiveness evaluated?
-
- Sketch the process flow of the products?

Quality Control

- How are processes planned and controlled to assure quality?
-
- What are the inspections and tests for incoming, in-process and final products? Are there

procedures for inspection?

-
- What procedures exist for identifying and segregating non-conforming products? Who is responsible for reviewing and authorizing the disposition of non-conforming products?
-

- What are the procedures for corrective action? How are the effects corrective actions determined?
-

- What statistical techniques are used:
-

- i) To monitor and improve processes?

- ii) To control processes and inspecting raw materials, and end products?

Quality Assurance

- What procedures are there to assure calibration of equipment? How are the capabilities of test equipments determined?
-

- What standards are used for verification?
-

Quality Cost

- Is quality cost calculated and how is the information obtained utilized?
-

- Which functions are involved?
-

Quality Audit and Review

- Is there a review for different operations in the organization?
-

- Does your organization audit (internal or external) its activities? If yes what are the procedures and how often does it take place?
-

Quality Documents

- Are there any quality records and for how long are they kept?
-

- Are there quality manuals? Does everyone know where it is or uses it?
-

APPENDIX B

Questionnaire Two

ይህ መጠይቅ በአዲስ አበባ ዩኒቨርሲቲ መካኒካል ኢንጅነሪንግ ዲፓርትመንት ድህረ ምረቃ ፕሮግራም የመመረቂያ ዕሉፍ ዝግጅት ማሞያነት ተብሎ የተዘጋጀ ነው። ጥናቱ የሚካሄደው የምርት ጥራት ዙሪያ ባሉ ችግሮች ሲሆን እርሶም እንደ ድርጅት አባልነትዎ ከሚያውቁዎቸው ነገሮች በመነሳት ከዚህ በታች ለቀረቡት ጥያቄዎች ትክክለኛ ምላሽ በመስጠት እንዲተባበሩን እንጠይቃለን።

1. ድርጅቶዎ የደንበኞቹን የምርት ጥራት ፍላጎት በሚገባ ያውቃል ብለው ያምናሉ?
አዎ ☐ አላምንም ☐
2. ደንበኞች በምርታችሁ ጥራት ረክተዋል ብለው ያምናሉ? አዎ ☐ አላምንም ☐
አሁን ያለው የምርት ጥራት መሻሻል አለበት ብለው ያምናሉ? አዎ ☐ አላምንም ☐
3. የምርት ጥራትን ለማሻሻል የሚደረጉ ጥረቶች በቂ ናቸው ብለው ያምናሉ?
አዎ ☐ አላምንም ☐
4. የምርት ጥራትን ለማሻሻል የሚደረጉ ጥረቶች ሠራተኛውን በሙሉ ያሳትፋል ብለው ያምናሉ?
አዎ ☐ አላምንም ☐
5. በቂ የሆነ መረጃ ስለድርጅቶዎ ወቅታዊ ሁኔታ አገኛለሁ ብለው ያምናሉ?
አዎ ☐ አላምንም ☐
6. የድርጅቶዎን የጥራት ፖሊሲ፣ ራዕይ፣ ግብና ዓላማ በትክክል ያውቁታል?
አዎ ☐ አላውቀውም ☐
7. የድርጅቶዎ አደረጃጀት የስራ አፈፃፀምን የሚያበረታታ ነው ብለው ያምናሉ?
አዎ ☐ አላምንም ☐
8. በድርጅቱ አመራር /ማኔጅመንት/ እና ሠራተኞች መካከል ጤናማ የሥራ ግንኙነት አለ ብለው ያምናሉ?
አዎ ☐ አላምንም ☐
9. በድርጅቱ ውስጥ ለሠራተኞች ማበረታቻና የማትጊያ ፕሮግራሞች አሉ ብለው ያምናሉ?
አዎ ☐ አላምንም ☐
10. በምርት/አገልግሎት/ ዲዛይን ላይ ሠራተኞች በቂ ተሳትፎ ያደርጋሉ ብለው ያምናሉ?
አዎ ☐ አላምንም ☐
11. በድርጅቱ ውስጥ በቂ ስልጠና ለሠራተኞች ይሰጣል ብለው ያምናሉ?
አዎ ☐ አላምንም ☐
12. ሁሉም ሠራተኞች ለምርት/አገልግሎት/ ጥራት ኃላፊ ናቸው ብለው ያምናሉ?
አዎ ☐ አላምንም ☐
13. በድርጅቱ ውስጥ በቂ የሆነ የጥራት ቁጥጥር አለ ብለው ያምናሉ? አዎ ☐ አላምንም ☐
14. ለድርጅቶዎ ተስማሚ የሆነ ዓለም አቀፍ የጥራት ደረጃ ያውቃሉ? አዎ ☐ አላምንም ☐
15. በድርጅቱ ውስጥ የአመራር መመሪያ/ማንዋል/ አለ? አዎ ☐ አላምንም ☐
ካለ ይህን መመሪያ በስራ ሂደት ይጠቀሙበታል? አዎ ☐ አላምንም ☐
16. በድርጅቱ ውስጥ የስራን መንፈስ የሚያነቃቃ ሁኔታ አለ ብለው ያምናሉ?
አዎ ☐ አላምንም ☐
17. በድርጅቶ ኩራትና የስራ ዋስትና ይሰማታል? አዎ ☐ አላምንም ☐
18. በድርጅቱ ውስጥ በቂ ጥንቃቄ ያልተደረገባቸውና አደገኛ የስራ ቦታዎች አሉ?
አዎ ☐ የለም ☐

APPENDIX C

Cost of Quality Type	D.H.GEDA Wheat Flour Mill	ELFORA Agro-Industries
Prevention costs		
• Product/service requirement	Process, wheat & flour specification setting costs	Cost of setting specification for canned meat, carcass etc.
• Quality planning	Wheat type combination test cost	
• Quality Assurance	Cost of conformance to quality standards (both local and international)	Cost of meeting HACCP, GMP, QSAE etc.
• Inspection equipment	Cost of equipment in the quality control department	Cost of setting up & running of laboratory, inspection
• Training	Cost of training	Cost of training
• Miscellaneous	Cost of setting up quality control department	Setting up cost HACCP, GMP quality department etc.
Appraisal Cost		
• Verification	Cost of making inspection of wheat, in-milling wheat & flour	Cost of inspection & testing at all levels
• Quality Audits	Cost making quality reviews and audits	Cost of making reviews and audits
• Inspecting the equipments	Cost of calibration and maintenance of milling machines & weighing equipments	Calibration, maintenance of machineries etc.
• Vendor rating		
Internal Failure Costs		
• Waste	Cost of low quality flour	Poor quality products costs
• Scrap	Any thrown away flour cost	Rejects of products cost
• Rework or rectification	Cost of making low grade flour right	
• Re-inspection	Cost of testing corrected low grade flour	
• Down-grading	Loss due the sell of down graded flour	Cost of down grading a carcass or canned product
• Failure Analysis	Cost of analysis the causes of poor flour	Cost of analysis of the cause of defects in products
External Failure Costs		
• Repair and Service	Cost of rework on recalled flour including testing	
• Warranty claim		
• Complaints	Cost of travel and checking complaints	Cost of travel and checking of complaints
• Returns	Cost of handling, investigating and transporting of recalled flour	Cost transporting and disposing of canned products
• Liability		
• Loss of Goodwill		