

**TOTAL
QUALITY
ASSURANCE
FOR THE FOOD
INDUSTRIES**

THIRD EDITION

Wilbur A. Gould, Ph. D.

TOTAL QUALITY ASSURANCE FOR THE FOOD INDUSTRIES

Third Edition

by

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For The Food Industries
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FOR HER SYMPATHETIC UNDERSTANDING,
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Dr. Gould retired from The Ohio State University after 39 years on the faculty as Professor of Food Processing and Technology. He taught nine courses during his tenure and advised over 900 undergraduate students, 131 Master of Science Students and 76 Doctoral students. His major research interests were in Vegetable Processing and Technology and Snack Food Manufacture and Quality Assurance. He has authored some 83 referred journal research publications, over 200 Food Trade articles, and twelve books.

Dr. Gould is a Member of Phi Kappa Phi, Phi Sigma, Phi Tau Sigma, Sigma Xi, Gamma Sigma Delta (Award of Merit in 1984), Alpha Gamma Rho, Institute of Food Technologists (Fellow in 1982), and American Society of Horticultural Science (Distinguished Graduate Teaching Award in 1985.)

The following are some of the recognitions that Dr. Gould has received: The Ohio State University Distinguished Leadership to Students Award in 1963 and a Certificate of Recognition Award in 1986; Ohio Food Processors H.D. Brown Person of Year Award in 1971; Ohio Food Processors Association Tomato Achievement Award in 1985; Ozark Food Processors Association Outstanding Professional Leadership Award in 1978; 49er's Service Award in 1979; Food Processing Machinery and Supplies Association Leadership and Service Award in 1988; Ohio Agricultural Hall of Fame in 1989 and an Honorary Life Membership in Potato Association of America in 1990. In May 2001, The Ohio State University recognized Dr. Gould by naming the section of Howlett Hall that houses the food center as The Wilbur A. Gould Food Industries Center.

Dr. Gould is Retired Executive Director of Mid-America Food Processors Association, Food Technology Consultant to the Snack Food Association, Secretary-Treasurer of The Guard Society, and Consultant to the Food Industries.

Dr. Gould's philosophy is to tell it as he sees it, be short and get right to the point.

Ronald W. Gould was born on May 26, 1947 at Worthington, Ohio. He received his Bachelor of Science degree in Food Technology from The Ohio State University in June 1969. At the same time he was commissioned an Ensign in the United States Navy. He spent the next two years aboard USS Mona Loa and saw time in the Mediterranean Sea during the 17 day war in the Middle East.

Upon Honorary discharge as a Lieutenant from the Navy he immediately went to work for General Mills in Toledo, Ohio as a Quality Control Technologist. He moved through the Company as a Food Engineer, Mix Plant Manager, Technical Resource person, Senior Food Scientist, System Engineer, to his present position as Associate Principal Engineer. He has worked in the General Office in Minneapolis, the Toledo Plant, the Cincinnati Plant and in other facilities on special assignments. He serves on several committees for his firm and he gives leadership in the area of computers and computerization of plant operations.

PREFACE

First Edition

The quality of the foods we eat is of prime importance to each of us. The food industry has an obligation to produce uniform quality, nutritious, and safe foods. The responsibility rests with management and the food plant worker to produce, process and pack safe, wholesome, and nutritious quality foods. The quality assurance technologists role is to assure management and the ultimate consumer that the quality of the food meets the firm's expectation. Only through a total quality assurance program can a food firm expect to grow and provide a satisfactory return on the investment for the stockholders. Total quality assurance in a food firm works for the consumer, the food plant worker, and the firm's management. It is a necessary part of the successful operation of a food firm today.

This text is divided into two major parts. The first part sets forth the basic principles of total quality assurance for management and the ultimate employee. These principles are necessary for the successful operation of a food firm in these times. The second part of the text describes the various attributes and characteristics of food product quality and quality evaluation methods. Examples are given for the evaluation of a wide array of food products. The methods and procedures described in this text have been applied to most situations for control, evaluation and auditing of the quality of foods.

The authors are deeply indebted to former students now employed in various segments of the food industries for their suggestions and help in the formatting of this text. Further, we are indebted to our colleagues for their constructive help and cooperation. We particularly thank Art Judge, and Nancy and Randy Gerstmyer for their support, interest and wholehearted cooperation.

Ronald W. and Wilbur A. Gould

PREFACE

Second Edition

Changes in the food industries are constantly taking place, particularly in the field of Quality Assurance. Many new practices, procedures and concepts are coming to the forefront. Some of these are finding their rightful place for the control of quality on the production line. On-line sensors are finding wide application for line control and in the long run will eliminate much of the laborious laboratory work.

Perhaps the most important change since the first publication of the fore runner to this book was first published back in 1977 is the modern emphasis on training the line operator-employee to control his unit operation as part of the process. By empowering the employee to control his operation to given specifications or parameters, quality of food products should be more uniform and consistent in quality. The employee must be held accountable and he should be made part of a team to constantly improve the process. Only then will food firms move forward with assured confidence that their products are meeting the expectations of the customer all the time.

The authors are deeply indebted to the many readers of this text for their suggestions and interest in this field of quality assurance. The methods and procedures in this edition have been up-graded where necessary and new chapters have been prepared to help the reader gain more insight into this field.

Quality assurance in the food industries is an area of work that offers many opportunities for great achievement for the food employee and his or her firm. With the use of computers and optimization of production lines, the future looks very bright for those food employees who understand process and product control and food product evaluation.

We are, also, deeply indebted to all the personnel at CTI Publications for their constant encouragement, interest, and cooperation. We particularly thank Art Judge II and Randall Gerstmyer for their many considerations and dedicated help.

Ronald W. and Wilbur A. Gould

PREFACE

Third Edition

This book has been upgraded to provide new information and help to all in the food field who are concerned with product quality. The assurance of product quality is a function of management as the customer expects it right every time. Repeat business makes a food firm and repeat business comes about because the customer is satisfied. The customer is receiving what is expected with every purchase.

Assurance of product quality is a never ending function of a food firm. The line worker can and will do only what they have been trained to do. The quality assurance department and all technical personnel must stand ready to assist with the right know how and the willingness to share and to help all concerned. By working together quality can and will be manufactured and controlled to any given level established by management. It is a team effort and teams want to win and make their mark for their firm. The customer becomes the real winner and champion for the firm and their products.

Quality assurance does not cost, it pays a firm over and over and it improves the bottom line for those that practice quality assurance. Our suggestions are simple and straight forward and they represent the right starting place. As a firm grows, quality assurance must grow too. New methods and new practices must come to fruition and become part of the every day effort. Personnel must be in place to do the right job all the time. They must stay up to date and they must lead rather than follow. Quality of our food is a mainstay for success and it is the reason that many firms continue to grow and improve their operations. The future looks bright and the quality of food that we eat is what it is all about. We never want to say that we are sorry, we always want to say thank you for the many compliments we receive for our efforts.

We greatly appreciate our past users of this book and we look forward to new users because we know that this material can help you to grow in your profession. We sincerely thank Randy Gerstmyer and his staff for their dedication and hard work in helping to revise this book. We are proud to be a part of this whole project for nearly 25 years to help the students and industry help themselves. Thank you all.

Ronald W. and Wilbur A. Gould

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Part I

Fundamentals of Quality Assurance and Process Control

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CHAPTER 1

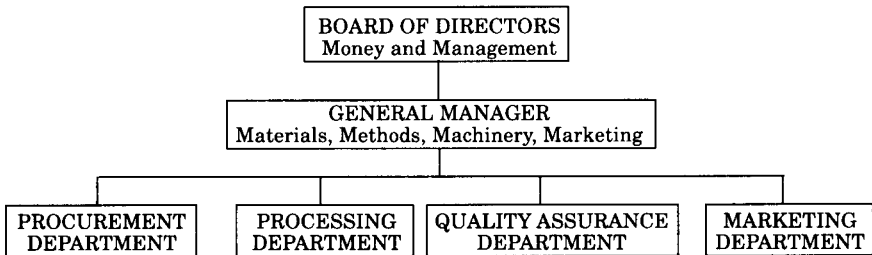
Introduction — Total Quality Assurance In The Food Industries

Total quality assurance in the food industries is a requirement for consumer enthusiasm and acceptance. Total quality assurance means processes and products are acceptable and in conformance to requirements. Total quality assurance must start with top management supporting the concept of quality and their taking time to explain to all personnel the need for manufacture and control of product quality. Total quality assurance must provide better job instructions for all employees as some people working in a food system may not know good practices from bad practices. Most importantly for a firm to manage quality of production, management must take the time to train all personnel in the concept of statistical techniques and the application of statistical practices to the production line to help solve problems of reproducing quality products.

One way to obtain an insight into the food industry is to look at the organization plan of a typical food firm as shown in Figure 1.1. A modern food plant is organized around the M's and the first M of the food industry is Management. Management is responsible to the Board of Directors to see that the firm returns a profit on the invested capital. To return a profit, management must fully utilize the resources of Materials, Machines, Manpower, Methods, Money and the Managers of the respective departments in the plant. Perhaps the most important M is Manpower-womanpower and their achievement in producing a quality product at a profit.

Generally, workers in a food plant are a mirror image of the management. They will do their jobs right if given the proper tools, environment, knowledge, and direction or message. The environment is the most critical of the causes or lack of employees doing their job right. The environment is often called the "common cause" of production

Figure 1.1 — Organizational Plan For a Food Firm



problems. “Common causes” are considered the faults of the system and can only be removed by management. Generally they represent up to 85% of the faults of the system. Some typical “common causes” are:

- 1.) Poor supervision;
- 2.) Lack of instructions;
- 3.) Varying quality of incoming materials;
- 4.) Machines out of control;
- 5.) Uncomfortable working conditions (humidity, noise, confusion, too hot or too cold, poor ventilation, poor light, dirty, etc.);
- 6.) Lack of statistical information or performance data;
- 7.) Poor design of process.

All of these are faults of the system and can only be corrected by management.

Total quality assurance implies the establishment of goals of quality improvement and the analysis of the costs associated with non-conformance of products and processes to established quality levels. The evidence of non-conformance must be conveyed to all personnel through newsletters, videotapes, personal contacts, statistical charts, and in open forums.

The first requirement in establishing a total quality assurance system is for the Manager of the Quality Assurance program to thoroughly convince the management about the system so that there is excitement and enthusiasm for the program. The enthusiasm and the excitement must go all the way up and down the line and to each individual employee in the firm.

The function or job of the plant manager is to give consistency of purpose and continuity to the organization. He is solely responsible to

see that the firm has a future. Workers work in the system, but the manager works on the system. He sees to it that it produces the highest quality product at the lowest possible cost. No one else is responsible for the system as a whole for its continued improvement. A successful manager relies on his staff to help make the many decisions as each staff member has a specialized knowledge and interest. Further, each one can focus on their area of expertise. All on the staff must be committed, visibly involved and they must project a strong leadership attitude. They must be truthful with each employee, be consistent with their facts, and be confident when dealing with others. For success, they must use 'we' instead of 'I'. Most importantly, a good manager must remember where he came from. The 15 key traits to look for in a Manager are as follows:

- 1.) Positive attitude;
- 2.) Initiative-willingness to dig in and get started;
- 3.) Ambitious-always broadening view, developing new skills, and willingness to take a risk;
- 4.) Self confident-a competitor, one who gets the job done;
- 5.) Courage and willingness to train a successor;
- 6.) Flexible-not set in his ways;
- 7.) Resilient-ability to bounce back;
- 8.) Stamina and mental attitude to cope with endless streams of stress;
- 9.) Ability to judge people and how to develop people;
- 10.) Goal setter-long range plans including budgets and deadlines;
- 11.) Collaborator;
- 12.) Imaginative;
- 13.) Creative;
- 14.) Objective;
- 15.) Stable with great self-discipline.

In the real world the only people who make the economic detailed observations of the system on a day-by-day basis are the workers. Thus, they should be part of the decision process as they are the ones who observe the system and the ones that best know its behavior.

The performance of the worker is directly related to how the system operates. Problems within the system are usually first observed by the workers. If they complain about poor maintenance and have the statistical data and facts to back up their complaints; good managers do not consider them troublemakers; but, welcome their contributions to the success of the system. The manager, if he is working on the system,

takes proper action based on the observations of the workers. Learning to share power and responsibilities will make the work-place more effective and will make managers more competent and productive. Workers want to be involved in the decision process. They will develop great pride, enthusiasm, and become more effective if given a voice in the operation of the system.

QUALITY CIRCLES

During recent years many American firms have adopted the Quality Circle or similar Improvement Systems for working with employees. Some firms use the term "task force committee" or "work teams" in lieu of Quality Circles. The terms refer to the work environment and have the common objective of resolving problems in a given situation. This management concept originated in the United States several years ago, but never really attracted much attention until after the automobile crisis when U.S. management started to question the great success the Japanese were having with employee motivation. The Japanese were utilizing the Quality Circle concept in many of their businesses.

A Quality Circle is a voluntary group of workers who have shared areas of responsibility. They meet together weekly to discuss, analyze and propose solutions to quality problems. They are taught group communication process, quality strategies, and measurement and problem-solving techniques. They are encouraged to draw on the resources of the company's management and technical personnel to help them solve problems, and they generate and evaluate their own feed back. In this way, they are also responsible for communicating. The supervisor may become the leader of the Circle. The leader is trained to work as a group member, but not as a "boss" during the Circle meetings.

The Quality Circle may be defined as a small group of employees doing similar work who voluntarily meet for an hour each week to discuss their quality problems, investigate causes, recommend solutions and take corrective action. It is primarily a normal work crew, that is, a group of people who work together to produce a product on a given line.

The Circle leader goes through training in leadership skills, adult learning techniques, motivation, and communicating techniques. The leader is trained in the use of various measurement techniques and quality strategies, including Cause and Effect Diagrams and Cards (CEDAC), Pareto Diagrams, Histograms, Run Diagrams, Average (X

Bar) and Range (R) charts. More advanced Circles move on into sampling systems, data collection, scatter diagrams, charting techniques and Design of Experiments (DOE) and statistical interpretation of same. The purpose of all these techniques is to improve productivity for the firm.

Some of the topics that Circles get involved in include: overview of product quality, line controls, sanitation, food regulations, waste, absenteeism, product rejection, accidents, poor work flow, excessive inventories, inefficiencies, spoilage, etc.

The whole concept of the Circle provides an opportunity for the workers to develop their skills. It allows workers to have fuller participation in the operation of the firm and it provides a vehicle for allowing the worker to have a sense of dignity.

THE SUPERVISOR

The key to the success of the Quality Circle and the motivation of each employee is the supervisor. A good supervisor needs constant training in human relations. This training includes incentive standards, discipline, how to settle grievances and how to train others. Further, he needs training in cost analysis, how to manage, motivate and communicate, and leadership principles. A good supervisor sets a good example, he displays enthusiasm, he is always neat and clean, he is job oriented and interested in his people. He is a good listener, always respectful, tactful, and courteous. Most of all he is sound in his judgement.

The supervisor is between top management and the worker. He is in daily contact with each employee under his supervision. To the employee, the supervisor is management. Therefore, the morale of the supervisor affects the morale of the worker.

The general philosophy and thinking today by most successfully managed firms is that a shift has taken place from the quality assurance technologist and his or her laboratory to the line employee and their exercising their responsibility for producing quality products efficiently. The technologist is still an integral part of the company plan to assure product quality, but the accountability has shifted because the line employee now understands what the company's standard of quality is all about. They know their job depends on efficient production of a quality product and they know the laboratory will be auditing and evaluating the job they are doing.

SUMMARY

In summary, an effective food plant operation includes the obtaining of good people and the giving of adequate training to help them do what is expected of them. The right person is put in the right job. Through proper communications they can see their role and know how they are contributing to the success of the firm. Management, including the supervisor, must help them succeed and hold all personnel accountable for their performance. Those who perform up and beyond expectation must be rewarded accordingly. Most importantly, every effective organization has a good manager. The manager must plan carefully and he must work through his supervisors and they in turn with their workers. A good manager gives direction to the system, he coordinates all the activities and he controls the system to produce quality products efficiently. Management is the key to any firm's future.

CHAPTER 2

Modern Concepts Of Quality Assurance

The relationship of the Quality Assurance Department to the other operating Departments in a typical food firm is shown in Figure 1.1. The important point to note in this Chart is the lines of communication among the Departments as well as to Management. Only by working together can a firm succeed. The key personnel are the quality assurance personnel as they must work across all departmental lines in doing their job for the continued growth of the firm. Quality Assurance personnel must take the lead in communicating to the respective departments as well as the training of all production personnel for product control and assurance.

WHAT IS QUALITY ASSURANCE?

Quality assurance is the modern term for describing the control, evaluation and audit of a food processing system. Its primary function is to provide confidence for management and the ultimate customer, that is, in most cases the consumer. A firm is in the business of producing a product intended for sale to a customer from which the firm hopes to make a profit. The key word is the customer. The customer is the one a firm must satisfy and it is the customer who ultimately establishes the level of quality the firm must manufacture. The customer is management's guide to quality and this is what the firm builds its specifications and label requirements around. Only by having a planned program can a firm continue to succeed in supplying the customer with the desired products.

A large part of a quality assurance program is built around quality control. Quality control means to regulate to some standard. It is usually associated with the production line, that is, specific processes and operations. As used today, it is the tool for the production worker to help him operate the line in conformance with the predetermined parameters for any given quality level.

Quality evaluation is also a part of any quality assurance operation. It is the modern term used to describe or appraise the worth of the product. It generally means taking a measurement of the product in a laboratory. It is used to include the evaluation of all incoming materials, products in process, and or finished products.

A third part of a quality assurance program is to audit or verify or examine the products or even processes over time. It is a term used frequently with firms having multiple plants. It should be a part of any quality assurance program to verify products in the warehouse, in distribution, and/or competitors products in the market place.

A typical organization plan indicating the three primary concerns is shown in Figure 2.1. Some firms assign the quality assurance department the additional functions of product development, plant sanitation, waste disposal, and research on processes, equipment, ingredients, etc. These are all specialized areas and require expertise well versed in these areas for success.

- 1.) What is quality?
- 2.) Why have a Quality Assurance program?
- 3.) What are the fundamentals that should be considered for a successful quality assurance program?
- 4.) What are the factors affecting quality?

It should be pointed out that many food firms today have attained their enviable position by the control of the many products they process. They do not process a product that is lacking in uniformity or one that will "just get by," but rather a product that will continue to build their business. Perhaps more important than their success is the fact that management knows at all times what kind of quality is being packed. Thus, a quality assurance program serves the management of a food firm by keeping them fully informed or assured of the quality and the condition of the products being packed as well as keeping management and the firm in line with the industry trends.

WHAT IS QUALITY?

Quality makes a product what it is. Quality is conformance to requirements or specifications. Quality as defined in the USDA Marketing Workshop Report (1951): "It is the combination of attributes or characteristics of a product that have significance in determining the degree of acceptability of the product to a user." Industry defines quality as a measure of purity, strength, flavor, color, size, maturity, workmanship, and condition, and or any other distinctive attribute or

characteristic of the product. Thus, the term quality, without being defined in terms of some standard, means very little. On the other hand, the trade generally uses the term to mean the finest product attainable. Food processors have learned from years of experience that high quality products never fail to sell. This is because the consumer recognizes brands that maintain their quality at the standard set for that particular product. Repeat sales are, thus, the outgrowth of quality assurance practices.

Standards For Quality

What are the standards for quality evaluation? There are different ways of arriving at the many standards for product quality. However, the four common methods are:

Legal Standards—Legal standards are those commonly established by the World bodies, federal, state or municipal agencies and generally are mandatory. These mandatory standards are set up by law or through regulations and represent the Federal Food, Drug and Cosmetic Act minimum standards of quality, the various state minimum standards of quality or the municipal minimum standards of quality. They are generally concerned with freedom from adulteration. This may involve insects, molds, yeasts, and pesticides, maximum limits of additives permitted, or establishing specific conditions in processing so that foods are not contaminated with extraneous materials. Examples of all legal standards that we are concerned with are available from the various agencies involved.

Company or Voluntary Label Standards—The company or voluntary label standards represent the standards established by the various segments of the food industry. The voluntary standards generally represent a consumer image and may become a trademark or symbol of product quality. Generally speaking these voluntary standards are used by private firms or supermarkets and they tend to vary depending upon the particular requirements for any given label.

Industry Standards—The industry standards are those whereby an organized group attempts to establish given limits of quality for any given commodity. Normally these have become effective by pressure from marketing organizations or by specific commodity groups where legal standards are not involved. Examples of these are standards for cling peaches, peanut butter, and some of the frozen food standards.

Consumer or Grade Standards—The consumer standards represent the consumers' requirements of a product and generally are based on experience in use by the industry for consumers. Consumers are not