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Collaboration among the University of Macedonia and Equivalent Institutions
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Total Quality Management: Contemporary Trends and Prospects in Greece and Bulgaria Technical Guide

Elaborated by the University of Macedonia
And the Euroconsultants

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Total Quality Management

Contemporary Trends and Prospects in Greece and Bulgaria

Technical Guide

Elaborated by

UNIVERSITY OF MACEDONIA AND EUROCONSULTANTS S.A.

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1. Introduction

1.1 What is Quality?

1.1.1 Quality

A much-misunderstood term that, finding no acceptance in America, moved in the early '50s (along with its gurus, Juran, Deming and Crosby) to the fledgling economic powerhouse of Japan, where it was promptly adopted and transformed into the cornerstone of the Japanese miracle. Thirty years later, high-powered and in great demand, it returned to its birthplace in the United States, where it has been acclaimed as the key to salvation from the looming economic crisis and increasingly cut-throat competition. It was not long before the rest of the business world recognized it as indispensable to survival in an extremely demanding environment shaped by ever-growing customer requirements.

1.1.2 Quality Definitions

"The total of the characteristics and properties of a product or service, that relate to its capacity to satisfy an expressed or deduced [customer] requirement".

"Quality is every activity that results in the satisfaction of the customer", or "quality is meeting or exceeding customer expectations".

1.1.3 Examples of Quality

The following example may make the concept of quality a little clearer. The person who is buying glass for the windows in a sky-scraper wants glass that is unbreakable, even if a large and heavy person should fall against it. A film producer, on the other hand, may want glass that will shatter instantly, on impact, for the requirements of a film.

The strength of the first type of glass is not a sign of higher quality, compared to the fragility of the second. Each product must be suitable for its intended purpose, must meet the specifications of the customer and must be properly designed and manufactured to do the job required of it.

1.2. The importance of quality

1.2.1 Competitive advantage

Competitive advantage is the key to growth and survival in an ever more competitive market, and it is a position that is becoming harder and harder to attain. Once upon a time a company could achieve it by cutting the price of a product, using some new technique to cut its costs.

1.2.2 Today

Today, the price of a product is not enough to ensure a competitive advantage, nor indeed is the product itself, which can easily be copied. What can, however, ensure competitive advantage, is superior quality compared to the competing product. This is because quality cannot be copied: it can only be developed within a company by unceasing hard work.

1.2.3   Why is Quality so important for an enterprise?

Statistics show that while one happy customer influences no more than another 8 people, one unhappy customer "infects" another 22. In addition, keeping a customer is 5 times cheaper than winning a new one.

Quality is important to a company because, apart from being a powerful competitive advantage, it also represents clear profit, since improving the quality of operations within the company tends to eliminate extra inspections, delays, time-consuming procedures and misunderstandings. This results not only in reduced costs but also in better working conditions, and thus in greater worker satisfaction. The image the company presents to its customers through the products it produces can be substantially improved by a general overall improvement in quality.

Many consumers are inclined to buy whichever product is cheapest. Few of them, however, are willing to purchase the same product again if they were not fully satisfied with it the first time. "No one is disposed to make the same bad choice a second time".

1.3.   Historical review

1.3.1   The Need to improve Quality

Conscious action in pursuit of quality is not, of course, a new phenomenon. Long before the industrial revolution those who produced goods were already carrying out a crude form of quality control. Minor developments occurred over the years until, with the outbreak of World War II, for the first time industrial production (of war materials) multiplied exponentially and industry's inability to control quality became evident.

The observed need to improve quality generated research that in the 1950s led to the creation of the first form of organized quality control system. The development of the science of statistics in the years immediately following made a major contribution to the improvement of quality control systems.

1.3.2   Quality control definition

"Quality control is the total of the operational technical procedures which **ensure** the quality of a product or service on the grounds of particular specifications".

1.3.3   The evolution of the quality system

At this stage, however, quality control still had one great weakness, in the fact that it merely identified defects in a product once it had been produced. Quality control, in other words, was not a way of eliminating defects, but simply a means of identifying them.

The next step was the implementation of quality control systems. Initially applied in large organizations, these ensured that a product or service met certain specifications.

In 1987 the International Standardization Organization (ISO) published its ISO 9000 series of quality control standards.

The domain of quality is not stationary, however, and continuing developments led to its application not only in the improvement of product quality but also in the reduction of costs, the exploitation of innovations and the global engagement of company personnel in the effort to improve weak points in all the above systems.

Efforts to resolve these problems eventually resulted in the development of the best form of quality system to have appeared to date, and that is Total Quality Management, which involves the implementation of basic quality principles at all company levels and in all company activities. Total Quality means the constant pursuit of quality, in a system in which each employee is an active link in a chain where the "customer" of one element is in turn the "supplier" of the next.

The evolution and the extend of each quality system from the aforementioned is shown in **Figure 1.1**

Figure 1.1: Quality Systems Evolution

1.4.   The "Gurus" of Quality

"Guru" is the name given to those who first developed the principles of quality and who are consequently regarded as authorities in the field. People whose thinking has created a new era in quality. The following paragraphs present, very briefly, some of these figures and their work.

1.4.1   W. Edwards Deming

One of the engineers of the Japanese miracle, statistician Dr W. Edwards Deming, was born in America in 1900 and died in 1993. It was 1950 when, after the end of World War II, he was called in to save Japan's tottering industrial sector. Today, the results of his work can be seen everywhere. The Japanese have instituted in his honor an annual business prize awarded to companies for efforts in the field of quality. He became known in America in 1980 thanks to a television program on which he appeared. His philosophy is based on 14 principles.

1.4.2   Joseph Juran

Another American, Joseph Juran, university professor, engineer and labour expert, argued the importance of the commitment of Senior Management in improving the running of any organization. Like Deming, he first applied his principles in Japan, remaining unknown in America until much later.

1.4.3   Phillip B. Crosby

A third American guru, and father of the zero defects theory, Phillip B. Crosby was the first to introduce the philosophy of "do it right the first time"

The Japanese learned quickly from the theories of the American gurus, and not only improved the quality of their industry but also built the foundations for further development by creating their own gurus. These include Dr Kaoru Ishikawa, who was the first to work on the application of quality circles and who proposed the "cause-and-effect diagram" as a tool for problem-solving, and Dr Genichi Taguchi, who formulated the theory that the cost of poor quality is the product not only of exorbitant average values but also of deviation from them. His contribution to this field is considered extremely important.

1.5.   Total Quality

Total Quality is a concept that relates to a set of management tools aimed at the efficient provision of products and services of assured and acceptable quality. American experts such as Deming and Juran introduced the philosophy of Total Quality Management (TQM).

The principles of Total Quality Management, however, were first applied in Japan, with the result that that country came to dominate the world market. Today, with Japan as the paradigm, both America and Europe are experiencing a "**quality revolution**"; while many people argue that continuously improving quality through application of the total quality management concept is perhaps the most effective way of managing companies and organizations.

Total Quality focuses on:

a. ***continuously improving*** quality, and

b. effective management of ***human resources***

1.5.1   Production Organization Procedures in the framework of Total Quality

Efforts to improve quality include a series of organizational and production procedures, such as:

- Promotion and establishment, within the company, of systems ensuring product quality (Quality Assurance)

These systems, which will be described in more detail below, have been developed and improved on the basis of internationally accepted standards, so that today they can guarantee the quality of a company's products. Quality assurance systems are a fundamental factor in the philosophy of quality, but are not the only one.

- Quality control on the basis of statistical methodology

This includes the use of statistical methods in the design, production and quality control of finished products. Some of these are:

1. ***Statistical Design and Analysis Methods*** (control at the design stage). These include Experimental Design techniques: off-line quality process control methods, generally known as Taguchi methods after the Japanese professor who first applied them.

2. ***Statistical Process Control / SPC*** (control during the production process).

3. ***Acceptance Sampling (***control/inspection of raw materials and finished products). *Acceptance Sampling Systems* are based on statistical quantities that determine the probability of the acceptance or rejection of a batch of raw materials or products.

- Use and exploitation of human resources

This means the proper use of human resources, making the work force aware of quality concerns, and it uses systems like:

Quality Circles.
Quality circles are the regular gatherings of a number of employees who discuss, analyze and propose solutions to problems of quality.

Development of devotion.
The Management guides, supports, collaborates and communicates with the workers, inspiring them to assume initiatives and responsibilities

Recognition of the role of employee.
Apart from monetary incentives (bonuses) there should also be psychological incentives for employees, including awards and recognition of their role in improving quality.

Training
Employee training is both an investment and a competitive weapon, when it is part of a philosophy of quality.

1.5.2 Total Quality Management

The next step in the further improvement of an enterprise through quality is **Total Quality Management.**

1.5.2.1 Definition of Total Quality Management (TQM)

One commonly accepted definition of TQM is that given below:

TQM is the philosophy and the actions that aim at constant satisfaction of customer requirements, minimizing cost and mobilizing all the employees in the company or organization.

1.5.2.2 The Deming Cycle

It is obvious, then, that TQM is possible only when it is accepted at all company levels. The implementation of a TQM program in a company aims at the use of quality tools, usually by quality circles, which are volunteer groups of employees within a company, for the constant improvement of company quality on all levels and actions, and full customer satisfaction.

This improvement is achieved by quality cycles, on the basis of the dynamic of constant improvement (KAI-ZEN), which according to Deming comprises the following series of actions: Plan - Do - Check - Act. (Deming's circle **Figure 1.2**).

Figure 1.2: Application of Deming's circle
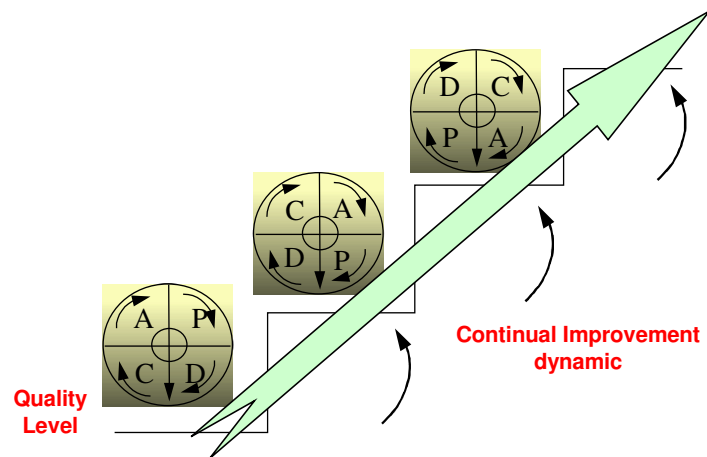
1.5.2.3 Deming's 14 points for the Total Quality Management

1) "Create a goal stability for endless product and service improvement".

2) "Adopt the philosophy of financial stability".

3) "Don't depend on the (final) inspection for the quality achievement".

4) "Put an end to the supply purchase practice with unique criteria the price".

5) "Continually and for ever improve the production and service system.

6) "Make sure for the training introduction during work".

7) "Adopt and enact modern methods of supervision and leadership".

8) "Get rid of fear".

9) "Break down the obstacles between departments and people".

10) "Exclude the use of slogans, posters and precepts".

11) "Avoid work standard and arithmetic percentages".

12) "Remove the obstacles that steal from the hourly paid worker the right to be proud of his work".

13) "Establish an active training and retraining program".

14) "Define a permanent commitment of higher management towards interminable quality and productivity improvement".

1.5.2.4 Dr Juran's views on quality

Dr J. Juran believes that quality is something that does not happen by chance, but must be designed. He also believes that Quality Control has to be one of the duties of Management. His philosophy is expressed in the following "quality trilogy":

- DESIGN

- QUALITY CONTROL

- QUALITY IMPROVEMENT

Dr Juran's method is encapsulated in the following steps:

1) Identify the customer

2) Identify the customer's needs

3) Translate these needs into the "language" of the company

4) Develop products to meet the above needs

5) Improve the characteristics of the products so that they meet other company requirements as well

6) Develop production procedures

7) Improve these procedures

8) Test procedures in real conditions

9) Apply procedures

1.5.2.5 P. Crosby's views on quality

Phillip Crosby is the inventor of the principles of "zero defects" and "do it right the first time". His program, which is designed to allow the company to make no mistakes and to produce quality products the first time round, is based on 13 points:

1) Get Senior management committed

2) Create Quality Improvement groups

3) Train company Management and Personnel

4) Determine the Cost of Quality

5) Institute Corrective Actions

6) Establish Efficiency Indexes

7) Awaken personnel awareness

8) Set challenging and attainable goals

9) Promote and institute Zero Defects Days

10) Create a committee to monitor the zero defects program and establish a system for problem-solving

11) Have regular meetings

12) Recognize and accept progress

13) Do it all from the beginning

2. TQM Methodologies

2.1. Overall about Quality Management

2.1.1 Definitions

Initially, the necessary definitions are quoted in order to clarify some basic concepts.

Management System: It refers to the actions that must be made by the Organization in order to manage its processes or activities. These actions are possible to include some recorded procedures, instructions or files, so as to be ensured that everyone knows his responsibilities as well as that there is an order way with which the organization operates. In this way, the effective management of organization resources is assured. It is generally acceptable that especially the enterprises of great extent or complex processes are not likely to run effectively without Management System.

Quality Management: It includes that part of the total management of the enterprise operation, which determines and materializes its quality policy.

Management System Standards: They provide the organization with an implementation and operation model of the Management System. This model includes all the features, which ensure a supreme management level and are commonly acceptable by the experts of the sector. Such a standard family is constituted by the ISO 9000 series, which refers to the process management organization, aiming the fulfillment of the customers' demands (Quality Management System).

2.1.2 What Quality Management is not

The concept of Quality Management must not be confused with the Quality Control, which constitutes a kind of traditional approach of quality. The Quality Management concerns clearly the processes of an organization and how they must be defined and executed if the desirable result is to be achieved, which is not other than the customer's satisfaction. In no case the Quality Management is referred to products, intermediate or final, apart from the fact that the way in which the organization managers its processes affects the products it produces. The control of the last ones is the subject of Quality Control, which is responsible for the separation of the suitable from the faulty products.

Moreover Quality Management is not:

■ Exercise of excessive control

■ Quality control or inspection

■ High cost – generating sector

■ Responsible for technological decisions

■ Panacea for all problems.

2.1.3   Characteristics of Quality Management System

The most important of the characteristics that entitle a system to be called Quality Management System are:

- Responsibility on all organizational levels

- A healthy management structure

- To be an auxiliary parameter of productivity

- To provide a good return on investments made in it

- To realize the perception that a product must be made right the first time

2.2.   Creation and development of standards

Historically, Quality Management began in the 1960s, arising out of the need to create quality programs for suppliers of products and services to the American armed forces. Thus, in 1959 the MIL-Q-9858 "Quality Program Demands" is issued by the American Ministry of Defense, opening the path for meanings as Quality Management and Quality System. The successful application of Quality Management Systems principles in the war and nuclear industry, led to the expansion of their use in many other industrial sectors.

As the industrial sector expanded, it became apparent that a common standard was needed, a framework describing Quality Assurance Systems that could be applied to any industry. This led in 1979 to the first such standard, published by the British Standards Institute under the title BS 5750, which in turn was used eight years later by the International Standardization Organization as the basis for the creation of its ISO 9000 series.

The special characteristic of these Standards, apart from their international power, is that they are likely to be applied to any organization, regardless of size, producing commodity or kind of activity. In 1994, the ISO 9000 series, after being subject to a relatively limited revision, it was reissued. From 1998 started a systematic effort of extensive review of the structure and strategy of the existing series. After all the requisite procedures were abided by, the official revised ISO 9000:2000 "Quality Management Systems" was issued on 15th December of the same year.

In Figure 2.1, the Quality Systems development is presented in diagram. As it is obvious, the development of every new standard was based on the respective already existing standards. Undoubtedly, the base for the development of the new series ISO 9000:2000 was its corresponding issue of 1994.

Figure 2.1: Development of Quality Systems
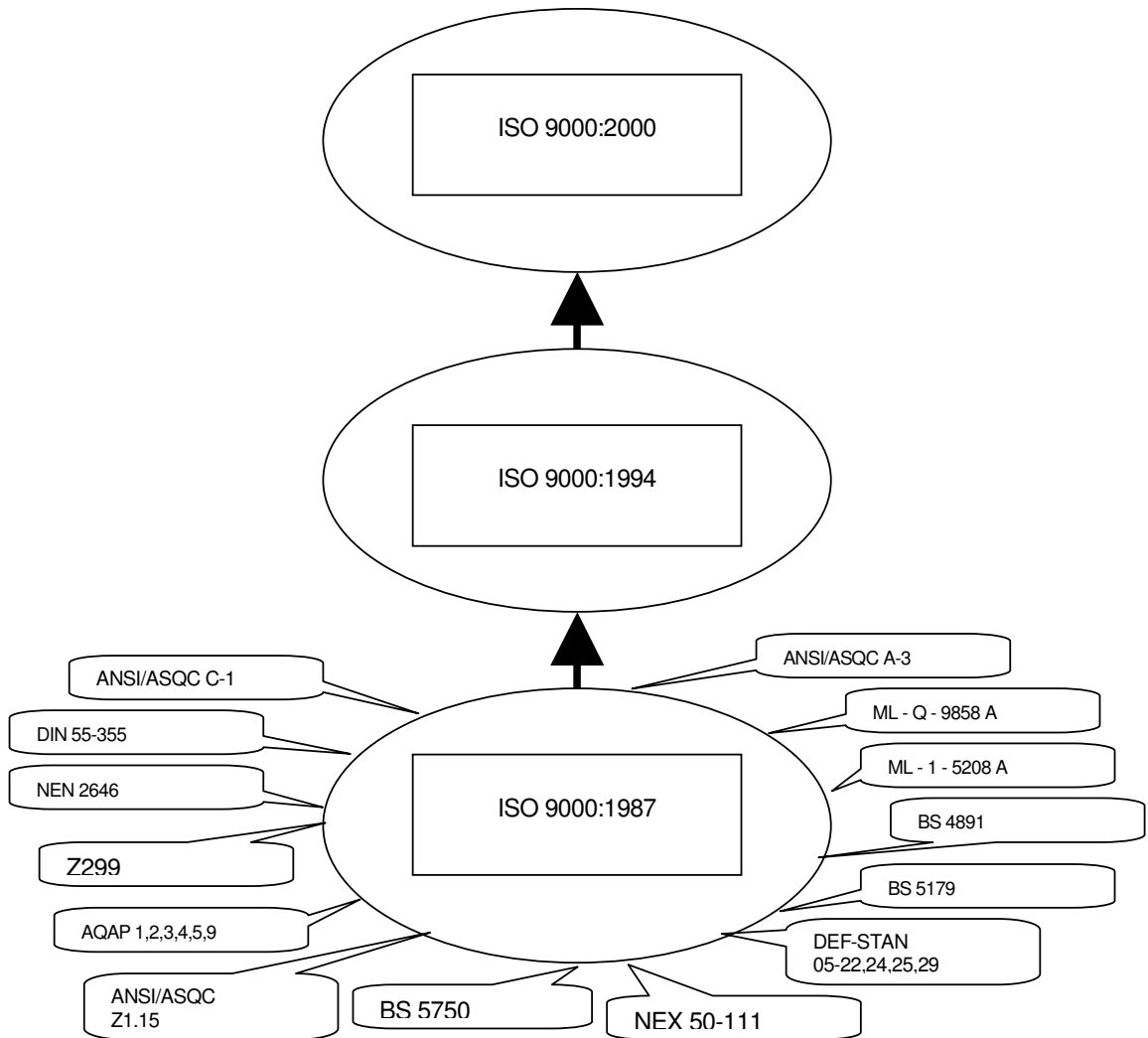
2.3. The ISO 9000: 2000 series standards

In table 2.1, the Quality Management Systems Standards of the new ISO 9000:2000 series are presented synoptically. What someone can notice is that now the ISO 9002 and ISO 9003 standards are abrogated.

Table 2.1: ISO 9000:2000 Quality Management Standards.

International ISO Standard	Description
ISO 9000	**Quality Management Systems - Fundamentals and vocabulary**
ISO 9001	**Quality Management Systems - Requirements**
ISO 9004	**Quality Management Systems - Guidelines for performance improvements**

It is reminded that these standards have overall power and are not restricted by the type or the activity of the organization. They are likely to be applied to industrial enterprises, service organizations, and government organizations or to any other sector.

2.3.1   Basic Requirements of these Standards

Broadly speaking, there are three basic requirements associated with these standards:

- *Documentation* of the quality system and the procedures followed.

- Ensuring that every employee *understands* and *follows* the guidelines developed from the documentation.

- *Monitoring* the documented quality system by means of either internal or external audits and, when required, *modification* and *up-dating*.

The procedures included in a Quality Assurance System apply to all levels of a company's organization. This means that even before the final product has been developed and launched, there have already been a whole series of controls at intermediate production stages that in all likelihood have detected and removed any malfunctions. Companies that develop and apply an ISO 9000 Quality Assurance System *are certified* by recognized certification bodies and can use this certification to promote their products on the international market.

2.4.   Presentation of the new series ISO 9000:2000

The new standard series **ISO 9000:2000** consists of three international standards in contradiction of the older series, which included five standards. Each one of them serves a different purpose. It is noted that it constitutes policy of ISO organization itself, to review and revise these standards every five years. The three models of the new series are presented in brief afterwards.

2.4.1   *ISO 9000:2000*

ISO 9000: Quality Management Systems - Fundamentals and Vocabulary.

It composes a regulative reference for the ISO 9001 and 9004 standards, describing the basic principles of Quality Management, but of the Quality Management Systems too. Furthermore, it also defines the vocabulary of these systems. In any point of the ISO 9001 that there are terms interpreted in the ISO 9000 standard, the required definition is that provided in ISO 9000.

2.4.2 *ISO 9001:2000*

ISO 9001: Quality Management Systems – Requirements.

This standard specifies the minimum requirements with which an effective Quality Management System must agree. It is necessary for the certification and registration of a Quality Management System.

2.4.3 *ISO 9004:2000*

ISO 9004: Quality Management Systems – Guidelines for Performance Improvement.

It is recommended as a guide for the development of a Quality Management System that gives emphasis on high performance. It is fully compatible and can be used along with ISO 9001:2000 Standard. This standard leads the enterprises "a step ahead" from the minimal demand if ISO 9001: 2000, giving emphasis on the concept of continual improvement. Therefore, it is not intended nor it should be used for certification.

2.5. Analysis of ISO 9001: 2000 Standard

The analysis that follows aims to the description of basic requirements and characteristics of the new ISO 9001:2000 standard. The structure of the new standard differs significantly from the one of ISO 9001:1994 which included twenty paragraphs - demands (4.1 - 4.20). The ISO 9001:2000 is divided in five big units (4-8), each one of those includes a number of paragraphs - requirements whose total number is twenty-three. In all the extent of the analysis the respective unit and paragraph numeration of the standard is referred in parenthesis

2.5.1 QUALITY MANAGEMENT SYSTEM (Unit 4)

General Requirements (Paragraph 4.1)

This paragraph includes a series of the organization obligations, of general character, that concern the processes necessary to be developed for the Quality Management System materialization (Q.M.S). These requirements refer, among others, to the organization obligation to identify these processes, to determine their sequence and interaction, to determine criteria and methods for the assurance of their effectiveness. From the first phrases of this paragraph, and therefore of the standard itself as a whole, the organizations should realize the importance of the continual improvement of the QMS effectiveness, that the new standard dictates.

Documentation Requirements (Paragraph 4.2)

Generally the QMS documentation shall include:

- Documented statements of a quality policy and quality objectives.

- A Quality Manual, which includes the QMS subject, the QMS documented procedures, as well as a description of their interaction.

- The documented procedures required by the present International Standard.

- The documents needed by the organization to ensure the effective planning, operation and control of its processes. Specifically, the control of these documents includes a further series of requirements.

- The quality records required by the present International Standard. These records shall be established and preserved so that the QMS compliance with the requirements as well as the effectiveness of the latter to be proved.

2.5.2 THE MANAGEMENT RESPONSIBILITY (Unit 5)

Management Commitment (Paragraph 5.1)

The present paragraph refers to the higher organization Management and in the ways it provides evidence of its commitment to the development and implementation of the QMS and continually improving its effectiveness. These ways include the communication in all organization levels of importance of meeting customer requirements, the establishment of the quality policy and the assurance that the quality objectives have been established. In addition, the management has to conduct reviews and to ensure the availability of the required resources.

Customer Requirements (paragraph 5.2)

Top management shall ensure that the customer's requirements are defermined and fulfilled.

Quality Policy (Paragraph 5.3)

The assurance need by top management, that the quality policy is appropriate to the purpose of the organization and includes a commitment to comply with requirements and continually improve the effectiveness of the QMS. Furthermore, the establishment and review framework of the quality objectives must be provided. Moreover it has to be reviewed so that the continual suitability is assured.

Planning (Paragraph 5.4)

The quality planning contains two sections:

- The quality objectives, which are established, by top management, for every function and level in the organization. These objectives shall be measurable and consistent with the quality policy.

- The QMS planning, which is carried out in order to meet the requirements given in paragraph 4.1, as well as the objectives for quality. The QMS integrity has to be maintained when changes are planned and implemented.

Responsibilities, Authority and Communication (Paragraph 5.5)

In this paragraph is pointed out, the obligation from the side of top management for the assurance that their responsibilities, authorities, and mutual - correlation have been fully defined, while the organization is aware of them. In addition, top management shall appoint a person who irrespective of other responsibilities, shall ensure that the processes needed for QMS are established, implemented and maintained. This person reports to top management for the QMS performance and ensures that the whole organization is aware of the customer requirements. Furthermore, top management shall ensure that appropriate communication processes are established within the organization and that communication takes place regarding the effectiveness of QMS.

Management Review (Paragraph 5.6)

The QMS organization review, regularly, constitutes the management obligation so as to ensure its continual sufficiency and effectiveness. These reviews must foresee possible needs for QMS change, while in every case the records of these reviews must be kept. The inputs these reviews must take into consideration include the audit reports, the customers' complaints or satisfaction, information on the processes performance as well as possible improvement recommendation. On the other hand the results of the conducted reviews, shall to include decisions and actions related to the improvement of the effectiveness of QMS, of product related to customer requirements and resource needs.

2.5.3 RESOURCE MANAGEMENT (Unit 6)

Provision of Resources (Paragraph 6.1)

The organization is responsible to determine and provide the necessary resources for the QMS implementation, its continually improvement as well as for enhancing customer satisfaction.

Human Resources (Paragraph 6.2)

The term "human resources" refers to the organization personnel, whose work influences the product quality. The organization has to define the necessary competence of this staff providing them with further trainings and assessing the effectiveness of this training or other relevant actions. Moreover, it must be assured that the personnel are aware as much of its actions significance as its contribution to the quality targets. The organization has to keep records of education, training, skills and experience.

Infrastructure (Paragraph 6.3)

The necessary infrastructure, so as to achieve conformity to product requirements shall to be determined, provided and maintained by the organization itself. This substructure can include a wide range of equipment, computers and software, transport services etc.

Working environment (Paragraph 6.4)

Except for the aforementioned, the organization must ensure the existence of the working environment necessary for the achievement of the product compliance with the requirements.

2.5.4 PRODUCT REALIZATION (Unit 7)

Planning of product realization (Paragraph 7.1)

In planning product realization, the organization shall determine the quality objectives and requirements for the product, the need to establish processes, documents and provide resources specific to the product. Moreover the verification, validation, monitoring, inspection and test activities specific to the product and the criteria for product acceptance are required, while it is necessary all the records that provide evidence that the realization processes and resulting product meet requirements, to be kept.

Customer- related processes (Paragraph 7.2)

This paragraph is analyzed in three sections and includes:

- **Determination of requirements related to the product,** which requires from the organization to determine the requirements specified by the customer, the necessary requirements from the given use of the product, the regulatory requirements for the product as well as the additional requirements determined by the enterprise.

- **Review of requirements related to the product,** which includes the product requirements definition, the analysis of the order contracts and the assurance that the organization has the strength to correspond to the defined requirements. This survey has to be carried out by the organization before any commitment for the supply of the product to the customer.

- **The communication with the customer,** which is impemented by the organization and concerns information on the product, questioners, contracts, possible corrections as well as the customers complaints.

Design and Development (Paragraph 7.3)

In this paragraph the organization obligations as far as the design and development of the product is concerned are analyzed. These obligations include:

- **The design and development planning,** according to which the design - development procedure stages must be verified, the suitability of every design to be certified and the design development responsibilities - activities to be defined.

- **The design and development inputs,** which include among others the customer's given requirements, the regulatory requirements and the results of possible previous designs.

- **The design and development outputs,** which shall to fulfill the requirements of design - development inputs, to provide information on the purchases and production, to include acceptance criteria of the product and to define the characteristics of suitable and safe use of the product.

- **The design and development review,** which includes the evaluation of the ability of the results of design and development to meet requirements and to maintain records of the result of the reviews.

- **The design and development verification,** which aims to ensure that the design and development results fulfill the given requirements.

- **The design and development validation,** which will assure that the resulting product, meets its application requirements. Wherever practicable, validation shall be completed prior to the delivery or the implementation of the product.

- **Control of design and development changes,** according to which design and development changes shall be reviewed, verified and validated before their implementation. At the same time consequences of these changes on the product itself are assessed. It is noted that for all the above procedures, the organization has to keep the necessary records.

Purchasing (Paragraph 7.4)

The organization shall ensure that purchased product conforms to specific purchased requirements. The extent of the control applied to the supplier, depends on the overall effect of the raw material on the final product. The criteria of suppliers' selection should be clearly definite. The purchasing information shall describe the product to be purchased, including where appropriate requirements for the products approval, for the suitability of the staff and the QMS itself. Moreover, the verification of the supplied product / service requires inspection for ensuring that purchased product meets specific purchased requirements.

Production and service provision (Paragraph 7.5)

The procedures required by the specific paragraph are:

- **Control of production and service provision,** which, among others requires the availability of information about the product characteristics, the availability of working instructions, the use of necessary equipment as well as the implementation of inspection, measurement and release - delivery activities of the product.

- **Validation of processes for production and service provision,** which mainly dictates the defined criteria for acceptance of the processes, equipment and staff suitability. In addition, the use of specific methods - processes and keeping records are required.

- **Identification and trace ability,** which refers to the need for identification method of the product and its condition.

- **Customer property,** which requires the organization to identify, verify and protect customer property for use or incorporation into the product.

- **Preservation of product,** which has to do with the organization obligation for the preservation of the conformity of the product during internal processing and delivery to the intended destination.

Control of monitoring and measuring devices (Paragraph 7.6)

The need of product conformity to determined requirements demands from the organization the proper use of monitoring and measurement devices. Where necessary to ensure valid results, measurement equipment shall be calibrated, adjusted or re-adjusted, be safe from transformations that could make the measurement result invalid and finally to be protected from damage and deterioration during handling, maintenance and storage. In cases where the equipment does not meet the requirements, the organization shall take appropriate action on the equipment and any product affected.

2.5.5 MEASUREMENT, ANALYSIS AND IMPROVEMENT (Unit 8)

General (Paragraph 8.1)

The general obligations of the organization include monitoring and measurement processes so as to demonstrate conformity of the product and the QMS. It is noted once more that the latter must be continually improved as far as its effectiveness is concerned.

Monitoring and Measurement (Paragraph 8.2)

Customer satisfaction is the indicator of the QMS performance and therefore the organization has to collect information and to conduct measurements whether has met customer requirements. The organization shall plan and conduct internal audits so as to determine if the QMS complies with the requirements of the present international Standard as well as if it can be implemented and maintained in an effective way.

In addition the organization shall apply suitable methods for monitoring and, where applicable, measurement of the QMS processes. These methods shall demonstrate the ability of the processes to achieve planned results.

Monitoring and measurement methods shall apply to the product itself in order to verify that its requirements have been met.

Control of the non-conforming product (Paragraph 8.3)

The organization shall to identify and control non-conforming products in order to prevent their unintended use or delivery. The controls shall include actions of elimination of detected nonconformity, authorization of use, release or acceptance, actions to preclude its original intended use or application. For all the above actions records must be kept. When non-conforming product is detected after delivery or use has started, the organization shall take action appropriate to the effects, or potential effects, of the nonconformity.

Analysis of data (Paragraph 8.4)

The organization shall determine, collect and analyze appropriate data to demonstrate the effectiveness of QMS. This analysis shall provide information relevant to customer satisfaction, conformity to product requirements, characteristics and trends of processes and products and suppliers.

Improvement (Paragraph 8.5)

This part includes three sections.

- **The continual improvement** of the effectiveness of QMS, through the use of the quality policy, quality objectives, audit results, analysis of data, corrective and preventive actions and management review.

- **The corrective actions** must review, determine the cause and eliminate the cause of nonconformities in order to prevent recurrence. The corrective action shall record and reviewed.

- **The preventive action** must determine potential nonconformities, evaluate the need for action to prevent occurrence of nonconformities and implementation of action needed. The preventive action shall record and reviewed.

2.6. Basic differences of the new standard series ISO 9000:2000 from the outdated series ISO 9000:1994.

The most obvious difference between the outdated and new issue of the ISO 9000 series is that the standards ISO 9002 and 9003 are abrogated. The new series includes three standards, compared to the five of the outdated. Moreover, the structure of the new issue is significantly differentiated, with its data organized in four basic units (4-8). The previous series had its data organized in twenty paragraphs - requirements (4.1 - 4.20).

As far as the strategy difference between the two standards is concerned, the new model faces the organization as a whole, as a united process (processes oriented model) in contrast with the previous one, which demanded the enterprise segregation in departments examining each one separately (functional oriented model).

The new standard adopts the known model of Deming "Plan-Do-Check-Act" in order to tempt the organizations to seek their continual improvement. In this way after the organization has planned, (Plan) collects the necessary data (Do) and checks (Check) the effectiveness of this checking. Finally it is activated (Act) for the re-planning and improvement of the process. This perpetual circle is repeated and the continual improvement is achieved "step by step".

Moreover a significant difference between the two standards is the grate importance that the new series gives to the Customer Satisfaction. The latter consists now a very important parameter of the effectiveness of the QMS of the organization. The management of the organization, by means of its representative, must promote the notification of customer requirements in every part of the organization. The obligations of the organizations to perceive customer requirements becomes clearer in the new standard, taking them into account during planning, implementation and improvement of the Quality System.

In addition the new standard gives emphasis on the Resource Management, contrary to the previous one, which devotes just one paragraph for the supply of resources that are necessary for the support of the Quality System. Now, the provision of certain resources from the side of the organization is required. They include human resource, information, communication, infrastructure and the working environment. Special mention should be made to the significantly involvement of the management organization in the planning, the operation and the effectiveness of the Quality Management System according to the new standard.

On the other hand, there must be noted that now there is an accordance and harmony between the structures of the two basic standards of the series (ISO 9001:2000 and ISO 9004:2000). These standards follow the basic structure of the four units that have already been analyzed above. In the past, there were complaints due to the fact that the standards of the previous series seem relatively unconnected and confused with each other. In addition of the above, it is clear now the best harmonization and convention of the new standards with the known standard ISO 14001, with possible future goal the integration of all these in one management standard.

The model of the new "orientated to the process" Quality Management System is illustrated graphically in the **Figure 2.2**.

Figure 2.2: Model of "orientated to the process" Quality Management System.
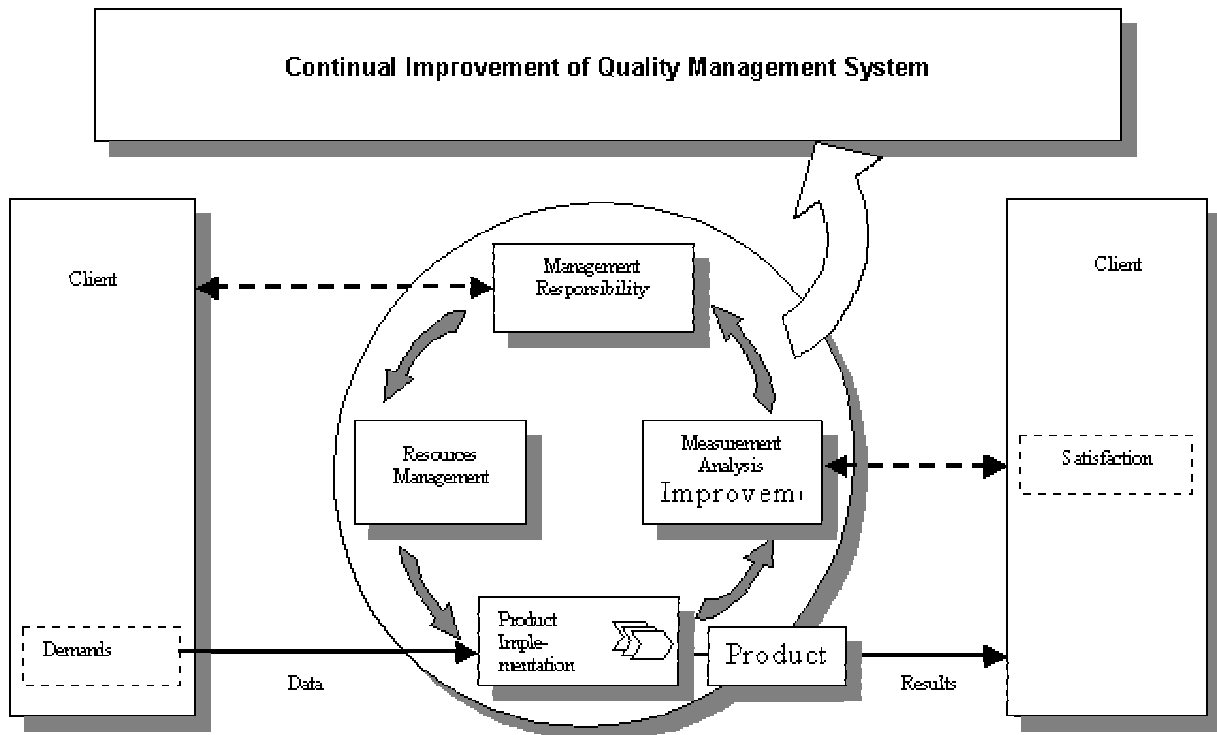
2.7 How will the transition to new standard take place?

It is a fact that the important change that took place with the arrival of the new standard series will make the organizations think. Therefore it must be pointed out that the standards of ISO 9000:2000 series are structured on fundamental principles of 1994. So the organizations that had already been certified according to ISO 9000:1994 have the bases for their transition to the new System. Definitely, the details of the transition vary according to case. On the other hand, it is certain that an important part of the existing management system of the certified organizations will be include without changes to the new Quality Management System.

The parts of the quality system and / or of the business plan of the organization that will need to be modernized according to the new requirements are analyzed briefly below.

■   The contract review process shall include procedures, which will assure that customer needs and expectations will result in internal requirements for the organization.

■   The training programs.

■   The procedures of the evaluation of the effectiveness of training program.

■   The procedures of the internal organization communication.

- The additional communication with the employees and their training procedures so that they are aware of customer requirements and the importance of these requirements to be achieved.

- The defined procedures of measurement of services and customer satisfaction.

- The defined management procedure of the enterprise for the communication with customers, customer complaints and handling of orders.

- The specific quality policy, which must include the continual improvement concept.

- The defined quality objectives as well as the support plan for the quality policy.

- The defined procedures of collection and analysis of data and their use for the achievement of the continual improvement.

- The new requirements as far as the objective and results of Management Review are concerned.

It must be noted that a transition period of three years term has been foreseen according to which the outdated standards will continue to be in force, at the same time with the new series ISO 9000:2000. This grace period will allow the enterprises to adapt to the new requirements, upgrading the Quality System they already apply.

2.8 The HACCP System: Hazard Analysis and Critical Control Points

The HACCP system is a systematic and scientific approach to the control of the processes of the organizations, in the field of food industry. It is designed and applied basically with the aim of both eliminating the possible problems, through the confirmation of the existence of control points in every stage of the productive procedure that are susceptible to dangerous or critical situations, and assuring hygiene and safety of products.

The innovation introduced by the emergence of HACCP system lies on the fact that it focuses on the element of prevention, contrary to the older approach of the simple testing of raw materials and the intermediate or final products. The basic principles of HACCP could be simplified to the following seven activities:

1) Identification and Analysis of the possible Dangers and the respective Preventive Actions.

2) Identification of the Critical Control Points.

3) Identification of Critical Limits for every one of the existing Critical Control Points.

4) Establishment of Procedures to Monitor the Critical Control Points.

5) Establishment of the adequate Corrective Actions to be taken.

6) Establishment of the Documentation Procedures of the respective Processes.

7) Establishment of Procedures to Verify that the System is working properly.

All the above procedures presuppose some certain preparatory stages, which include the collection of data and the creation of a HACCP team, the description and determination of the product use, its delivery conditions, the planning and the

confirmation of the productive process Flow Chart as well as the application of Good Manufacturing Practice methods.

It must be mentioned that, contrary to the other systems described in this guide, the adoption of HACCP methodology by the food enterprises in the European Union is mandatory according to the Directive 93/43 of E.U. This Directive also suggests the simultaneous implementation of a Quality System, according to the ISO 9000 requirements. This provides the organization with an integrated frame in which the HACCP system is fully effective. Generally, it is accepted that the principles of HACCP are similar to the ones of ISO 9000 standards, which are the basic elements of a more integrated Quality System. A Quality System based on the ISO 9000 series deals with the overall quality characteristics of the product. On the contrary, HACCP deals exclusively with those concerning the safety and hygiene parameters of the product. Thus, the combination of these two systems is considered to be a necessity for all food enterprises.

2.9 The Environmental Management Standards

2.9.1 The EN ISO 14001:1996: Environmental Management Systems - Specifications with Guidance for use

This standard is a basic constituent of the ISO 14000 Environmental Management Standards series, issued in 1996 by the International Standardization Organization. It is also recognized by the respective European Bodies. ISO 14001:1996 aims at the development of an Environmental Management System by the organizations that will allow them to minimize the possible harmful effects of all the stages of the product manufacturing and disposal. This standard is generic and applicable to a variety of organizations, from industries to governmental and service provision bodies.

As far as the essential requirements of this standard, these could be separated into three main categories:

1) The requirements for considering all the environmental aspects of the organization's product and services.

2) The requirements by the organization for monitoring and measuring the environmental performance of its activities, products and services in order to continually improve such performance.

3) The requirements for conducting Environmental Management Systems Audits.

The most obvious -but not the most significant- advantage from the adoption of an integrated Environmental Management System, based on ISO 14001:1996, by an organization lies on the prevention of penalties because of possible violation of the environmental legislation. On the other hand, the most essential advantages for the organizations conformed to ISO 14001:1996 requirements are:

■ The reduced costs of waste management.

■ The savings in consumption of energy and materials.

■ The lower distribution costs.

■ The improved corporate image among regulators, customers and the public.

■ The framework for continuous improvement of the organization's environmental performance.

The European Regulation of Eco-Management and Audit Scheme (EMAS)

(Source: EMAS Regulation)

EMAS is a voluntary environmental management scheme, based on harmonized lines and principles throughout the European Union, open to companies in all sectors of activities operating in the European Union and the European Economic Area. The aim of the scheme is to promote continuous environmental performance improvements of industrial activities by committing sites to evaluate and improve their own environmental performance. The exceptional characteristic of this scheme is **its requirement by the organizations to provide information, relevant to their environmental performance, to the public**. The scheme does not replace existing Community or national environmental legislation or technical standards nor does it, in any way, remove a company's responsibility to fulfill all its legal obligations under such legislation or standards. Registration in the scheme requires a company to adopt a company environmental policy containing the following key commitments:

- Compliance with all relevant environmental legislation.

- Prevention of pollution.

- Achieving continuous improvements in environmental performance.

An additional requirement refers to site environmental audits, covering all activities at the site concerned, which must be conducted within an audit cycle of no longer than 3 years. On completion of the initial environmental review and subsequent audits or audit cycles a Public Environmental Statement is produced. This statement should include key elements such as a description of the site's activities, an assessment of all the significant environmental issues, a summary of figures on pollution emissions and consumption of resources, a presentation of the company's environmental policy and site's program and management system as well as the deadline for the next statement along with the name of the accredited environmental verifier.

Recently, a systematic effort of partial revision of the EMAS regulation was completed. That effort started in 1998 and its purpose was the improvement of some weaknesses of the scheme. The European Parliament adopted the text of the new EMAS regulation, on 14 February 2001. The essential changes that EMAS was subjected to are the following:

1) The extension of the scope of EMAS to all sectors of economic activity including local authorities.

2) The integration of ISO 14001 as the environmental management system required by EMAS.

3) The adoption of a visible and recognizable EMAS logo to allow registered organizations to publicize their participation in EMAS more effectively.

4) The involvement of employees in the implementation of EMAS.

5) The strengthening of the role of the environmental statement to improve the transparency of communication of environmental performance between registered organizations and their stakeholders and the public.

The comparison between the two Environmental Management models, mentioned above, leads to the conclusion that they are focused on different aspects of the environmental management. EMAS "goes a step beyond" the requirements of ISO 14001, in the areas of environmental performance improvements provision for legal compliance and environmental performance reporting. Hence, it should be emphasized that **the two models are complementary, rather than in competition**. The fact that an organization is certified to one of them does not exclude its simultaneous certification to the other. In general, EMAS is considered to be more rigorous model than ISO 14001 and especially in the countries of the European Union EMAS tends to be more prestigious.

3. The European Foundation for Quality Management

The European Foundation for Quality Management (EFQM) was founded in 1988 to promote Total Quality Management in Europe. TQM is a valid and appropriate response to the organizational problems of companies, and as companies can prosper only by developing in a competitive environment, the EFQM can unquestionably play a major role in shaping our future.

The EFQM believes that, through Total Quality Management, Europe will become a leading force in the world market. Its objective is to enhance the position of European industry by strengthening the role of management in quality strategies.

The EFQM's mission is to support the management of European organizations in accelerating the process of making quality a decisive influence for achieving global competitive advantage, to stimulate, and where necessary, assist all segments of the European community to participate in quality improvement activities, and to enhance the quality culture. The EFQM has already provided European organizations with the EFQM Model for Business Excellence that adapts to our European cultural differences. With a representative office in Brussels, the EFQM is a non-profit organization, with over 700 members from 33 European countries.

The European Foundation for Quality Management has also developed a portfolio of Benchmarking activities since 1995. Benchmarking is the process of systematic, detailed comparison of one's own organizational structure and performance against that of exemplary organizations. In Europe this method is rapidly becoming one of the main instruments to facilitate business excellence. Benchmarking provides the key interface between the theory and the practice of total quality management, between identifying and understanding the key criteria for change and attuning these to the reality of specific organizations in the global economy.

Whilst inter-business comparisons have traditionally been a hit-and-miss exercise, the EFQM has developed a *cost-effective Benchmarking framework* to allow preferential and tailored comparisons among and between EFQM members. This is achieved through a coherent and integrated program of Benchmarking Services. The Benchmarking Services include: Common Interest Days, Benchmarking Groups, as well as Best Practice Implementation Workshops. And for the first time now also the Week of Benchmarking Excellence.

3.1 The EFQM Excellence Model

3.1.1 The need for a model

Regardless of sector, size, structure or maturity, to be successful, organizations need to establish an appropriate management system. The EFQM Excellence Model is a practical tool to help organizations do this by measuring where they are on the path to Excellence; helping them understand the gaps; and then stimulating solutions. The EFQM is committed to researching and updating the Model with the inputs of tested good practices from thousands of organizations both within and outside of Europe. In this way we ensure the model remains dynamic and in line with current management thinking.

3.1.2 The Fundamental Concepts of Excellence

The EFQM Model is a non-prescriptive framework that recognizes there are many approaches to achieving sustainable excellence. Within this non-prescriptive approach there are some Fundamental Concepts that underpin the EFQM Model. These are expressed below (there is no significance intended in the order of the concepts. The list is not meant to be exhaustive and they will change as excellent organizations develop and improve).

■ **Results Orientation**

Excellence is dependent upon balancing and satisfying the needs of all relevant stakeholders (this includes the people employed, customers, suppliers and society in general as well as those with financial interests in the organization).

■ **Customer Focus**

The customer is the final arbiter of product and service quality and customer loyalty, retention and market share gain are best optimized through a clear focus on the needs of current and potential customers.

■ **Leadership & Constancy of Purpose**

The behavior of on organization's leaders creates a clarity and unity of purpose within the organization and an environment in which the organization and its people can excel.

■ **Management by Processes & Facts**

Organizations perform more effectively when all inter-related activities are understood and systematically managed and decisions concerning current operations and planned. Improvements are made using reliable information that includes stakeholder perceptions.

■ **People Development & Involvement**

The full potential of an organization's people is best released through shared values and a culture of trust and empowerment, which encourages the involvement of everyone.

■ **Continuous Learning, Innovation & Improvement**

Organizational performance is maximized when it is based on the management and sharing of knowledge within a culture of continuous learning, innovation and improvement.

■ **Partnership Development**

An organization works more effectively when it has mutually beneficial relationships, built on trust, sharing of knowledge and integration, with its Partners.

■ **Public Responsibility**

Adopting an ethical approach and exceeding the expectations and regulations of the community at large, best serve the long-term interest of the organization and its people.

3.2   Overview of the EFQM Excellence Model

The EFQM Excellence Model is a non-prescriptive framework based on nine criteria. Five of these are "Enablers" and four are "Results". The "Enabler" criteria cover what an organization does. The "Results" criteria cover what an organization achieves. "Enablers" cause "Results".

The Model, which recognizes there are many approaches to achieving sustainable excellence in all aspects of performance, is based on the premise that:

Excellent results with respect to Performance, Customers, People and Society are achieved through Partnerships and Resources, and Processes.

The EFQM Model is presented in diagrammatic form below:
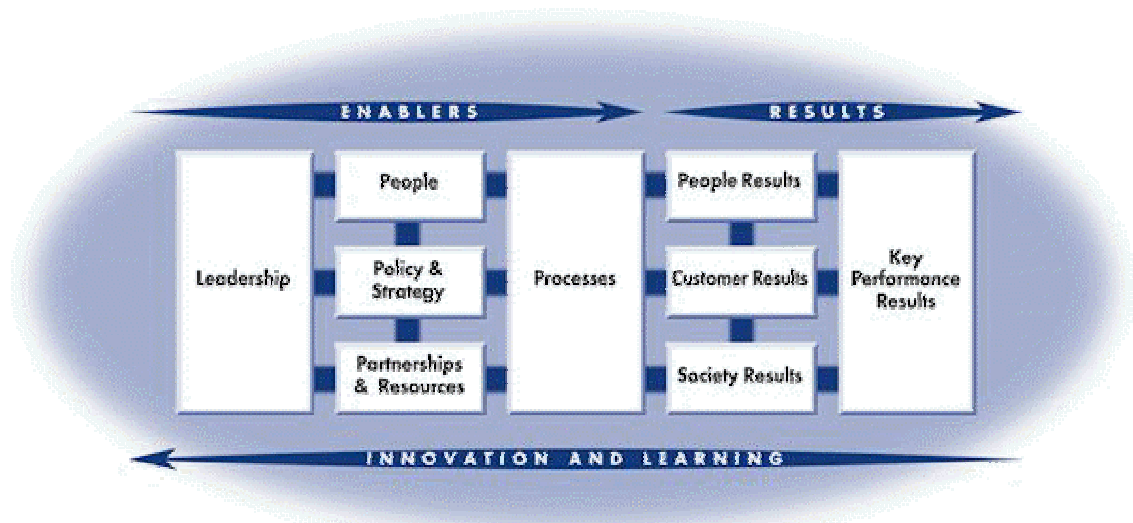
The arrows emphasize the dynamic nature of the model. They show innovation and learning helping to improve enablers that in turn lead to improved results.

3.3   Model contents structure

The Model's 9 boxes, shown above, represent the criteria against which to assess an organization's progress towards excellence. Each of the nine criteria has a definition, which explains the high level meaning of that criterion.

To develop the high level meaning further each criterion is supported by a number of sub-criteria. Sub-criteria pose a number of questions that should be considered in the course of an assessment. Both the nine criteria and their sub-criteria are presented below:

Criterion 1

Leadership
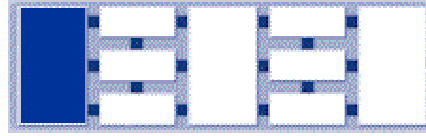
Definition

How leaders develop and facilitate the achievement of the mission and vision, develop values required for long-term success and implement these via appropriate actions and behaviors, and are personally involved in ensuring that the organization's management system is developed and implemented.

Sub-criteria

Leadership covers the following four sub-criteria that should be addressed.

1.1 Leaders develop the mission, vision and values and are role models of a culture of Excellence

1.2 Leaders are personally involved in ensuring the organization's management system is developed, implemented and continuously improved

1.3 Leaders are involved with customers, partners and representatives of society

1.4 Leaders motivate, support and recognize the organization's people

Criterion 2

Policy and Strategy
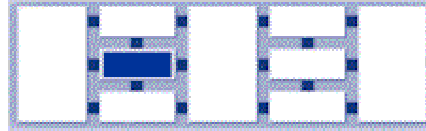
Definition

How the organization implements its mission and vision via a clear stakeholder focused strategy, supported by relevant policies, plans, objectives, targets and processes.

Sub-criteria

Policy and Strategy cover the following five sub-criteria that should be addressed.

2.1 Policy and Strategy are based on the present and future needs and expectations of stakeholders

2.2 Policy and Strategy are based on information from performance measurement, research, earning and creativity related activities

2.3 Policy and Strategy are developed, reviewed and updated

2.4 Policy and Strategy are deployed through a framework of key processes

Policy and Strategy are communicated and implemented

Criterion 3
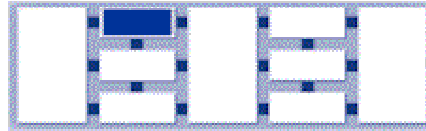
People

Definition

How the organization manages, develops and releases the knowledge and full potential of its people at an individual, team-based and organization-wide level, and plans these activities in order to support its policy and strategy and the effective operation of its processes

Sub-criteria

People cover the following five sub-criteria that should be addressed.

3.1 People resources are planned, managed and improved

3.2 People's knowledge and competencies are identified, developed and sustained

3.3 People are involved and empowered

3.4 People and the organization have a dialogue

3.5 People are rewarded, recognized and cared for

Criterion 4
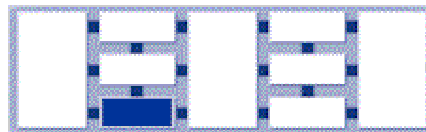
Partnerships and Resources

Definition

How the organization plans and manages its external partnerships and internal resources in order to support its policy and strategy and the effective operation of its processes.

Sub-criteria

Partnerships and Resources cover the following five sub-criteria that should be addressed.

4.1 External partnerships are managed

4.2 Finances are managed

4.3 Buildings, equipment and materials are managed

4.3 Technology is managed

4.4 Information and knowledge are managed

Criterion 5

Processes
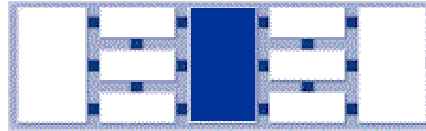
Definition

How the organization designs, manages and improves its processes in order to support its policy and strategy and fully satisfy, and generate increasing value for, its customers and other stakeholders.

Sub-criteria

Processes cover the following five sub-criteria that should be addressed.

5.1 Processes are systematically designed and managed

5.2 Processes are improved, as needed, using innovation in order to fully satisfy and generate increasing value for customers and other stakeholders

5.3 Products and Services are designed and developed based on customer needs and expectations

5.4 Products and Services are produced, delivered and serviced

5.5 Customer relationships are managed and enhanced

Criterion 6

Customer Results
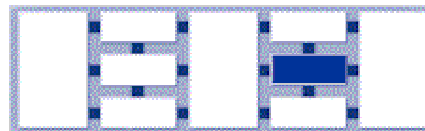
Definition

What the organization is achieving in relation to its external customers.

Sub-criteria

Customer Results cover the following two sub- criteria that should be addressed.

6.1 Perception Measures

6.2 Performance Indicators

Criterion 7

People Results
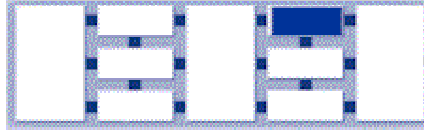
Definition

What the organization is achieving in relation to its people.

Sub-criteria

People Results cover the following two sub- criteria that should be addressed.

7.1 Perception Measures

7.2 Performance Indicators

Criterion 8

Society Results
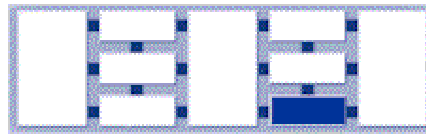
Definition

What the organization is achieving in relation to local, national and international society as appropriate.

Sub-criteria

Society Results cover the following two sub- criteria that should be addressed.

8.1 Perception Measures

8.2 Performance Indicators

Criterion 9

Key Performance Results
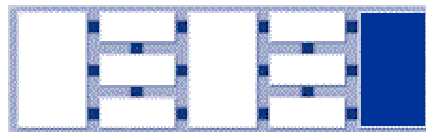
Definition

What the organization is achieving in relation to its planned performance.

Sub-criteria

Key Performance Results cover the following two sub-criteria that should be addressed. Depending on the purpose and objectives of the organization some of the measures contained in the guidance for Key Performance Outcomes may be applicable to Key Performance Indicators and vice versa.

9.1 Key Performance Outcomes

9.2 Key Performance Indicators

4.   Benchmarking

4.1   General

The control of the competitiveness by using indicators or benchmarking is a significant enterprising tool towards the achievement of continual improvement. By implementing a Benchmarking procedure, enterprises measure their performance against that of best-in-class enterprises, determining how the best-in-class achieves those performance levels using the information as a basis for your one's entrepreneurial targets, strategies and implementation.

Benchmarking can be implemented with the same success by both industry and service enterprises. Implemented examples are easily met in several business operations, such as new product designing, quality assurance procedures, problem solving techniques, reengineering, etc. The main advantage of Benchmarking, due to which its propagation is wide, is that it encourages enterprising decisions based on substantial facts and records, not based merely on intuition.

4.2   Benchmarking Definition

Benchmarking is a business continuous process of measuring products, services and processes against either the strongest competitors or those renowned as world leaders in their field, which lead to maximum performance. To date there have been several Benchmarking definitions.

The official definition however has been given from the American Productivity and Quality Center as:

"The process by which enterprises choose sectors or operations-keys for improvements, define and study the best ways and practices of other enterprises upon these sectors, and develop new procedures and systems in order to improve their own productivity and quality".

According to the Quality Guru "Deming", enterprises that want to implement Benchmarking successfully must adapt the best practices upon their own data and not to adopt them the exact way they are ("adapt, not adopt").

Benchmarking is about:

- Constant improvement procedure

- Quality and quantitative measurement procedure

- Products and services as well as operational methods

- Best practices followed

4.3   Types of benchmarking

The main categories of benchmarking depending on the inputs used for the benchmarking implementation are: internal, competitive and functional/generic (see **Figure 4.1**).

4.3.1 Internal benchmarking

Benchmarking does not necessarily involve comparison with another company. Internal benchmarking is relatively easy to implement. For many multinationals this is an untapped and rich source of data and an intensive internal search is the starting point for any benchmarking exercise, followed, as experience grows, by competitive and functional/ generic.

4.3.2 Competitive benchmarking

Competitive benchmarking, as its name implies, can be used as a way of informing people how badly - or well - they are doing against direct competition. Obtaining information on competitive processes or targets can be considered as a disadvantage though. Sometimes this can be difficult if not impossible. Customer feedback obtained through anonymous surveys conducted by independent consultants can provide excellent and objective indicators of a corporate company performance vs. competition and it can make up for the above-mentioned disadvantage.

However, while it is helpful to compare against similar industries, a "me-too" strategy may as well be the response. Breakthrough actions might not be achieved. Care is also required to ensure when competitors are not truly comparable; the size of an operation has an influence on this.

4.3.3 Functional/generic benchmarking

Functional/generic benchmarking compares specific functions, distribution, logistics, service, etc, with the best in industry and class. One major advantage of this approach is that it is easier to obtain access to other organizations than competitive benchmarking, as it is less threatening and there is also a greater likelihood that a two-way partnership of equals could be forged with a greater potential for learning. It is encouraging how open a business will be if asked to share its success stories; this is particularly true when the benchmarking focus is on process. Most organizations seem willing to share information if approached in a professional manner and if they know the purpose of the questions addressed. In addition, a source of inspiration from another company can challenge existing assumptions and lead to new approaches. There is, however, a limitation that because it only relates to specific functions, it may not be of benefit to other operations in the business organizations concerned. In addition, care is required in selecting companies to benchmark, as the nature of comparison is complex. Cultural or demographic factors, for example, and differing definitions of measurement frequently play a key role in undermining the credibility and subsequent implementation of the findings of such studies.

Figure 4.1: Types of benchmarking
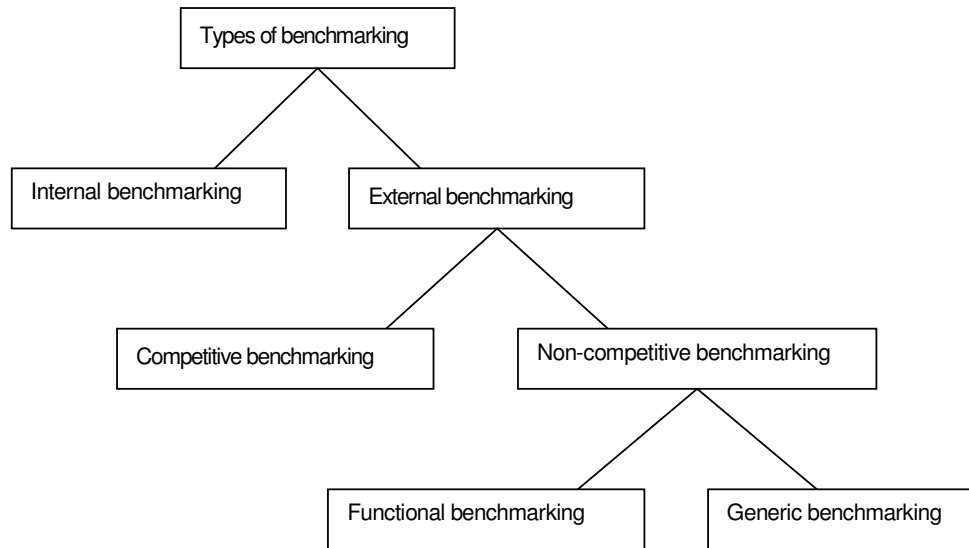
In order to facilitate the implementation of External Benchmarking, International Bodies that promote its implementation, have adopted a Code of Conduct. In this code, basic directions for the participants in the procedure are documented and in the code's paragraphs the principals that govern the information exchange are determined (principal of legality, principal of confidentiality, etc).

Depending on the scope of the study, Benchmarking is usually distinguished in:

1) Process Benchmarking

2) Performance Benchmarking

3) Strategic Benchmarking

The objective of **Process Benchmarking** is to detect the more efficient practices, which are implemented in sectors or enterprises that perform similar operations. Process Benchmarking can bring significant productivity improvement when it is implemented upon vital procedures where the results might bring out immediate cost reduction and profitability increase.

Performance Benchmarking allows enterprises to evaluate their position in relation to competition, through comparisons of the products they produce or services they provide. The comparisons concern mainly production cost elements, prices, quality, etc.

Strategic Benchmarking examines the way other enterprises exercise competitiveness and its objective is to improve the enterprise's competitive position. The control is carried out usually through enterprises that come from other sectors of production and are distinguished for their strategy success, because basically the induction of new ideas must come from other sectors. Strategic benchmarking usually demands investments for the implementation of actions in order to change the enterprise's strategy (such as entry in new markets, extension of the enterprising activities, etc) – the results though are long-term.

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4.4　The Benchmarking Process

The benchmarking process has ten steps in five phases (see **Figure 4.2**). The process provides a discipline and structure to drive benchmarking activities. The structure is adaptable and can usefully be applied to all three types of benchmarking and all functions of a business. While each phase is critical and needs to be completed thoroughly, the more time is devoted to the planning stage the less time is likely to be wasted later on. The process is dynamic and requires some flexibility in application, inevitably some trade-offs will be made, however these should be conscious trade-offs.

In each of the five phases there are action items, which need to be addressed. While they can be modified to suit any environment, it is important to remember that these actions are minimal for successful implementation of the overall process. There is nothing mystical and the process is a combination of common sense and sound business practice. The following sections of the chapter summarize these phases, concerning on what should be done, and contrasting this against the common pitfalls.

Figure 4.2: The Benchmarking Process

PLANNING

```
                    ┌─────────────────────────────────┐
                    │ 1. Identify Benchmark outputs   │◄──────┐
                    └─────────────────────────────────┘       │
                                                              │
                    ┌─────────────────────────────────┐       │
                    │ 2. Identify best competitor     │       │
                    └─────────────────────────────────┘       │
                                                              │
                    ┌─────────────────────────────────┐       │
                    │ 3. Determine data collection method│     │
                    └─────────────────────────────────┘       │
                              │                               │
ANALYSIS                      ▼                               │
                    ┌─────────────────────────────────┐       │
                    │ 4. Determine current competitive gap│   │
                    └─────────────────────────────────┘       │
                                                              │
                    ┌─────────────────────────────────┐       │
                    │ 5. Project future performance levels│   │
                    └─────────────────────────────────┘       │
                              │                               │
INTEGRATION                   ▼                               │
                    ┌─────────────────────────────────┐       │
                    │ 6. Establish functional goals   │       │
                    └─────────────────────────────────┘       │
```

PLANNING

1. Identify Benchmark outputs

2. Identify best competitor

3. Determine data collection method

ANALYSIS

4. Determine current competitive gap

5. Project future performance levels

INTEGRATION

6. Establish functional goals

| Communication of data | Acceptance of analysis |

7. Develop functional action plans

ACTION

8. Implement specific actions

9. Monitor results/report progress

10. Recalibrate Benchmarks

MATURITY

- Leadership position obtained
- Process fully integrated in our practices

4.4.1 Phase 1 – Planning

This first phase is crucial to success. The objective is to agree on the Benchmarking plan. The requirement is apparently straightforward.

First, identify what the subject to be benchmarked is, second, who the "best competitors" are and third, agree upon the most appropriate data collection method. Experience has proved the following keys to successful implementation in tackling these questions.

First of all, as with any venture of organizational significance, it is critical to have leadership and commitment at the top. In this context the notion of a benchmarking sponsor is used to endorse and support a benchmarking activity. This sponsor has line responsibility in the area of the benchmarking subject and is briefed in detail on the proposed benchmarking activity prior to it taking place and on an on-going basis once it is initiated. For a group to succeed in benchmarking, the sponsor must play a leading and supportive role in determining which companies will be benchmarked, how the information will be gathered and who will be involved.

Second, although an individual can conduct a benchmarking effort, a team approach is recommended. Benchmarking relies on and builds effective teamwork through mutually established goals and the group's agreement to achieve them. Benchmarking project teams are generally composed of a cross-section of levels in a company. A blend of experience, knowledge and skill in a project team is required, including those who are in a position to influence and implement the finding. Certainly, a team with sales flair, technical/subject matter expertise interviewing and analytical skills is required. Under certain circumstances (e.g. where there are time-constraints) a consultant may be used. The risk in using a consultant is that a learning opportunity is lost and ownership of findings could be less likely.

Benchmarking is an active learning experience, the value of benchmarking comes from seeing and understanding how companies achieve their performance levels. Possessing database or reading a benchmark report, although it may assist in target setting, does not automatically result in actions to improve.

4.4.1.1 Choosing a subject to benchmark

There has to be realism about the scope of the benchmarking project. When excessively ambitious subjects are selected they are generally doomed to failure unless substantial resources are available. Very often, benchmarking teams rush into action without a clear and systematic rationale beforehand. There is a focus on action, a process is designed-a "how" without resolving "the why". Indeed, this is one of the most common characteristics of unsuccessful studies. The point is that all benchmarking studies must be aligned to business priorities and critical success factors-particularly where results are not as good as planned. A narrow and focused study has a greater chance of success than a study that is broad and works uphill.

4.4.1.2 Understanding your own process

As a prerequisite to benchmarking the importance of **really** understanding **in detail** one's own processes cannot be stressed enough. Successful benchmarking depends on how well you know and understand your own work processes. Invariably this can take time. However, an intriguing learning point is that in doing this, one is already generating all sorts of ideas for improvement. There is another pay-off in that, while it is potentially time-consuming in documenting a process, it enables the appropriate metrics to be selected. It is also important to involve the same internal "experts" in the selection of the best "competitors" and agreement on the best data collection method. Part of this phase is concerned with gaining management and the appropriate internal customers to "buy in" through early involvement at the design stage of a study, to the later findings of a benchmarking initiative.

4.4.1.3 Looking at what is already available

In working out the selection of "competitors" and data collection method(s) there is no need to reinvent the wheel. A review of internal units that are known to be effective in similar work should be one considered starting point. This can be linked to an examination of companies that compete in your business area or other industries that are recognized as leaders in your areas of interest. There needs to be active exploration of material that is available in the public domain as well as consultation within the company. A particularly good source of information on companies' areas of strength is the conference circuit. Attending relevant conferences is a superb opportunity to meet with fellow professionals and understand current best practices. In this way such conferences provide the forum for informal networking and understanding who to benchmark, what they do in another organization and how to establish initial contact.

There are numerous data collection methods - qualitative, quantitative and so on. Ideally, a face-to-face benchmarking meeting is desirable and provides the "richest" data, particularly in relation to process benchmarking. Detailed questionnaires are prepared and are answered in-house before any benchmarking visit. In formulating questions, the focus should be on enabling practices as well as performance measures. Any difficulties encountered in answering the questionnaires have to be resolved before the visit is authorized or questionnaire distributed. Questions/answers of a sensitive nature are excluded from the exercise. The golden rule is: "If we would not like to be asked this question, then we won't ask it in the first place!"

4.4.1.4 Working successfully with a benchmarking partner

There is an assumption that benchmarking automatically provides an entry permit and carte blanche access to another organization. This is not always the case. Why should another organization be prepared to provide information without getting something in return? This issue in benchmarking is often neglected, yet the quality of information gained is reliant on the establishment of a partnership of equals. Sales flair is often required to obtain access and maintain the appropriate contact level in a potential benchmarking partner. Naturally, there has to be an openness to reciprocate and this selling point can facilitate the establishment of a relationship.

In preparing for a benchmarking visit as recommended above, it is advised that questions and the purpose of a benchmarking exercise are reviewed and responded to internally prior to discussion with the "partner" and sent before a site visit. If the questions are user friendly and the purpose of the study intelligible, it is generally easier to gain agreement to proceed and to get the right people to be involved. At these early stages there is need to be a specific agreement relating to the use of the data, confidentiality issues and the information each organization is prepared to share. An agenda needs to be developed which is clearly understood and both parties should share the names and job roles of participants beforehand.

It is a time-consuming task coordinating diaries and setting up the meetings. The more a benchmarking visit appears to be a delegation with a team descending **en masse**, the more challenging it is to arrange a meeting and the greater the likelihood of a canned or sanitized presentation. Managing the agenda of a benchmarking site visit must be a two-way process and generally the number of people kept to a minimum. At the meeting there is need to be an agreed process to achieve the purpose of the visit. If the agenda is hijacked by one of the parties, then the future of a long-term benchmarking alliance is immediately put at risk. One final warning at this stage: do not select too many companies to benchmark and do not assume all companies have to be visited prior to implementation of findings. Benchmarking is a discovery process. Learning increases as the process continues. However, too much information can be a disadvantage and result in "paralysis by analysis".

4.4.2 Phase 2 – Analysis

At this stage it is essential to be able to address the following questions: (1) Is the "competition" better? If so, how much? (2) Why are they better? (3) What can be learned? (4) How can the learning be applied?

Success in this phase is dependent on the quality of the information gained and will help understand competitor strengths and assess company performance against these strengths. It must be stressed that if preparation is not adequate, then the analysis will be impoverished. The current competitive gap is the difference between the internal organization's performance and the best. If questions are relevant and a suitable framework is used, comparison and identification of the competitive gap is a relatively easy task. However, it may be that the questionnaire was inadequate, in which case there is a need to return to the previous phase. This could also, of course, mean subsequent trips to companies already visited during this benchmarking exercise. This is not recommended. It may give the impression that the "bench marker" does not really know exactly what he is looking for and therefore comes across as being less than professional. This could well lead to companies being less willing in the future to become benchmarking partners. This will obviously jeopardize the building up of any long-term relationships.

If the analysis reveals a positive performance advantage, rather than a negative performance gap, this will generate an opportunity to recognize the achievement of the people working within that particular process. A negative gap requires action and evidence - there may be a level of scepticism about the findings of the analysis, which can only be overcome by irrefutable proof. There must also be a serious attempt to identify what is causing or driving the gap(s) before any projection about future status is made.

At this point it is useful to attempt to estimate the future performance of the company over a period of time and to estimate the performance of the benchmark company over the same period of time. While this is often a challenging exercise, it is true to say that any difficulties can be exacerbated by too much precision and over-analysis, resulting in a confusing picture and making any recommendations for change very difficult. Prediction is not easy and the focus should be on the word "projected". What is needed is not only an understanding of today's practices but also where the performance is likely to be in the future. Precision through quantification about future trends is not always possible. Even so, the realization for a function that historical productivity levels are inadequate is unsettling and is likely to inspire action and change. If this step is not attempted a false sense of security could be the outcome.

4.4.3 Phase 3 – Integration

This is where the benefits from benchmarking are applied. Normally, the objective of this phase is to use the data gathered to define the goals necessary to gain or maintain superiority and to incorporate these goals into the planning process. However, a technically outstanding analysis can be weakened by inadequate communication of the findings. Major gaps or practice differences will require strategic actions and a degree of internal selling of results may be needed. The culture of an organization can often determine the best way to communicate findings. For some organizations a well-written report is essential; for others, a lengthy report could be the kiss of death. The emphasis in this situation may be more on punchy presentation slides. Probably a combination of the two is desirable. An assumption is made that benchmarking is integrated into the formal planning process. Since this is not always the case and the objective findings or presentation of a benchmark study can challenge existing assumptions, an emotional reaction to negative findings is always possible. In all likelihood data will be questioned, particularly if they point to a significant gap; so make sure the methodology is sound. In this phase more than ever, the active support of decision-makers and sponsors involved is essential to limit the "not invented here" or "shoot the messenger" syndromes and ensure the resources

necessary to accomplish those goals are available and discussed in an objective fashion. A frequent problem is that key influencers are not kept in the picture. This is why the benchmarking team needs to have a sponsor who keeps the relevant staff up to date with the study. The findings of benchmarking studies are best implemented when the affected people are involved in the process. Universally, people object to having things done to them and prefer to be involved in the decision-making process. Again, this emphasizes why it is important to establish a solid foundation for success in phase 1.

4.4.4   Phase 4 – Action

During this phase the strategies and action plans established are implemented and periodically reassessed. At this point, once the recommendations for change - the revised goals - have been accepted and agreed by all concerned, the next step is to put together a detailed action plan designed to bring about, at the very least, a closure of the competitive gap identified in previous steps. This involves identifying who will do what, by when, etc., and these data are laid out very clearly, for example, on a GANTT chart. At this point, approval and acceptance are sought from all concerned before the plan is implemented. Immediately after implementation, monitoring must begin. Is the plan on track? If not, what is being done about it? Is it having any unforeseen impact anywhere in the organization? If so, what is being done about it? But most importantly, **is it filling up the gap**?

Once these action items have been set for and in a dynamic environment, it is probable that changes to the goals are needed; the benchmark will be reassessed. For strategic benchmarks critical to the long-term success of a company, this reassessment or recalibration should be conducted on a routine basis, regardless of whether or not the situation appears to call for it. This ensures that competitor or industry practice changes are taken into consideration. This is what is termed "recalibration". Recalibration sounds scientific and complex but it is not necessarily so. At its most basic this implies a need to maintain the links with a benchmarking partner and have a documented report available to ensure that any follow-up to revisit the organization to update the study is easier to conduct. While it does not mean that every benchmarking exercise should take place on an annual basis, it does reinforce the fact that benchmarking is not a one-off activity when conducted at a strategic level.

4.4.5   Phase 5 – Maturity

The objective of this phase is to determine when a leadership position is attained and to assess whether benchmarking has become an integral part of the management process. While this sounds idealistic it means that successes as well as failures in benchmarking should be periodically evaluated at a company level.

4.5   Benefits through Benchmarking

The benefits from the application of benchmarking are:

Without Benchmarking	With Benchmarking
Determination of costumers demands	
- Based on records of the past or intuition - Insight - Low compliance	- Market reality - Objective estimation - High compliance
Determination of effective objectives	
- Not focusing on the external environment - Reaction and not prevention - Hysteresis in the sector	- Reliable goals - Prevention - Precedence in the sector
Development of realistic productivity measures	
- Use of familiar actions - Implementation of an easier method - Lack of understanding of the strong and weak points	- Solution in real problems - Reliance upon the best practices that are applied - Understanding of the products
Competitiveness improvement	
- Focusing on the enterprise's internal environment - Slow adoption of changes - Low participation	- Realization of tangible facts of competition - New ideas of confirmed practices and technology - High participation
Implementation of best practices of	
"Not of our business" syndrome - Limited solutions - Achievement of mean progress value of the sector - No rational reaction towards evolutions	- Preventive search for change import - Variety of choices - Implementation of innovative enterprising practices - Excellent performance

4.6   Summary

In summary, Benchmarking is an opportunity for an organization and its individuals to learn from the experience of others. As in all learning experiences, there are internal and external environmental factors conducive to success or failure. For example, complacency or high security does not lend itself to a successful Benchmarking exercise. On the other hand, a "shock" experience can stimulate the self-questioning and self-doubt which is often the necessary prelude to growth. A constructed crisis and challenging of ideas is in itself a beneficial experience. However, in order to translate a beneficial educational experience into concrete actions, a structure and process has to be in place. Unless there is an appreciation of the sources of resistance to change in an organization and involvement of key players in a Benchmarking experience, then any effort will be to no avail. Senior management sponsorship, along with a long-term perspective, is essential to prevent Benchmarking to become an academic event.

There are many examples of technically outstanding Benchmarking exercises, which have failed to grasp this fundamental prerequisite. By the same token, some of the more apparently superficial Benchmarking events, when senior managers have visited other organizations, can work because they have provided a first-hand vision and tangible examples of what can be achieved. They can provide a motivational source of energy. However, unless there is a follow-up mechanism in place and reinforcement through a systematic process, then the learning from such visits can fade. It is also true to say that reports and enthusiasm from Benchmarking visits can be as interesting to others as a colleague's holiday snaps. There is nothing like a "prophet in foreign land" syndrome to incur antagonism and defensive reactions to the implementation of benchmarking findings.

Benchmarking is not a one-off analysis or a recipe book approach to a recipe where ingredients and directions are uniform. It provides insights into and challenges a business as usual methodology. Implementation of the results and findings depends on the willingness to both change and adapt new ways of doing things.

4.7   Benchmarking and TQM

Benchmarking philosophy and Total Quality Management (TQM) have many common elements. The effort toward continual improvement, the satisfaction of costumer's demands, the improvement of competitiveness, the institution of performance criteria, the research for best practices, the determination of effective performance goals, are some of the elements met through implementation of TQM programs and which in the same time characterize Benchmarking. In practice, many enterprises started implementing Benchmarking after their decision to concern into TQM programs because they discovered that Benchmarking is a valuable tool for the improvement of their procedures.

5. Statistical Process Control (SPC)

5.1 What is Statistical Process Control?

Statistical process control is generally accepted to mean control (management) of the process through the use of statistics or statistical methods. Perhaps because of this generalized definition of SPC, or people's poor understanding of the subject, some misconceptions have arisen about its applicability and usefulness.

There are four main uses of SPC:

1) To achieve process stability.

2) To provide guidance on how the process may be improved by the reduction of variation.

3) To assess the performance of a process.

4) To provide information to assist with management decision-making.

SPC is about control, capability and improvement, but only if used correctly and in a working environment, which is conducive to the pursuit of continuous quality improvement, with the full involvement of every company employee. It is the responsibility of the senior management team to create these conditions, and they must be prime motivators in the promotion of this goal and provide the necessary support to all those engaged in this activity.

It should be recognized at the outset that, on its own, SPC will not solve problems; the control charts only record the "voice of the process", and SPC may, at a basic level, simply confirm that a problem exists. There are many quality management tools and techniques, which support and facilitate quality improvement and, in many instances, they may have to be used prior to the application of SPC, and concurrently with it to facilitate analysis and improvement.

The application of SPC can potentially be extensive. It is not simply for use in high-volume "metal cutting"; it can be used in most manufacturing areas - industrial or processing - and in non-manufacturing situation including service and commerce.

5.2 Variation and Process Improvement

Products manufactured under the same conditions and to the same specification are seldom identical; they will most certainly vary in some respect. The variation, which may be large or almost immeasurably small, comes from the main constituents of a process-machine, labour, method, material and Mother Nature. The measuring system itself may also give rise to variation in the recorded measurement.

An important means of quality improvement is the reduction of variation. SPC is a very useful tool because, given the capability of the measuring system, it ascertains the extent of the variation and whether it is due to special and common causes of variation; process improvement being achieved by removal of either or both causes. It should be stressed that while SPC, if properly used, will give an indication of the magnitude of the variation; it will not give the source.

The efforts of management, technical, engineering, and management service activities should be directed at establishing the likely source(s) of variation and, more importantly, reducing it on a never-ending basis. A number of management decisions are based on interpreting variations in data, whether they are sales, output or financial, and, if the variation is misinterpreted, it could lead to incorrect decisions being made. Therefore, it is important that managers develop their knowledge of variation and its causes.

The first step in the use of SPC is to collect data to a plan and plot the gathered data on a graph called a control chart. Once the process is rendered stable by the identification and rectification of special causes of variation, its process capability can be assessed. The next task is to reduce, as much as possible, the common causes of variation so that the output from the process is centered on a nominal or target value. This is a continuing process in the pursuit of never-ending improvement. It is not the natural state of a process to be in statistical control, and a great deal of effort is required to achieve this status and a great deal more to keep it so. The amount of this effort and its focus is a function of senior management within their overall remit; consequently, engineering, economic and financial considerations must and do play their part in eliminating variation.

5.3   What are special and common causes of variation

1)   Special (or assignable) causes of variation influence some or all the measurements in different ways. They occur intermittently and reveal themselves as unusual patterns of variation on a control chart. Special causes should be identified and rectified, and with improved process or even product design, their occurrence should in the long term be minimized. In the short term, their presence should be highlighted and a reaction program established to deal with them. It is imperative in the management and control of processes to record not only the occurrence of such causes, but any remedial action that has been taken, together with any changes that may occur or have been made in the process. This provides a valuable source of information in the form of a ''process log'', to prevent the repetition of previous mistakes and in the development of improved processes.

Typical special causes may include:

a.   Change in raw material,

b.   Change in machine setting,

c.   Broken tool or die or pattern,

d.   Failure to clean equipment,

e.   Equipment malfunction,

f.   Keying in incorrect data.

2)   Common (or unassignable) causes influence all measurements in the same way. They produce the natural or random pattern of variation observed in data when they are free of special causes. Common causes arise from many sources and do not reveal themselves as unique patterns of variation, consequently they are often difficult to identify. If only common cause variation is present the process is considered to be stable, hence predictable.

Typical common causes include:

a.   Badly maintained machines,

b.   Poor lighting,

c.   Poor workstation layout,

d.   Poor instructions,

e.   Poor supervision,

f.   Materials and equipment not suited to the requirements

In the pursuit of process improvement it is important that a distinction is made between special and common cause sources of variation because their removal may call for different types and levels of resources and improvement action. Special causes can usually be corrected by operational personnel - the operator and/or first-line supervisor. Common causes require the attention of management/engineering/ technical/management services personnel. Teams, commonly called quality improvement teams or SPC teams, are often set up to eliminate special and common causes of variation. Operational personnel often have a considerable knowledge of process parameters and they should be included in such teams

5.4   Difficulties experienced in introducing and applying SPC

The purpose behind the application of SPC is straightforward: to reduce variation in process output, first, by establishing whether or not a process is in a state of statistical control, and second, if it is not, getting it under control by eliminating "special" causes of variation. Finally, SPC may be used to help reduce "common" causes of variation.

The three most common difficulties in introducing SPC are:

1)   Lack of knowledge/expertise of SPC.

2)   Poor understanding and awareness within the company of the purpose of SPC.

3)   Lack of action from senior management.

The three main difficulties in its application are:

1)   Applying SPC to a particular process.

2)   Resistance to change.

3)   Deciding which product characteristic and/or process parameter to chart.

Lack of commitment, awareness, understanding, involvement and leadership of middle and senior managers cause the most difficulties. While SPC may be seen to be a bottom-up activity, used by people responsible for controlling a process, it needs management to take their obligations for quality improvement seriously if it is to be effective over the longer term. They need to devote more intellectual thought and day-to-day attention to SPC. It should not be treated merely as a source of control charts, which management uses to present a picture to their customers suggesting they are doing something positive about quality improvement.

5.5   Summary

SPC, supported by the positive commitment of all employees in an organization within a framework of Total Quality Management, has proved to be a major contribution in the pursuit of excellence. It supports the philosophy that products and services can always be improved. However, it is a technique, which, by itself, will do little to improve product and service quality. It is basically a measurement tool, and it is only when the whole mechanism is in place to remove "special" causes of variation and squeeze out of the process all "common" causes of variation that an organization will have progressed from simply charting data to using SPC to its fullest potential. Management commitment and leadership, a structured and on-going training program coupled with its proper use are crucial to the success of SPC.

6. Quality Function Deployment (QFD)

6.1 Introduction

This chapter focuses on the concept and methodology of Quality Function Deployment (QFD). It concentrates on the fact how the technique, when used by a multidisciplinary team with sound access to full market information obtained directly from the customer, can improve company competitiveness.

Product development and design has in the past often-concentrated on specification and performance required. With an abundance of production capacity worldwide, the customer has greater freedom of choice and will increasingly exercise that freedom. Products that only just satisfy the basic needs of performance and specification, but miss out on additional desirable or "excitement" features seen elsewhere, will probably cause the intending purchaser to select the competitor's product.

QFD is a process, which brings together the lifecycle of a product from its conception, through design, manufacture, distribution, and use, until the product has, in the customer's opinion, served its expected life.

The management of QFD ensures that vital customer satisfaction and excitement attributes are recognized and developed, so that the company can achieve a competitive edge. It is equally, if not more, important that this is achieved profitably, thereby providing increased security of the business and for its employees.

Quality function deployment is defined as:

A system for translating consumer requirements into appropriate company requirements at every stage from research, through product design and development, to manufacture, distribution, installation and marketing, sales and services. (ASI, 1987a)

This definition identifies the objective of QFD. However, it is best visualized as a technique, which identifies the true voice of the customer and ensures that this is the common continuous thread of information going through all stages of the product lifecycle, from design concept, component design, process and manufacture, through to the eventual user. The technique is not limited to a physical product: the concept is equally applicable to the running of a business, from the development of the strategy through to the final achievement of the objectives.

6.2 Why is QFD important?

The competitive priorities directly affecting market share in today's markets are improved product performance, quality, consistency and reliability of delivery and supply, all provided at a competitive price. This is in relation to the market sector chosen for the product or service and where the customer is provided with more than expected. To supply only the basic requirements is to provide an open door for the competitor to step in. In this context, "more" refers to what customers expect. It may simply be their concept of value for money, perceived performance, styling, quality, reliability, damage-free or "that something extra".

A further, and perhaps natural, customer expectation is for the next purchase to be a "better produced", however this is identified, at no extra cost. When satisfaction is not achieved, a competitor's product is likely to be chosen, even though it may not be superior. Nevertheless the customer has exercised the right of free choice when it was available.

Quality Function Deployment is a powerful technique, which enables companies to anticipate and prioritise customer needs in their totality and to incorporate them effectively into the product and service provided for the end-user. It is recognized that manufacture of many traditional products, which used to be made in the United Kingdom and the United States has now moved to the Far East. The reasons for this can be summarized as in-built quality, attention to customer satisfaction and attention to detail at every stage from concept design through to manufacture. The process that has led to the ability to achieve market dominance through quality and design for use is referred to as QFD.

While it is recognized that Japanese culture and the close links between government, financial institutions and industry are important contributing factors to the Japanese success, the single most dominant factor is the attention to detail given at every stage of the process by the best Japanese companies over the past twenty years. The importance of this is now realized and a number of leading Western companies are adopting the same practice of building in quality through attention to detail.

By this means the emphasis is shifted towards detailed pre-planning to meet customers' perceived needs and away from the three bastions of traditional Western Manufacturing companies' practice. These are:

1) To produce what the engineer/designer believes the customer will buy and what the company can manufacture. This product is then offered for sale in the marketplace.

2) The need for short-term profitability dictates an input of resources and the price paid to achieve this, is a matter of top-heavy administration.

3) Management that is first class at fire fighting is recognized, rewarded and promoted and is really worth applying it with the view to recruiting and training its successors to have the same abilities.

These statements are not made to denigrate Western practice, but to indicate that none of them really addresses the essential first priority of business, that of satisfying customer needs.

This position needs to be changed with businesses driven by the needs of markets and customers. It is necessary to create product designs, which satisfy these needs, and to be sure that when these are translated into component designs, manufacturing processes and assembly operations, the improved effectiveness will ensure higher profitability.

Resources and time made available through problem avoidance can be used to achieve economy in indirect costs, to bring forward a new product ahead of competition or to delay commencement in order to have more up-to-date information (market/ technical/ competitiveness), while still meeting a competitive launch date against competitors who are using traditional methods.

6.3   The methodology

QFD methodology provides a logical means of looking at the inter-relationship between critical characteristics. By their clear display in pictorial form a reasoned judgment can be made in design so that the confounding interactions are minimized. It makes problem – prevention a reality and removes the inevitability of problem – creation from the design, planning and manufacturing processes. It moves and concentrates action and resources upstream and by so doing minimizes the opportunity for problems to develop. By establishing at first hand from the customer precisely what is required, the best means of achieving it can be established.

A Western company might argue that in concept this is what its design engineers and planners practice now. However, the differences between QFD and traditional approaches are threefold. First, there is the way that, under QFD, customer information is obtained and presented as a series of charts cascading from concept to manufacturing detail. Because of its shape the chart is known as the "house of quality". Second, every person downstream is regarded as a customer, the last operation is thus performed in manner that satisfies the eventual end-user. Everything upstream had been done so that the next down-stream activity can be undertaken correctly. Third, because a multidisciplinary team undertakes the QFD procedure, the traditionally strong functional demarcation boundaries, supported by equally strong and protective vertical communication lines, are breached and consensus can be obtained.

The house of quality shown in **Figure 6.1** (ASI, 1987a) may at first sight seem complex and daunting but, when used as a process, the overall time taken to bring about a "better" design is shorter than by traditional methods. The approach also uses fewer resources and is therefore less costly.

Figure 6.1: The House of Quality
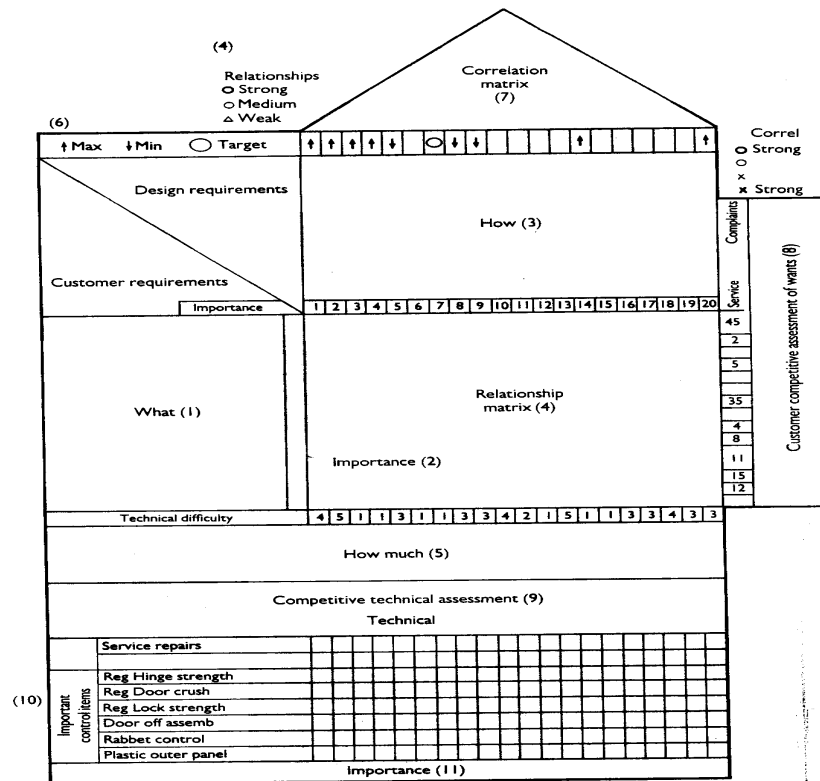
Figure 18.4   House of quality
Source: ASI (1987a)

6.4   Benefits of QFD

While QFD was developed for use in manufacturing industry in the United States and then Europe, and is now widely used in the automobile industry, its use now extends into other industries, including the service sector. The benefits of QFD can be summarized as follows:

- Improved quality

- Increased customer satisfaction

- Improved company performance

- Improved time to market

- Lower cost in design and manufacture

- Reduction in design changes /problem

- Improved product reliability

- Reduced decision/planning time.

- Improved productivity of technical and other staff.

- Improved communication.

- Reduced warranty claims.

- Improved marketing opportunities.

- Improved decision-making.

- Improved documentation.

- A more customer-oriented workforce.

- Opportunity for improved profitability.

Increasingly QFD will be used as the vital link between a company's desire for continuous improvement and customer satisfaction.

The strength of QFD lies in the involvement of a team of people, each with specific individual knowledge and experience, being brought together to work from customer-originated data. They establish a consensus opinion on how the end-user's requirements and priorities can best be presented. By forming multidisciplinary teams, functional barriers and the all-too-familiar lines of demarcation are broken down. The procedure does not include high technology, nor does it require lengthy periods of training or the acquisition of special skills. It requires instead the careful attention to detail at every stage as the procedure is worked through. Its apparent complexity and detail are indicative of the amount of relevant data over looked or ignored by the traditional methods of design, development, process planning and manufacture.

The process requires disciplined thinking and discussion to an orderly format. It is the application of the procedure that leads to the pictorial and easily understood presentation. In this way it is a permanent and complete record of all the relevant information currently available. It provides a solid starting point for any future work to be undertaken. There should be no knowledge-loss or the need to regenerate that, which has been lost or forgotten. It also serves as an information base available for any new member of the team.

One of the major uses of QFD is in the continuous fight to maintain and develop market share in the face of intense competition.

One small company with a highly specialized product was market leader over twenty of its competitors; it was faced with closure when one of the competitors launched a product at less than half the price of its own. They could close the product down or fight. They chose to use QFD and fight. The end-result was a new product, which was priced at 25 per cent of the cost of the competitor's product and also gave increased customer satisfaction. The company has increased its market share and can sell all they can make. QFD had provided a framework and focus for investigation, improved communication and trade-offs from the "voice of the customer".

6.5   QFD and Total Quality Management

QFD is most effective when it is recognized as one of a family of quality management tools and techniques. When used effectively it can make a significant contribution to improving company performance. QFD concentrates on establishing priorities and requires the use of measurements and in this way it provides one of the key building-blocks for the effective use of Total Quality Management The outline of TQM produced by Vocobo Ltd; as illustrated in **Figure 6.2**, shows how QFD provides an input and can be a vehicle for assisting with many of the components shown in each of the four phases.

Figure 6.2: Total Quality Management implementation; the framework Source: Vocobo Ltd
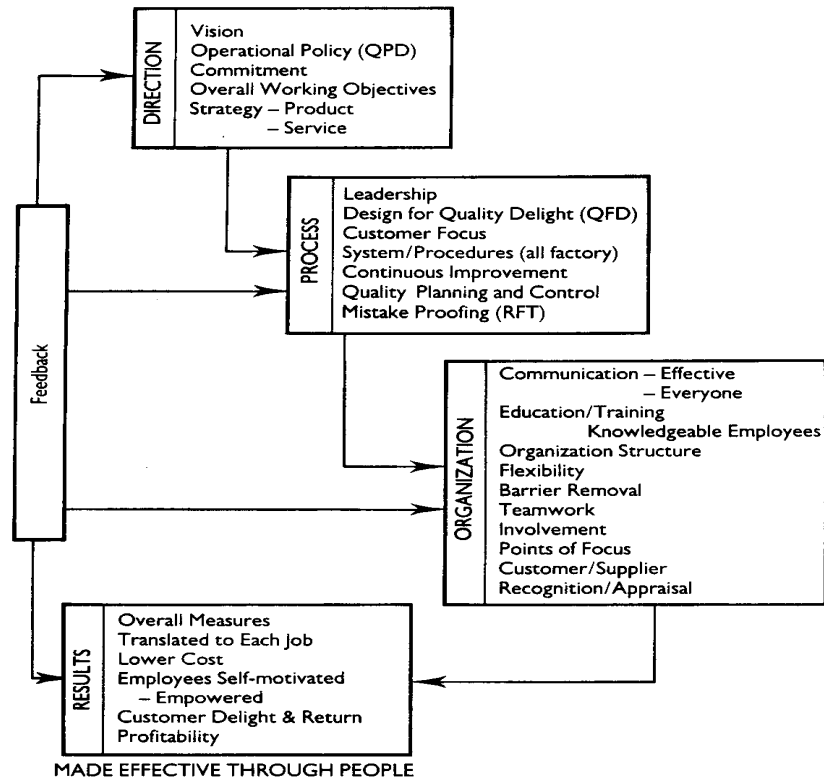

Figure 18.8   Total Quality Management implementation: the framework
Source: Vocobo Ltd

6.6   QFD in non-product applications

6.6.1   The service sector

The QFD process is equally applicable in non-product-related areas, for example in improving the service that a company provides to its customers, the service provided at an information desk, and the answering of the telephone.

It is widely recognized that a distinction between a service and a product is no longer clearly defined. In many cases the product that is delivered with good service as well as after sale service, establishes that company in the eyes of the customer as a caring company, warranting a successful business future.

Similarly those working in the service sector readily recognize that the service they are providing, whether it is cashing a check at a bank, a holiday enquiry or booking, service on a railway, or a hotel meal, is effectively a product. The techniques applicable to the manufacturing/ product scenario are equally applicable to services.
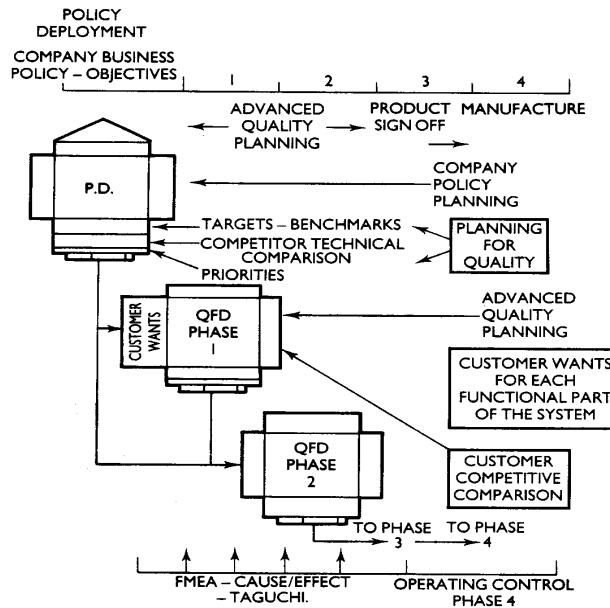
6.6.2 Policy deployment

A further use of QFD charts – e.g. "House of Quality" - is when they are used as part of strategic/ forward business planning.

The power of QFD is that it concentrates on planning the product or service before that product or service is provided. It is logical to extend this principle further back into the business policies themselves and to the organization goals and objectives to be achieved; to follow on to the strategy for the business and the way in which it is managed to achieve, the goals and objectives.

Policy deployment can help develop the business policy and plan providing the focus for carrying the strategy forward into the management of the individual function and section. It is a holistic approach where the structure enables the subordinate staff at all levels of the organization to be contributing directly to the achievement of the company objectives.

The illustrations shown on **Figure 6.3** demonstrate how policy deployment feeds into QFD phase 1, then into phases 2, 3 and 4. By this means the operators, actions with the controls and monitoring that can be exercised are directly contributing to the achievement of company goals and objectives. Measurements are the common thread with the chart always addressing customer priority.

Figure 6.3: Policy deployment and Quality Function deployment; Source: Vocobo Ltd

Figure 18.10 Policy deployment and quality function deployment
Source: Vocobo Ltd

Experience indicates that when QFD is used to plan the product and the process thoroughly, the overall time from concept to commencement of production can be reduced by one-half to one-third. It can also be argued that a similar reduction in manpower resources is possible and that this resource is freed for other work.

The QFD process is most useful when it is used to deal with more complex situations, as evidenced by the solution to the serious problem confronting Toyota with car body rust, a common problem with Japanese cars in the 1960s and 1970s. Toyota had made many attempts at improvement, but the real breakthrough had eluded them. The seriousness of the problem was such that the warranty charges exceeded the company profit by a factor of four.

Body rust was a very complex problem, with many contributing factors. The QFD process was used to identify and target the more important factors resulting in the elimination of rust problems arising during the warranty period. Details of this case are given in ASI (1987b).

6.6.3   Basic and excitement features

The use of QFD should not be restricted to problem solving. Its main use is to improve customer satisfaction through enhanced quality. Basic features are expected: they are essential and often taken for granted. For example, car engines now perform satisfactorily and usually start readily on a cold or damp morning. Easy starting is one of many basic features, which are now taken for granted, many previous dissatisfactions and irritations having been eliminated. Similarly, if a specified performance level, e.g. miles per gallon, is exceeded, there is acceptance that the product has performed better than planned or expected. This higher performance level then becomes the norm. While this gives satisfaction there would be dissatisfaction if the product under performed or even if it returned to the specified performance.

Today's market reaches out for, and even demands, additional features. These can be classed as those, which cause excitement. They may be trivia, but if they give the customer real satisfaction and pleasure, then the customer's perception is one of better value for money.

These excitement features can give the product an edge over its competitors. However, they first have to be identified and incorporated into the product in such a way that the cost does not take the product out of that market sector. The strength of the QFD process is to identify these excitement features. In many cases it can be a comparatively low cost excitement feature that causes the customer to select product A in preference to product B.

Because the QFD procedure quantifies the competitive position and the opportunities available, the team is guided towards a solution, which will have greatest potential for customer satisfaction. There will also be the certainty that the proposal will have been correctly engineered with dissatisfactions designed out. Engineers' designers and planners general experience and training often do not enable them to evolve a product, process or method that generates customer excitement at the first launch and the competitive edge that goes with it. QFD is a means of helping to develop a wider customer perspective in a directly operational manner. The quality of decision – making is improved.

6.7   Managing the QFD process

6.7.1   Team support

Most benefit is obtained from QFD when it is used on major projects; from concept design to manufacture. While it can be applied to concept design alone, most benefit is obtained when the whole process is covered through to the work of individual production operators. By this means there can be certainty that the voice of the customer and quality are being built into the final product offered for sale to the eventual user.

Progress through all four phases needs to be monitored by the team leader in order to measure progress and to be sure that the objectives and what was agreed during team meetings is implemented by the respective functions.

QFD is a detailed rather than a complex process; while it takes time to work through the whole process, this is much less time-consuming than the indecision and changes of mind, which occur so frequently under the traditional process. Nevertheless, time spent at meetings is accountable real time and needs to be planned and supported. Management's commitment throughout is therefore vital.

The best ways of showing this commitment are, first to give high priority to team members' attendance at meeting and, second, to ensure that the persons with the most experience and understanding join the team (this is not to prejudge the outcome). It is also important to seek evidence of progress and to show interest in the new ideas emerging.

QFD is not problem solving. The team is not looking for difficulties to resolve but for opportunities that can be developed effectively to satisfy the customer totally. Ideally, the CEO can demonstrate visible interest by attending team meetings, providing guidance and help on those occasions when the team requires guidance on matters of policy and showing interest informally outside meetings.

6.7.2 Charting

The charts used in QFD procedures contain a wealth of information and it is not possible to discuss all the aspects in this chapter. The main considerations to be kept in mind when analysing the House of Quality information can be summarized as follows:

Evidence	Indication to check
Blank rows	The customer's demand is either not satisfied or is not applicable.
Blank columns	The customer's demand is not being satisfied. It may be not a first priority want; otherwise it has to be satisfied.
Rows and columns with weak relationships	An indication of weak customer opinions or just a vague interest – check.
Immeasurable Rows	Measurement needs to be introduced in order to be sure that a change means substantial improvement.
Too many relationships	Strive for 50 per cent no relationship, in order to prioritise.
The competitive benchmarks	Look for opportunities where there is a high customer requirement but low competitive attainment.
Negative correlations between the rows	Attempt to eliminate or compromise.
Conflicting competitive assessment	High customer requirements must correlate with a corresponding high specification.

6.8   General advice

1) Like any other technique QFD should not be used on everything. It should be used for the really important or complex situations having a high priority.

2) Be sure the team works as a team and that it has the right participants with the right attitudes.

3) Ensure that management gives support with encouragement, and that commitment is demonstrated.

4) The individual charts are important only as long as they enable progress to be made and action taken. They are not ends in themselves; many compromises will be necessary from the analysis of the data.

5) Be certain to let new ideas surface and come to the front; new marketing opportunities will only come through new, solid and better ideas being made to work successfully. Remember, in quality terms the old-fashioned mangle never broke down; but it could not be programmed to come on at night. The electronic machine must be equally reliable and its design must anticipate potential hazards that could arise with the absence of the operator.

6) Keep meetings short and commensurate with the problem; by this means progress is seen to be made.

7) Keep the team integrated and part of the management processes of the company

6.9   Has QFD been implemented correctly?

A number of questions should be asked:

1) Has the true voice of the customer been obtained or are there any biases or omissions?

2) Were design and manufacturing standards established by reference only to traditional in-house standards and consequently limited?

3) Do we compare favourably with the best-known and potential competition in our chosen marketplace worldwide?

4) Has the team identified the best opportunities and acted to gain the most competitive position?

5) What additional information would be useful and how can it be obtained?

6) What is the best action to take to be sure that the decisions made will be correctly implemented?

7) Are any compromises necessary, which if not made could present difficulties?

8) Is any further help needed or planned?

6.10   Summary

QFD is best thought of as a systematic approach to identifying and recording areas for priority action to indicating where the use of other procedures and techniques, e.g. the Taguchi Method of experimental design (ASI, 1987b), will achieve most benefit in relation to the customer's perceived needs. It requires disciplined effort both personally and organizationally.

Many of the entries on the charts will appear obvious, but unless they are written down they can easily be overlooked. It is the total result that is important, not the individual items that traditionally have often excluded the obvious. QFD is designed to prevent these inadequacies, although it is not itself a method improvement technique. If there are too many difficult areas then it is likely that the QFD process is not being undertaken correctly.

The charts are not an end in themselves; they are a means to the end of anticipating and satisfying the perceived needs of the customer. Remembering that the customer may not know or take for granted many basic requirements; these must not be overlooked. Ways and means must be found to price out of customers their real needs, in anticipation of them being required when the product arrives at the marketplace some time later, in the competitor's product.

Although the process of QFD is not foolproof, it goes α long way towards being so. It can be used in a wide variety of situations, ranging from developing forward strategies to investigating α single situation. Its strength lies in the development of team working, using the charts in a disciplined manner to identify all the opportunities and potential in order to assist the company to achieve market leadership with enhanced profitability.

7.   Quality Tools & Techniques

7.1   Introduction

To support and develop a process of continuous quality improvement, it is necessary for an organization to use a selection of quality management tools and techniques. Some of these tools and techniques are simple (sometimes deceptively so), while other are more complex. There is a considerable number of quality tools and techniques.

This chapter, according to AT&T Bell Laboratories Publication Center, describes the tools and techniques recommended to support process quality management and improvement activities. Although not exhaustive, it includes many of the most useful tools and techniques.

The quality management tools and techniques have different roles to play in a process of quality improvement and if applied correctly, give repeatable and reliable results. Their roles include:

- Data collection.

- Summarizing data.

- Data presentation.

- Discovering problems.

- Understanding the problem.

- Finding and removing the causes of the problem.

- Assisting with the setting of priorities.

- Selecting problems for improvement.

- Identifying relationships.

- Structuring ideas.

- Performance measurement.

- Capability assessment.

- Planning.

- Implementing actions.

- Monitoring and maintaining control.

Process Management Tools	• Affinity Diagram/ KJ Method • Block Diagram • Brainstorming • Cause and Effect Diagram • Cause and Effect/Force Field Analysis • Control Chart	• Flowchart • Graph • Pareto Diagram • Tree Diagram
Process Improvement Tools	• Action Plan • Block Diagram • Brainstorming • Cause and Effect Diagram • Cause and Effect/Force Field Analysis • Control Chart	• Decision Matrix • Flowchart • Graph • Histogram • Pareto Diagram

When to use:

Use...	When you need to...
Action Plan	Explain implementation plans to management and workers, and ensure an organized, objective implementation.
Affinity Diagram/ KJ Method	Organize into groupings a large number of ideas, opinions, issues, or other concerns.
Block Diagram	Obtain a macro-level view of the process as it currently operates.
Brainstorming	Generate, clarify, and evaluate a sizable list of ideas, problems, or issues.
Cause and Effect Diagram	Systematically analyze cause and effect relationships and identify potential root causes of a problem.
Cause and Effect/Force Field Analysis	Identify problems, their causes, and the driving and restraining forces that affect process performance.
Control Chart	Monitor the performance of a process with frequent outputs to determine if its performance reveals normal variations or out-of-control conditions.
Decision Matrix	Select from a group of potential problems or solutions those having the greatest impact, need for attention, etc.
Flowchart	Describe an existing process, develop modifications, or design an entirely new process.
Graphs: Bar, Line, Pie	Visually display complex and quantifiable data.
Histogram	Display the dispersion or spread of data.
Pareto Diagram	Identify major factors and distinguish between the "vital few" causes and the potentially less significant ones.
Problem Definition Checklist	State specifically the improvement opportunity the team is addressing.
Tree Diagram	Define a hierarchy of needs, objectives, characteristics, or goals.

Action Plan

Description   The Action Plan is a catalogue of the activities required to ensure a smooth and objective trial and implementation of a solution. Although its format may vary, the Action Plan should identify who, what, when, where, and how and should document obstacles and advantages of the plan.

Procedure   1. Break the proposed solution implementation into steps.
2. Identify the materials and numbers of people involved at each step.
3. Brainstorm, if necessary, for other items of possible significance.
4. Add to the list until you think it is complete.

Illustration

			Action Plan Prepared *by*_____Date_____Page_____of .		
TASK ASSIGNMENT RECORD			Loc./ Proj. Period		
No.	Task/ Project	Priority Due Date	Assigned To	Date Assigned	Status/ Remarks

Affinity Diagram/KJ Method

Description   When large numbers of ideas, opinions, issues, and other concerns are being collected, this tool organizes the information into groupings based on the natural relationships that exist among them. The process is designed to stimulate creativity and full participation. It works best in groups of limited size (maximum of eight members recommended), in which members are accustomed to working together. This tool is often used to organize ideas generated by brainstorming.

Procedure   1. State the issue in broad terms (details may prejudice the responses).
2. Record individual responses on small cards.
3. Mix the cards and spread them randomly on a large table.
4. Group related cards together:
- Sort cards that seem to be related into groups.
- Limit number of groupings to ten without force-fitting single cards into groups.
- Locate or create a header card that captures the meaning of the group.
- Place this header card on top.
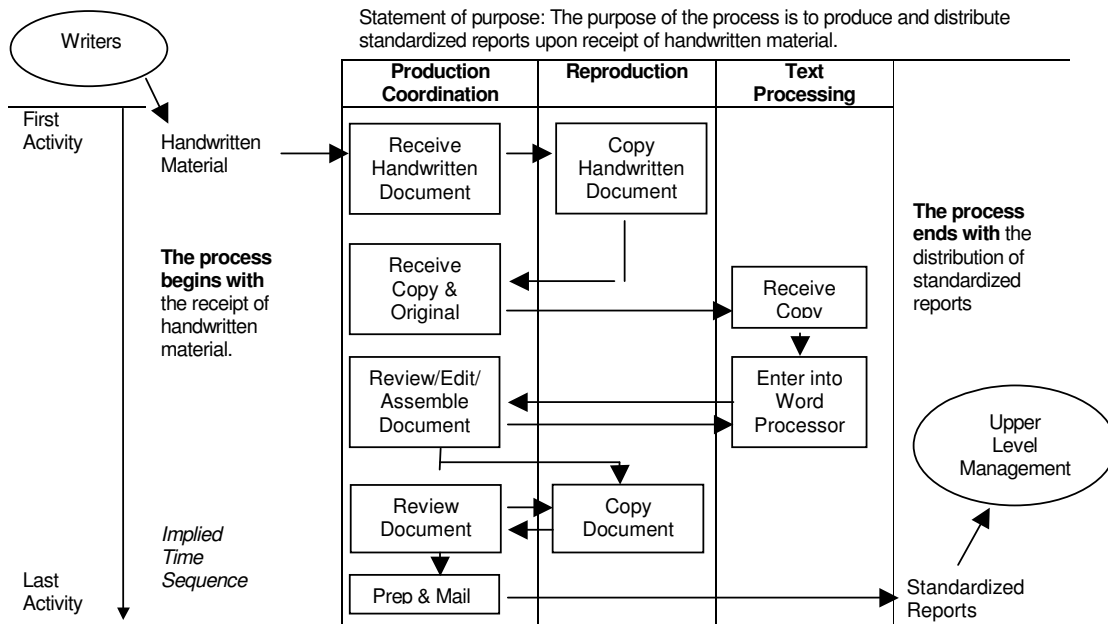5. Transfer the information from cards onto paper, outlined by groupings.

Block Diagram

Description   The block diagram helps to develop a common understanding at a high level of how the process is currently operating and how major work groups within the process interact and interface with outside organizations. The diagram traces the various paths that materials and information can take between input from suppliers and final outputs. The diagram includes individual *boxes* or *blocks* representing activities performed by individual organizations/ groups and connecting lines representing the hand-off points or interfaces between activities.

Procedure   1. Define the purpose and boundaries of the process.
2. Draw a box containing columns for
   - Each of the major work groups within your process.
   - Customers and suppliers external to the process.
   Label the top of each column with the group name.
3. For each input to your process identify the supplier and define the work activity that it feeds. Draw and label a representative activity box in the appropriate column.
4. For each activity defined, determine the output it produces, the activity or customer who receives the output, and the individual or group who performs the activity. Document this information on the diagram.
5. Label each new activity box and continue generating work/information flows and work activities until you connect into all process outputs defined to the right of the process box.
6. Verify with members of major work groups that the diagram accurately reflects the way the process currently works.

Illustration   The following figure shows a block diagram for the document production process.

Statement of purpose: The purpose of the process is to produce and distribute standardized reports upon receipt of handwritten material.

Brainstorming

Description Brainstorming is an excellent technique for tapping the creative thinking of a team to quickly generate, clarify, and evaluate a sizable list of ideas, problems, issues, etc.

- In the **Generation Phase**, the team leader reviews the rules for brainstorming and the team members generate a list of items. The objective is quantity, not quality of ideas.
- In the **Clarification Phase**, the team goes over the list to make sure that everyone understands all the items. Discussion will take place later.
- Finally, in the **Evaluation Phase**, the team reviews the list to eliminate duplications, irrelevancies, or issues that are off limits.

Rules for Brainstorming
- State the purpose clearly.
- Each person may take a turn in sequence, or ideas may be expressed spontaneously.
- Offer one thought at a time.
- Don't criticize ideas.
- Don't discuss ideas.
- Build on others' ideas.
- Record all ideas where they arc visible to team members.

Note: Brainstorming is a subjective technique that must later be substantiated by data.
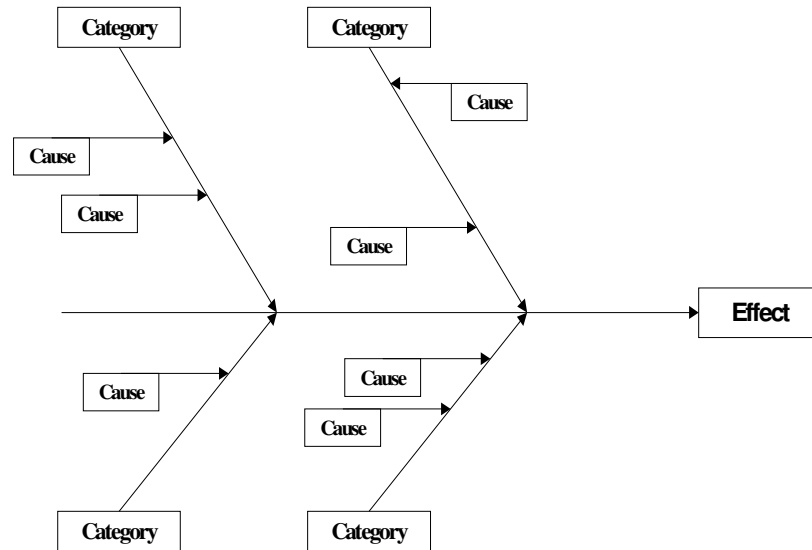
Cause and Effect (Fishbone) Diagram

Description A Cause and Effect or Fishbone Diagram represents the relationships between a given effect and its potential causes (cause and effect analysis). Cause and Effect Diagrams are drawn to sort out and relate the interactions among the factors affecting a process. A well detailed Cause and Effect Diagram will take the shape of a fishbone, hence its alias.

Procedure
1. Define the problem (effect) clearly and objectively.
2. Define the major categories of possible causes. Use generic branches.

Factors to consider include:

- Data and Information Systems
- Dollars
- Environment
- Hardware
- Materials

- Measurements
- Methods
- People
- Training

3. Begin to construct the diagram, defining the effect in a box at left and positioning major categories as "feeders" to the effect box.
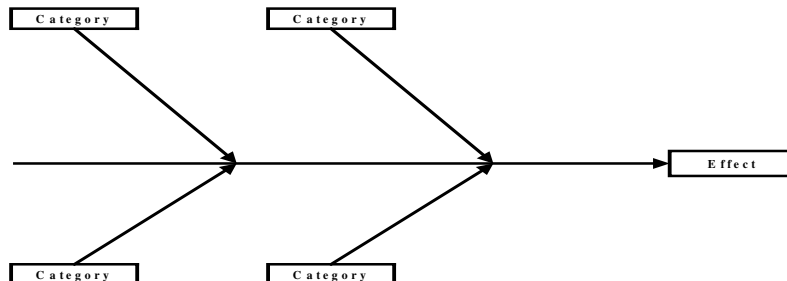
4. Brainstorm possible causes within major categories and position these to feed into related categories.

5. Analyse each cause to focus in on more and more specific causes.
6. Identify and circle the likely actionable root causes.
7. Gather data to verify the most likely root cause(s). A Pareto diagram is a good way to display this data.

## Cause and Effect/Force Field Analysis

Description Cause and Effect/Force Field Analysis (CEFFA) is a combination of Cause and Effect Analysis and Force Field Analysis. CEFFA is used to identify problems, their causes, and the driving and restraining forces that affect process performance.

Procedure 1. Select the problem.

A group of six to ten people and an individual trained in CEFFA techniques brainstorm the quality problems (*effects*) and then reach consensus on one effect that is the most significant.

2. Construct Cause and Effect (fishbone) Diagram.

Led by a facilitator, the group constructs a diagram that documents potential causes related to the effect.

3. Rank order these causes according to their level of importance.

This figure shows a rank-ordered list of causes related to failure to achieve effective implementation of a quality training and education proposal.
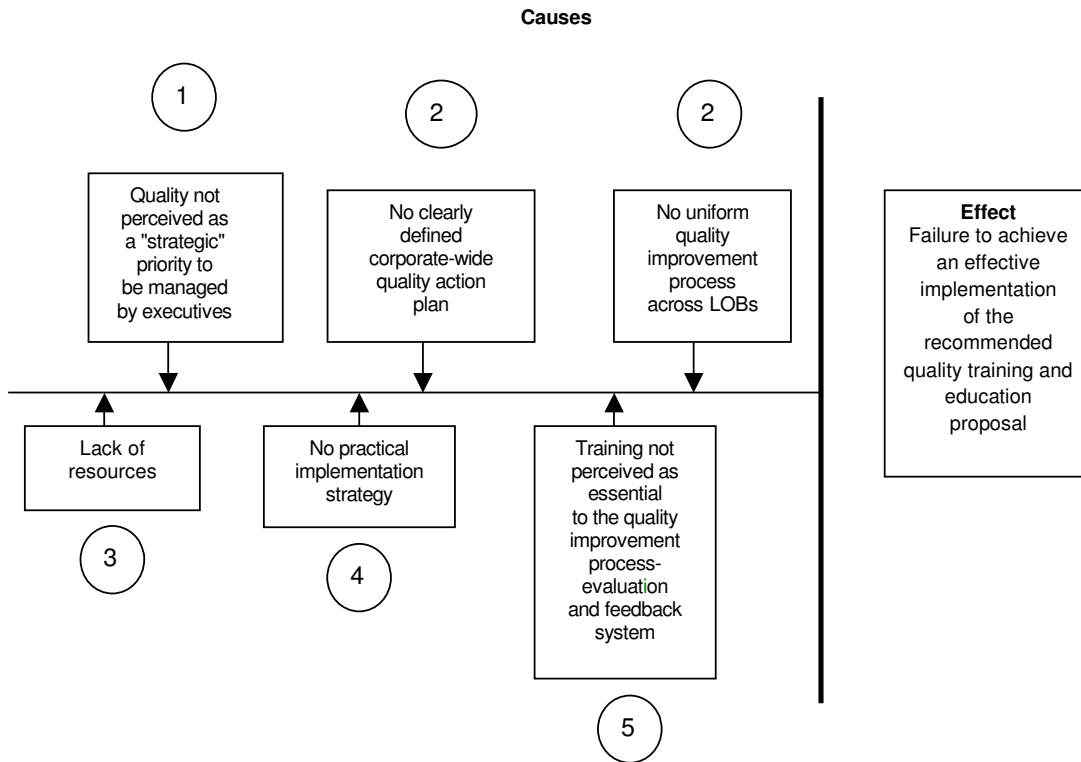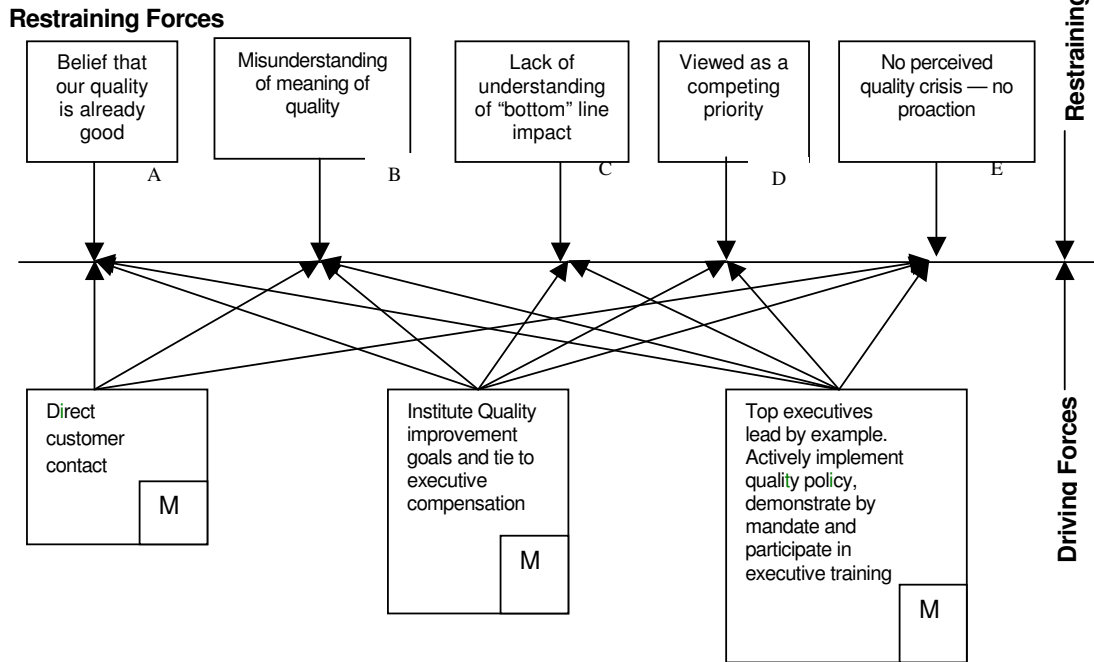
Causes

4. Perform Force Field Analysis.

The group identifies the *restraining forces* that are keeping the problem at its current level (the causes of the problem) and the *driving forces* that are pushing the problem toward improvement (the solutions to the problem).

In this figure the most important cause is identified as, "the level of perception of quality." Restraining forces push the problem *down* toward its current level, represented by the horizontal line.

Level of Perception of Quality as a Strategic Priority is too LOW

Restraining Forces
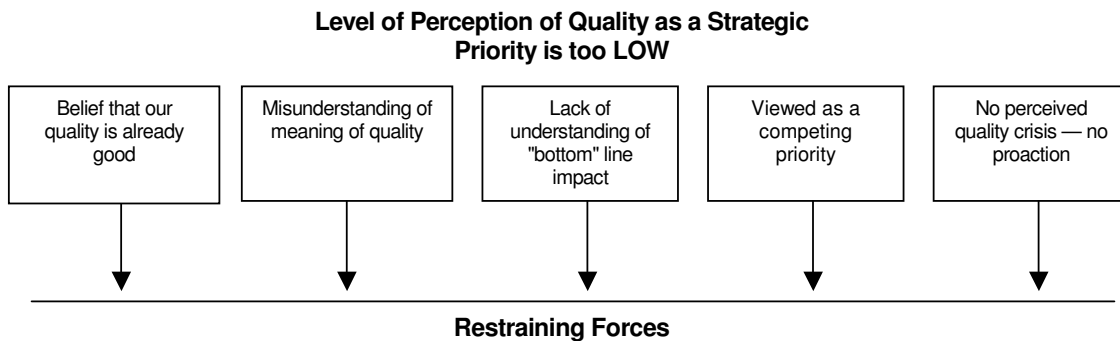
After identifying the relevant restraining forces, the group looks for driving forces to counter the restraining forces. In the following figure, the upward arrows are pointing the driving forces toward their associated restraining forces. To clarify the results, the driving forces are numbered and the restraining forces are lettered. The key lists the three driving forces and the associated restraining forces.

Level of Perception of Quality as a Strategic
Priority is too LOW

Restraining Forces

Belief that our quality is already good	Misunderstanding of meaning of quality	Lack of understanding of "bottom" line impact	Viewed as a competing priority	No perceived quality crisis — no proaction
A	B	C	D	E

Direct customer contact

M

Institute Quality improvement goals and tie to executive compensation

M

Top executives lead by example. Actively implement quality policy, demonstrate by mandate and participate in executive training

M

Restraining

Driving Forces

Driving Forces

Key	1	2	3
	A	A	A
	B	B	B
	E	C	C
		D	D
		E	E

5. Summarize the diagram.

The completed force field analysis diagram provides a list of possible solutions to the identified quality problem. Next, the group determines ownership of the problem and identifies management (M) or worker (W) alongside the respective driving force. If possible, the responsible individual should be identified by name. Since, in this example, the problem deals with a high-level strategic business issue, management owns 100 percent of the driving forces.

To complete the analysis, the results are documented and presented to the appropriate level of management for action.

Control Charts

Description
Control charts monitor the ongoing performance of a process. They show departures from a standard, objective, or average and illustrate the level of statistical control of a process over time. They can be used lo study process capability, to help define achievable quality objectives, and to detect changes in process average and variability that require corrective action.
Control charts are based on four concepts:

- All processes fluctuate with time.
- Individual points are unpredictable.
- A stable process fluctuates randomly, and groups of points from a stable process tend to fall within predictable bounds.
- An unstable process does not fluctuate randomly, and the non-random fluctuations are generally those that fall outside of predictable boundaries.

Control charts allow you to use current operating data to establish statistically normal operating limits (control limits). They can be used to determine whether fluctuation is normal (in control) or abnormal (out of control). Normal operating limits consist of the average value plus or minus three standard deviations. This gives you a "range" of normal operations that will result in some of your points appearing above the center (average) line and some below, but 99.75 percent within the boundaries of the Upper Control Limit (UCL) and the Lower Control Limit (LCL).

Using control charts
To use the control chart, you examine the location of the data points. If your process is basically consistent and stable, most of the data points fall within the established limits. Points that fall outside one of the control limits can be reported or investigated.

Continued use of the control chart can help to determine whether or not your operations are staying within established operating limits.

To obtain useful information about process performance, you must also establish customer requirements for process output and acceptable variation (which may be zero).
This constitutes process requirements. Actual output of the process is measured over time and compared with these process requirements to determine that the process is
- Out of control but capable of meeting customer requirements (process control/ management required).
- In control but incapable of meeting customer requirements (process improvement required).
- Out of control and incapable of meeting customer requirements (process control/management required; process improvement required).

Choosing the right chart
The type of Control Chart you use depends on the type of data you collect. This figure can help you to determine what type of control chart to use.
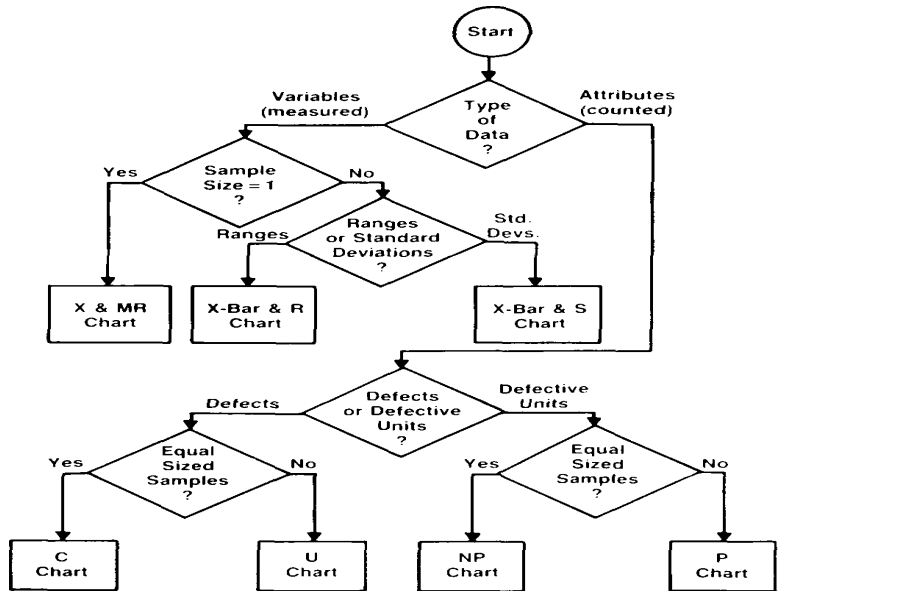
Procedure
1. Select the control chart type(s) appropriate to your data and process characteristics.
2. Decide what you want to measure, and record measurement data on the vertical axis.
3. Divide the data into subgroups or measurement intervals according to date, time, lot, etc. Plot the subgroups on the horizontal axis.
4. Calculate the average value and control limits.
5. Mark these points on the vertical axis, and draw horizontal lines from their respective values.
6. Complete the chart by plotting the observations.

Decision Matrix

Description The Decision Matrix is an evaluation tool, useful for assessing the relative impact of a problem or a potential solution.

When used to rank problems, it helps teams to identify as action items the problem areas that affect customer and business objectives.

When used to compare potential solutions, it provides insights about relative effectiveness and suggests areas where information is insufficient to make comparisons.

Procedure
1. List alternatives: problem areas or potential solutions.
2. Brainstorm selection criteria: For problems, consider customer impact, variation between customer expectations and current performance, cost of unmet expectations. For solutions, consider cost of implementation, required resources and commitments, impact on problem.
3. Rate each alternative on a scale of 1 (low) to 5 (high) for each criterion.
4. Determine overall priority by combining ratings of all criteria for each alternative.
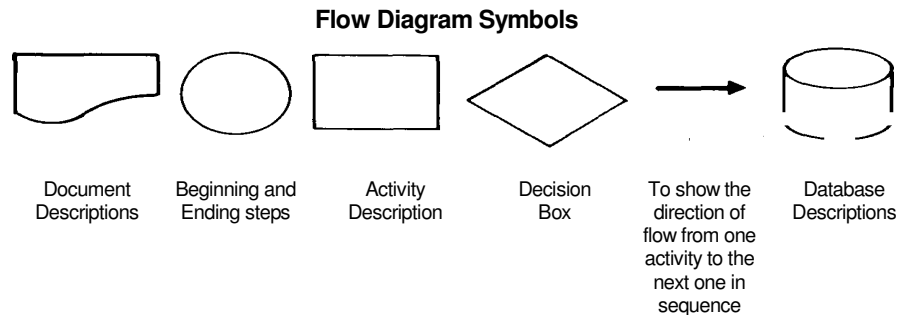
Illustration This illustration represents a template for a Decision Matrix to select from among a group of solutions.

Alternatives	Cost to Implement	Required Resources	Impact on Problem	Feasibility	Overall Rank
Solution A					
Solution B					
Solution C					

Flowchart

Description A flowchart is a pictorial representation of the steps in a process, useful for investigating opportunities for improvement by gaining a detailed understanding of how the process actually works. By examining how various steps in a process relate to each other, you can often uncover potential sources of troubles. Flowcharts can be applied to any aspect of the process from the flow of materials to the steps in making a sale or servicing a product.

Flowcharts are constructed with a set of conventional, easily recognized symbols. These symbols are illustrated below.

Flow Diagram Symbols

| Document Descriptions | Beginning and Ending steps | Activity Description | Decision Box | To show the direction of flow from one activity to the next one in sequence | Database Descriptions |

Procedure 1. List the inputs to the process or activity.

2. For each input, ask questions such as:
   • Who supplies the input?
   • Who receives the input?
   • What is the first thing that is done with the input?

3. List the outputs from the process or activity.

4. For each output, ask questions such as:
   • Who receives this output?
   • What happens next?

5. Use the appropriate flowchart symbols to show activities and decisions involved in converting the inputs to outputs.

6. Continue building the chart until you connect into all outputs originally defined.

7. Review the chart and ask:
- Do all work/information flows properly map into process inputs and outputs?
- Does the chart show the serial and parallel nature of the activities?
- Does the chart show all the potential paths work/information can take? What about   special cases such as rework loops and ad-hoc procedures?
- Does the chart accurately reflect all major decisions that are made?
- Does the chart accurately capture what really happens - as distinct from how you think things should happen or how they were originally designed?

8. Date the chart for future reference and use. It should serve as a record of how the current process actually operates.

Illustration   This process flowchart illustrates the steps that might be involved in reproducing a document
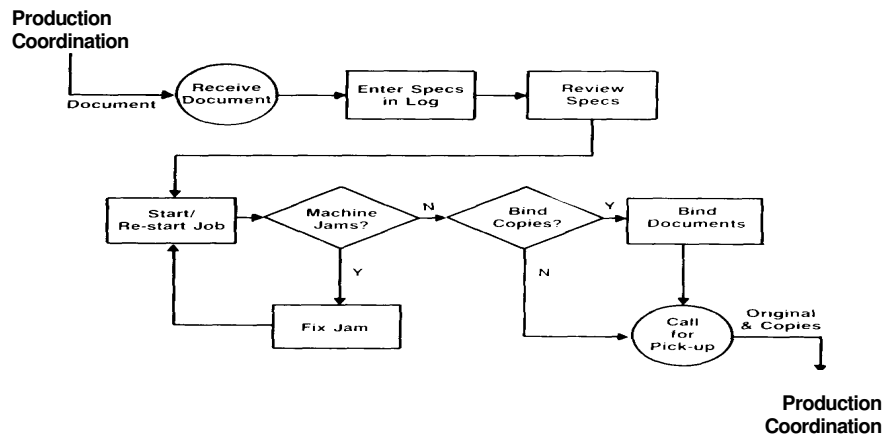
Graphs

Description   Graphs are among the simplest and best techniques to analyse and communicate data. Graphs vary in size and form, including bar charts, line graphs, and pie charts. Common elements include:
- A title explaining what is being represented.
- A vertical or Y-axis representing frequency (how many times something has happened, percentage of something, number of dollars, etc.).
- A horizontal or X-axis representing the distribution or division of the data (for example, time in days, weeks, months) or another defined category (number of data points between 7.34 and 7.45), etc.
- Clear labeling for both axes.
- A scale adjusted to best illustrate the data.
- An indication of the total number of data points represented; this is indicated by $N = \_\_\_$. As appropriate, the average of the data points should also be indicated by $\bar{X} = \_\_\_$.
- An arrow indicating positive direction.
- Information about data collection: when, where and by whom; also, if it is a percentage or average rather than raw data points, how the data was calculated (a formula).

Bar Charts description   Bar Charts show a comparison of quantities by the relative lengths of the bars representing them. Quantities may be frequencies of events in different locations, cost of different types of breakdowns, etc.

Bar Chart procedure
1. On the horizontal axis, show the items or events being compared.
2. On the vertical axis, show the quantities (i.e., frequency of events in different locations, cost of different types of breakdowns, etc.).

Bar Chart illustration

COLLECTED	
BY	
ON	
AT	
FORMULA	
N =	
X̄ =	

Units Produced
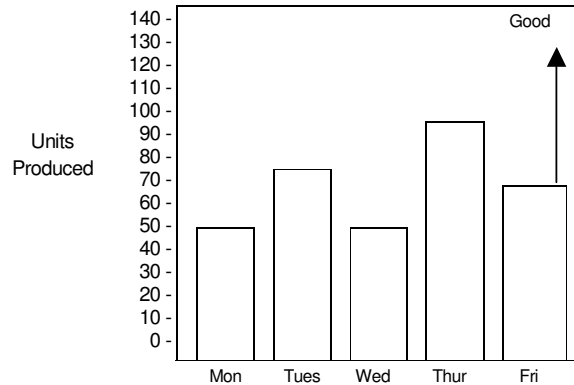
Line Graph description

Line Graphs use lines rather than bars to illustrate data. They show trend lines and description display several sets of data on one chart. If several graphs arc used for similar data, it is advisable to use the same scale for each.

Line Graphs are used to monitor process performance to identify meaningful shifts in the long-range average. Line Graphs are commonly used to graph the results of a process as they vary over time.

When using a Line Graph, you should not interpret every variation in data as an important change. Rather, you should use the chart to focus on vital long-term changes in process performance. For instance, when a series of nine points arc plotted on one side of the average, it indicates that the average has changed.

Line Graph procedure

1. Show intervals on the horizontal axis (usually time - hour, day, week, etc.).
2. Show quantities on the vertical axis (frequency of events).
3. Draw a line to connect the quantities observed on each successive interval.

If you arc using several lines, use the solid black line for greatest emphasis: your own department or actual data. Dotted lines arc for less emphasis, that is, other departments or projected data.

Line Graph illustration

| COLLECTED	
BY	
ON	
AT	
FORMULA	
N =	
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Teams
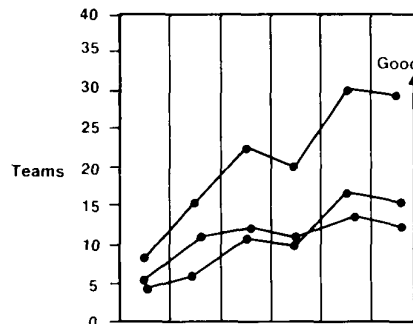
**Pie Chart
description**

The Pie Chart shows relationships among quantities by dividing a circle into wedges (like pieces of a pie) of proportionate size. It is most useful when the whole pie (circle) represents 100 percent. The size of each wedge indicates a percentage of the whole.

**Pie Chart
procedure**

1. Calculate the size of each wedge by dividing the value of each item by the total value of all items.
2. Multiply by 360 to determine the number of degrees for each wedge; use a protractor to plot the degrees accurately.
3. Divide a pie (circle) into wedges so that each represents the desired proportional part of the whole.

**Pie Chart
illustration**
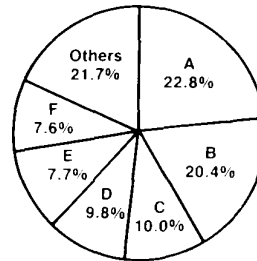
Histogram

Description

A histogram is a visual representation of the distribution of variable data. It is useful for visually communicating information about a process and for helping to make decisions about where to focus improvement efforts.

This information is represented by a series of equal-width columns of varying heights. Because column width represents an interval within the range of observations, columns are of equal width. Column height represents the number of observations within a given interval. Height, therefore, varies proportionately from column to column. With natural data there is a tendency for many observations to fall towards the center of the distribution (central tendency), with progressively fewer as you move away from the center.

Measures of Central Tendency include:
Average — The sum of all the measured or counted data divided by the total number of data points.
Mode — the most common value or class interval grouping.
Median — the value of the data point that has an equal number of points above and below it when all the data points are arranged in ascending order of magnitude. If two values fall in the middle (even number of data points), the median is the average of the two.
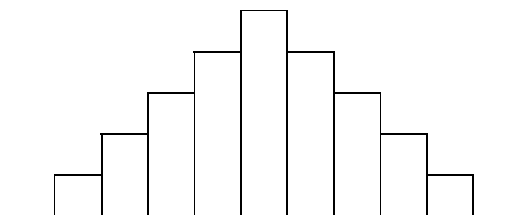
Procedure
1. Collect data; count the total number of data points.
2. Arrange the data points in ascending order.
3. Determine the range of your data: subtract the smallest data point from the largest.
4. Determine the number of columns in your histogram (between 6 and 12) and divide the range (step 3) by the number of columns to determine the width of each class interval (column).
5. Put class interval scale on the horizontal axis.
6. Put frequency scale (number or percent of observations) on the vertical axis.
7. Draw the height of each column in line with the point on the vertical axis that represents the number of data points that fall within that interval. Remember that the width is the same for each column.

Pareto Diagram

Description
A Pareto Diagram is a simple graphical technique for rank ordering causes from most too least significant. The Pareto Diagram is based on the Pareto principle, which states that just a few of the causes often account for most of the effect. By distinguishing the critical causes—what Juran calls "the vital few"—from the potentially less significant causes, you may get maximum quality improvement with the least effort.

The Pareto Diagram displays, in decreasing order, the relative contribution of each cause to the total problem. Relative contribution may be based on the number of occurrences, the cost associated with each cause, or another measure of impact on the problem:
- Blocks are used to show the relative contribution of each cause.
- A cumulation line is used to show the cumulative contribution of causes.

Procedure
1. Select the problem to be compared or rank-ordered.
2. Select the standard unit of measurement for comparison, such as annual cost, frequency, etc.
3. Select the time period to be analysed.
4. Gather necessary data on the occurrence of each cause (Examples: Defect A occurred ten times in the last six months. Defect B cost $100 in the last six months).
5. Compare the frequency or cost of each cause relative to all other causes (Examples: Defect A occurred 75 times. Defect B occurred 89 times, and Defect C occurred 50 times; Defect A cost $200 annually. Defect B cost $500 annually, etc.).
6. List the causes from left to right on the horizontal axis in their order of decreasing frequency or cost. You can combine the categories containing the fewest items into an "other" category. Place this category at the extreme right, as the last bar in the diagram.
7. Above each classification, draw a rectangle whose height represents the frequency or cost in that classification. If you record raw data on the left vertical axis with a percentage scale on the right vertical axis, be sure that the two axes are drawn to scale. For example, 100 percent should be opposite the total frequency or cost and 50 percent should be opposite the halfway point in the raw data.
8. To help interpret the chart, draw a line from the top of the tallest bar, moving upward from left to right. This shows the cumulative frequency of the categories.

Illustration
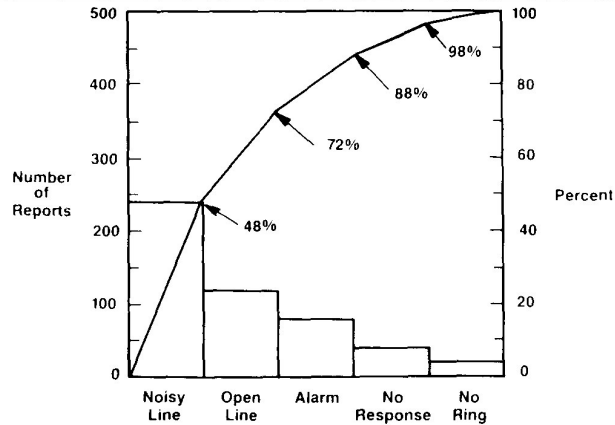
Problem Definition Checklist

Description   A well-stated problem describes what is wrong in specific, concrete terms, avoiding hidden solutions. It describes the problem in terms that are

Specific: State where and when the problem is occurring. It should locate the "pain" of the problem.

Declarative: State the problem clearly and definitely, not as a question or an incomplete statement.

Quantified: State the difference between "what is" and "what should be" in measurable terms. Some problems are difficult to quantify. However, a problem that is impossible to quantify should be re-examined.

Factual: Consciously avoid implicit assumptions about solution or cause; state only the facts. Any problem definition using "lack of," "due to", or similar phrasing implies a cause or solution.

The Problem Definition Checklist is helpful for developing a good problem statement.

Checklist   • Does the problem definition answer the questions who, what, when, and where?
Questions   • Does the problem definition focus on the effect, not the cause, of the problem?
   • Does the definition clearly describe the difference between "what is" and "what should be"?
   • Does the definition describe this difference in measurable terms?
   • Does the problem definition avoid broad categories?
   • Is the definition positive (avoiding such phrases as "lack of")?
   • Is it a declarative statement (as opposed to a question)?
   • Does it focus on the "pain" aspect of the problem (how things are affected)?

Tree Diagram

Description   A tree diagram uses a systematic approach to define a hierarchy of needs, objectives, characteristics, or goals.

The tree diagram method is best suited to:
- Translating very ill defined needs into operational characteristics.
- Exploring all the possible causes of a problem.
- Defining specific tasks to reach higher level goals.

Procedure   1. State the core issue, problem, or goal.
2. Generate all possible tasks, methods, or causes related to the statement.
3. Construct the actual tree diagram:
- Place the central issue/goal/problem to the far left of the chart.
- Find the ideas, which are most closely related to that statement.
- Place the ideas/tasks immediately to the right of the central issue.
- Focus on these as central issues and repeat the task generation steps until all of the ideas are exhausted.
- Review the tree diagram for obvious gaps in sequence or logic.
- Review with other groups for comments and recommendations.

Illustration   This figure shows a tree diagram for producing a quality document.
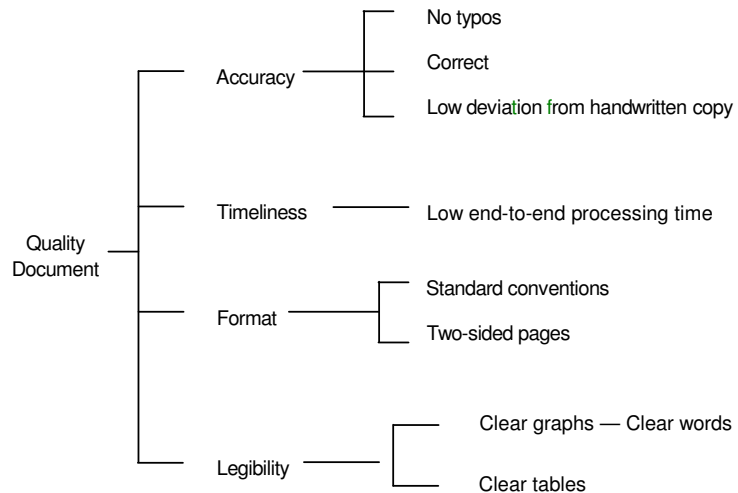
7.2   Summary

To support and develop a process of continuous improvement, an organization needs to use a selection of quality management tools and techniques. It is wise to start with the more simple tools and techniques and to ensure that the tools and techniques, which are currently employed, are used effectively before attempts are made to introduce other tools.

A planned approach for the application of quality management tools and techniques is necessary. The temptation to single out one tool or technique for special attention should be resisted, and to get maximum benefit from the use of tools and techniques should be used in combination. It should be recognized that quality management tools and techniques play different roles, while management and staff should be fully aware of the main purpose and use of these tools and techniques, they may be considering of applying within the organization; if this is not the case, they could be well disappointed if the tools or techniques fail to meet their expectations. It is also important to understand the limitations of how and when tools and techniques can best be used.

The tools and techniques should be used to facilitate improvement and be integrated into the way the business works rather than being used and viewed as "bolt-on" techniques. The way the tool or technique is applied and how its results are interpreted is critical to its successful use; a tool or technique is only as good as the person who uses it.

Tools and techniques on their own are not enough; they need an environment, which is conducive to improvement and to their use. An organization's CEO and senior managers have a key role to play in the effective use of quality management tools and techniques, they should, for example:

1) Develop their knowledge of the tools and, when appropriate, use them in their day-to-day activities and decision-making.

2) Delegate responsibility for their promotion to suitable individuals.

3) Maintain an active interest in the use of tools and the results.

4) Endorse expenditure arising from the education and training required and the improvement activities resulting from the employment of tools.

8.   TQM: Contemporary Trends and Prospects in Greece

8.1   Historic review

In Greece, the first efforts at standardization and creation of Greek standards were made in 1970, when the concepts of "standardization" and "quality control" had not yet been fully clarified by the different bodies and chambers. The result of this unpreparedness was the failure to implement quality control systems.

In 1976, the Arms Industry Office was founded, as the responsible National Office of the Ministry of National Defence for the materials, which were used by the army. This was the result of an effort that was made by the Ministry of National Defence, in order to develop an optimal way of producing qualitative products. Thus, in Greece as well as in USA, the first major step towards quality was taken in the National Defence sector. In 1978, it follows the foundation of the Hellenic Organization for Standardization (ELOT), which was mandated to establish, for the first time, a set of Greek standards.

In Greek industry, companies began to develop quality assurance systems in the 1990s. Most of these companies were subsidiaries of foreign organizations with certified quality assurance systems, and were forced to follow the quality strategy dictated by their mother company. In the beginning, the quality assurance systems propagation was rather slow, mainly due to the lack of adequate information, but soon the growth became exponential. The main reason for this was the inclusion of ISO 9000 certification within the EC procedures for the certification of industrial products, and the demand of already certified companies to their suppliers (domino effect). Since 1991, which was announced as "the Year of Quality", a large number of lectures and seminars took place, motivating Greek companies of any size to develop and implement their own quality assurance systems.

In the mid '90s, Greek companies stood somewhere between quality control and quality assurance. However, many of these companies had gained a remarkable reputation, due to their sensitivity in quality matters and their true commitment to quality. The challenge for these companies was very small, since the international standards had nothing new or revolutionary to propose. Only a slight adaptation of their quality system would be enough for their conformance to the standards' requirements. The Hellenic Organization for Standardization (ELOT) had already certified about 30 companies according to ISO 9000 standards, while a number of other companies had been certified by other foreign organizations. Most of these companies were leaders in their domain and this was expected to have an influence on their hundreds of suppliers who will be forced to create and certify their own quality assurance systems.

Till December 1999, in Greece the number of certified companies according to ISO 9000 came up to 1050. Considering the fact that in the beginning of 1993 that number was notably smaller (18 companies only), during the seven-year period 1993-1999 a rise of 5700% took place. To date, an even more dramatic increase of this number took place. Suggestively, today the number of certified companies according to ISO 9000 is more or less 1870. The rise boosted on the order of 10380%. Thus, during the last decade, the number of certified companies was raised geometrically. This reveals the importance that Greek companies gave notice on quality and on satisfaction of their costumers' demands. Furthermore, these organizations began to understand the fact that adopting an effective quality management system gives them the opportunity to systemize their processes in order to improve their overall operation. Finally, the more and more competitive environment of the enterprise area in the European Union often obliges Greek enterprises to pursue standardization according to ISO 9000.

ISO 9000 certification may prove to be not only a competitive advantage, but also a necessity. Greek companies, in order to survive in tomorrow's increasingly competitive market, must be able to produce competitive products both in price and in quality. Especially when the borders in the EC will completely vanish and laws that protect the domestic products will disappear, Greek companies will remain naked against the well-organized Western Europe competitors. It might then be the time when no one will be willing to buy from a supplier who does not possess a certified quality assurance system.

8.1.1   Quality status in the Greek Business World in the early 90's

According to a survey contacted by University of Macedonia in 199, the conclusions regarding "the level of quality culture", are presented below:

- The quality of products produced by the Greek enterprises, is not proportional to their financial power.

- After a number of telephone calls asking for the responsible employee for quality, 65% of the replies stated that there was no person at this position in the enterprise.

- The implementation of quality in Greek enterprises varies sensibly from that in foreign enterprises, which operate in Greece, mainly due to the fact that the second ones use packages already prepared by their mother enterprises.

- Greek enterprises that collaborate with foreign ones are more sensitive in matters of quality than the rest, mainly because they operate based on specifications set by their collaborators.

- There is no national policy and strategy regarding quality.

- The institution of collaboration among enterprises and educational institutions has strongly faded. Collaboration of any kind could be very profitable for both of them.

- While all enterprises acknowledge the fact that quality assurance is necessary in order to obtain a competitive advantage, in practice very few of them implement quality assurance systems or total quality management.

- The fact that enterprises environment changes rapidly obliges Greek enterprises to implement mainly short – term quality programs, while at the same time foreign ones implement medium-term or even long – term quality programs.

- The basic quality policy followed by the companies is preventing actions.

- Consumers in Greece are not organized and informed thus, not protected.

- Greek enterprises follow the philosophy of the "west type enterprises", paying much more attention to machinery, materials and the informative system than the issues of human resources.

- Quality in Greek enterprises depends mostly on senior and superior key staff than on the personnel base. It must be clarified that concerning quality matters everybody is responsible regardless the hierarchy.

- Personnel training on quality must be more intensive in order to change their attitude.

- Competitive products/services and the increase of their share in the market are the main motives for Greek enterprises to improve the level of quality of their products or services.

- There are very few enterprises, which measure quality cost. Many think of quality as a non-measurable factor.

- There is a positive reaction by personnel regarding the implementation of quality programs, proving that the quality systems implementation in Greece has prospective.

- There is no necessary infrastructure and support for quality management.

- Public and private bodies should collaborate in a better way.

Furthermore, the results presented below are based on another study contacted in 1993 by students of National Technical University of Athens, which examined the level of quality assurance systems implementation according to ISO 9000 Standards.

- Management responsibility - organization

    - The quality policy is not properly developed and defined

    - Non-detailed planning of the organizational flow chart

- Quality system

    - The Quality Assurance Manual does not exist

    - Lack of detailed documented quality system procedures

- Contract review

    - A well-organized production system provides all necessary elements in order the programming of the contracts to be accurate. This usually remains as a capability and an analytical study of each contract never carried out

- Document control

    - There are problems concerning the contents of the documents

    - Problematic document circulation and distribution system

    - Time period for the retention of records

  - Procurement

    - Inexistent systematic method for the evaluation of suppliers

- Costumer-supplied products

    - The incoming products are controlled much more than the costumer-supplied products

- Identification – Marking – Trace ability

    - Non-systematic recorded identification of all data which influence the product status tills it reaches the costumer

    - Product recall is usually not mentioned

- Processes control

  - Acceleration of the production procedures leads to deficiencies of inspection and testing

  - Lack of trial productions

- Audit – Control – Testing

  - Specification and tolerance limits are not followed.

  - Lack of sufficient quality control systems

- Monitoring – Measuring – Test Equipment

  - Rare preventive maintenance of process equipment and even more rare calibration of Measuring and Test Equipment

- Auditing and inspection status

  - Analytical procedures concerning identification of raw materials, semi finished and finished products are rarely recorded.

- Control of non conforming product

  - There is no infrastructure regarding the control of the non conforming product

- Corrective actions

  - The role of corrective actions and quality improvement groups is underestimated

  - Top management is usually not aware of the real employees working conditions therefore the suggestions made are strictly theoretical

- Storage – Packaging – Delivery handling

  - The majority of Greek Industries (pharmaceutical and food industries and other whose product are sensitive are excluded) do not take serious actions regarding material handling.

  - Material distribution is considered to be a part-time job

  - In storage areas the concept of FIFO (first in – first out) is not followed.

  - Storage conditions are not systematically observed

- Quality records

  - The majority of Greek Industries do not keep Quality records

- Internal quality audits

  - Internal quality audits are not frequently carried out, and when they are, they do not follow the procedures according to the ISO standards

- Training

    - Limited training programs per employee, per year

    - Lack of training and personal skills records

    - Employees have the old employee attitude

- Statistical techniques

    - Statistical techniques are not applied, because specialized personnel is required in order to run them

8.2   Current situation

The contents of this chapter are based on two surveys, whose characteristics as well as their differences are presented in the following table:

	First Survey	**Second Survey**
Responsible:	University of Macedonia	Euroconsultants S.A.
Year:	1996	2000
Type:	Questionnaire	Questionnaire
Range:	Greece	North Greece
Enterprises certification status:	All enterprises were certified according to ISO 9000 standards	Not all enterprises were certified according to ISO 9000 standards

Despite their differences, the results of the two surveys are similar. In the following paragraphs these results are commented, compared and significant conclusions arise.

8.2.1   The concept of the term "Quality"

Enterprises fully comprehend the concept of the term "quality" and most of them describe quality using the most up-to-date description, which is: "Quality is to correspond or even to overcome costumers expectations".

**Chart 8.1:** Enterprises opinion about the term "quality" (2000 survey)
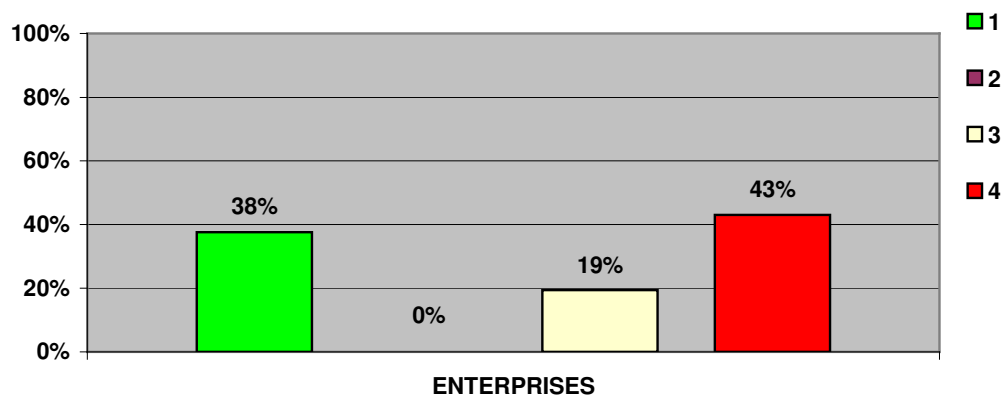
whereas:

1) Quality is the totality of characteristics of an entity that bear on its ability to satisfy stated and implied needs (ISO 8402)

2) Quality means fitness for use (Juran)

3) Quality is every single activity resulting in costumer satisfaction

4) Quality is to correspond or even to overcome costumers expectations

8.2.2 Impacts due to unsatisfactory quality products

Enterprises identify the fact that bad quality products or services is possible to have significant consequences, such as, costumers complaints, return of defective products but mainly sales reduction.

Chart 8.2: Impacts due to unsatisfactory quality products (2000 survey)
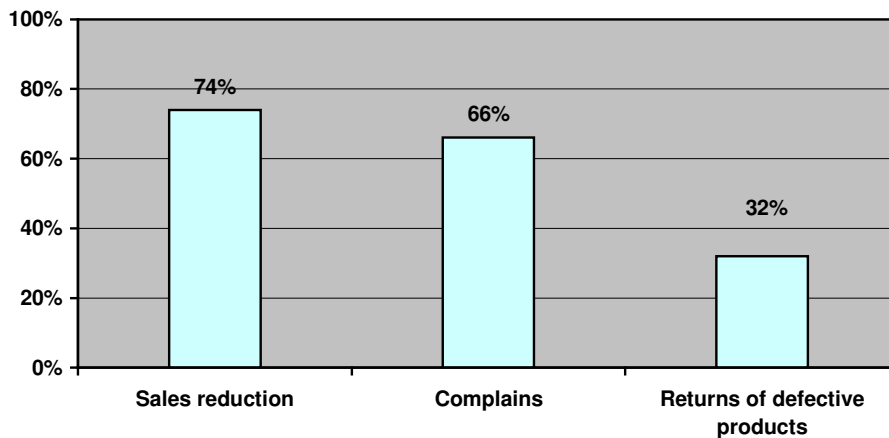
Enterprises acknowledge the fact that bad quality affects sales and consequently increases cost. However they do not follow a documentary system of measuring bad quality cost, therefore they don't have clear knowledge of the effect bad quality has towards sales. Many factors affect the increase of sales. If they are analyzed, they lead to the conclusion that quality improvement affects positively the increase of sales and simultaneously decreases the cost, much more than the enterprises believe.

8.2.3 Methodologies enterprises either use or would use in order to avoid unsatisfactory quality products

Most of the enterprises implement quality assurance systems in order to produce satisfying quality products. Only a few implement the lowest levels of quality methodologies, such as, quality control and quality audit. However, a great percentage believes that the next step after quality assurance should be Total Quality Management.

Chart 8.3: Methodologies enterprises either use or would use in order to avoid not satisfying quality products (2000 survey)
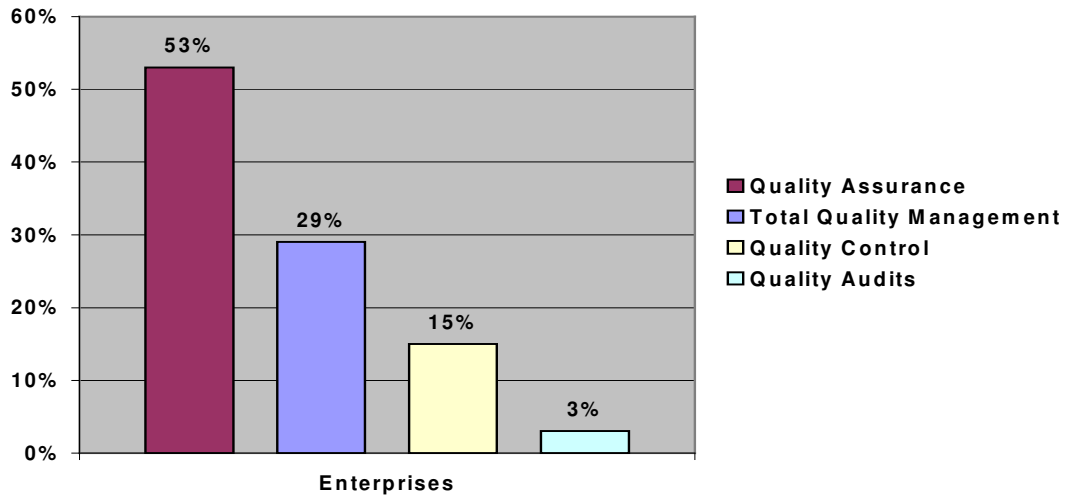
8.2.4   Specification/ Standards enterprises claim to follow

All enterprises state that their products follow certain specifications as presented in the following chart. Nevertheless, a great deal of enterprises does not have a clear view of the international or departmental specifications, as well as of the European legislation. They are focused on Greek legislation. It is necessary the centralization, possible revision or even institution of specifications for the most significant sectors of the enterprises. This can be achieved with collaboration among enterprises and their representative bodies. Moreover, the existence of a mechanism, which would provide enterprises with continuous information of relevant legislation, standards and specifications, is more than imperative. This mechanism will coordinate all information sources.

Chart 8.4: Specification/standards enterprises claim to follow (2000 survey)
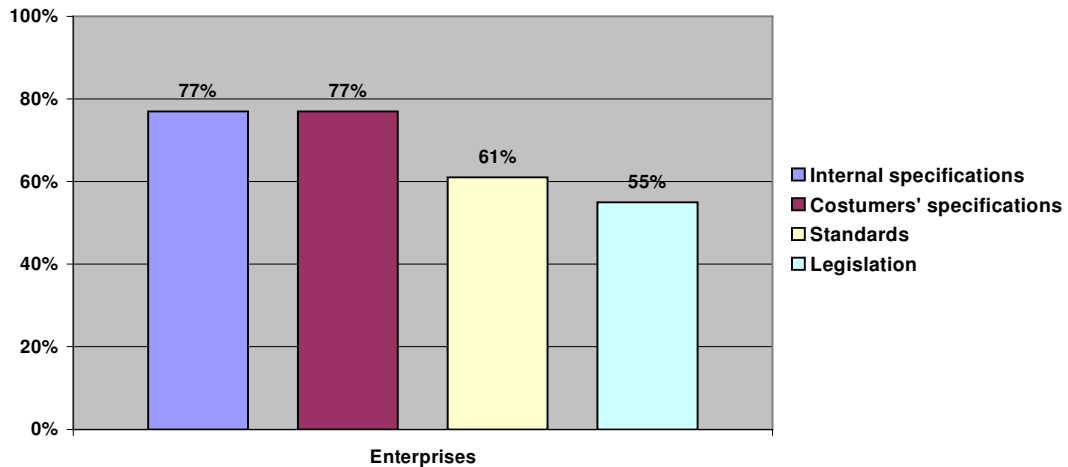
8.2.5 Enterprises distribution according certification

Nowadays, many Greek enterprises are certified according to ISO 9000 standards, while many others have already begun the procedure to implement the standards. Most of the enterprises not belonging in one of the two previous categories, implement written or unwritten rules in order to control quality. However, Total Quality Management does not interest or is not in the primary plans of the majority of enterprises. It is obvious that most enterprises are forced to follow market demands in matters of quality, while they are not aware of the fact that new techniques, such as TQM techniques, will be able to give them an even greater competitive advantage, which is not only the position of a certificate, but also a continual quality improvement on the whole of their company operation by setting measurable goals and results.

Chart 5. Enterprises distribution according their certifying process (2000 survey)


Enterpises
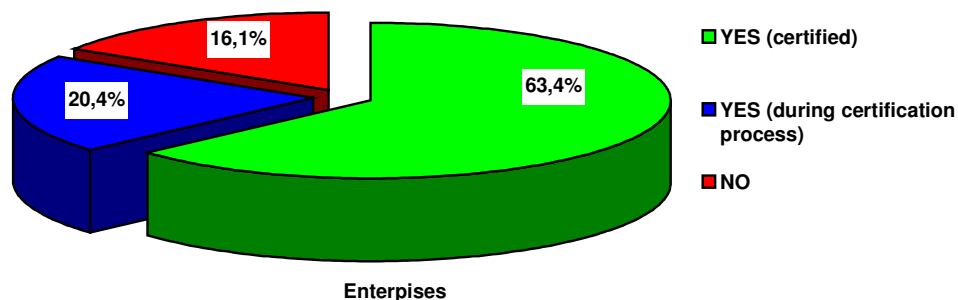
8.2.6 HACCP, ISO 14001-EMAS implementation

Very few of the food enterprises have implemented the Hazard Analysis Critical Control Points (HACCP) system. Therefore, food enterprises have not clearly understood yet, the legislation demands in matters of hygiene and safety of foods. The main reason for this is the fact that the inspection mechanism in Greece is inferior in this area. On the contrary, food enterprises are forced to apply legislation demands when this is a demand of foreign costumers, mainly Europeans and Americans, which, in many cases, audit the proper implementation by the enterprises of hygiene and safety rules.

Also, very few enterprises have been certified according the Environment Management System standards (ISO 14001 is more preferred than EMAS, which substantially is not implemented at all). It is obvious that enterprises should be more sensitive about environment protection, and the improvement of the inspection mechanism will help. Furthermore, the implementation of Environment Management Systems, as well as other relative systems, like the Occupational Health and Safety Systems, together with the implementation of quality systems, must constitute the elements of a complete management and operational system of an enterprise.

8.2.7 The Motives for ISO 9000 Certification

The improvement of internal organization of enterprises and its connection to the implementation of a quality assurance system is an obvious necessity. The most significant certification motives for the enterprises according to the first survey (1996), are: 1) the company's quality policy, 2) the quality improvement of final products, and 3) the quality improvement of internal operations.

Chart 8.6:The Motives for ISO 9000 Certification
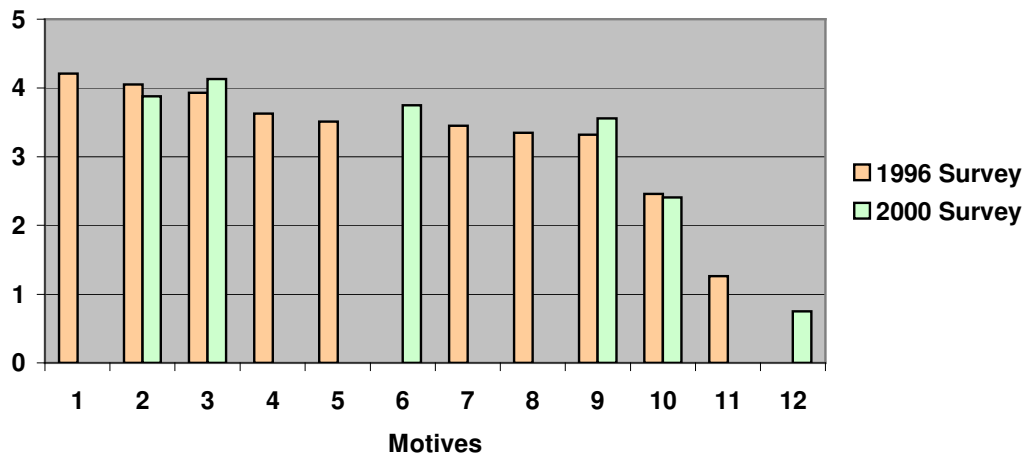
0 = Not at all, 1 = Very Low, 2 = Low, 3 = Moderate, 4 = High, 5 = Very High

Table 8.1: The Motives for ISO 9000 Certification

	Certification Motives	**1996 Survey**	**2000 Survey**
1.	Part of Quality Policy	4,21	Not asked
2.	Quality Improvement of Final Products	4,05	3,88
3.	Quality Improvement of Internal Operations	3,93	4,13
4.	Future Costumers Demands	3,63	Not asked
5.	Competitive Advantage	3,51	Not asked
6.	Marketing tool	Not asked	3,75
7.	Improvement of Internal Communication	3,45	Not asked
8.	Introduction to TQM	3,35	Not asked
9.	Entry to Foreign Markets	3,32	3,56
10.	Costumer Demand	2,46	2,41
11.	Certification of competitors	1,26	Not asked
12.	Other	Not asked	0,75

In the second survey (2000) the motive of quality policy was considered to be redundant since, nowadays, enterprises have become much more aware of the necessity of certification as a part of their quality policy, compared with 4-5 years ago. This fact is proved by the grate increase of the number of certifications that took place n Greece during the last 2 years, as we have already mentioned in a previous chapter. The inversion of the significance of the motives "Quality Improvement of Final Products" and "Quality Improvement of Internal Operations" in the two surveys imply the fact that enterprises have become more mature and believe that the quality improvement of Final Products comes as a result of the quality improvement of Internal Operations.

Also, in the second survey (2000) the motive of introduction to TQM did not appear due to the fact that enterprises during the last few years started to understand more and more that the introduction to TQM prerequisites, as a first step, the certification according ISO 9000 Standards.

As far as the rest motives concerned, the motive of "Marketing Tool" holds a rather high position in the hierarchy of the second survey (2000) while in the first survey the specific motive is divided into several motives such as "Future Costumers Demands", "Competitive Advantage" and "Improvement of Internal Communication".

Finally the motive of "Entry to Foreign Markets" is higher in the second and more recent survey due to the more intense export character that enterprises have nowadays.

The fact that the "Company Quality Policy" is the most significant certification motive in the first survey, verifies the claim that the standards offer a well-structured tool to "start with quality", for those companies that become quality aware and they want to improve their quality management system. Although the ISO 9000 standards assure the quality of the production process and not the quality of the products themselves, companies hope/expect that the improvement of the production process will finally also improve the quality of their final products. Enterprises have made a very positive step, recognizing the fact that product quality improvement comes as a result of implementing a quality system. This proves the sensitivity of companies towards quality and their desire to improve it.

Finally, the third most important motive for certification, which is the "Quality Improvement of the Internal Organization and Operations", is truly claimed to be one of the main benefits offered by the standards implementation.

The gain of "Competitive Advantage", and the satisfaction of "Future Customer Demand", proved to be secondary motives, while two of the motives that represent the so-called "force to certification', "Market Pressure" and "Competitor's Certification", came last in the hierarchy in a long distance from all others. These two motives, together with three others, which are the "Improvement of Internal Communication", the "Introduction to Total Quality Management (TQM)" and the "Costumers Demand" prove that certification in the Greek industry is mainly a result of internal motivation for real improvement, instead of companies pressure or enforcement towards this direction. This finding is particularly important and encouraging, because the pressure for certification, which encourages quick and easy application of the standards, together with the seek of certification mainly for advertisement and short-term competitive advantages, are said to be two of the most important and frequent reasons for the long-term failure of the standards. Lack of true leadership commitment and/or the existence of serious time constraints for certification, deprive companies some of the main advantages of certification, which are employee participation, teamwork, and re-evaluation and improvement of key business processes before their documentation.

8.2.8   Problems – Difficulties enterprises deal with through implementing a Quality System

According the survey that took place in 2000, the primary difficulties enterprises deal with through implementing a quality system are: the growth of bureaucratic procedures, employees adaptation to the quality system specifications and the finding of specialized personnel.

Chart 8.7: Problems – Difficulties enterprises deal with through implementing a Quality System (2000survey)
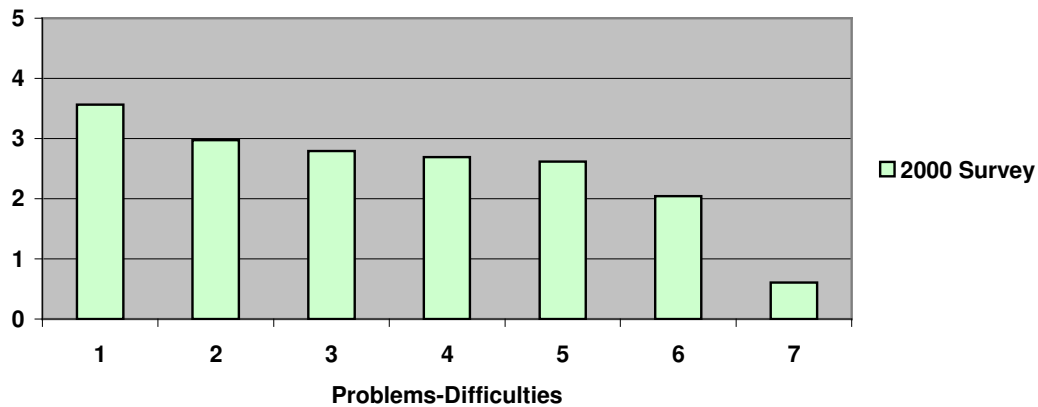
0 = Not at all, 1 = Very Low, 2 = Low, 3 = Moderate, 4 = High, 5 = Very High

Table 8.2: Problems – Difficulties enterprises deal with through implementing a Quality System

	Problems - Difficulties	2000 Survey
1.	Increase of bureaucratic procedures	3,57
2.	Employees' adaptation	2,97
3.	Finding qualified personnel	2,80
4.	Suppliers/ subcontractors adaptation to company specifications	2,69
5.	Staff adaptation	2,62
6.	Finding of material resources	2,04
7.	Other	0,61

The problems and difficulties are presented below analytically:

- The wrong understanding of the ISO 9000 standards might cause the growth of bureaucratic procedures through implementing a quality system, which is considered to be a disadvantage for the enterprises, as well as for the relevant bodies (consultants, certification bodies). The new ISO 9000:2000 standard is expected to improve this situation. Furthermore, the usage of up-to-date integrate management information systems could embody the demands of the quality system concerning data documentation, data transfer and filing, resulting in the reduction of bureaucratic procedures.

- The finding of qualified staff and the training of the already existing personnel upon modern management techniques can be the first and primary step towards an overall change of culture and attitude. It can also provide great help in enterprises modernization in order to adapt easier not only to a quality system demands but to the more general demands of modernization, considering the rapid development of technology.

- It must be clarified that the investment on personnel training and specialization is equally or ever more significant with the investments on specialized equipment, which, in most of the cases, cannot operate without the properly specialized personnel. A representative example, which takes place very often, is investments on personal computers and software without the existence of properly trained personnel, the result of which is PCs to operate faulty without the full utilization of their abilities.

- It is very difficult to change the quality culture of the company and convince everybody for the usefulness of the necessary changes. It requires great effort from the management, because what are really needed are not only the certification but also the development of the quality culture.

- The development of a Quality Assurance System, demands great effort and group work. At least in the initial phase of the implementation there will be a significant increase in workload for everybody.

- Serious problems are possible to arise when the people who define and document the processes, differ from those who have to apply them. Employees cannot commit themselves to processes that they do not approve and find inadequate.

- Disappointment may arise when a huge number of problems and deficiencies that exist in today's system will be realized.

- Disputes may arise between members of the company, when they are searching for causes of the problems and of the people who are responsible for them. This is a policy mistake and should be avoided, since we should only be interested in "what" and "who" caused the problems.

- Another difficulty is to change the buying policy, from the "cheapest supplier" in the market to the "suitable cheapest supplier" in the market.

- In Greece there is a lack of well-trained and experienced internal quality auditors. This is a serious problem, considering the importance of internal quality audits for certification.

- The cost for the development and certification of a Quality Assurance System may be too big for a small company to afford it.

- Great problems are also possible to arise from the necessary changes in the organizational structure of the company. Some employees try to take advantage of the new opportunity to empower their position in the company. Others fight to maintain their current position and the power they already have. Some of them react negatively because they feel threatened and inconveniently with the change of the status quo, while others find this as an opportunity to express their personal disagreements and contrasts with their colleagues or with the company in general. All these attitudes may sabotage the whole effort, and can be handled with effective management.

- A last difficult point is the choice of the right Body of Certification, among the great number of them that are available today. The company must choose the most suitable for its needs and the one that is widely accepted and appreciated.

8.2.8.1 How could an ISO 9000 implementation fail

The reason ISO 9000 implementation may fail is not the inadequacy of the Standard but company inability or unwillingness to implement it correctly. The real benefits of the Standard can be achieved only if the company that implements it realizes both its potential and its limits. Some common reasons for its failure described below:

- Absence of Management Commitment seems to be the main reason for the failure of many ISO 9000 programs. It is caused when the management fails to understand the magnitude of the effort and the commitment that is required. For this reason, the project should begin only after the management realizes its magnitude and decides to fully support it. True commitment means not only

provision of the necessary means, but also active involvement in all phases of the process, from design to implementation and to maintenance.

■ Very often there are severe time constrains imposed by the market, forcing companies to achieve certification in the shortest possible period of time. This distorts the learning process and encourages bad implementation.

■ Sometimes, top management uses ISO 9000 as a means to "escape" from its own responsibility towards quality. They know they must do something to assure and improve the quality they offer and so they decide to implement the ISO 9000 Standards. Once certification is achieved, they relax and think that they have finished with quality and that they should stop worrying about it. In these cases the "burden" of quality is resting totally on the Quality Assurance System and its certification and is doomed to fail.

■ For many companies certification becomes an end in itself. Managers seek certification just for the sake of it, worrying only about how to achieve and preserve it. ISO 9000 is implemented by satisfying only the minimum necessary requirements that assure certification, while anything more is considered as a waste of money and time. Certification is viewed only as a tool to compete in the domestic and international market, and not as a means of adding value to the organizational process and improving quality, productivity, performance and profitability. But although certification is in effect a significant tool for entering wider markets, its competitive advantage can very easily be lost, once competitors get also certified. The real long-term value of certification lies in the development of a solid quality assurance system that is continuously tested and improved.

■ Another mistake that companies may do during the development of their Quality Assurance System, is to document the already existing procedures and activities without first re-examining them to detect errors, inefficiencies, or redundancies. In fact, companies simply document their sub-optimized system. In these cases, they are deprived of one of the main benefits of Quality Assurance, which is the reassessment, improvement and redesign of its ineffective or non-value operational processes.

■ Finally, some companies relax on their certification, assuming that they have achieved the desired level of quality, and they do not need to be concerned with it anymore. They think that Certification is the end of their efforts, while in fact it is only the start. A Quality System must be dynamic, continuously adapting to the variable external requirements. Therefore, the right way to implement the standards is to combine standardization with improvement. The cycle should be: "standardize – test – improve – standardize".

8.2.8.2 Conclusion

The effectiveness of the ISO 9000 standards depends mainly on the way of developing and implementing them by each and every company. The main reason for quality assurance, according to ISO 9000 standards, failure, is not the deficiency of the standards itself, but the inability or the lack of willing of the companies to implement them properly. ISO 9000 standards offer the ability to the companies to develop an effective and dynamic quality system witch main target would be constant improvement and adoption as long as there is commitment and disposal on behalf of the company in order to utilize this ability. The key is the depth in which each company is willing to proceed according the satisfaction of the standards demands. Companies that satisfy the necessary demands for certification in the most minimized possible way have no prospect on taking advantage of the true potentialities of quality assurance systems, and it is almost certain that failure will befall. On the contrary, enterprises who deal with matters of quality assurance in a way of internal organization and labor set-up, will be truly availed and will be able to create a dynamic

quality system, with goals for continual improvement and a possible evolution of it in a Total Quality System (TQM).

8.2.9 Benefits gained by implementing a Quality System according to ISO 9000 Standards

The application of ISO 9000 standards in Greece was delayed, because the benefits of their implementation cannot be measured and quantified. However, according to the managers of the Greek companies that implement them, the benefits are many, and can be divided in internal, external and National.

8.2.9.1 Internal Benefits

The ISO 9000 Standards:

- Provide a new method for managing companies and improving competitiveness without any extra technical investment.

- Modernize the internal organization and operation of the company, according to the latest improvements.

- Aid in the establishment of clearly defined responsibilities and operational rules at the production level, reducing improvisations of the employees.

- Provide direct instructions to everyone involved in the company, through carefully documented procedures. Thus, they ensure a uniform and properly distributed communication and an effective control of all procedures, even in cases of staff recruitment or staff movements to different work positions.

- Offer a systematic approach to personnel training.

Also,

- The high level personnel are now free to deal with the more important matters of research and technology, instead of the everyday problems that are now assigned to the low level employees.

- The sensitivity of personnel in quality matters increases, since they all become more quality aware.

- The relations between the different departments are improved. In addition, the relations between management and employees and between employees themselves are improved, since all the above relations are now clearly defined and documented.

- There is an increase of employees productivity due to the systematic approach to the work operations and the well defined and streamline interface between functions.

- The internal quality system audits in order to detect shortages, deficiencies or non-value added activities, help continuous improvement with a serious reduction in operational costs. Written procedures are continuously examined for their effectiveness and redesigned whenever necessary.

- There is reduction of variation and improvement of products and/or services quality. Since the procedures that produce the products are established, the quality of the products is standardized too.

- There is a reduction in quality cost due to the reduction in scrap, rework and product returns.

- The recording data, aid managerial decision-making and analysis of bad quality causes. Decision-making is now based on facts and not on management instinct.

- The short, three year period, that the certification is valid, and the frequent, usually every one year, external surveillance audits from the Certification body, oblige the manufacturer to maintain and develop his own quality system. Otherwise, the application of the system might fade. The Internal Benefits for both surveys are presented in **Chart 8.8**

Chart 8.8: Internal Benefits

0 = Not at all, 1 = Very Low, 2 = Low, 3 = Moderate, 4 = High, 5 = Very High
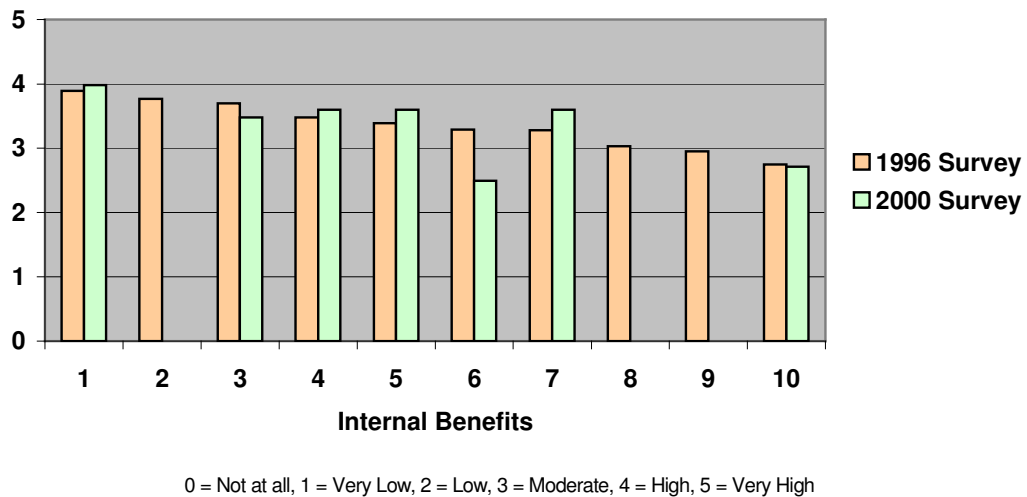
Table 8.3: Internal Benefits

	Internal Benefits	Survey 1996	Survey 2000
1	Improvement of internal organization & operation	3,89	3,98
2	Development of quality culture	3,77	Not asked
3	Final product quality improvement	3,7	3,48
4	Development of teamwork	3,48	3,60
5	Improved employee-management relationships	3,39	3,60
6	Less rework & waste	3,29	2,49
7	Better relationships among employees	3,28	3,60
8	Increase of employee satisfaction	3,03	Not asked
9	Increase of employee participation	2,95	Not asked
10	Increase of productivity	2,75	2,71

According to both surveys, ISO 9000 standards set a strong basis for companies organization, since internal organization and operation improvement is proved to be the most important benefit. This also justifies the intention of Greek companies for internal operations improvement as one of their basic motives for getting certified. The improvement of product quality, although indirectly related to standards implementation and certification, was proved to be a very important benefit, justifying again its second position in the overall hierarchy of certification motives. Finally, the

results support the claim that the ISO 9000 standards can help the introduction of a company to TQM, since, according the first survey (1996), the second most important certification benefit was proved to be the development of a quality culture.

The change of culture is found to be the first most significant problem/obstacle for TQM adoption, while it is also said to be one of the main determinants for the success of any TQM program. The standards contribution towards this direction becomes very significant for those companies interested in further quality improvement and adoption of Total Quality Management. The change of culture boosts quality awareness and commitment throughout the company, highly increasing the probabilities for long-term success.

The "Development of Quality Culture" benefit did not appear in the second survey (2000), due to the fact that the drastic increase of the number of certified enterprises the last two years caused the gradual realization of the necessity of the "quality philosophy – culture" development in the enterprises.

While in the first survey (1996), the "Final Product Quality Improvement" benefit took the third place in the hierarchy, in the second survey (2000) was placed below the benefits related with the improvement of internal communication and collaboration relationships, proving that the last two years enterprises started to realize more and more the necessity for certification. Finally, the "Increase Productivity" benefit is considered to be moderate according to both surveys.

8.2.9.2 External Benefits

The ISO 9000 Standards

- Offer a strong competitive advantage.

- Provide satisfaction of the market demand or pressure.

- Result in more satisfied clients, and easier attraction of new clients.

- Increase company reputation and trust in its products.

- Unify the criteria used from different customers for evaluation of the companies quality assurance system.

- Offer better evaluation and clarification of suppliers due to the existence of clear and specific supplier evaluation criteria and reduce the incoming material inspection costs.

- Support and facilitate the exports wherever these exist. They aid n faster and more secure penetration in new, especially external, markets.

Finally, the widespread compliance with international standards can help an entire industry to protect itself from competition. "ISO 9000 will create a barrier for new companies to enter a market, based on low price".

The External Benefits for both surveys are presented in **Chart 8.9**.

Chart 8.9: External Benefits

0 = Not at all, 1 = Very Low, 2 = Low, 3 = Moderate, 4 = High, 5 = Very High
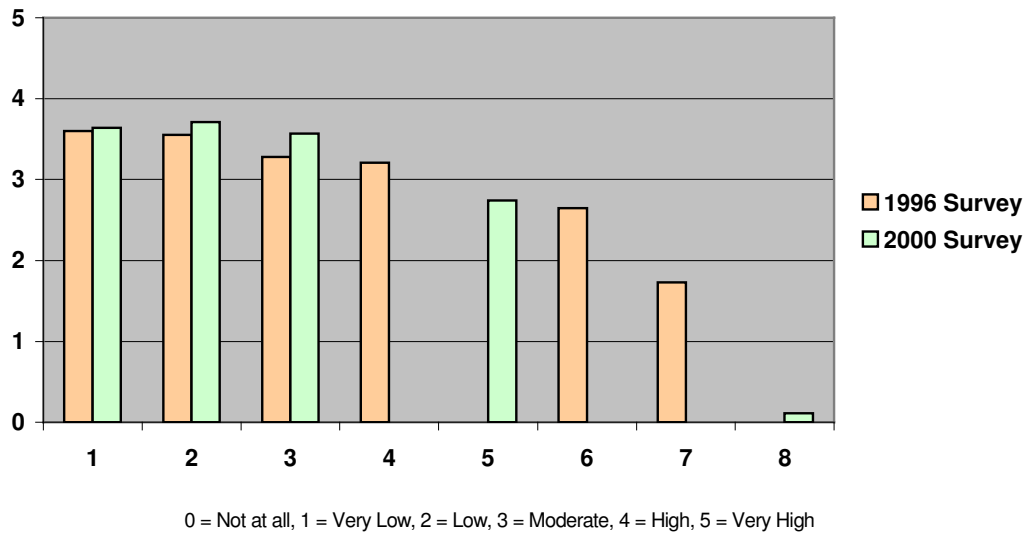
Table 8.4: External Benefits

External Benefits	Survey 1996	Survey 2000
1. Improvement of relations with costumers	3,60	3,64
2. Improved competitive position	3,55	3,71
3. Improved suppliers performance	3,28	3,57
4. Easier penetration to new markets	3,21	Not asked
5. Improvement of relations with suppliers/ subcontractors	Not asked	2,74
6. Higher profits	2,65	Not asked
7. Reduction of absences	1,73	Not asked
8. Other	Not asked	0,11

According to both surveys, improvement of customer relations and improved competitive position are the most significant external benefits. The costumer is particularly positive and encouraging for the long-term success of the certified enterprises. On the contrary, competitiveness improvement, although positive for the short-term, cannot alone guarantee an enterprise's success in the future. The short-term competitive advantage of certification can very easily be lost once an enterprise competitor gets also certified.

The higher score of "Improved Competitive Position" benefit in the second survey (2000), than in the first (1996), comes as a result of the wide spread of Quality Systems in the marketplace. Nowadays, the market believes that the possession of a quality certificate by an enterprise is a very significant competitive advantage. Also, supplier performance is being improved day-by-day, because they have also entered the sphere of certification. Suppliers' certification has improved the quality of their products and services towards the supplied enterprises. This justifies the higher score of "Improved Suppliers Performance" benefit in the second survey (2000) than in the first one (1996).
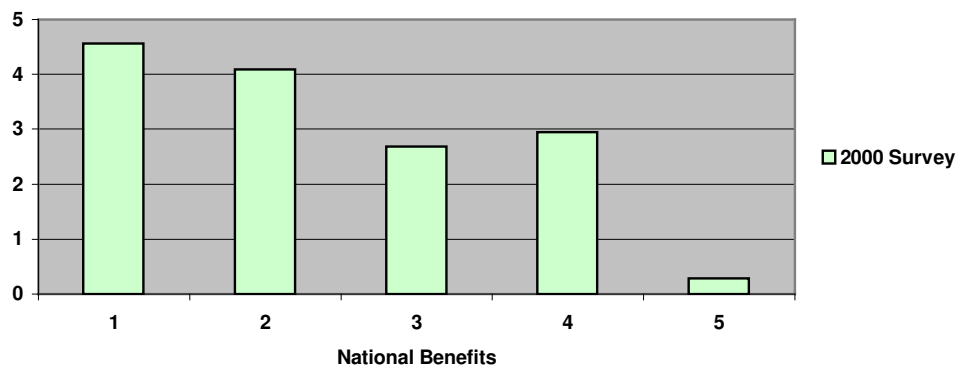
8.2.9.3 National Benefits

The benefits of Greek National economy through quality assurance systems implementation and propagation by Greek enterprises are:

1) Trust to Greek products and step-up of their mane throughout the International market.

2) Improvement of competitiveness of Greek enterprises

3) Increase of employment, mainly for qualified staff in quality.

Chart 8.10 presents the results of the 2000 survey according National Benefits.

Chart 8.10: National Benefits

0 = Not at all, 1 = Very Low, 2 = Low, 3 = Moderate, 4 = High, 5 = Very High

Table 8.5: National Benefits

National Benefits	Survey 2000
1 Confidence in Greek products	4,56
2 Competitiveness improvement	4,09
3 Added value increase	2,68
4 Employment increase	2,95
5 Other	0,29

On the contrary, enterprises do not acknowledge an increase of their products added value but see an increase of their market share, as a result of the expansion of their costumers and the greater stability of their already existing costumers.

More detailed information of enterprises about quality awards and the specific role of the European Foundation for Quality Management (EFQM), can lead them to try to acquire relevant quality awards, in order to upgrade their name and furthermore to improve the general image of Greek products in the European market.

8.2.10 Certification contribution towards TQM performance

The first survey (1996) gives an answer to the ISO 9000 effectiveness debate, proving that the development and certification of an ISO 9000 quality assurance system really

Chart 8.11 presents the performance improvement achieved in each one of the eight basic TQM categories, in the ISO 9000 certified Greek enterprises.

Chart 8.11: Performance on the Basic TQM Categories Before & After ISO 9000 Certification

0=Not at all, 1=Very Low, 2=Low, 3=Moderate, 4=High, 5=Very High
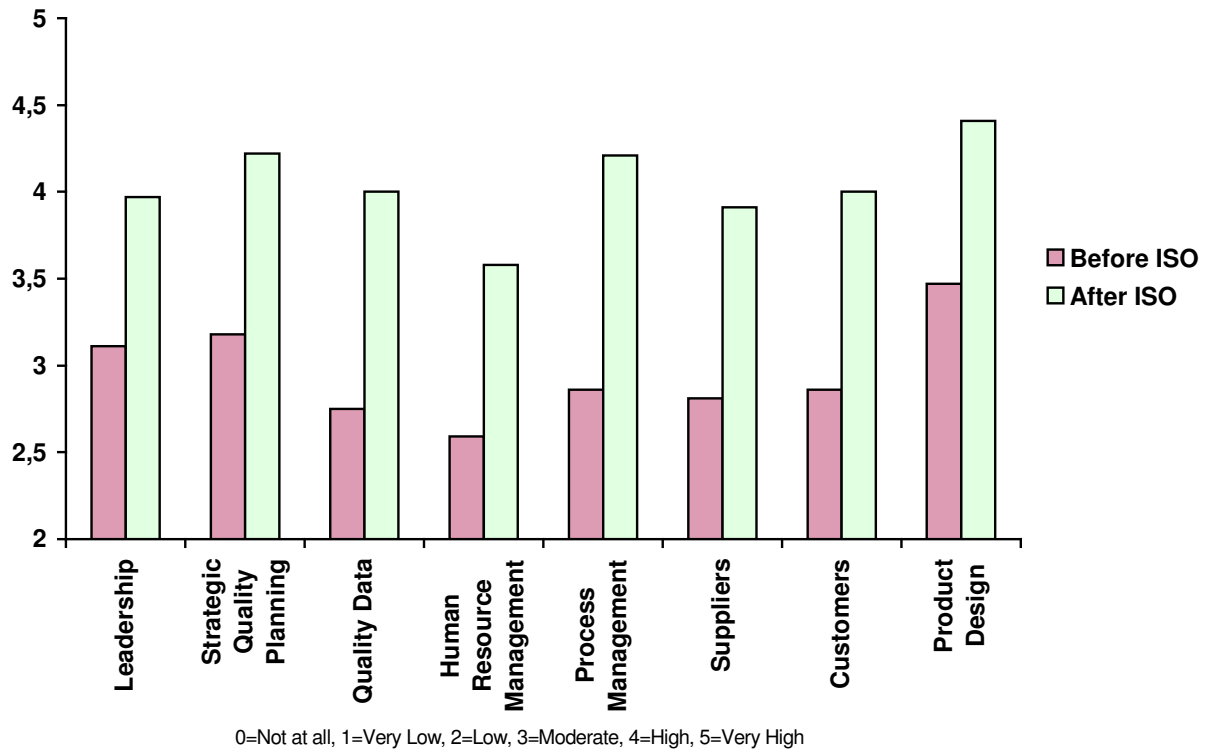
The most important contribution of the standards was in the category "Process Management". This was more or less expected since the standards mainly concern the development, standardization and documentation of those processes that directly affect quality. Thus, while the mean performance in this category before certification, was less than moderate, after certification it reached very high levels, mainly by increasing the systematic documentation and control of critical processes and products quality, which provides a solid basis for future improvement. Generally, the process management methods and techniques become more preventive than detective, since the standards require tighter controls during, instead after the production process, preventive maintenance and calibration of equipment, errors prevention at the product design phase, and clear definition and standardization of duties and responsibilities. On the contrary, there is little, if any improvement (the lowest in this category) regarding system flexibility, which was the only question in which some companies (seven) declared an even negative effect as a result of certification, an argument that is frequently made by the standard's opponents.

Also is less encouraging the dramatic increase of incoming materials supervision and control after certification. Although this increase helps in assuring the quality of the materials, and thus the quality of the final products, it contradicts with the TQM philosophy, according to which, excessive quality controls of incoming materials should be replaced by mutual trust and co-operation between the company and a small number of carefully selected and reliable suppliers. The same happens also for the final products controls, which also highly increase, although to a lower degree, after certification. This increase also adds cost to the final product without really adding value to it, and should ideally be replaced by trust in the production process and by the philosophy of "do it right the first time". Deming's (Deming, 1982) point "Cease dependence on massive inspection", and Crosby's (Crosby, 1979) slogan "Do things right the first time" are indicative of the TQM philosophy on this matter. However, before a enterprise reaches the point where it can really trust its operations, excessive

quality controls are necessary in order to assure the quality of the products that reach the customer and to avoid the enormous cost of dissatisfied or disappointed customers. Dramatic improvements in the operations process can really increase enterprise trust in it and decrease the need for excessive quality controls. On the other hand eliminating quality controls in order to improve operations would be a disaster.

Also, the contribution of ISO 9000 standards to the monitoring and use of "Quality Data" is very significant. This category has the poorest performance before certification. However, the improvements in this category are mainly related to the monitoring and keeping of quality data, and less to their real processing and evaluation for fact-based decision making and quality improvement.

The standards contribution is also very significant in enterprise performance in the category related to "Customers". Although this contribution is not as high as in other TQM categories, it proves to be very important because it improves areas with very poor performance before certification, but also areas, which are vital for customer satisfaction and enterprise survival in the future. Particularly positive is the improvement it offers in complaints handling and processing for the quality improvement of products and/or services.

Significantly lower is the improvement in the category "Human Resource Management", which was the one with the lower performance both before and after certification. The results in this category are impressive, proving that Greek enterprises have very low performance before certification, almost the lower of all TQM elements, in issues related to human resource management. Particularly low is their performance relative to employees training and education in quality related issues, in methods and techniques for quality improvement, in the development of employee participation programs and systems for formal proposals submission, in employee evaluation, appraisal and continuous training, in offering formal incentives for quality improvement, participation and contribution to decision making, as well as in recognizing those who contribute towards quality improvement. For the majority of the companies, the improvement they have in these issues, as a result of certification, is almost zero, although it increases for enterprises with very poor performance before certification. Thus, it seems like human resource management constitutes the most challenging and demanding category for those enterprises that want to proceed to TQM, since its requirements are not adequately addressed by the standards.

Regarding the enterprises relations with their "Suppliers", a highly positive result is the increase of quality significance, related to the significance of cost and time, in choosing suppliers. On the contrary, there is very little improvement, as a result of certification, in the development of close partnership, mutual trust, and parallel growth with suppliers, all of which are highly stressed in the TQM philosophy.

The greatest improvement in the category "Product Design", was achieved in the clarity of the product and process design specifications, in the totality of new product tests and inspections before entering the market, and in customer requirements analysis at the product development phase, all of which are particularly important for customer satisfaction.

Finally, the category with the lowest improvement from certification is the category concerning "Leadership". At first, this observation looks particularly discouraging, since the role of leadership is commonly agreed to be decisive for the success of every effort, and particularly for the adoption of TQM. However, performance in this category may not be very high after certification, as desired, but it does get improved from the standards implementation, while particularly promising for the long term success of enterprises, is the fact that the highest score after ISO 9000 certification in this category, was top management's commitment to quality and the importance of quality as a strategic competitive weapon.

Great improvement is also achieved in the evaluation of the managerial system, in the frequency of quality issues discussions in top management meetings, and in the development and monitoring of quality goals in the business plan.

Evaluating the certified companies TQM performance after their certification, we found it quite good in most TQM categories, and especially in "Product Design", "Strategic Quality Planning" and "Process Management", although their performance in specific elements of those categories must be further improved. On the opposite, there is need for more effort in the areas of "Human Resource Management" and "Suppliers Relations", which have the lower after-certification performance. The role and importance of the human factor in improving quality and increasing customer satisfaction has been strongly stressed by all TQM authors, and so employees commitment and participation is regarded as necessary for the successful adoption of TQM.

More specifically, it is proved that certified enterprises performance is particularly high in TQM elements directly related to the final product quality, like quality control of processes and final products, recording and availability of quality data, and the role of the quality department, while it is particularly low in elements less directly related to final product quality, but equally important, like employee motivation and participation for quality improvement, employee training in quality improvement methods and statistical techniques, employee encouragement for offering suggestions and proposals, development of partnership and technical support of suppliers, and finally, systematic monitoring of customer satisfaction and comparison of this satisfaction to the one offered by competitors.

8.3   Quality and Competitiveness of Enterprises

Greek enterprises produce and sell their products to the final consumers and to other companies almost equally. 17% of Greek enterprises are addressed only to the final consumers, while 28% of them are addressed only to other companies.

Chart 8.12: Interviewed Enterprises By Type of the Market
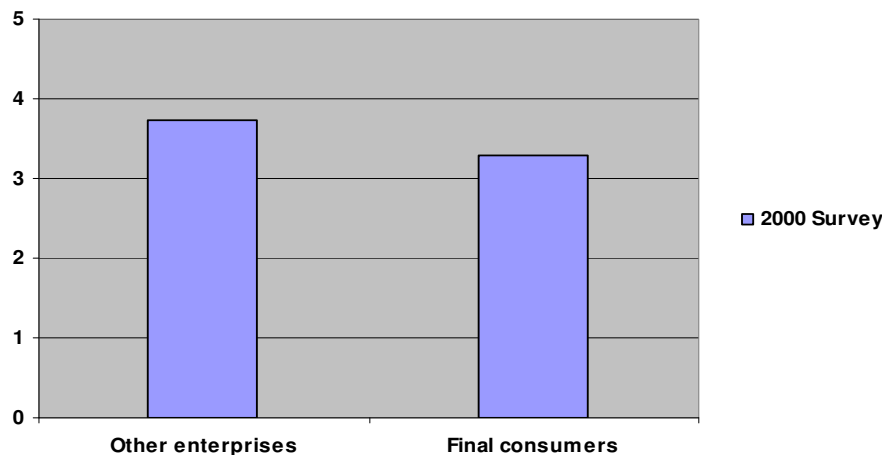
0 = Not at all, 1 = Very Small, 2 = Small, 3 = Secondary, 4 = Main, 5 = AllBoth final consumers and industry have high quality demands.

Chart 8.13: Quality Demands by Type of the Market
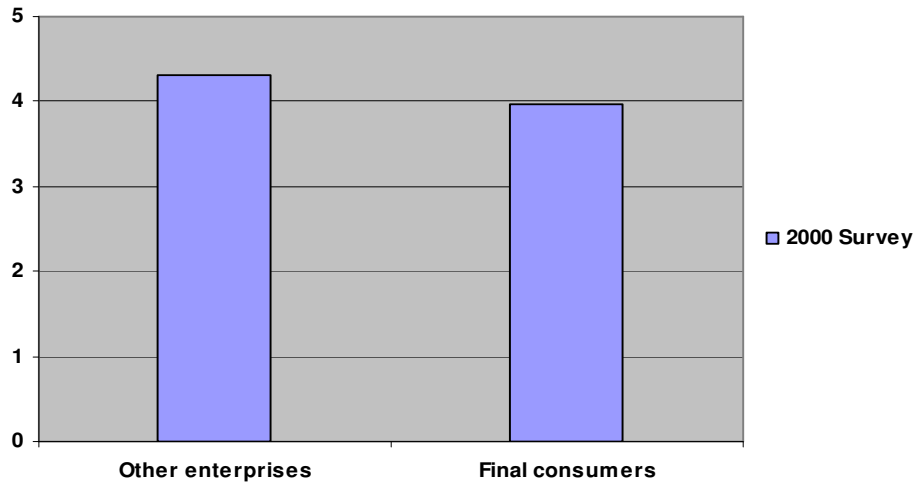
0 = Not at all, 1 = Very Low, 2 = Low, 3 = Moderate, 4 = High, 5 = Very High

For Greek enterprises, the local market is the main market, but exports play also a significant role. A great volume of exports goes to E.U. countries, while the Balkan countries market as well as other markets such USA and Cyprus hold an equal share of exports.

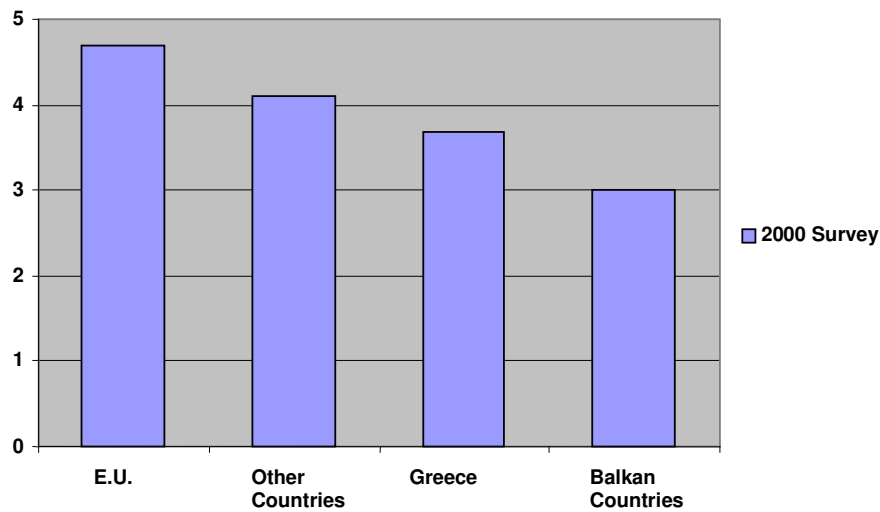**Chart 8.14:** Interviewed enterprises by Location of Costumers
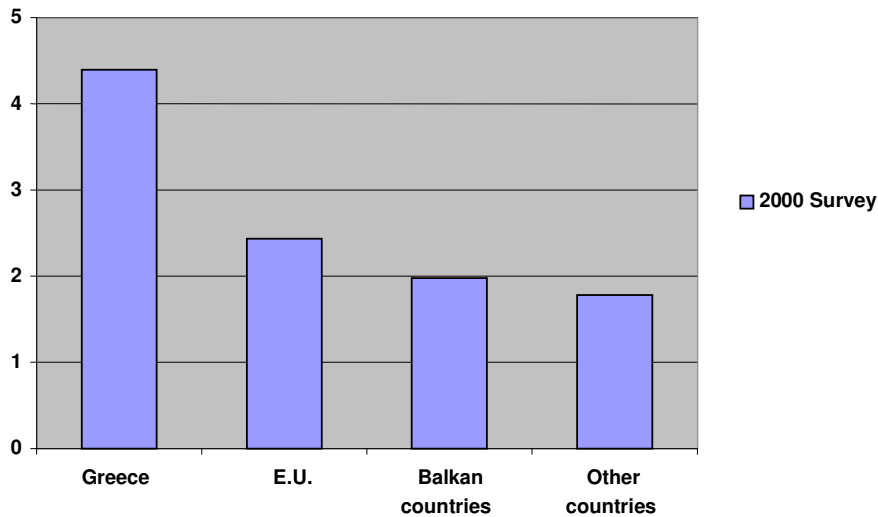
0 = Not at all, 1 = Very Small, 2 = Small, 3 = Secondary, 4 = Main, 5 = All

The quality demand of Greek and Balkan markets is lower than that of foreign markets. E.U. countries of are more demanding than USA countries.

Chart 8.15: Quality demands of the Domestic and Foreign Markets

0 = Not at all, 1 = Very Low, 2 = Low, 3 = Moderate, 4 = High, 5 = Very High

In satisfying customer needs Greek enterprises facing a number of difficulties. The most important of them are:

■ Fluctuation of the quality of raw materials especially the agricultural one

■ High production cost

■ High cost of quality control

■ Lack of qualified personnel

On the other hand, the lack of information for quality issues, legislation, environment and new technologies is not considering main difficulty.

Chart 8.16: Sources of Difficulties for Satisfying Costumers Needs
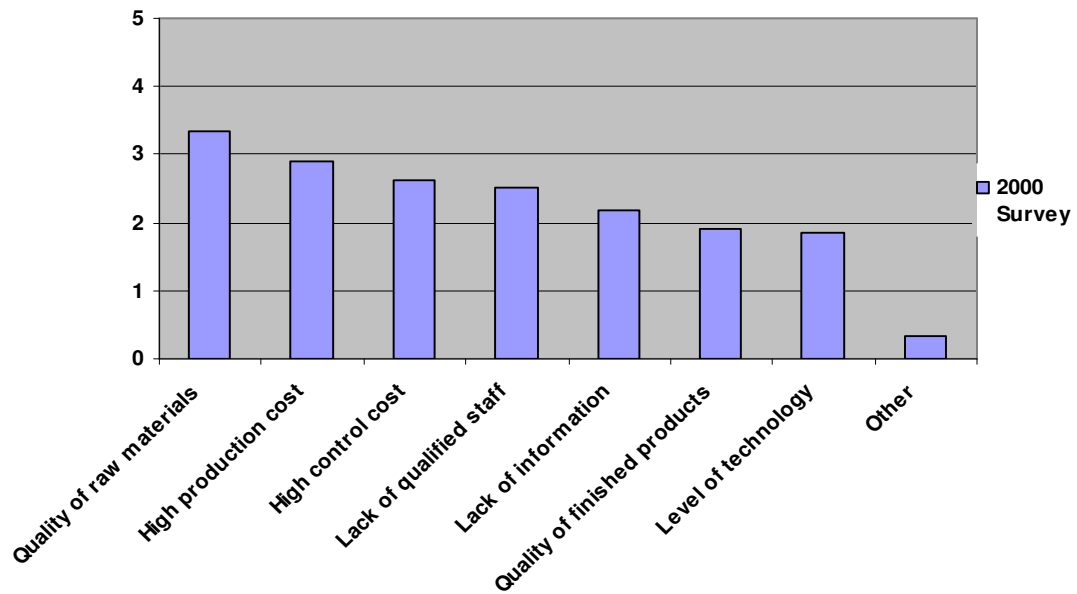
0 = Not at all, 1 = Not Important, 2 = Less Important, 3 = Moderate, 4 = Important, 5 = Very Important

In order to overcome these difficulties Greek enterprises believe that they should focus and invest on:

■ Staff training

■ Improvement of quality control procedures

■ Evaluation and relationships with suppliers

■ New qualified staff

■ External cooperation for quality matters

■ Renewal of mechanical equipment

■ Laboratory equipment

Chart 8.17: Instruments for Improvement of Quality
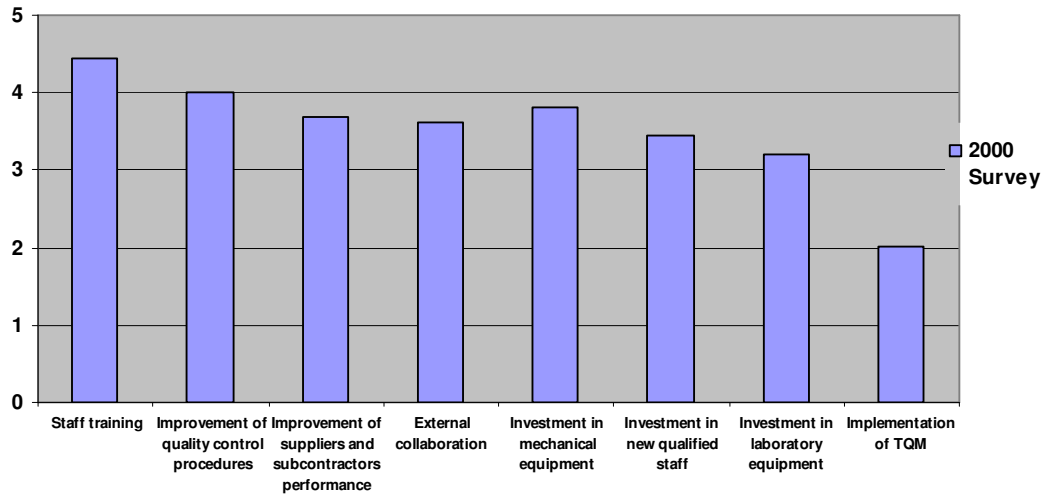
0 = Not at all, 1 = Not Important, 2 = Less Important, 3 = Moderate, 4 = Important, 5 = Very Important

On the contrary, Greek enterprises do not consider TQM such important tool to overcome quality difficulties, because they believe the TQM implementation it is premature. It is important the QMS to be wide spread and fully implement before Greek enterprises move to Total Quality.

8.4   Prospects

Greek enterprises face strong competition from the international environment. In order to survive this competitive environment, the state has focused on the development of a National Quality Policy based on a specific Strategic Plan, which supports the competitiveness, the development of enterprises, the introduction of new technology and the employment. The objectives of the National Quality Policy are:

■   Congruity of the national quality infrastructure to the one of the European Union.

■   Improvement of enterprises competitiveness and development of National economy through the upgrade of the quality Greek product and services.

■   Increase of exports and reinforcement of the credibility of Greek products and services.

■   Reinforcement of the position of Greece in the sector of quality services in an international level and mainly in Balkans and southeast Europe.

■   Consumer protection from products dangerous for their health.

■   Environment protection.

■   To avoid unfair competition by cost reduction due to Quality diminution.

The above-mentioned objectives can be accomplished by the following strategic measures:

1)   **Reinforcement of National Quality System, which constitutes the necessary infrastructure for the implementation of Quality Policy.**

The National Quality System is based in four pylons:

a.   **Standardization**

b.   **Accreditation**

c.   **Certification**

d.   **Metrology**

a. The objective of **Standardization** is to produce Standards that will be used for the standardization of products and services and for the control of their conformance according specific requirements.

The basic measures standardization foresees are:

■   Integration of European Standards and directives in the National Standardization.

■   Expansion of Standardization in the sectors, related to critical or dynamic products of Greek economy.

■   Standards Creation for products certification.

■   Creation of specifications for small-medium/ very small enterprises for management systems that will be adapted according to their needs and abilities.

The Hellenic Organization for Standardization (ELOT) is the body responsible for the implementation of the National Standardization Policy.

b. The Objective of **Accreditation** is the control of the proper operation of certification bodies, auditing, control, testing laboratories according to EN 4500 standard because this is a necessary requirement for the recognition of the certifications they assign.

The basic measures Accreditation foresees are:

- The creation of a National Accreditation Body.

- The reinforcement of certification bodies, auditing, control, testing laboratories in order to apply for accreditation from the National Accreditation Body.

The Hellenic Council for Accreditation (ESYD) is the body responsible for the implementation of the National Accreditation Policy.

c. The Objective of **Certification** is to control the compliance of products and services according to specific standards and to assign certificates and Quality marks. Certification is provided by public or private bodies, which have been accredited from the National Accreditation Body.

The basic measures Certification foresees are:

- The reinforcement of creation of relevant mechanisms and certification bodies.

- The expansion towards product certification systems especially in sectors interesting for the National Economy.

- The expansion of Certification towards new management systems (e.g. health and safety).

- The reinforcement of the existing and the creation of new testing laboratories.

- The training of the personnel of the certification bodies and of the testing laboratories.

d. The Objective of **Metrology** is to assure the credible operation of calibration and testing laboratories for the measurement devices.

The basic measures Metrology foresees are:

- The completion of the statutory frame of metrology.

- The completion of the system and infrastructure of the National Metrology System.

- The development of standards, methods and measurement techniques.

- The reinforcement of a National Institute of Metrology in order to provide specialized education to scientific and technical personnel.

The Hellenic Institute for Metrology (EIM) is the body responsible for the implementation of the National Metrology Policy.

2) Provision of motives for the enterprises in order to

- To adopt and implement Quality Standards

- To win Business Excellence Awards

The objectives of these reinforcements (subsidies) are:

■ The certification of enterprises according to ISO 9000 standards

■ The improvement and completion of enterprises production activities through the implementation of modern management systems for quality, health and safety, environment, etc.

■ The ecological reorientation and the introduction of a friendly environmental technology in enterprises production activities.

■ The specialization of t enterprises personnel in Quality.

3) Reinforcement of quality products and services demands through consumers' information in quality matters – Reinforcement of Business Excellence.

Business Excellence is defined as the operational model of an enterprise aiming at the balanced satisfaction of competitiveness and the quality improvement.

In the frame of reinforcement of Business Excellence, the establishment of institution of a National Reward of Quality and National Recognition in enterprises is anticipated, which reach specific levels of Business Excellence.

By this measure Greek enterprises are encouraged to develop proper management systems and internal processes that lead to integrated and upgraded services and furthermore to the balanced satisfaction of the consumers, the employees, the stockholders as well as the general public.

4) The Assurance of the National Quality System utilization and the production of quality products and services through the creation of a monitoring and supervising system of the market.

One of the basic factors of sustainability of assurance of Quality Policy is the development of a culture of demanding quality products and services by the consumers and the public opinion. In order to succeed this, the following measures are suggested:

■ The creation of sensitization/information mechanisms of the public opinion in matters of quality.

■ The creation and implementation of an action plan of sensitization/ information per groups – goals.

■ The promotion of introduction of concepts and lessons relevant to quality in all stages

9.   TQM: Contemporary Trends and Prospects in Bulgaria

9.1 Description of the Survey

The survey was conducted in the second half of May 2001. The method of registration was personal interview using a questionnaire **(Annex A)** and carried out with the high managerial staff of the selected companies. The total number of the interviews conducted was 46 but only 40 of them were considered eligible after the logical examination of the questionnaires.

The survey covered several Bulgarian cities - Sofia, Plovdiv, Varna, Rousse and Stara Zagora. The distribution of companies by location is given on **Chart 9.1**

Chart 9.1: Location of the Interviewed Companies
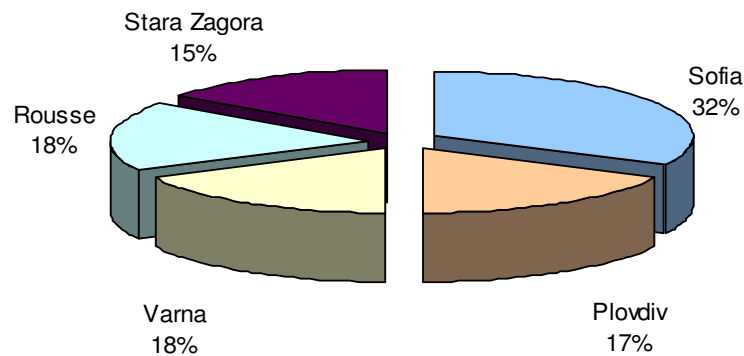
The sample was divided between two main types of companies:

- Companies implementing ISO 9000 quality management systems (certified or not certified)

- Companies that are <u>not </u>implementing ISO 9000 management systems

The companies to be interviewed were randomly selected. The sectoral distribution of companies is given on **Table 9.1**.

Table 9.1: Distribution of Companies by Sector

Sector	Number	Percent
Machine building	13	32.5
Metal working	9	22.5
Textile and apparel	5	12.5
Chemistry	4	10
Electromechanical industry	3	7.5
Wood processing and furniture	2	5
Services	2	5
Food industry	1	2.5
Construction	1	2.5
Total	40	100

9.2 Business Organization Concerning Quality

9.2.1 Definition of Quality

The predominant part of the interviewed managers of the Bulgarian companies relates quality to the satisfaction of customer needs. Thus about 95% of the managers of the interviewed companies select definition of quality in which satisfaction of customer needs is an integral component (**Chart 9.2**).

Chart 9.2: Definition of Quality
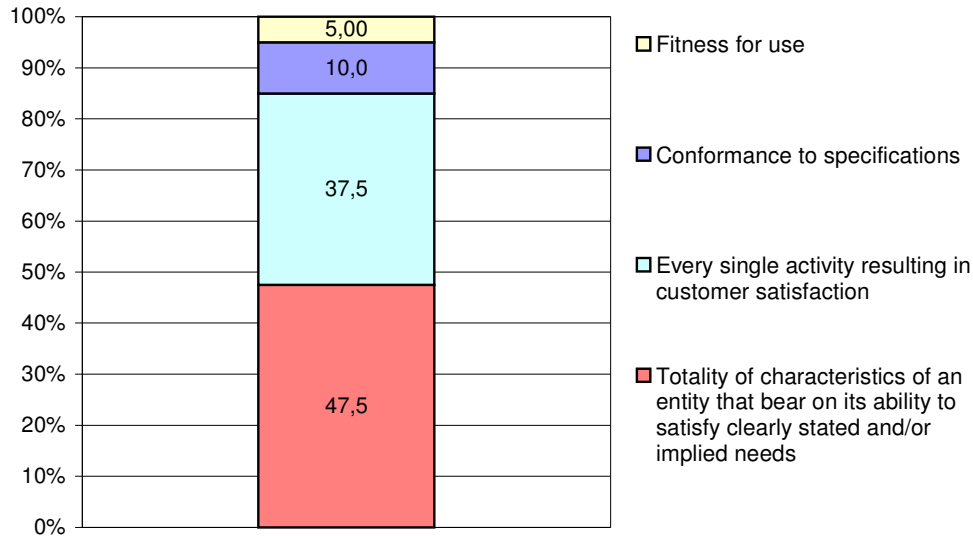
The major difference between companies is on whether they relate quality to the process or to the product. Thus 47% of the interviewed consider that quality is the totality of characteristics of the product satisfying customer needs. Quality as an activity resulting in customer satisfaction is a guiding definition of 38% of the companies.

There are no significant differences in the accepted definition of quality by sector of activity or market of the company.

9.2.2 Quality management methodology

About half of the interviewed companies respond that they have total quality management system. Quality assurance is accepted as a methodology in 26% of the interviewed companies. The quality control or inspection of the final product is done by 23% of the interviewed companies (see **Chart 9.3**).

Chart 9.3: Quality Management Methodology
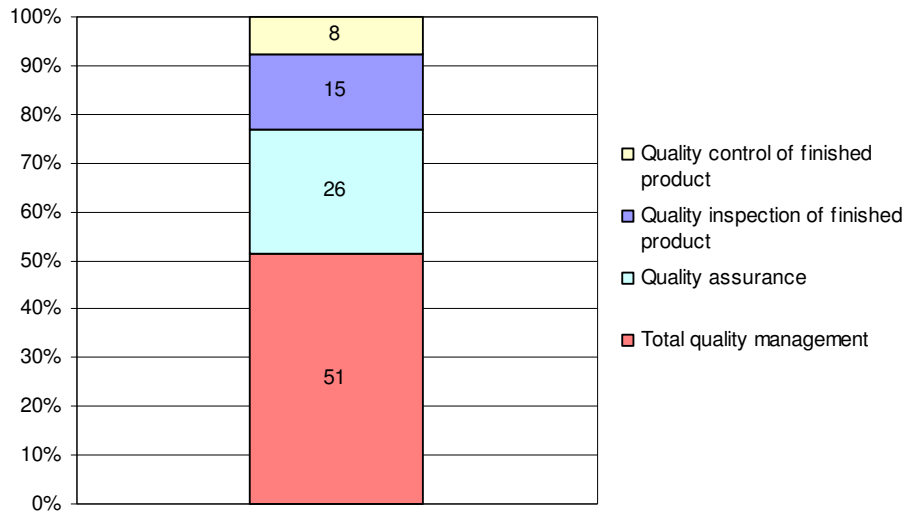
It should be noted however that some 17% of the companies give more than one answer to the question of the methodology of quality control. This is typical for the companies that are not ISO certified. About quarter of not ISO certified companies respond that they apply all possible approaches for quality management – from quality inspection of the final product to total quality management. This may imply that some of the ISO certified companies do not clearly distinguish between the different approaches for quality management. In any case it should be noted that about 30% of the not ISO certified companies respond that they apply quality assurance approaches and another 30% - total quality management system.

There are some differences in quality management systems by the type of the market of the company. The major is the difference between quality management methodologies of exporting and non-exporting companies. As it could be seen from **Chart 9.4** the share of companies that follow total quality management systems among exporting companies is considerably higher – 78% of exporting companies compared to 29% of non-exporting.

Chart 9.4 Quality Management Methodologies of Exporting and not Exporting Companies
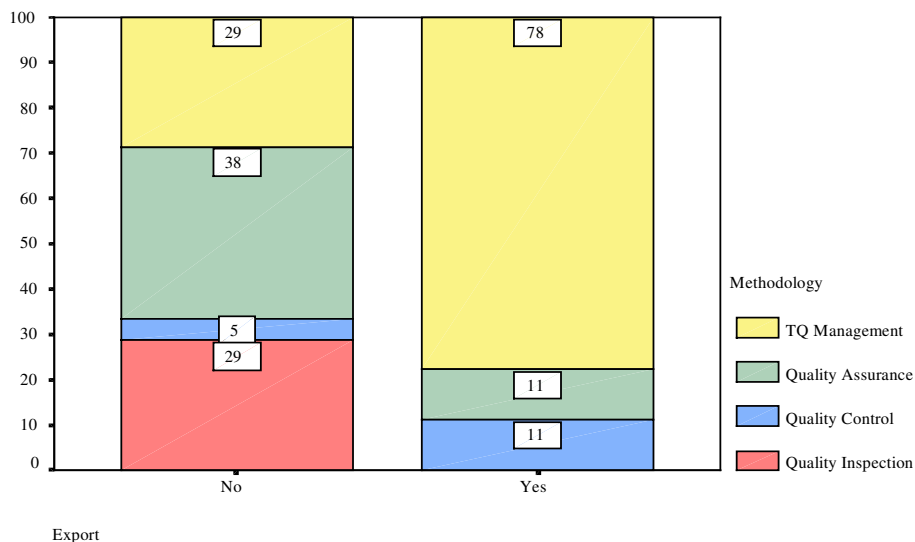
All interviewed companies respond that their products are produced according to certain specifications. In about two-thirds of the companies there is no unique standard that is followed.

In 18% of the cases national standards are in force and are followed and in 22% sectoral standards exist. The quoted standards are Bulgarian State Standard, Law on Spirits, Harmful Substances Regulations, etc.

Company specifications of the products exist and are followed by about two-third of the interviewed. It could be noted that in about one-third of the cases the company specifications are the only existing standard of the product. This applies mainly for the sectors of textiles, machine building and metal works.

Chart 9.5: Product Specifications
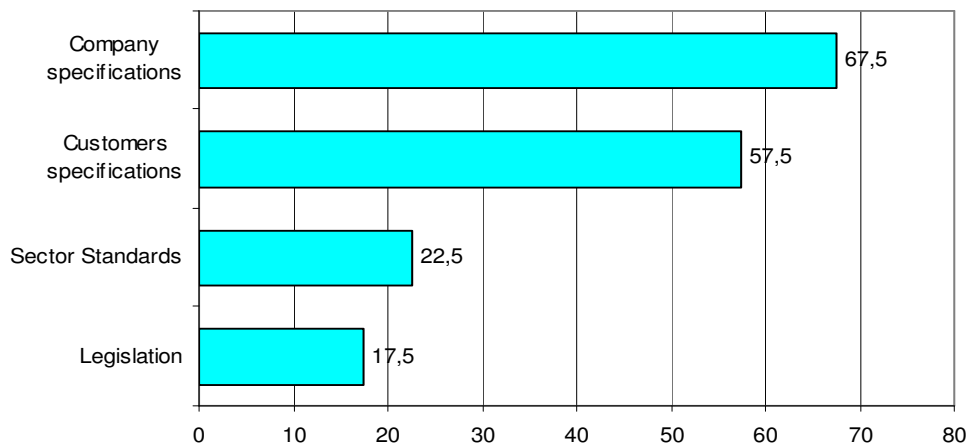
9.2.3 Problems with Quality

The survey results show that a considerable share of companies have problems with quality. On average about 40% of the interviewed companies occasionally have complaints from customers about the quality of the products and in 33% of cases there are sometimes returns of defective products. The impact of unsatisfactory quality on the reduction of sales is registered by in 13% of the companies.

Chart 9.6: Frequency of Customer Complaints on Quality
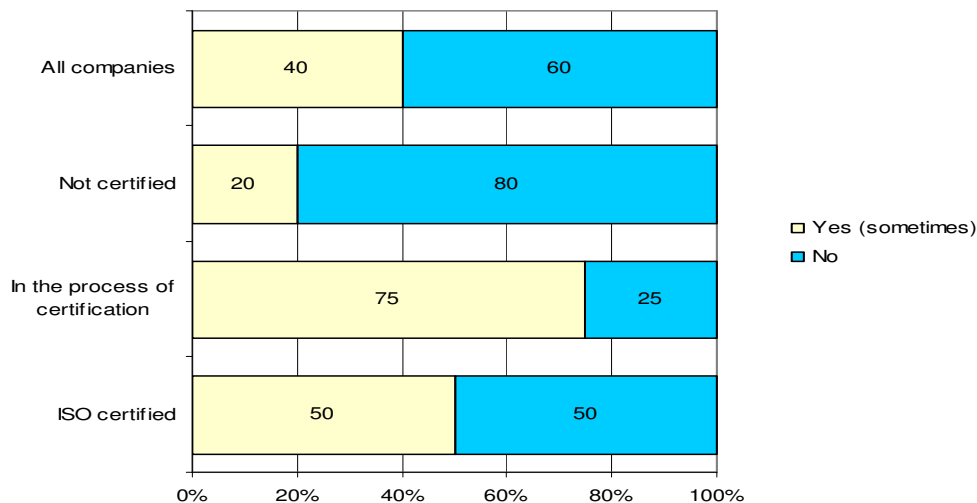
The share of companies that respond having occasional customer complaints is higher among companies that are in the process of ISO certification – 75%. More than 60% of these companies suffer sometimes from returns of defective products and 25% of them have suffered sales loses due to unsatisfactory quality.

Chart 9.7: Frequency of Returns of Defective Products
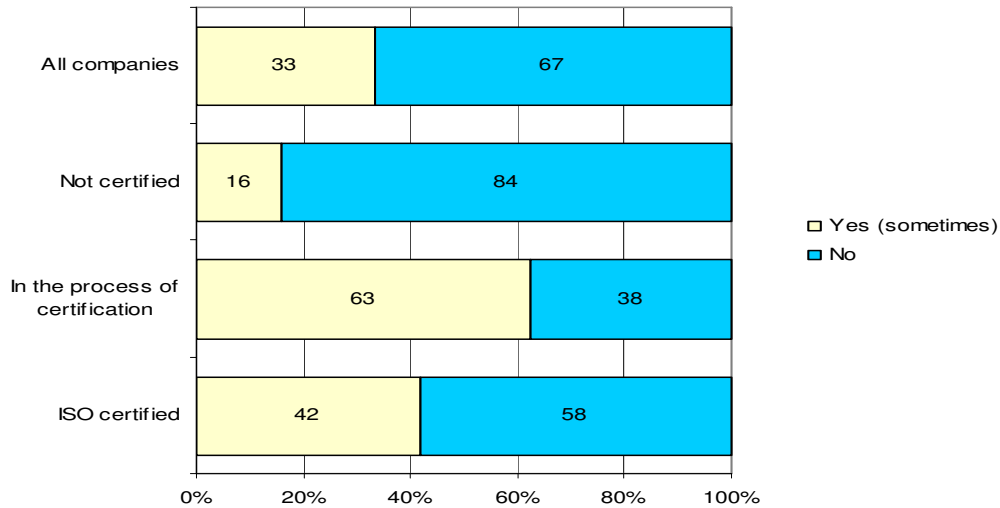
It is interesting to note that companies that are not ISO certified appear to have smaller problems with quality. Among this group of interviewed companies about 80% respond that they never have complaints from customers, 84% have never had returns of defective products and in 95% of the companies quality have never influenced negatively sales.

On of the possible explanations could be that these companies follow modern approaches for quality management without being ISO certified. As mentioned before 60% of them apply either quality assurance or total quality management systems. Other explanation could be that these companies produce less sophisticated products and supply less demanding markets.

Chart 9.8: Reduction of Sales Due to Problems with Quality
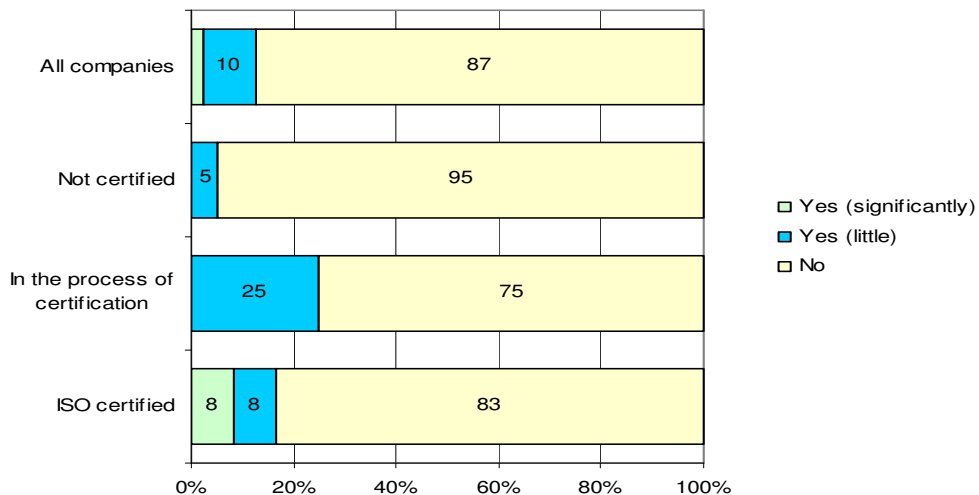
There are no big differences between exporting and non-exporting companies on the incidence of problems with quality of the products and services. The major difference was observed for the type of the service market - final consumer or intermediate products (other companies). As it could be seen from the figure below among companies producing intermediate products the share of those receiving occasionally complaints from the customers and returns of defective products is considerably higher.

Chart 9. 9: Share of Companies with Quality Problems by Type of the Market
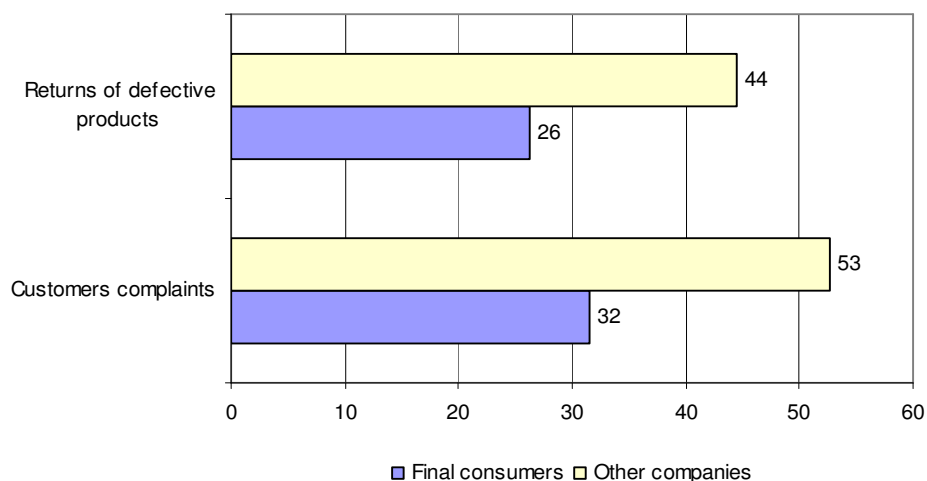
9.3 Quality Management Systems and Certification

9.3.1 Enterprises distribution according certification

In recent years the number of Bulgarian ISO 9000 certified companies has been increasing. The number of certified companies however is still quite small. The register of certified companies of the Bulgarian Industrial Association includes 274 companies, which is less than 1% of all active companies in Bulgaria.

The majority of the registered companies are from the industrial sector. Among the industrial companies machine building and electromechanical industry has about 60% share.

Table 9.2: ISO Certified Companies by Sector

	ISO 9001	ISO 9002	ISO 9003	Total
	Number	Number	Number	Number
Extraction and Metallurgy	3	2	1	6
Machine-building and metal-working	46	11		57
Electromechanical industry	43	12		55
Chemicals	17	5		22
Textile and apparel	16	2		18
Agriculture and food processing	5	7		12
Transport and communications	4	12		16
Other manufacturing	37	9		46
Trade	9	9		18
Finance and credit	5	12		17
Other services	4	3		7
Total	**189**	**84**	**1**	**274**

The introduction of quality management systems is defined as a priority in the Bulgarian National Economic Development Plan 2000-2006.

A major support for the introduction of quality management systems will project Phare project, which is expected to start in September 2001. The total budget of the project is 8.89 million euro and it will provide assistance in three main areas:

- Preparation of companies for quality management certification (ISO 9001-9003, QS900, HACCP)

- Purchase of equipment;

- Training and consultancy.

The Bulgarian Bavarian Quality Management Center (BBQM) - a joint project of Bulgarian Chamber of Commerce and Industry and Bavarian East West Management Center, did the Bulgarian experts training about ISO 9000 management system. Around 100 Bulgarian experts have been trained in development and implementation of ISO management system by BBQM.

The share of companies implementing quality assurance system of ISO 9000 series in the sample is 50%. About two-third of them are certified. It is interesting to note that about two-thirds of the interviewed companies were certified in the year of 2000. Different certifying agencies have been mentioned – Lloyds, TUF, AFAQ-ASCER, etc.

Chart 9.10: Share of Companies with Quality Management Systems
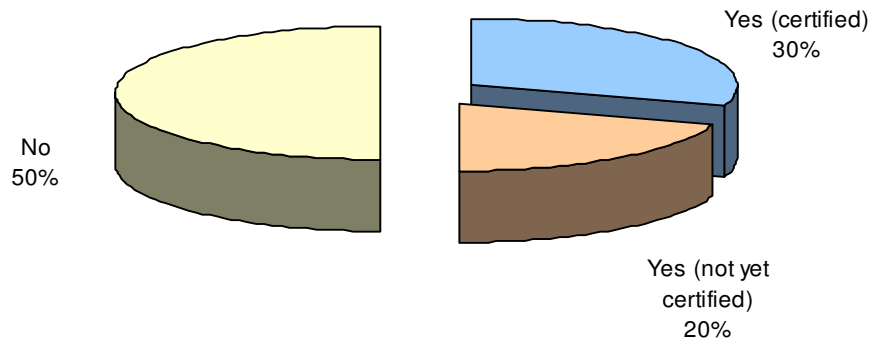
A high share of the respondents is aware of the existence of the European Quality Organization (80%). Even 50% of the respondents who have not be informed yet about the activity of the organization, are interested in its operation and targets (**Chart 9.11**).

**Chart 9.11:** Awareness on the activities of the European Quality Organisation

Are you aware of the existence of the European Quality Organization?

If no, are you interested in its operation and targets?
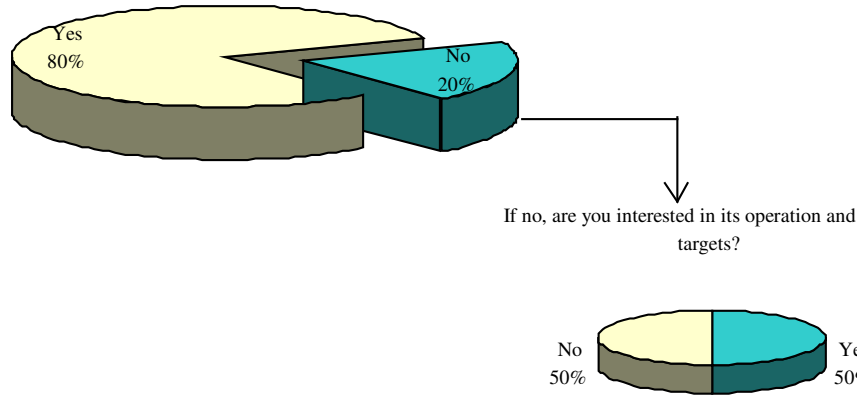
Nevertheless, the system of quality awards is not familiar to the better informed interviewed – more than two-thirds of them are not acquainted with the criteria set. Most of those who know about the quality award system follow its criteria, because their application would help the firm to nave better market abilities, no claims, to show better results or to improve its competitiveness. Most of half of the respondents who are not informed about quality awards, believe that these criteria can apply to their company.

Chart 9.12: Awareness about European Quality Awards

Are informed about quality awards

If no, would you like to be informed

If yes, do you follow these criteria
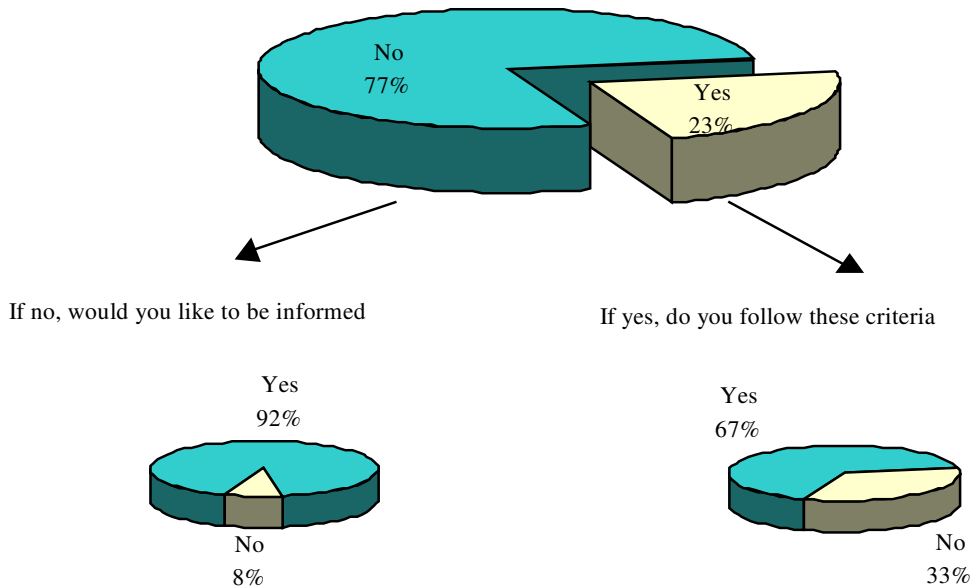
### 9.3.2 The motives for ISO 9000 certification

The managers of the interviewed companies think that the implementation the ISO quality management systems would help them mostly in (**Chart 9.13**):

- Improvement of the product quality (71%);

- Being in line with the foreign customers demands (67%);

- Improvement of the internal structure (56%);

- Being in line with the future (56%).

If we take not only the top figures (based on the "very important" answers), the range of the important reasons ("very important "+" important") for the implementation the ISO quality management systems would be enlarged, as well as their values and positioning. The picture would be the following:

- Being in line with the foreign customers demands (94%);

- Being in line with the future (94%).

- Improvement of the internal structure (94%);

- Improvement of the product quality (88%);

- Marketing tool (87%).

Chart 9.13: Reason for Implementation of ISO Quality Management Systems
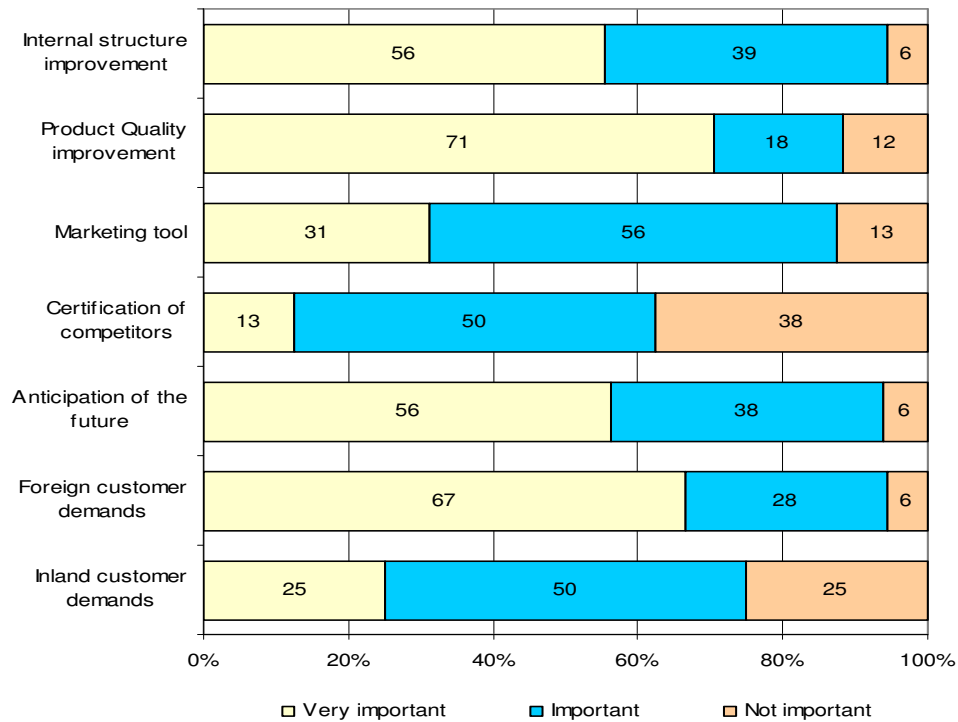
9.3.3 Difficulties enterprises deal with through implementing a Quality System

The companies consider that introduction of the quality management systems is related to a variety of problems (**Chart 9.14**).

In Bulgaria, as in other countries changing quality culture of the organization is the most important problem in the changing of the quality management approach. As it is well known the change of the organizational culture takes about 2.5-3 years. The adaptation of the human resources to the new quality management systems is considered to be an important difficulty. On average 60% to 70% of companies perceive adaptation of key staff and employees as "important factor" and another 20% - as very important. Therefore staff training is also considered as a factor for a successful change of the quality culture within the organization.

Chart 9.14: Difficulties in Quality Assurance Systems Implementation
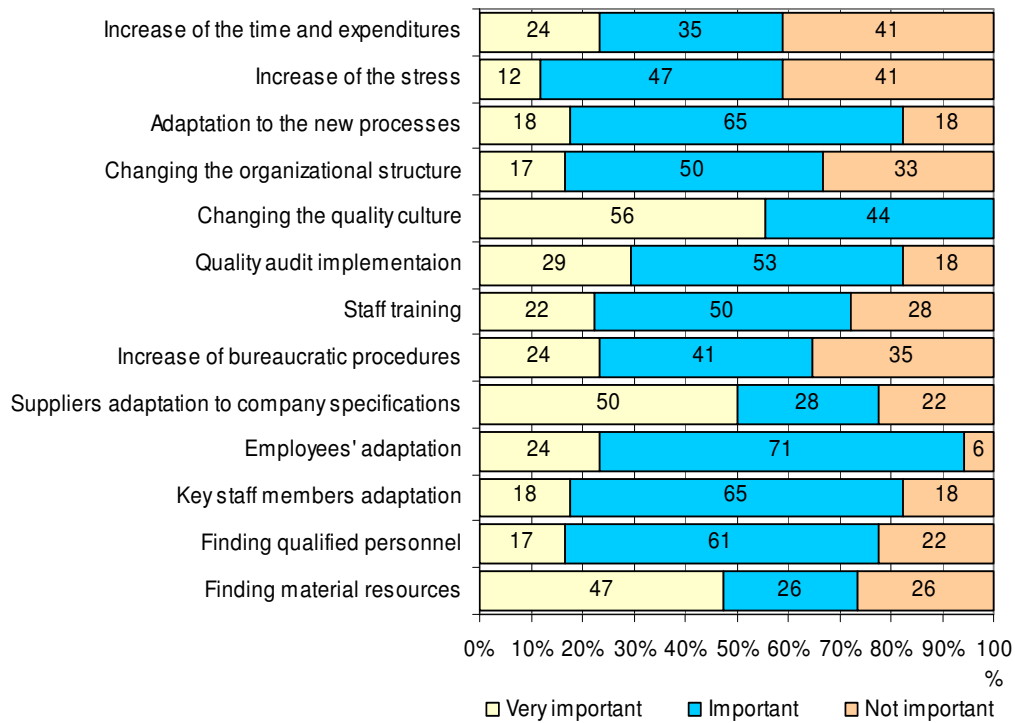
The difficulties ranked second and third are external to the enterprise. Thus around 50% of the interviewed companies state that the most important difficulty in the quality management implementation is supplier adaptation and access to the material resources.

It seems that cost consideration (monetary and non monetary) is not so important for the companies. Thus around 40% of the companies consider that increases in time and expenditures, as well as increase in stress and bureaucracy are not important problems for the implementation of the quality management systems.

9.3.4 Benefits gained by implementing a Quality System according to ISO 9000 Standards

Bulgarian companies implementing quality management systems consider that the benefits of quality are quite high in the long-term.

According to the survey data companies appreciate most the benefits related to the increase of efficiency. Thus the vast majority of companies points out all factors determining the efficiency of the enterprise as very important:

- Product quality improvement – 84%;

- Cost reduction – 79%;

- Productivity increase – 74%.

Chart 9.15: Internal Environment Benefits from the Quality Management Systems
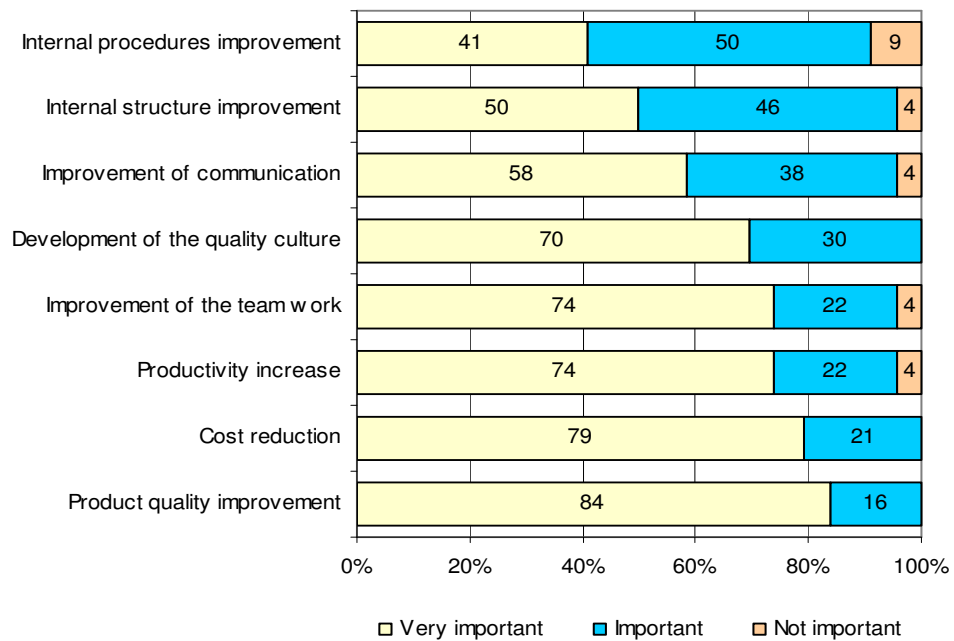
Chart 9. 16: External Environment Benefits from the Quality Management Systems
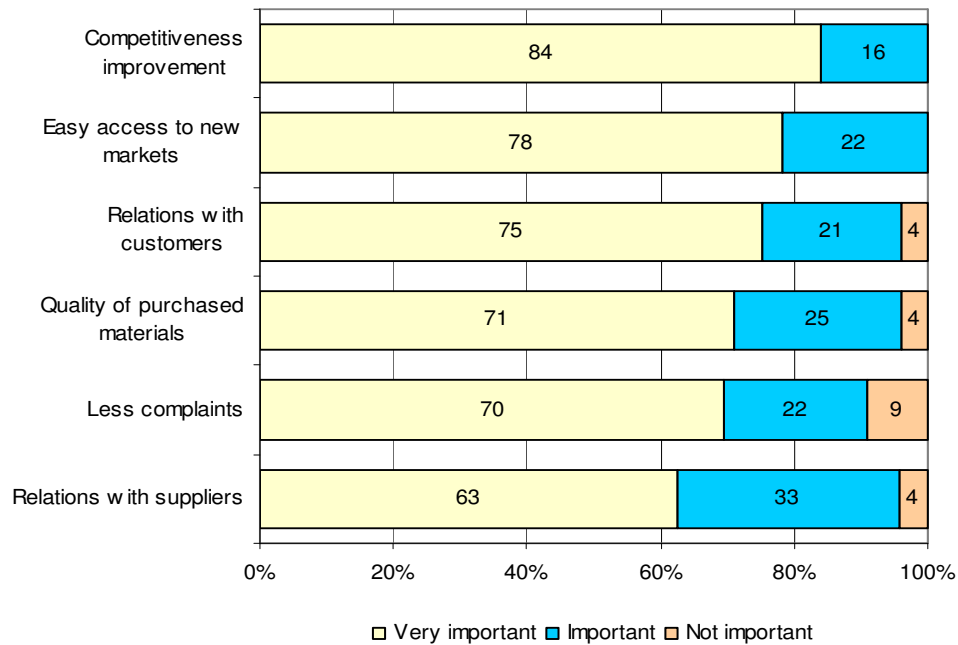

The benefits related to the overall improvement of the organizational structure and internal communications are considered to some extent less important.

The internal improvements of the enterprise are expected by a majority of respondents to have considerable impact on company external position. The raising of the competitiveness is pointed out as the most important benefit of the quality management system implementation **(Chart 9.16)**. The enhancement of the ability to penetrate new markets is ranked second in importance. Thus about 80% of the respondents point out that development of new external markets for the company products is very important benefit of the quality management systems.

Among the benefits for the National Economy the confidence in the Bulgarian products is considered by far the most important one (**Chart 9.17**). About 80% of the interviewed pointed out that this is a very important benefit for the national economy. This is easily explainable due to the fact that liberalization of trade increased the competitive pressure Bulgarian companies face on the domestic market. The increased penetration of foreign competitors on the internal market was facilitated by unstable or poor quality of products of some of the Bulgarian producers. Therefore, regaining of the domestic market by improvement of consumer confidence in the Bulgarian products is one of the national priorities.

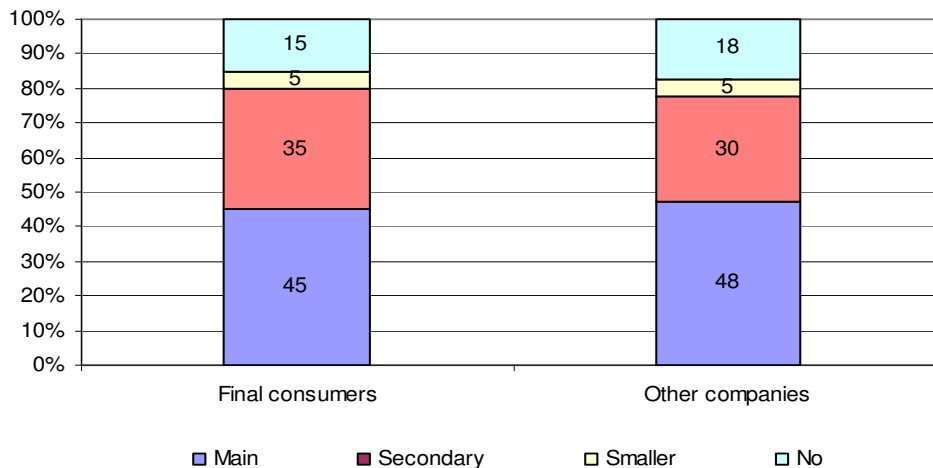**Chart 9.17:** National Benefits from the Quality Management Systems
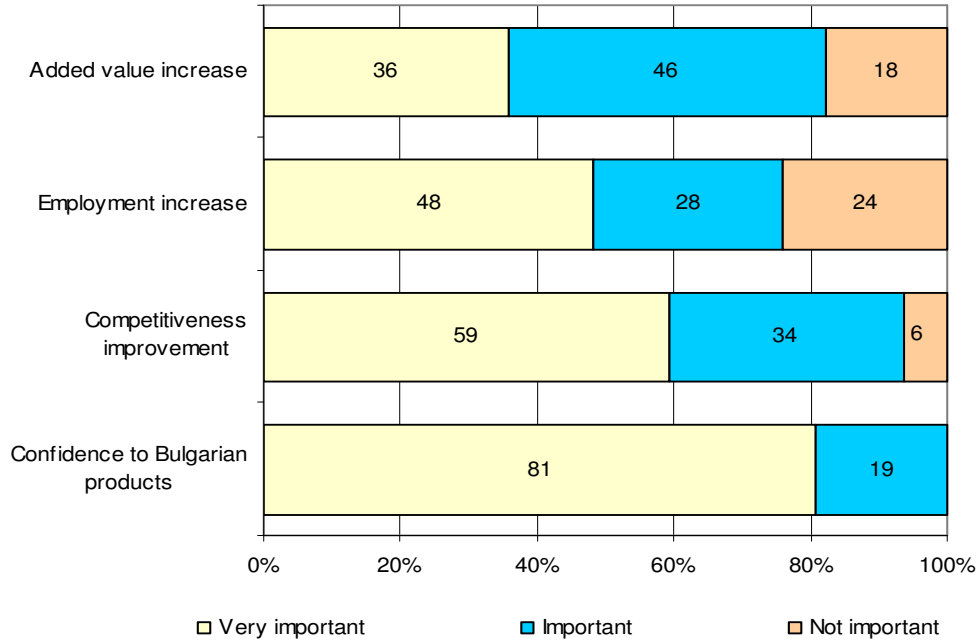
The benefit of boosting the Bulgarian national economy competitiveness is considered as a very important by about 60% of the respondents. The impact of the implementation of quality management systems on the increase of employment and GDP is ranked third and forth.

9.4 Quality and Competitiveness of the Enterprises

The surveyed companies are nearly equally distributed between those selling their production to final consumers mainly and those producing intermediary products whose main market are other companies (see **Chart 9.18**).
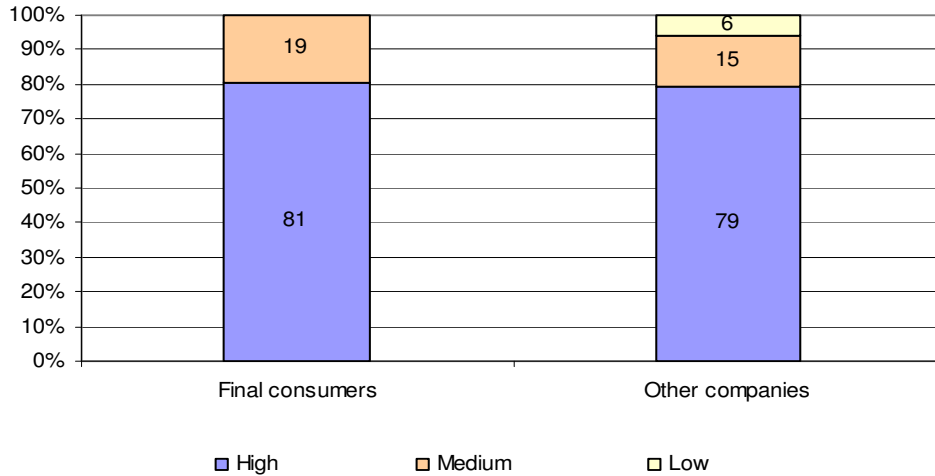
Chart 9.18: Interviewed Companies by Type of the Market

As regards to the quality requirements, companies do not consider that there are significant differences by the market type (**Chart 9.19**). About 80% of the interviewed companies consider that customer requirements are high.

Chart 9.19: Quality Requirements by Type of the Market

For the prevailing share of the interviewed companies Bulgarian market is the main market (**Chart 9.20**). It should be noted however that the share of exporting companies in the sample is quite high. About 45% of the interviewed reported that some part of their production is exported.

Next in importance for the interviewed companies is the E.U. market (Germany, Italy, France, Austria), which is pointed out as main by about third of the respondents. The Balkan market is of much smaller importance for the interviewed. Companies direct their export mainly to FYROM, Greece, Serbia. Comparable to the share of the Balkan market is the market in other countries such as Russia, Japan, Ukraine, etc.

Chart 9.20: Interviewed Companies by Location of Customers
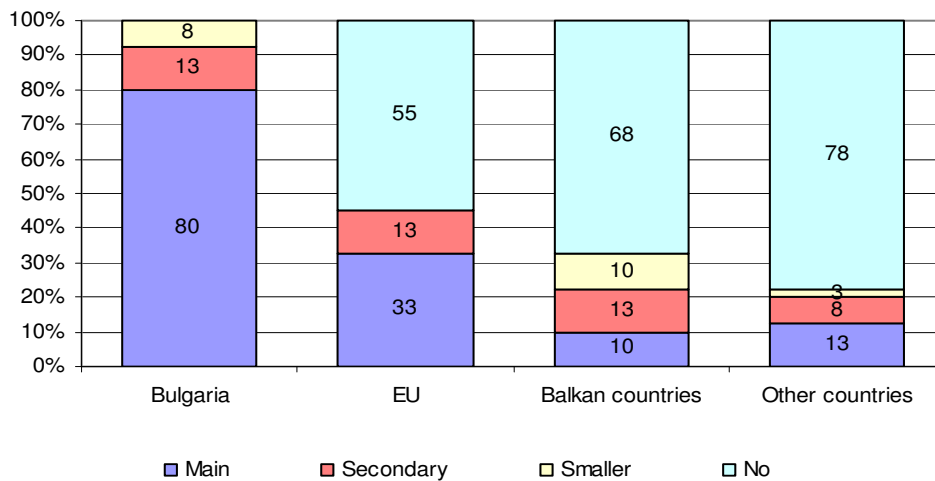
The quality requirements of Bulgarian market are considered to be to some extent lower than that of the foreign markets (**Chart 9.21**). About third of the respondents consider customer quality requirements as medium or low. In contrast all companies assess E.U. market as one with high quality demand. Similar is the evaluation of the quality requirements of the Balkan countries market. Among the foreign markets the so-called "other countries" market is assessed to be to some extent less demanding.

Figure 9.21: Quality Requirements of the Domestic and Foreign Markets
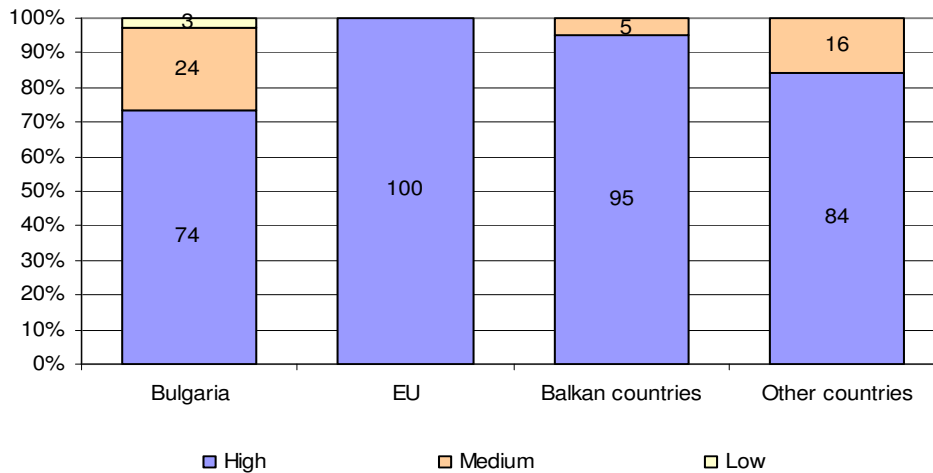
In order to satisfy customer needs companies face a variety of difficulties. The Bulgarian companies consider that the most important are the unsatisfactory quality of raw materials and the level of technology (**Chart 9.22**).

The unstable quality of the supplies is often stated by Bulgarian companies as one of the main problems for assuring quality of the final products and services. In the current survey about 60% of the respondents state it as a difficulty. This problem appears to be more pressing in ISO certified companies. About two-thirds of the ISO certified companies rank quality of raw material as main difficulty, compared to half of the non-certified companies.

**Chart 9.22:** Sources of Difficulties for Satisfying Customers Needs
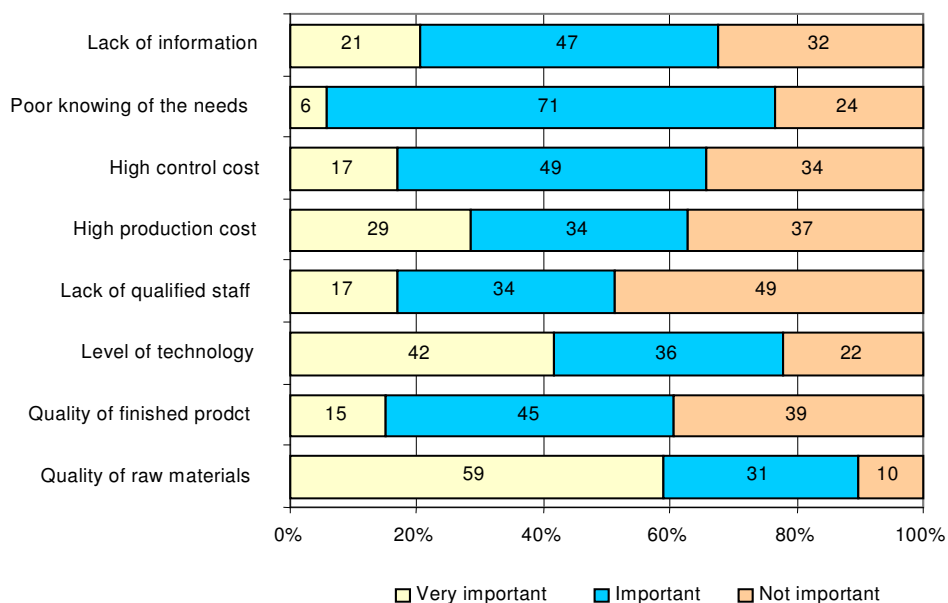
The prolonged transition period in Bulgaria led to the significant under investment in equipment and technologies. The outdated technology leads to problems with quality in many Bulgarian companies. More than 40% of the interviewed stated that the level of technology is a barrier for assuring quality of the products.

About 30% of the companies consider production cost as a very important barrier. As it could be expected, the share of exporting companies ranking this problem as very important is considerably higher – 37%.

The share of companies considering lack of qualified staff as a problem for quality assurance is quite small. About half of all interviewed companies consider that this is not an important factor influencing their products quality. Among ISO certified companies the share of those not experiencing problems with staff is higher – 67%, apparently due to the fact that these companies make significant investments in training.

Companies' perceptions on the most effective instruments for quality improvements are given on **Chart 9.23**. As it could be seen, strengthening of the quality management systems is considered to be a main instrument for better servicing of customer needs. It is worth mentioning that there is no considerable differences in the appreciation of this factor between ISO certified and not certified companies.

Chart 9.23: Instruments for Improvement of Quality
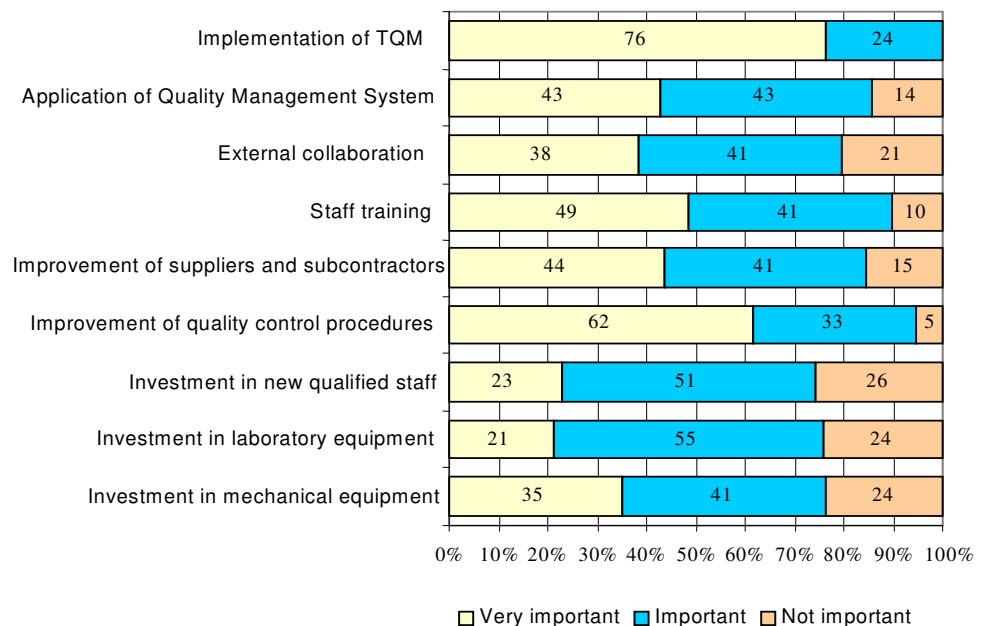
Staff training is an important tool for improvement of the quality management according to interviewed companies. About half of the respondents assign as primary importance the continuous analysis of the training needs of the employees and the upgrading of their knowledge and skills. The share of ISO certified companies giving primary importance to staff training are 10 percentage points higher.

Improvement of relations with supplies and sub-contractors is another important factor for quality management improvement according to the survey respondents. Thus 44% of them consider it as a very important and another 41% as important.

10. Conclusions and Prospects

Comparing the two surveys that contacted the one in Greece and the other in Bulgaria we can conclude that:

- Greek companies perceive quality as "customer satisfaction", while Bulgarian companies perceive quality as "conformance to specifications".

- In Greece although "not satisfying quality" products lead to customer complaints and sales reduction, there is no documented system to measure "bad quality".

- In Bulgaria, on the other hand, "not satisfying quality" products lead also to customer complaints and returns of defective products but do not affect sales.

- In both countries, more than 50% of the interviewed companies implement Quality Management Systems and acknowledge them as a tool to improve internal organization structure and product quality.

- Although Greek companies do not have sufficient information, Greek products comply with E.U. legislation and National/ International/ Sectorial Standards.

- Bulgarian companies are focused more on internal and customer specifications.

- The increase of bureaucracy, the adaptation of employees and the difficulty to find qualified staff are the main difficulties that Greek companies are facing in the implementation of Quality Management Systems.

- For Bulgarian companies the main difficulties are the adaptation of employees and suppliers.

- The most important benefits for Greek companies in implementing Quality Management Systems are the improvements of communication, internal organization, product quality and competitiveness.

- Bulgarian companies appreciate the improvement of product quality; the cost reduction and the productivity increase as the most important benefits.

- Both markets are facing difficulties to cover quality demands due to fluctuation of raw materials, high production and control cost. Except of these difficulties, the lack of information and the low level of technology are for Bulgarian companies another two one.

- In both countries Environmental Management Systems are not applied yet and Total Quality Management is not first priority due to the fact that Greek and Bulgarian companies are not aware of the advantage of continual improvement.

If both counties really want to move to the direction of Total Quality Managements, then the main requirements are:

- The implementation of integrated Management Systems (quality, environment, health and safety, HACCP).

- The application of Quality Management Systems in the whole production chain, from the supplier to the retailer.

- Investments on staff training, new qualified staff and mechanical equipment.

- The institution of National Quality Awards.

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Annex A

Bulgarian Enterprises and Quality: Questionnaire