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PAR

REDA DAHAB

RELATION BETWEEN THE DEGREE OF IMPLEMENTATION OF THE QUALITY SYSTEM AND THE DEGREE OF CUSTOMER SATISFACTION

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RÉSUMÉ

Pour les consommateurs, la qualité devient de plus en plus importante. Au cours des deux (2) dernières décennies, un mécontentement de la qualité des produits fabriqués en Amérique du Nord s'est fait particulièrement sentir. Les produits fabriqués au Japon ont, quant à eux, reçus la confiance des consommateurs nord-américains.

Au Canada, les statistiques concernant la performance de nos entreprises en ce qui concerne les pratiques de la qualité sont décevantes. Par exemple, selon Néron (1990) le coût de la non qualité pour la société québécoise est estimée à environ $21 milliards par année. C'est une perte énorme.

Ce mémoire de maîtrise en gestion de petites et moyennes organisations a pour but d'étudier le rapport entre le degré d'implantation du système de la qualité et le degré de satisfaction du client.

Pour achever cet objectif, quatre (4) entreprises de taille moyenne opé-

rées dans la province de Québec ont été sélectionnées à titre d'étude de cas. Le système de la qualité de chaque entreprise a été évalué et son niveau d'implantation a été établi.

Une société corporative qui représente un client important pour les quatre (4) entreprises a été choisie. Le personnel clé de cette société a été interrogé pour connaître le degré de satisfaction de la qualité des produits et services rendus par chacune d'entre elles.

Il a été démontré qu'il y a une tendance de corrélation positive entre le niveau d'avancement d'implantation du système de la qualité du fournisseur et le niveau de satisfaction du client.

ABSTRACT

Two decades ago consumers began to lose faith in "Made in North America" products. Consumers have come to perceive these goods as of inferior quality when compared with those of certain global competitors. Consider for example Japan whose manufactured goods once were the scorn of the western world. Now Japanese goods have a very impressive reputation with North American consumers.

In Canada, gloomy statistics about quality practices in the manufacturing sector are evident. For instance, according to Néron(1990), the cost of nonquality for the Province of Québec is estimated to be 21 billion dollars annually. This loss for the provincial economy is staggering.

As a result, this thesis discusses "Quality" as an issue from the viewpoint of consumers of goods and services. It also discusses "Quality" as a challenge to those who produce these goods and services.

The main objective of this thesis is to investigate the relationship between the degree of implementation of the quality system applicable in medium size organizations and the degree of customer satisfaction.

To achieve this objective, four (4) companies operating in the manufacturing sector were selected to represent medium size organizations (MSOs) operating in the province of Québec.

The quality system of each case study was investigated and the degree of advancement of implementing the system was correlated to the degree of satisfaction of a large corporate customer. It was found that there is a very positive correlation between the degree of implementation of the quality system and the degree of customer satisfaction.

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QUALITY CHALLENGES FACING THE MANAGEMENT OF MEDIUM SIZE ORGANIZATIONS

1.1 THE EMERGENCE OF QUALITY AS AN ISSUE

The breadth and complexity of new demands for quality are reflected in the reality of today's marketplace.

Consumers' expectations for quality performance have grown rapidly during the last two decades. In addition, their perception of what constitutes a quality product or service is in a state of rapid evolution. Consumers depend increasingly upon the availability and the efficient operation of products and services which demand higher levels of scientific, technical and economic performance.

Cosider, for example, the automotive industry. Certainly no other industry has been more affected by such customer expectations. The automotive industry must meet many challenges in an era when the customer is becoming more and more discriminating. Consumers demand that car manufacturers design vehicles that weigh less, exhibit improved fuel economy, produce fewer emissions, have better quality, are safer, are more stylish and yet still are price competitive(Booth,1990).

1.1.1 QUALITY PRODUCTS

Many factors have had a noticeable impact upon consumers' awareness of quality and their perception of what constitutes a quality product. Consider, for example, the following:

* **Energy**

  Energy consumption has always been somewhat of a quality consideration for the consumers of many industrial products.

However, consumers' consciousness about energy consumption, energy cost and the availability of energy resources has led to major changes in the way consumers perceive some products.

The energy crisis in the early seventies was the principal factor in the change of perception, particularly in the case of the automobile (Baker,1990).

* **Environment**

The quality of the environment has never before been of such importance to the public in general as well as individual consumers. The public attitude has changed so much that the pressure is now on legislators, administrators, corporate management and others to correct past excesses and to curb the undesirable effects of industrial activities on the environment.

A case in point is the public concern about the effect of packaging materials on the environment. Traditionally, product presentation in attractive and colorful materials appealed to consumers and was perceived by them as a *"quality"* characteristic. Nowadays, consumers are more and more willing to trade off this "quality" characteristic against the quality features related to minimizing the negative impact on the environment.

* **Inflation**

Inflation and high prices are important factors which have contributed to consumer quality awareness. Consumers recognize

that the initial price of a product is only the beginning of the product's ultimate cost. The product life cycle cost must be a major consideration in an era of higher prices.

For example, in the fifties and sixties, consumers traded in vehicles every two years . Nowadays, when prices are much higher, automobiles are purchased to last much longer. In addition, quality criteria such as maintainability and warranty provisions play an important role in the evaluation and buying of an automobile.

1.1.2 QUALITY SERVICES

Not only are consumers demanding and expecting good quality for manufactured products, but also they are demanding higher standards of quality for an **increasing number of services** that are being purchased in today's marketplace. These services can range from medical assistance and specialized education and urban transit through mail-order supplies and fast-food restaurants and recreational facilities.

Traditionally, a principal characteristic of service activities has been that they are likely to be heavily dependant upon human skills, attitudes and training. As services have become organized on a wider scale, becoming more professional and more mechanized, quality management and quality control applications to services have become more and more similar in many respects to those for manufactured products (Feigenbaum,p. 31).

Restaurants represent one example. Once an industry of small, personal service oriented, individual proprietorships, today's restaurants are likely to be parts of large chains whose integrated activities are central to the quality of the services provided to customers. Food may be purchased under quality standards that are measured and controlled throughout the entire chain; food preparation may take place according to recipes and schedules that are carefully documented and vigorously respected; store managers and counter clerks may be trained for full customer service; and customers may be regularly queried about the quality of services they have received.

The increasing emphasis expressed by buyers of products and services upon the the *basic concepts of quality* (see Appendix 1 for a discussion of the meaning of quality) as true value is being strongly felt by producers.

1.1.3 IMPACT ON PRODUCERS

Producers of goods and services have realized that the quality ground rules are changing in the following basic areas:

* **Quality Responsibility**

  Quality responsibility as a fundamental concept is being more widely recognized. According to this concept, it is the primary obligation of the producer and seller to satisfy the buyer with respect to the performance and economy of products and services. When this obligation has not been respected, it is then the obligation of the producer and the seller, not the

buyer, to set matters right and to bear the cost of doing so. Bad product quality has often occurred and has usually persisted where those producers and sellers have not borne the responsibility for quality failures and the corresponding costs, but instead have inflicted these costs upon buyers and consumers (see Appendix 2 for definitions of the terms customer, user and consumer). Now the burden of these quality failure costs has begun to move largely to producers and sellers.

* **Warranty**

The doctrine of product warranty to consumers had great impact on the performance and reliability of goods and services.

Increasingly, the producer's responsibility has come to extend into the circumstances of how the customer actually uses the product rather than how the manufacturer has instructed that it be used (Feigenbaum,p.37).

The trend indicates that today's producers and merchants in fact may in some instances assume a warranty obligation whether that obligation is so stated on the typical warranty card. Thus, there is a force acting upon manufacturers and service vendors to give guarantees that are explicit and that do not contain conditions or qualifications which may be ambiguous or unfair to the purchaser.

* **Product Recall**

Even well-managed corporations today find themselves obligated to prepare for the possibility of having to call back quantities of product from the field to correct problems which they have been unable to anticipate.

Recent years have seen voluntary recall by the major North American car builders for a variety of reasons. The list of other recalled products extends to baby grips, kettles, bikes and household appliances, to name but a few.

* **Developing Nations**

Another challenge to producers is coming from countries we used to call, a few years ago, the "Developing Countries". For example, Taiwan, Brazil, Mexico, and Korea, which were consumers to our products a decade ago, started to produce similar commodities and compete in North American markets. These countries put North American producers in a disadvantage position, not only because of the inferior prices of their products but also because of the good quality of these products.

* **Global Competition**

Nowadays, nations tend to create common markets and open their frontiers to free trade. In 1992 in which the full economic integration of the European community will take place and create a four (4) trillion dollar market. This market will constitute more than 300 million consumers (Gottlieb,1989).

Another example is the conclusion of a free trade agreement between Canada and the United States.

Regional suppliers stand to lose their traditional monopoly on local markets due to the influx of foreign competitors.

In such a highly competitive climate, producers will be under pressure to improve the quality of their products and services in order to survive.

1.2 THE EVOLUTION OF QUALITY CONCEPTS

The persistence of consumers in demanding quality products, the continuous technological advancement, and the complexity of the products themselves have led, in part, to the evolution of quality systems from merely a simple technical inspection of the product into a complex systemic concept of management. The phases of this evolution can be summarized as follows:

1.2.1 OPERATOR QUALITY CONTROL

The first step in the development of the quality field, operator quality control, was inherent in the manufacturing job up to the end of the nineteenth century. Under that system, one worker, or at least a very small number of workers, was responsible for manufacture of the entire product, and therefore each worker could totally control the quality of his or her personal work.

1.2.2 FOREMAN QUALITY CONTROL

In the early twentieth century foreman quality control evolved. This period saw the large scale advent of the modern factory

concept, in which many individuals performing a similar task were grouped so that they could be directed by a foreman who then assumed responsibility for the quality of their work.

1.2.3 QUALITY CONTROL BY INSPECTION

When the manufacturing system became complex and where large numbers of workers reported to each foreman, the full time inspectors appeared on the scene and inspection quality control was born (see Appendix 3 for definitions of the terms control, quality control, etc). Inspectors, headed by a chief inspector, were located at the end of the manufacturing lines sorting out non-conforming products and releasing the conforming ones for shipping. This method remained in effect until the tremendous mass production requirements of World War II.

It was then unrealistic to inspect the entire production(100%) and keep pace with the output of the production lines.

1.2.4 STATISTICAL CONTROL OF PRODUCTS

In its early stages, this phase was an extension of the inspection phase and boiled down to making the large inspection organizations more efficient. Inspectors were provided with a few statistical tools, such as sampling. The most significant development was that it provided sampling inspection rather than 100% inspection.

1.2.5 STATISTICAL QUALITY CONTROL

Basically, Statistical Quality Control (SQC) is one aspect of

controlling quality by which the statistical technique is utilized for quality control. It comprises Statistical Process Control (SPC), statistical sampling, and, in general, using statistics for identifying and solving quality problems (Kelada,1986,p.2).

Dr. W.EDWARDS DEMING is generally regarded as the father of modern manufacturing quality assurance (Wilson,1987). He also is credited with popularizing the use of statistical process control in Japan after the second world war. Deming holds that the key to achieving quality control is the use of statistics, control charts, and a minimum number of suppliers. The use of meaningful statistics and charts is not enough in and of itself to achieve adequate quality through better uniformity and greater output at reduced cost per unit. These must be backed up by management that embodies a quality approach.

There are fourteen Deming directives (obligations) which are to be practiced by management (Ford Motor Company,1982) in order to attain quality. They are :

1.2.5.1 Innovate. Plan products and service for the years ahead. The next quarterly dividend is not as important as the company's existence five, ten, or twenty years hence.

1.2.5.2 Learn the new philosophy of statistical quality control. Discard the old philosophy of accepting defective products.

1.2.5.3 Discard dependence on mass inspection for both incoming and outgoing materials. Statistical control of the

process is the only way to provide evidence of quality and cost.

1.2.5.4 Most companies must drastically reduce the number of their suppliers.

1.2.5.5 Recognize that about 85% of the waste and defects are caused by management.

1.2.5.6 Institute modern on-the-job training.

1.2.5.7 Provide a higher caliber of supervision and supervisory requirements.

1.2.5.8 Drive fear out of the organization. Many workers and even some managements are afraid to ask questions or report trouble.

1.2.5.9 Break down barriers between departments so that everyone can pitch in when necessary to solve mutual problems.

1.2.5.10 Eliminate numerical goals, slogans and posters that urge people to increase productivity. These devices are management's lazy way out and they signify desperation and incompetence.

1.2.5.11 Look carefully at work standards. They often cause as much loss as poor materials and mistakes, especially if standards do not take quality into consideration.

1.2.5.12 Institute a program to instruct all employees in simple statistical methods.

1.2.5.13 Start a vigorous program to re-train people in new skills to keep them in tune with industry changes.

1.2.5.14 Make maximum use of statistical knowledge and talent in your company.

Statistical Process Control (SPC) is a term used generally to describe a concept and methodology that uses proven statistical analysis to determine whether a repetitive activity, be it an operation, step or action, be it few or a series of the same, is in a predictable state once it is attained. The critical concept of statistical process control can be summarized as follows (Deming,1981; Rieker,1983):

* Management must strive for the prevention of defects instead of the detection of defects
* Left to natural forces, there is no such thing as unchanging operational performance. There are only two states in nature;
  - operational performance improvement, and
  - operational performance deterioration.
* Quality and productivity improvement are inseparable. All relevant factors that indicate quality improvement will be translated into productivity improvement. Quality improvement and productivity improvement are reciprocal.
* A continual and determined effort to improve quality must be incorporated into management practice. The mentality of "Acceptable Quality Level" can no longer be accepted.
* The importance of quality cannot be delegated, understated, or assumed. It can be understood only through the training of all employees from executive officers to the active workforce.

* Process or system control is the only way in which quality can be defined in predictable terms. Samples taken from lots or batches produced under unknown conditions cannot provide accurate predictable information about the quality of those lots or batches.
* All resources used in systems or processes must come from stable sources. Statistical evidence of quality must be provided with each resource in order to have confidence in the quality of the process output. This knowledge is needed in order to maximize the output quality of the process.
* Only statistical analysis using proven statistical techniques can provide the necessary quality that is acceptable to customers. The most successful analysis of data is one in which graphical techniques based on applicable theory will be used to establish whether the process output comes from a stable source or not and whether it is within specification requirements.
* *Special* or *assignable* causes are responsible for non-stable conditions. These causes are usually operation oriented and can be corrected at the operator's level.
* *Common* or *chance* causes are those that are the result of system variations. Corrections or reduction in system variation requires physical changes to the process or the system.
* Consumers' demands for quality requires that no defective products be delivered and only statistical evidence be

accepted as proof of the quality delivered.

* Vendors and suppliers, both internal and external, will need to implement process control programs. The responsibility for educating vendors and suppliers is that of the customer. Only if vendors are trained can they be expected to learn what is required in quality and supporting evidence.

Elaborating on these points, the basic concept of statistical process control using statistical signals to indicate the need for action to improve performance or output is almost a universal. It can be applied to any area where work is done, where outputs exhibit variation and where there is a desire to make improvements in that work or output

The desire for improvement goes hand in hand with a strategy that emphasize *prevention* rather than *detection*. After the fact inspection is not cost efficient and is unreliable because at the point of inspection wasteful and unreliable production has already occurred. It is much more effective to avoid waste by not producing goods which will be unusable in the first place...a strategy of *prevention*. This strategy is exemplified in the motto; *"Do it right the first time"*.

A process control system is essentially a feedback system. The process is the aggregate of the people, equipment, materials, methods and environment that work together to produce goods or services (output). The ultimate performance of the process depends on how that process has been designed, how it has been

constructed and how it is being operated. The system is useful only if feedback from it is used to improve the performance of the process.

There is a difference between action on the process and action on the output. Action on the process is future-oriented. In other words, appropriate and timely actions prevent the production of output which is not within established specifications. This type of action could theoretically be taken on any of the components integral to the system. Action on the output is *"after the fact"*,that is, it involves detecting already produced output which is outside specification. Acceptance sampling is performed too late to have any effect on the inherent quality of the products already produced.

As mentioned earlier, if output does not consistently meet requirements of the customers, it may be necessary to institute a costly sorting, reworking and/or scraping for any items not conforming to specifications. Obviously, inspection of output is a poor substitute for doing things right the first time.

1.2.6 THE QUALITY ASSURANCE SYSTEMS

The quality assurance (see Appendix 4 for a definition of the term quality assurance) system can be defined as the activity of providing, to all concerned, the evidence needed to establish confidence that the quality function is being performed adequately. In this context, quality assurance systems have been developed and standardized by national as well as international organizations to provide the needed proof to customers that the

products or services are produced in conformity with the established specifications (Kélada,1987).

In Canada, the quality assurance (Q.A.) programs are prepared by the Canadian Standards Association (CSA) and approved by the Standards Council of Canada. The CSA reflects a national consensus of producers and users, including manufacturers, unions, and professional organizations, and governmental agencies.

The main objectives (Canadian Standards Association,1986) of a quality assurance program are :

* To provide customers with assurance that products and services of the required quality will be supplied;
* To have suppliers assume responsibility for achieving the required quality and then demonstrating that it has been provided.

Four (4) categories were published in 1985 by the Canadian Standards Association, the types and scope of which are as follows.

1. *CAN3-Z299.1 Q.A. Program (Category 1)*

   This standard aims at preventing the *occurrence* of nonconforming products or services. This is achieved by thorough planning and controls which extend to identifying and correcting weaknesses in the program.

2. *CAN3-Z299.2 Q.A. Program (Category 2)*

   This standard aims at reacting to nonconforming products or services to prevent their *recurrence*. This is achieved by specifying feedback control to correct causes of nonconformance.

3. *CAN3-Z299.3 Q.A. Program (Category 3)*

   This standard requires suppliers to plan and establish a program for *verifying* the conformance of products or services throughout the process. The program is documented but in a limited manner.

4. *CAN3-Z299.4 Q.A. Program (Category4)*

   This standard requires suppliers to plan and establish a program for *sorting* the good from the bad.

The standards contain two major aspects. The first is requirements concerning the supplier's internal quality assurance programs. Suppliers can usually implement these in a cost effective manner in their management of quality. The second aspect is the requirements concerning interfaces with customers, such as specific record keeping, document submittal, approvals, and right of access. The main features and structure of the standard systems are shown in Table 1. As one progresses from the simplest, Z299.4, to the most stringent, Z299.1. With each step, the requirements increase in number to become comprehensive.

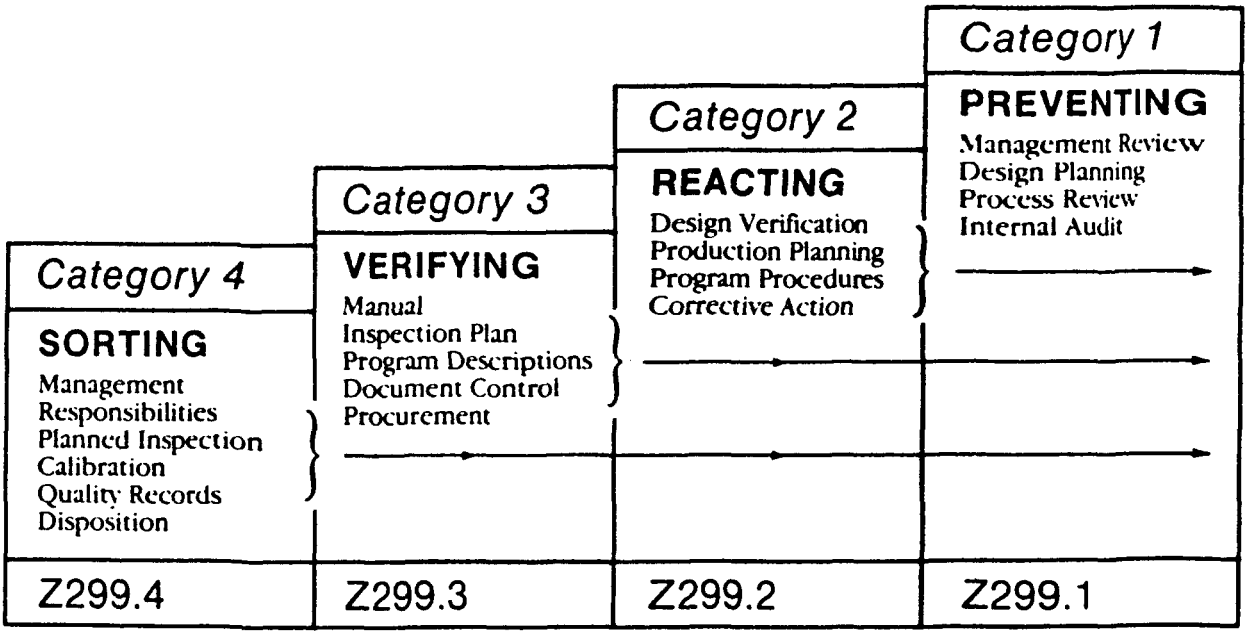


Table 1. The Features of the CAN3 Z299(85) Quality Standard Systems.

The program elements are management activities affecting quality that need to be planned and controlled to ensure products and services meet specific requirements. Table 2 lists the program elements required in each standard and the applicable clauses.

Other national and international quality assurance program systems are listed below:

* **CANADIAN STANDARD ASSOCIATION (CSA)**

  CAN3-N286.0 Quality Assurance Program Requirement for Nuclear Power Plants

* **NATO ALLIED QUALITY ASSURANCE PUBLICATIONS**

  AQAP-1 Quality Control System Requirements for Industry

  AQAP-4 Inspection System Requirements for Industry

  AQAP-9 Basic Inspection Requirement for Industry

* **CANADIAN DEPARTMENT OF NATIONAL DEFENCE**

  D-02-001-002/SF-001 Quality Program Requirements for Contractors-DND 1015

  DND 1016 Contractors' Inspection System Requirements

  DND 1017 Basic Inspection Requirements for Contractors.

  Note: The Canadian Department of National Defense now specifies NATO AQAP Standards.

	Z299.1	Z299.2	Z299.3	Z299.4
3.5 Quality Assurance Program Elements	I	II	III	IV
3.5.1 Tender and Contract	I	II	II*	III*
3.5.2 Design	I	II		
3.5.3 Documentation	I	I	III	
3.5.4 Measuring and Testing Equipment	I	I	III	IV
3.5.5 Procurement	I	I	III	
3.5.6 Inspection and Test (Plan(s))	I	I	III	
3.5.7 Incoming Inspection	I	I	III	IV
3.5.8 In-Process Inspection	I	I	I*	
3.5.9 Final Inspection	I	I	I*	
3.5.10 Inspection Status	I	I	I*	
3.5.11 Identification and Traceability	I	I	I*	IV
3.5.12 Handling and Storing	I	I		
3.5.13 Production	I	II		
3.5.14 Special Processes	I	I	I*	
3.5.15 Packaging and Shipping	I	I	I*	
3.5.16 Quality Records	I	II	III	IV
3.5.17 Nonconformance	I	I	III	IV
3.5.18 Corrective Action	I	II	III	III*
3.5.19 Customer-Supplied Products or Services	I	I	I*	IV
3.5.20 Statistical Techniques	I	I	I*	
3.5.21 Quality Audits (Internal)	I			
Quality Audits (External)	I	I	I*	

Legend:
I—same as Z299.1.
I*—descriptions rather than Quality Assurance Program procedures.
II—less than Z299.1.
II*—descriptions rather than Quality Assurance Program procedures.
III—less than Z299.2 with descriptions rather than Quality Assurance Program procedures.
III*—same as Z299.3. No procedures or descriptions required.
IV—less than Z299.3. No procedures or descriptions required.
Blank—no coverage.

Table 2. Comparison Of The Quality Assurance Program Elements (After the Canadian Standards Association)

* **INTERNATIONAL STANDARDS ORGANIZATION (ISO)**

ISO 9001	Quality Systems for Quality Assurance in Design/Development, Production, Installation, and Servicing;
ISO 9002	Quality System for Quality Assurance in Production and Installation;
ISO 9003	Quality System for Quality Assurance in Final inspection and Testing.

* **AMERICAN SOCIETY FOR QUALITY CONTROL (ASQC)**

ASQC c-1	General Requirements for a Quality Program.

* **AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)/AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)**

NQA-1	Quality Assurance Program Requirements for Nuclear Power Plants.

* **US DEPARTMENT OF DEFENSE (DOD)**

MIL-Q-9858A	Quality Program Requirements
MIL-1-45208A	Inspection System Requirements

* **AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)**

Boiler and Pressure Vessel Code:

Section I, Power Boilers,

A300	Quality Control Systems

Section III, Nuclear Power Plant Components

NCA 3800	Metallic Material Manufacturer's and Material Supplier's Quality System Program

NCA 4000 Quality Assurance System

Section IV, Heating Boilers

Appendix F, Quality Control System

Section VIII, Pressure Vessels, Division 1

Appendix X, Quality Control System;

NQA-1 Quality Assurance Program Requirements for Nuclear Power Plants

* **BRITISH STANDARDS INSTITUTE (BSI)**

BS 5750:Part 1, Specification for Design, Manufacturing and Installation

BS 5750:Part 2, Specification for Manufacture and Installation;

BS 5750:Part 3, Specification for Final Inspection and Test.

* **UNITED STATES NUCLEAR REGULATORY COMMISSION (NRC)**

10 CFR 50 Quality Assurance Criteria for Nuclear Power

* **INTERNATIONAL ATOMIC ENERGY AGENCY (IAEA)**

Code of Practice 50-C-QA

Quality Assurance for Safety in Nuclear Power Plants.

The correlation and relationship between the CSA CAN3-Z299(85) systems and other national and international quality assurance systems are shown in Table 3.

	Z299.4	Z299.3	Z299.2	Z299.1
More coverage than	AQAP-9* DND 1017	ISO 9003	DND 1016 AQAP-4*	DND 1015 AQAP-1*
Comparable to	BS 5750: Part 3	ASME Sections I (A300), IV (Appendix F) VIII (Division 1, Appendix X, and Division 2, Appendix 18) ASQC C1	MIL-I-45208A BS 5750: Part 2 ISO 9002	MIL-Q-9858A BS 5750: Part 1 ISO 9001 ASME Section III NCA 4000 10 CFR 50, Appendix B CAN3-N286.0 ANSI/ASME NQA-1 IAEA Code of Practice 50-C-QA ISO-6215
Less coverage than	ISO 9003	ISO 9002 BS 5750: Part 2	ISO 9001	

Table 3 . Correlation Between The CSA Z299 Quality Program and Other International Systems.

1.2.7 TOTAL QUALITY CONTROL

By definition (Feigenbaum,pp78-79), a total quality system is an agreed upon companywide and plantwide operating work structure, documented in effective, integrated technical and managerial procedures, for guiding the coordinated actions of the work force, the machines, and the information of the company and plant in the best and most practical ways to assure customer quality satisfaction and economical costs of quality. Therefore , the systems approach to quality begins with the basic principle of total quality control that customer satisfaction cannot be achieved by concentrating upon any one area of the plant or company alone - design engineering, reliability analysis, inspection quality equipment, reject troubleshooting, operator education, or maintainability studies - important as each phase is in its own right. Its achievement depends, instead, both upon how well and how thoroughly these quality actions in the several areas of business work individually and upon how well and how thoroughly they work together. The creation and control of the proper product and service quality for plant and company require that the many quality activities in its product and service cycle be integrated and measured - from market identification and product development and design through shipment and product service - on an organized, technically effective, and economically sound basis.

The total quality system is the foundation of total quality control, always providing the proper channels through which the

stream of essential product-quality-related activities must flow. Together with other systems, it makes up the main-line flow of total business system. Quality requirements and product-quality parameters change, but the quality system remains fundamentally the same.

In other words, the Total Quality Control impact on the organization involves the managerial and technical implementation of customer-oriented quality activities as a prime responsibility of general management and of the main-line operations of marketing, engineering, production, industrial relations, customer services, finance, and as well as, of the the Quality control function itself.

This quality control framework made it possible to review design *regularly* rather than occasionally, to analyze *in-process* results and take control action at the manufacturing or the supplier source and, finally, to *stop* production when necessary. Moreover, it provided the structure into which the early statistical quality control tools could later be joined by the many additional techniques of metrology, reliability, quality information equipment, quality motivation, and the numerous other techniques now associated with the field of modern quality control and with the overall quality functional framework of a business.

Total quality control (Sandras,1988) is sometimes referred to as *total quality commitment* or by other closely related terms as *quality function deployment* or *process management*. The difference

is more on the emphasis of some particular process, not a difference in the basic philosophy.

Whatever the name chosen, Total Quality Control is a philosophy aimed at *continuous process improvement* resulting in increased customer satisfaction. A customer is anyone who uses the output of a process. A customer is someone external to the company who purchases its product or services, but a customer is also the next person in a series of process steps, the next department that makes use of one's output. Essentially total quality control views everyone as a part of a larger network of customer supplier links.

Total denotes that TQC is applicable to and expected of all organizations. It applies to sales, the reception desk, maintenance, etc. It applies also to purchasing and the resulting supplier and production satisfaction with the material supply chain. It includes all outputs of all processes, not just manufacturing processes that produce products to sell.

Quality is the study of the processes and products. Many techniques are available to help in getting past the superficial aspects of a problem down to the root cause of the problem. If one can understand the root causes of why the processes behave as they do, then one can learn how to control them.

Control involves making the outcome of each process behave as we intend. It involves not only controlling the process so that the resulting output conforms to requirements, but it also refers to minimizing process variations about the target value.

1.2.7.1 Total Quality Control In Modern Business

Management Concept: Profitability and Cash Flow

Nowadays the major new business strategic importance of quality has made it a central area of direct and explicit management attention.

Business managers are aware of the axiom that *Salability* plus *Producibility* plus *Productivity* equals *Profitability* (Feigenbaum,pp19-20).

It takes but a moment's reflection to realize that total quality control contributes substantially to each element in this business formula.

SALABILITY is enhanced through total quality control by the balancing of various quality levels and the cost of maintaining them. The result is that the manufactured product really can meet the customer's wants both in the satisfactory function of the product and the price that must be paid for it.

PRODUCIBILITY is improved because quality control offers guidance, based on quality experience, to the design engineer while new products are being developed and to the manufacturing while their production is being planned. Such guidance takes many forms, for example, consideration of the relationship between new design standards and the quality capability of the manufacturing plant.

PRODUCTIVITY is increased by emphasizing the positive control of quality rather than after-the-fact detection and rework of

failures. The amount of salable production that comes off the assembly line becomes much higher than it would otherwise, be, without increasing a penny in cost of production or increasing a single unit in the rate of production.

Furthermore, positive action taken in incoming-materials area frequently increases the production rate of manufacturing equipment itself because defective purchased materials is prevented from reaching the assembly line, where it will waste the efforts of skilled workers and expensive machines.

Thus, total quality control has a vigorous impact upon each of three factors which influence *profitability*.

Through careful analysis of customer wants and needs, the product can be provided with those qualities which motivates purchase by the customer and, thus, increase *salability*.

When the quality of product design and production process established with *producibility* in mind, manufacturing costs can be substantially reduced. Also the possibility of negative cost offsets such as costly product recall or very expensive product-liability suits is minimized.

Thus, the industrial manager finds in total quality control a powerful new tool to increase the *profitability* and the positive cash flow of the business.

1.2.8 THE JAPANESE APPROACH TO QUALITY MANAGEMENT

In the fifties the world considered "Made in Japan" as a recognized symbol of poor quality. How is it then that Japan is now one of the leading nations in the production of quality products ? U.S industry has always prided itself on the fact that it could get the job done, regardless of the hurdles it faced, and still remain competitive with any other producer in the world. Today, however, a nation much smaller than the U.S., with little or no raw materials, seems to be able to make the same claim.

Historically, quality control and quality assurance have progressed in *Japan from* inspection-oriented quality assurance through production process control oriented quality assurance to new product development oriented quality assurance.

Quality assurance was started to make sure that inspection was conducted in the right manner. Of course, accurate inspection is necessary when there are many nonconformities. In this "era", it was enough that quality control be executed by the quality control or inspection department only, even though inspectors are extra employees who lower productivity.

Inspection implies the recognition of an acceptable quality level (AQL). But an AQL of 2% or 1% is not acceptable to companies aiming at higher quality levels such as an AQL of 0.01% nonconformance or, in other words, parts per million (ppm) quality control.

According to Dewar (1989), the following points illustrate what it would be like in the United States if things were done right 99.9% of the time (AQL 0.1%):

> one hour of unsafe drinking water per month.

> two (2) unsafe landings daily at Chicago O'Hare international airport.

> 16,000 lost pieces of mail an hour.

> 20,000 incorrect drug prescriptions a year.

> 500 incorrect surgical operations performed each week.

> 22,000 cheques deducted every hour from the wrong accounts.

> 32,000 missed heartbeats per person each year.

Furthermore, many quality characteristics cannot be assured by inspection only. Even if inspectors find nonconformities, it will merely lower productivity because of scrap, rework, and adjustments, and will increase cost. Besides, these products, once they are reworked or adjusted, tend to fail or break down. Realizing that assuring the quality of products only by inspection is an impossible task, the Japanese began process-oriented quality control. Emphasis is placed on process analysis, process control, and Shewhart control charts rather than sampling inspection. The motto *"build quality into the product in the manufacturing process"* was born.

The Japanese consider that the producer is to be responsible for quality assurance. They consider also the vendor fully responsible for quality assurance. If the same idea is applied

within the company, quality assurance ought to be done by *Manufacturing,* not by *Inspection.*

With this approach, they were able to improve the process capability, reduce non-conformities to the range of parts per millions(ppm), and as a result produce products of higher reliability and quality with lower cost. They observed that a state of statistical control is essential to reliability and predictability.

For process control oriented quality assurance, it is impossible to execute quality control only in the Inspection department or the Quality Assurance department. The newer approach required the participation of not only Inspection, but also of such departments as sales, purchasing, production engineering, and manufacturing, as well as subcontractors. Foremen and workshop people must execute quality control too: all employees of the company must participate.

Despite the advantages of this approach over inspection-oriented quality control, it has become evident that control alone cannot accomplish quality assurance. For instance, it is impossible to assure quality if the consumer or user uses the products in ways the product was not designed to be used. And a company cannot assure the quality by process control if there is something wrong with the design or selection of materials.

The next step, therefore, was to move to quality assurance during new product development. Quality assurance oriented new product development was started in Japan in the late fifties.

Needless to say, both process control and inspection control systems must be implemented along with it. The effort was made to build quality into new product planning, design, trial production, and evaluation; then to mass production design, trial mass production, initial production, and special control for new sales. A new motto was born: *"build quality and reliability into the product during the designing and manufacturing processes"* (Ishikawa,1984).

Design optimization is a very powerful way to assure low cost and high quality. One of the most significant developments (Sullivan,1986) to come from Japan has been the methods of design optimization developed by *Genichi Taguchi*, who received the Deming Prize in 1960 for the development of practical statistical theory. Clausing (1984) has described the Taguchi method as follows: "The Japanese are well known for their ability to engineer quality into basic design. A definition of quality that comes from Japan looks at this nebulous and elusive term as the characteristic that avoids a *loss to society* from the time the product is shipped".

The loss is measured in terms of money and is linked to the hard technology of the product. Through this definition the Japanese engineer becomes *bilingual*. The loss function allows the engineer to speak the language of things and money. Because the Japanese all speak the same quality language, quality is not a problem reserved for the quality assurance or quality control department nor only the manufacturing division. Quality is

infused into all aspects of a product's life and inherent philosophy that is integrated throughout the entire corporate structure. In North America the tendency is to exclude Quality Control from the research and development(R&D) and engineering activities. This behavior emerges from a belief that quality control equates with only control charts and process control. The Japanese have, through the efforts of Genichi Taguchi, *built* quality methods into the engineering process. Quality loss is the financial loss imparted to *society* after a product is shipped.

Loss to society in Taguchi's thinking may be clarified by an example. Japanese farmers use sheets of vinyl to protect crops from storms. A Japanese Industrial Standard (see Appendix 5 for definition of standards) specifies the limits for the product. A manufacturer of vinyl sheeting worked to reduce variation in the production process, resulting in a very narrow distribution. The manufacturer then centered that distribution at the low end of the specification limit (see Appendix 6 for definition of specifications) , producing a sheeting that was very uniform, but barely within tolerance limits. The manufacturer reduced costs by doing this. The result was three losses. *First*, the product tore because it could not withstand the wind: the vinyl sheeting itself was the first loss. *Second*, farmers suffered losses as a result of crop damage. *Third*, the reduction in supply of crops caused prices to rise, resulting in a *loss to society*, which had to absorb the additional cost.

The result of the loss function calculation will be that, in

such a situation, the loss to society is always greater than the manufacturer's gain. According to Clausing(1984), the Japanese call such a manufacturer "worse than a thief". If a thief steals $10, he gains the entire $10, but the manufacturer will take more from society than the manufacturer will gain by deviating from the nominal value.

It is clear from the previous example that the loss function is built on a definition of quality as *"uniformity around a target value"*. Specification limits are, for this purpose, irrelevant because we are interested in the overall loss caused by the product and that loss becomes greater the more the product deviated from the target value regardless of whether it is within specification.

The Japanese management approach towards the shop floor and workforce may be summarized as follows (Beecroft,1990; Irving,1980):

* Managers take a long term view.
* Each employee has four jobs: cleanliness, quality, throughput of work and assistance to others.
* Employees will do anything within their capabilities as well as their own jobs.
* Highly committed people with shared responsibility for accomplishment.
* Very high product quality, little scrap and minimum work in process. Quality checked by each worker.

* Plant goal is to deliver products to customers on the date ordered in exact quantities and at high quality.
* Interpersonal management style.
* Foreman is the key leader.
* Closed homogeneous plant society reflecting Japanese culture. Low acceptance of diversity of behavior and background. Relatively narrow range of behavior.
* Atmosphere of strong cooperation. Each employee is a member of the company society as well as skilled in his own job.
* Company union has full knowledge of company financial position, goals and problems. 99% of grievances are settled within the union. Rare to strike. Decisions made by group agreement.
* Group responsibility for performance extends from company management to foreman's work group.

The success of Japanese Management is largely attributed to the emphases given to the motivation of human resources and the extensive study of customer's needs and wants. In addition, the Japanese culture and the fabric of the social collectivity contributed to achieving excellence in the quality of Japanese products.

Following are brief accounts on these three factors: *motivation, culture, and the respect for customer needs.*

1. MOTIVATION

Japanese management believes that the key to motivation is

getting people involved in the decision making process. This belief has led to the introduction of quality *control circles* (Arbose,1980). Because of the name , quality control circles(QCC), there is a tendency to think that they solve only quality problems. Not so. Problems such as scheduling, cost reduction, productivity, safety, attendance, and eventually problem prevention are all in the orbit of QCC's.

The quality control circle is a management technique which uses the principle of McGregor's theory "Y"(McGregor,1971).

The theory states that human nature is good and employees have more to offer to the job than just their hands - they offer also their intelligence. In addition, this technique uses Herzberg's teachings which states that motivating elements to a job are responsibility, recognition, communication and feedback.

These principles and teachings are very similar to the Japanese objectives for quality circles. According to Ishikawa (1984), the purpose of quality control circles (QCC) are:

* Self and mutual development
* Increase quality awareness
* Capture the creativity and brainpower of the workforce
* Improve worker moral
* Develop managerial ability of circle leaders
* Implement and manage accepted ideas.

The key element in the success of QCC is the appropriate and intensive training of the circle members (8-10 members and a

group leader) in *Problem Solving Techniques,* the main topics of which, are:

* Brain storming.
* Data collection.
* Formats and graphs.
* Pareto decision analysis.
* Process problem analysis.
* Histograms.
* Management presentation.

> The Structure Of Quality Control Circles

Quality control circles use existing organizational structures and do not impose any additional power structures on the organization. The leader of the employee group who volunteers to form a circle is the supervisor himself. Hence no duality of loyalities develops. In fact, many companies regard quality circles as a supervisor enhancing program designed to improve and solidify the supervisor's leadership position.

It is vitally important that all middle management and support organizations fully understand and comprehend the quality circle concept so that they will be able to assist and complement the circle activities when needed. In addition, it is vital that these people do not regard quality circles as infringing on their areas of responsibility.

Trade unions must be fully aware of the program's intent which historically has supplemented and not infringed on the union goal of worker involvement.

The diagram of Figure 1 shows how quality circles are formed. Quality circles operate primarily in manufacturing operations but have been extremely successful in support organizations such as offices, purchasing, mail room, hospitals, banks, insurance companies, retail stores, etc. In effect, any organization wishing to improve its operation can utilize the quality circle concept.

The diagram of Figure 2 shows the various stages of Quality Circle operation. Problems are brought to the attention of the QCC by the members themselves, by management or by other organizations or other circles. However, the selection of the problem to work on is done exclusively by the members themselves. Problem analysis is performed by the members but they may use data from technical specialists or may ask for help from these specialists. However, the solutions recommended are purely those of the circle members themselves. These solutions are then reviewed by management in a formal management presentation (unless the supervisor can implement the solution himself). The decision to implement and commit resources rests solely with management. It must be remembered that management is held responsible for the results and must remain in charge.

> Benefits of Quality Control Circles

From the management viewpoint, probably the typical economic objectives are paramount: better quality, lower cost, etc. These lead to customer satisfaction and a smoother running operation.

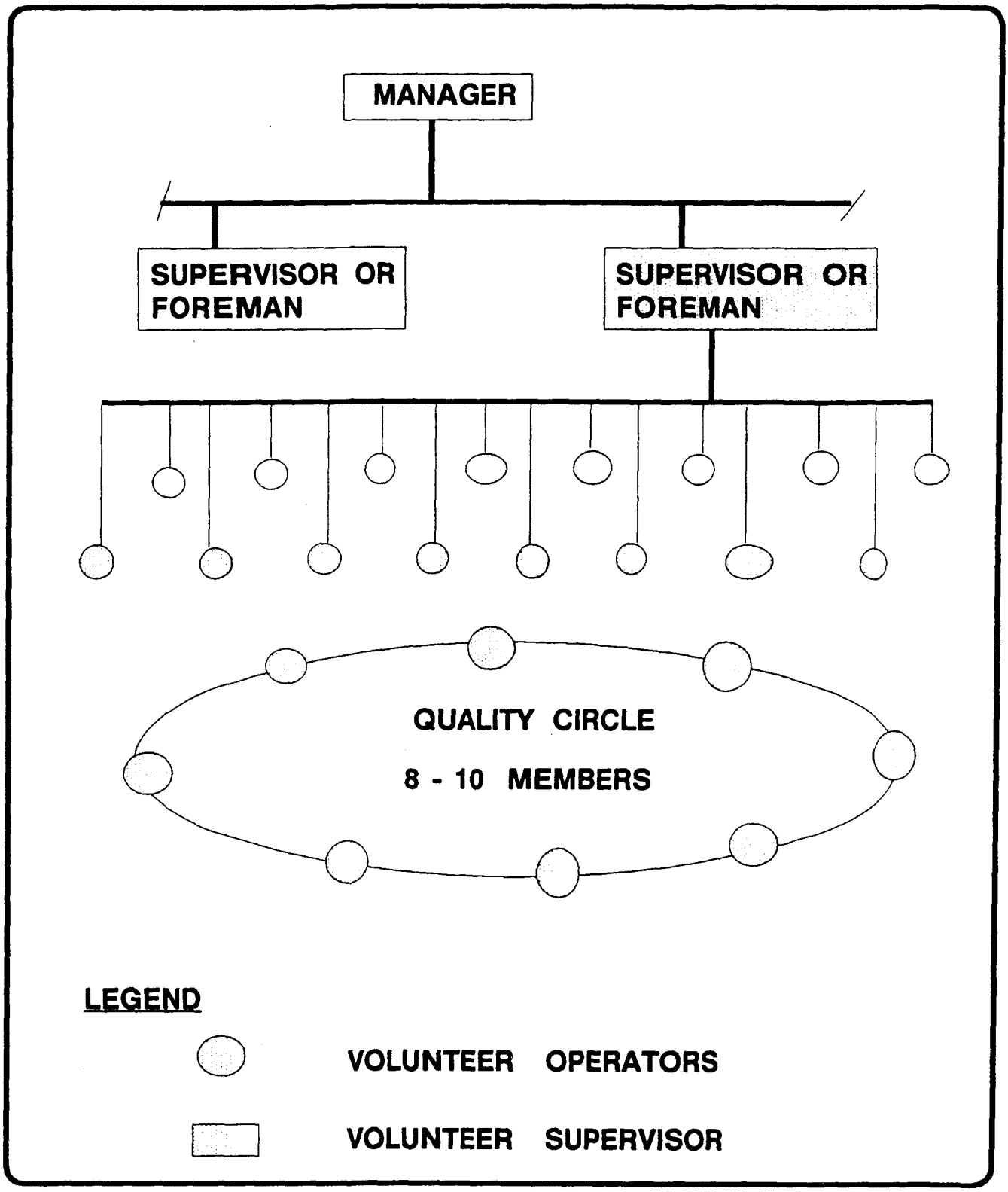


FIGURE 1: THE FORMATION OF A QUALITY CIRCLE

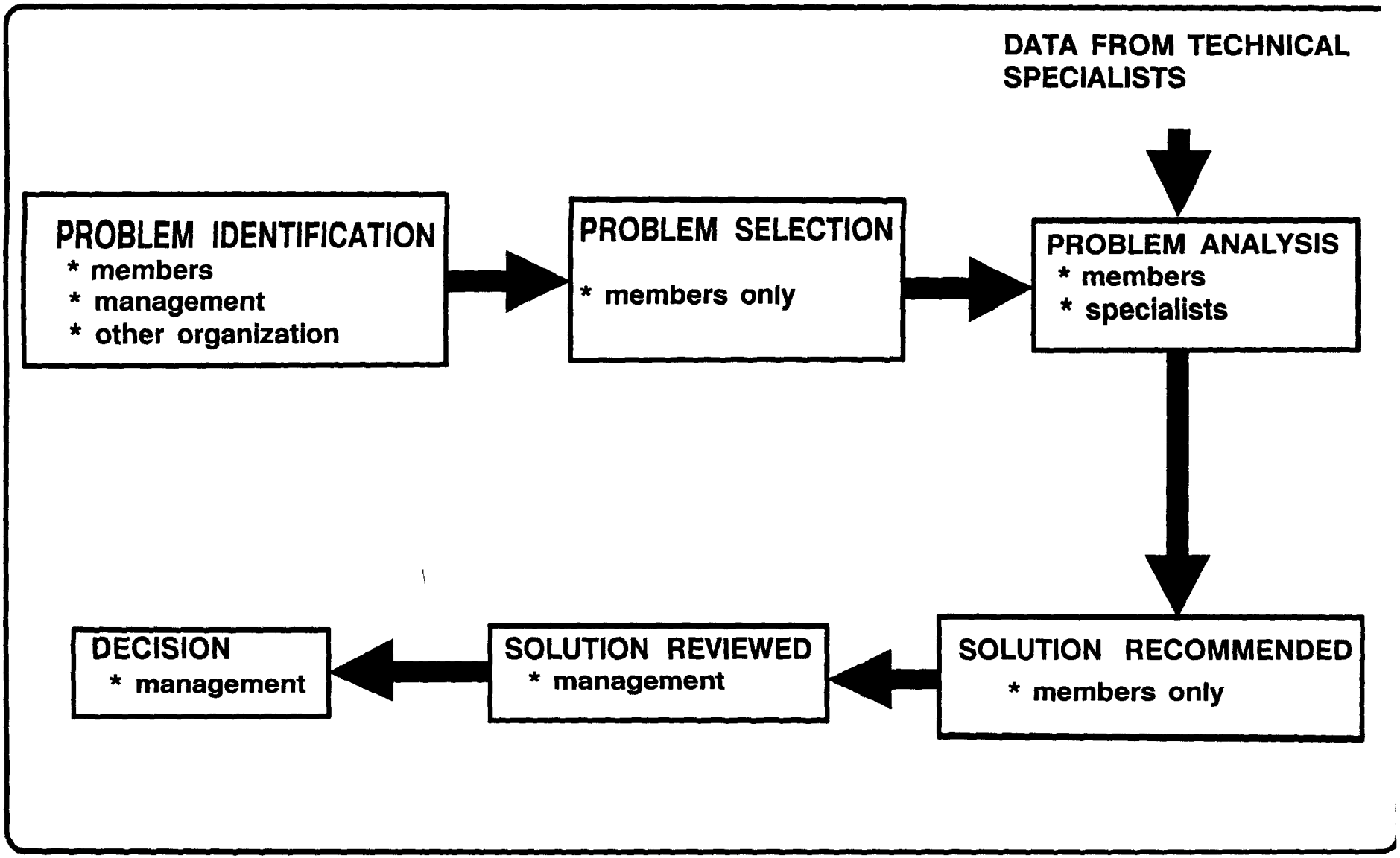


Figure 2: The Various Stages of Quality Circle Operation

However, the workers must see benefits as well. These usually include job satisfaction, personal growth, elimination of problems, better working condition, etc. Leaders must see benefits as well in the form of making their job easier, problem elimination, better motivation of employees and running a smoother operation. The union also may see the benefit of enhancing the role of workers whom they represent.

2. THE ROLE OF THE JAPANESE CULTURE

According to Likert organizational behavior (see Figure 3), organizations that adopt system 4 are open, supportive and favor a high degree of management and employee consensus (Galicinski,1983). Decision-making occurs at all levels and generally at as low a level as possible. System 1 organizations, on the other hand, are closed, top down oriented with frequent use of punishment and threats to achieve management goals. The decision making occurs entirely at the top with orders being handed down and obedience demanded.
Systems 2 & 3 are composites that fill in the spectrum.

The nature of the Japanese society and culture favors system 4 and clearly it has the participative environment that strengthen the motivation foundation of the quality control circles.

3. CUSTOMER NEEDS

Japanese management learned that , for good quality control, it is essential to know what characteristics consumers really want, and what the relation is among true and substitute

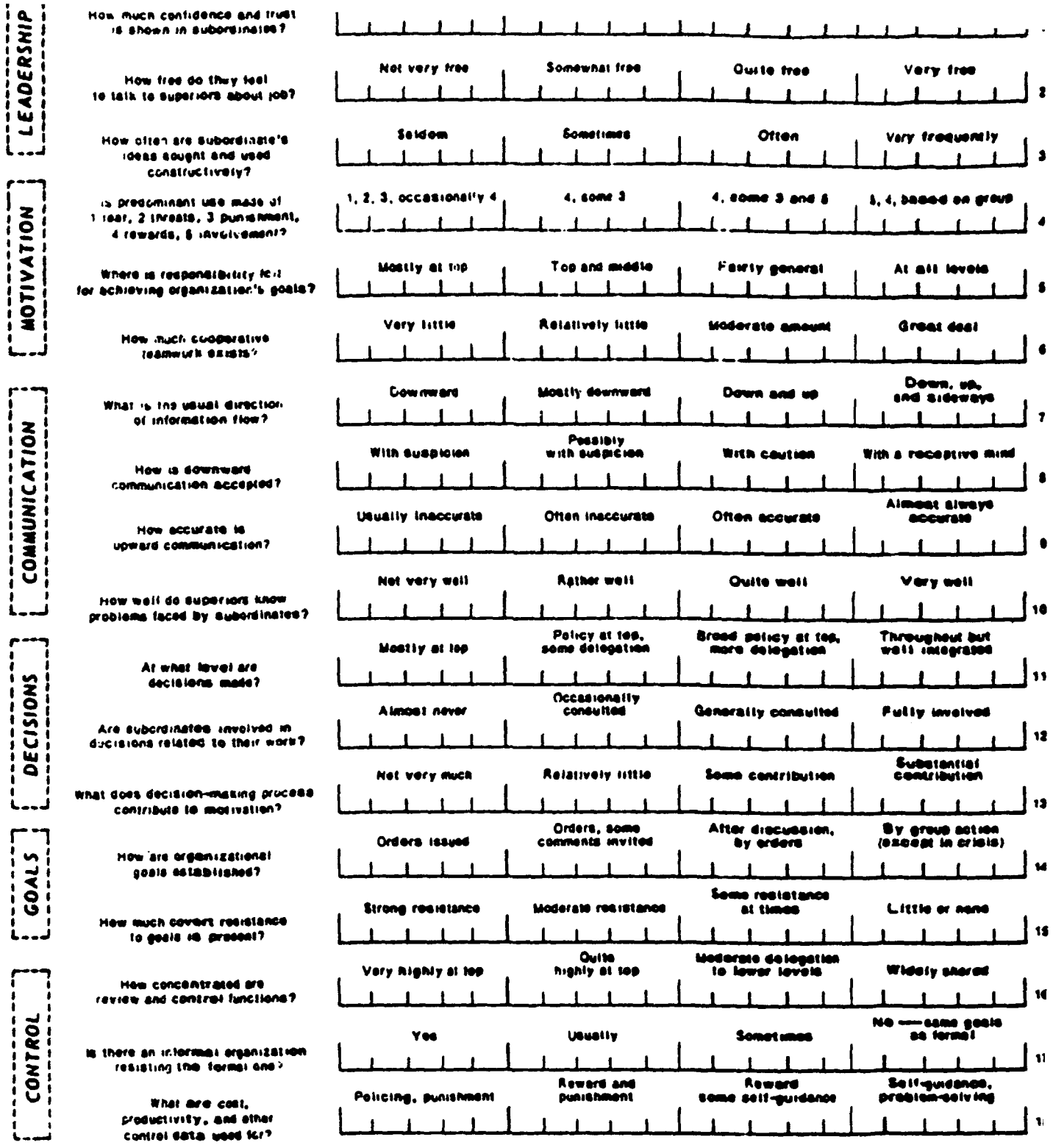


Figure 3. Likert Organizational Systems

characteristics.

A company may still receive complaints from consumers, in spite of good product design, good specification and sever inspection. Therefore it is necessary to carry out *Quality Assurance Analysis*. This analysis will allow one to find out how consumers use the product; to learn the true quality characteristics through product research; and to discover the relationship between the true and substitute quality characteristics.

Many statistical methods have been applied effectively and widely in quality control work, but quality analysis has yet a long way to go. The true characteristics often still remain unknown to producers as well as consumers.

Thus, producers may manufacture products in conformity with the taste of designers or top management and then inspect them merely for the purpose of inspection.

In other words, consumer's requirements are not as fully respected as they should be or not reflected enough in product quality. In order to improve the situation, not only should ordinary product research be conducted, but also more effort must be devoted to intensive research on the quality of product (fitness for use) in cooperation with consumers. *This is quality analysis*.

The *first step* of quality analysis is to determine true quality standards.

The *second step* is to analyze the relationship between the

true and the substitute quality characteristics and to determine the measuring methods and the required level for each of these characteristics.

The *third step* is to analyze, by statistical methods, the relationship between the substitute and true characteristics. In this context, it may be necessary to go beyond the national standards and thereby to manufacture high quality products as, otherwise, consumers or customers will not be fully satisfied.

In the years following World War II, a devastated Japan performed the "economic miracle" of its massive reindustrialization thrusting the country into the front ranks of economic powers. Perhaps the efforts spent by management to motivate, develop, and train the Japanese workforce have laid the foundation upon which basic fundamentals of manufacturing processes have been revolutionized. Just-in-time or zero inventories is a case in point.

Zero Inventories or Stockless production connotes a level of perfection not ever attainable in a production process. However, the concept of a high level of excellence is important because it stimulates a quest for constant improvement through imaginative attention to both the overall task and to the minute details.

The concept of just-in-time production emphasizes the methodology of producing exactly what is needed and conveying it to where it is needed precisely when required.

Ideally the system should achieve the following (Sandras,1988), (Hall,pp2-20):

* Produce products the customers want;
* Produce products only at the rate customers want them;
* Produce with perfect quality;
* Produce instantly-zero unnecessary lead time;
* Produce with no waste of labor, material, or equipment;
* Produce by methods which allow for the continuous development of people.

Therefore, the system eliminates waste in the following aspects:

* waste of overproduction
* waste of waiting,
* waste of transportation,
* waste of stocks,
* waste of motion,
* waste of making defects,
* waste of processing itself, when the products should not be made or the process should not be used in the first place.

The adoption of this philosophy removes many barriers in thinking, and that, in turn, leads to many new techniques for production. Its fundamental way of thinking is to transform manufacturing in the simplest way possible and to generate new and original techniques for doing so.

Just-in-time is characterized as a *pull* system. It means that material is drawn or sent for by the users of the material as needed. If completed production is stacked at the point where it

was made and no one comes for it, the workers can readily see that production of this part should stop. On the other hand, if someone wants parts that have not been made, that message is also clearly and immediately understood. The result is that people want to have on hand whatever will be wanted, but not too much, especially if space for parts is limited.

*****

Managing quality involves a number of separate activities each of which ought to be managed. It is, therefore, essential that an organization must adapt a clear and well-structured system for quality management which *Identifies, Documents, Coordinates, and Maintains* all the key activities needed to assure the necessary quality actions throughout all relevant company operations.

Managing quality is essentially the same as managing any other activity. It is the process through which people are mobilized to achieve designated goals (Juran,pp2-21). The process consists of a universal sequence of activities:

a) Establishing the broad principles which are to guide action. These principles are referred as *"policies"*.
b) Establishing the quantitative goals or targets for performance. These goals are referred to as *"objectives"*.
c) Defining the list and timetable of deeds which need to be done in order to accomplish the objectives. Defining the list of deeds is referred to as *"planning"*.
d) Defining the positions ,i.e., jobs which need to be set up so that the planned deeds will be executed. These

jobs are known, collectively, as the "organization structure". The process of setting them up is known as *"organizing"*.

e) Selecting and training people to man these jobs. This process is known as *"manning"*.

f) Stimulating to meet the objectives. This is known as *"motivating"*.

1.3 THE STATUS OF CANADIAN ORGANIZATIONS

Canadian organizations are not immuned from the historic changes in consumer expectations pertaining to quality or from the evolution of the quality systems mentioned earlier. They have no choice but to compete in a global market in order to insure their survival. The manufacturing sector has always been the driving force and the motor for the the economic development due to the spin-offs on the other sectors of the economy. It is also the sector that invests largely in research and development which generates new technologies and new commercial applications.

Accordingly, the competitiveness of this sector in the forthcoming period is a major concern for business, labor, and government.

By comparing the performance of the manufacturing sector in Canada and the province of Quebec with their counterparts from other industrialized nations, Tremblay (1988) has noted the following statistics:

* In the fifties, the manufacturing sector contribution to the

GIP was 36.7%, and it was responsible for 29.4% of the total employment in the province of Quebec. In 1986 , the Figures fell to 19.6%, and 20.2% respectively.

* The nations which have the best performance on the rate of employment creation , economic expansion, and technological development are those which have strong manufacturing sectors. For example,while Canada registered between 1960 and 1982 an average of unemployment rate of 7.1%, Japan , West Germany, and Sweden (the latter is comparable in population to Quebec) registered respective rates of 1.8%, 3.2%, and 2.1% for the same period.

  Likewise, by observing the contribution of the manufacturing sector to the GIP in the period between 1960 and 1981, one finds that in Canada the contribution was 21.8% while Japan, West Germany and Sweden the contributions were 29.8%, 35.7% and 28.1% respectively.

  Another example of significant importance is the impact of the manufacturing sector on technological advancement. While Canada had 3.7 robots per 10000 industrial jobs in 1984 (80% in Ontario and 10% in Quebec),Japan, Sweden, and West Germany had 32.1, 20.2, and 7.2 respectively.

* The cost of non-quality may reach 20-30% of the turn-over of Quebec companies and corporations. In dollars term, Quebec producers lose each year 12-15 billion dollars as a result of non-quality products.

* The prize for quality achievements (Mercure de la qualité) was first presented in Quebec in 1987. The same type of rewards were presented in Japan in 1951, thirty-six years ahead of Quebec.

By any account, the trend shown by the above statistics does not favorably reflect the Canadian or the Quebec manufacturing sector compared to some of the major industrialized nations in the free world; large multi-national corporations or medium size organizations (MSO) are no exception.

As a result of these unfavorable economic indicators, Canadian multi-nationals began to appreciate the possible gains and benefits when eliminating losses due to faulty practices.

Amongst these practices is that of accepting non-quality products and services provided by medium size organizations.

According to Chamberland(1989) the cost of non-quality of purchased items according to the corporation's specifications amounts to 10-15% annually . "In order to preserve our competitive position in a highly competitive marketplace, we will have no choice but to insist on buying quality products which conform to our specifications", Chamberland added.

Many other corporations such as General Motors of Canada (Peapples,1989), Bombardier (Baril,1989),IBM (Kelada,1987,p.8), and others have reflected the same attitude towards quality and effectively initiated various plans of action to improve the quality of their purchases.

In fact, almost all action plans envisaged by these major corporations focused squarely on the necessity of improving the quality systems of suppliers.

Being the main suppliers for large corporations, medium size organizations stand to lose the most if they ignore these demands from their major customers. Consequently, it is the objective of this study to investigate the quality systems applicable to medium size organizations.

1.4 OBJECTIVES

Being a system, quality management should address and satisfy the provisions of the following elements:

* The definition of objectives and policies
* Planning
* Organizing
* Motivating
* Controlling

As such...this study is to investigate the extent of which each one of those elements existed in the quality system of medium size organizations operating in the province of Quebec. Consequently, the **main objective** is to correlate the results of the investigation to the quality of the products provided by medium size organizations to a large corporate customer.

1.5 METHODOLOGY

In order to attain the main objective of this study as outlined in the previous section, the following approach was followed:

1.5.1 Approach for selecting MSO case studies:

Four (4) companies operating in the manufacturing sector were selected to represent MSOs. It should be pointed out that this selection does not represent statistical sampling, but rather it is based on a compromise with respect to the time limitations for research and the convenience of geographic location of these MSOs. In the course of this study, these organizations were referred to as case studies 1-4.

The criteria of selection were:

* All four organizations are operating in the province of Quebec.
* These companies are major suppliers for a large corporation which is also operating in the province of Quebec.
* They fall into the category of companies who employ 50-150 employees and have annual turn-over of 2-10 million dollars. This classification (Fortin,p.48) is in agreement with the definition of the Ministry of Regional Development concerning medium size organizations.

1.5.2 Approach for Collecting Data Pertaining to MSO Case Studies

The principal goal of data collected for each case study is to identify the parameters of each element of the quality system, and consequently to make a fair judgement about the degree of

advancement of each element.

In this study, the parameters of each element are defined as follow:

* **Policies and objectives**
  - Written commitment from top management.
  - Published documents outlining these policies and objectives.
  - Accreditation by a regulatory authority.
  - Awareness, comprehension and understanding by employees.
  - Participation of employees in formulating these policies and objectives.
* **Planning For Quality**
  - Responsibilities and authorities defined for quality planning.
  - Revision by senior management.
* **Organization**
  - Availability and maintenance of documents.
  - Communication.
  - Staffing.
  - The structure of the quality organization.
* **Motivation**
  - Existence of incentive programs such as profit sharing, ownership, or fringe benefits.
  - Indoctrination and training.
  - Extent of effective participation and involvement by

employees via means such as quality circles.

* **Control**
  - Existence of operating procedures and safeguards for respecting them.
  - Existence of the concept of statistical control as a tool for improvement and prevention.
  - Existence of a quality costs accounting system as a viable tool for control (see Appendix 7 for a discussion of quality costs) .

The main source of information was personal interviews with key personnel in each case study organization. These interviews were conducted according to the questionnaire of Appendix 8.

Following these interviews, a quality audit was conducted to evaluate the following activities:

- management organization
- quality planning
- documentation procedures
- procurement
- inspection control
- control of measuring and testing equipments
- control of non-conformities
- control of special processes
- applicability of statistical process control

The checklist of Appendix 9 was used for this purpose.

In order to achieve the **main objective** of this study, a large corporation was selected to represent a major customer for the

previously selected MSOs.

The degree of satisfaction expressed by the personnel of this large corporate customer was considered as an indicator for the quality of products supplied by each MSO case study organization. Then, this indicator (degree of satisfaction) was correlated to the extent of which the quality system elements existed in each MSO.

The data collected from the corporation was to provide information relevant to the following topics:

* The definition of the procurement cycle in the corporation and its intervening parties
* Policies and objectives of procurement
* The interface between the procurement department and other departments in the procurement cycle.
* Quality problems.
* The degree of satisfaction expressed by the concerned personnel of the corporation when dealing with each organization represented in the case studies. The parameters upon which satisfaction was measured were:
  - Conformity to requirements (specifications, standards, other contractual obligations, etc).
  - Performance in service.
  - Accessibility to quality records and documents.
  - Respect and adherence to delivery schedules.
  - Cost over-runs.
  - After sales services.

The tool by which information and data was collected was essentially personal interviews with key personnel from different departments. The questionnaire of Appendix 10 was used for conducting the interviews.

1.5.3 Limitations

Due to confidentiality requirements, the identity of the medium size organizations as well as the identity of the large corporation are not divulged in the present document.

CHAPTER II

THE STATUS OF SELECTED MEDIUM SIZE ORGANIZATIONS WITH REGARD TO THEIR QUALITY MANAGEMENT SYSTEMS AND THE CORRESPONDING DEGREE OF SATISFACTION OF A LARGE CORPORATE CUSTOMER

2.1 Data Collection Pertaining To Medium-Size Organizations

Four (4) companies were selected to represent suppliers to the corporation (see the approach to selection in the methodology section). The companies will be referred to as a case studies 1 to 4 respectively. The following information was gathered for each case study;

2.1.1 Case Study 1

1. Business and Product

1.1 Type of business

- Manufacturer of heavy machinery, welded assemblies, and jobbing machine shop

1.2 Turn-Over (1989)

Ten (10.0) million dollars approximately (welding and machine shop sectors)

1.3 Volume of business with the big Corporation

- 5-15% approximately

1.4 Present use of operating Capacity

- Less than 40%

1.5 Material Specification

- Customer specification
- American Society for Testing and Materials (ASTM)

1.6 Certification awarded

- Certified as per the Canadian Welding Bureau (CWB) standards W59 and W47.1 division 3.

2. Manpower

- Total number of employees (hourly paid and staff) is 110. The interviewer was told that substantial lay-offs were expected in the near future.
- Number of employees assigned to production: 65
- Number of employees related to quality control: 4
- Ratio QC/production: 6.2%

3. Quality Management System

3.1 Policies and Objectives

- The interviewer was told that the company had policies and objectives pertaining to quality. However, he was not able to verify the validity of this statement by documented evidence. Also, by when several employees were questioned, they failed to define or outline those policies.
- Employees perceive management as production oriented (recent shuffling in management positions may have been a contributing factor)
- The interviewer was told that a quality assurance program was under revision and would be structured to meet the requirements of the quality program CAN3 Z299(85) category3. No quality assurance manual was published yet.

3.2 Planning for Quality

- The interviewer received contradictory statements from the engineering and the quality assurance departments about who was responsible for the planning activities.

3.3 Organization

- Quality documents were well maintained and organized for one section only (the assembly of heavy machinery). On the other hand, documentation for other sections is comparatively confusing.
- At the present time (40% operating capacity), the staffing of the quality organization is sufficient, but at full capacity it would not be sufficient.
- The main task of the quality control department was to conduct in-process and final inspection on products.

3.4 Motivation

- The lower operating capacity is a noticeable demotivating factor.
- The unsold surplus production is a demotivating factor.
- During the past five (5) years, there was one long and bitter strike against the company.
- There is no profit sharing program.
- All training courses and similar activities are suspended for the time being.

3.5 Control

- The technique of statistical process control was not employed.
- The costs of quality are not documented. A recent study shows that 25-30% of the total operating cost was attributed to non-quality practices, mainly non-conformance to established company specifications.

4. Quality Problems

- Repairs and re-work are major concerns.
- Workmanship of welders assigned to precision jobs is sometimes unsatisfactory.

5. Future plans for Quality Improvement

- Completion of the quality manual
- Implementation of the quality system CAN3 Z299(85) category 3.
- Accreditation to the above mentioned program.

2.1.2 Case study 2

1. Business and Product

1.1 Type of business

- Manufacturing of metallic assemblies and sub-assemblies by means of welding.
- Machine shop.

1.2 Turn-over (1989):

- Fourteen (14.0) million dollars.

1.3 Volume of business with the Corporation

- Sixty eight (68%) percent of the turn-over.

1.4 Present use of Operating Capacity:

- More than 100%

1.5 Material Specification:

- Canadian Standard Association, CSA W 59
- American Society for Testing and Materials (ASTM)

2. Manpower

- Total number of workers (staff & hourly paid): 135
- Number of employees assigned to production: 115
- Number of employees assigned to quality assurance: 6
- ratio QA/production : 5.2%

3. Quality Management System

3.1 Policies and Objectives

- There was a policy statement with regard to quality signed by the general manager
- There was a quality manual based on the quality assurance

program CAN3 Z299(85) category 3.

- The quality program was not accredited yet by the Quality Management Institute (QMI)
- The quality objectives and policies were not explained yet to employees. Information sessions are planned for the next few weeks. It is noticed that the employees were not involved in formulating these policies.
- These policies were not published except for department managers.

3.2 Planning for quality

- Responsibility for planning is under the authority of the quality assurance manager and the head of the engineering department.
- Senior management occasionally review the quality procedures if sporadic problems appeared or in case of resurgence of customer complaints.

3.3 Organization

- Quality documents were well maintained and easily accessible.
- Most of the quality records and documents were available at work stations.
- Communications between departments were generally good.
- At the present time, the quality organization is under staffed to accomplish its tasks due to production over capacity. Under normal conditions, it would be sufficient.
- The structure of the quality organization and the interface

with other departments is depicted in the organigram of Figure 4.

3.4 Motivation

- No strikes were encountered during the past five (5) years due to the fact that the workers are not unionized.
- Training (orientation) courses were given to new employees. These courses were organized by the quality department.

3.5 Control

- Statistical Process Control (SPC) was not used. The knowledge of this technique was minimal and frequently confused with statistical sampling.
- The costs of quality are not documented.
- There was a confusion between the costs of quality and the cost due scrap. According to the quality manager, the losses due to scrap amounts to about 15% of the annual turn-over.
- Senior management review the quality program when the scrap rate is high.

4. Quality Problems

- Considerable amount of time was lost (not documented) due to rework and repairs.
- Most of the available machinery (machine shop sector) were not capable of meeting customers' tolerances.

  This shortcoming led eventually to high scrap rate or time waste in order to repair or to rework.

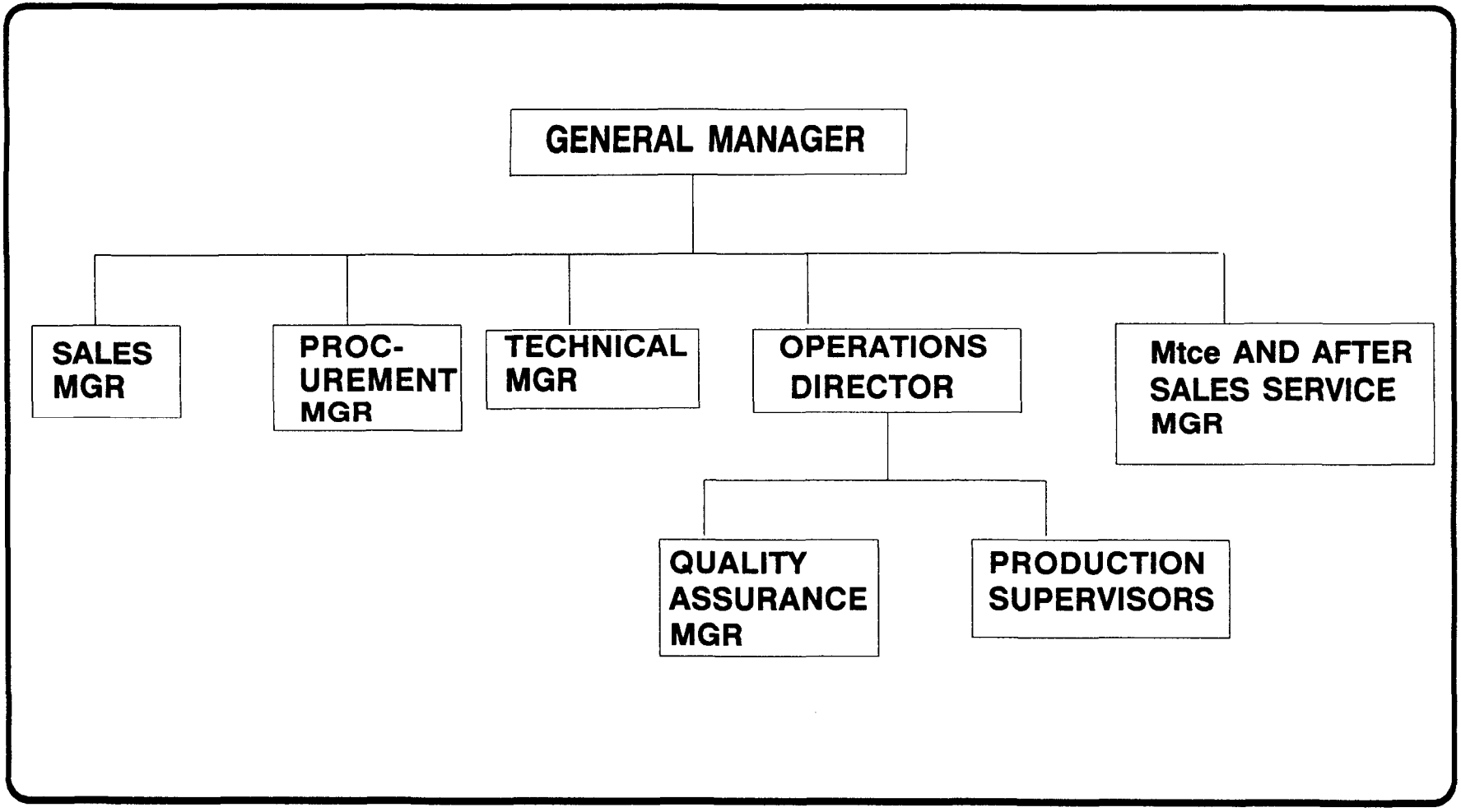


Figure 4: Organigram Of Case Study #2

- Sometimes customers' specifications and/or drawings were incomplete and not precise which led to many different interpretations and confusion.

5. Future Plans for Quality Improvements

- Accreditation by QMI for the quality assurance program.
- Sensitizing the company personnel about the requirements established in the quality assurance manual.

2.1.3 Case Study 3

1. Business and Product

1.1 Type of Business

- Iron foundry producing gray cast iron and high alloy white cast iron.
- Heat treating facilities for some of the above mentioned products.

1.2 Turn-Over (1989):

- Three (3.0) million dollars approximately.

1.3 Volume of business with the Corporation:

- Approximately 5%

1.4 Present use of Operating Capacity

- 85-90% approximately

1.5 Material Specification

- Proprietary
- American Society for Testing and Materials (ASTM).

2. Manpower

- Total number of employees: 50
- Number of employees assigned to production: 35
- Number of employees assigned to quality control: 4
- Ratio QC/production: 11%
- No union

3. Quality Management System

3.1 Policies and Objectives

- There was a policy statement documented and published in a quality assurance manual.
- The policies and quality objectives were signed by the general manager of the plant.
- The quality program depicted in the quality manual was based on the CAN3 Z299(85) category 3.
- The company applied officially for accreditation by the above mentioned program.
- Accreditation by the QMI is expected in early 1991.
- Information sessions started in order to explain the requirements of the Quality Assurance program and the corporate objectives.
- Consultation with staff personnel was conducted before formulating those policies. However, floor personnel were not involved.
- Publication of those policies was done via the quality assurance manual.

3.2 Planning for Quality

- The quality assurance manager was responsible for quality planning after consultation with the general manager.
- The pre-established plans are reviewed if scrap rate increases.

3.3 Organization

- Documents related to quality were well maintained. It was noted that the accessibility to these documents was somewhat difficult due to a poor indexing system.

- Pertinent documents were available at work stations.
- Communication between departments was excellent.
- Staffing:
  . The staffing of the quality organization was sufficient for the present volume of production.
  . The organigram of Figure 5 shows the inter-relation between the quality organization and the company structure.

3.4 Motivation

- No profit sharing program.
- No employee ownership.
- Orientation courses were given to new employees.
- No quality circles or similar activities existed.

3.5 Control

- Monitoring procedures for special processes were under revision. These procedures would be instituted as per the requirements of the quality assurance program Z299(85) category 3.
- Statistical process control techniques were not being used. The quality assurance manager agreed that this technique is very beneficial for this type of business.
- There was no systematic cost analysis for activities related to quality.
- Estimates for losses due to non-quality practices (scrap, rework,etc) are 15% of the annual turn-over.

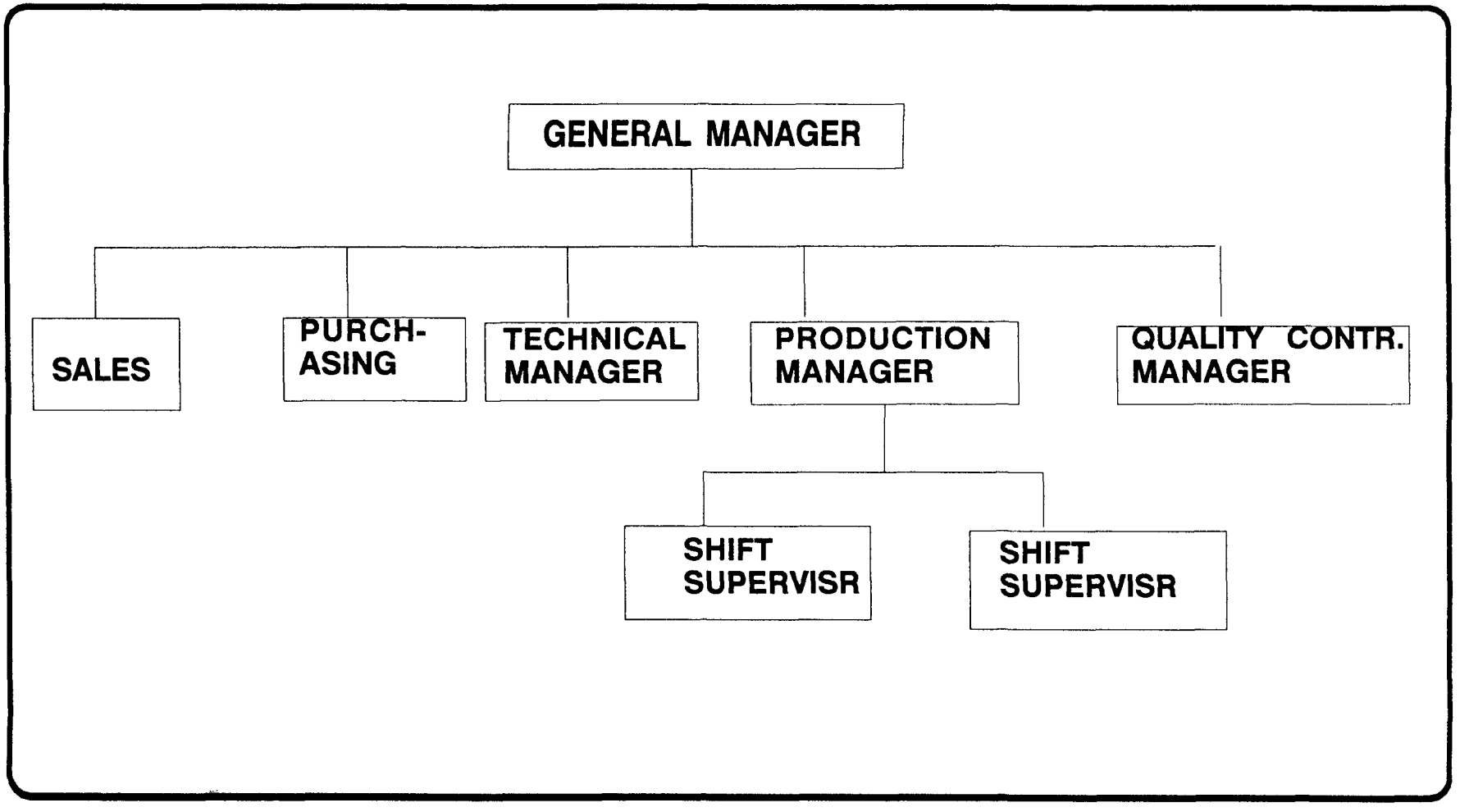


Figure 5: Organigram Of Case Study #3

4. Quality Problems

- Losses due to rework and repairs.
- Availability of highly qualified foundrymen.
- Non-consistency of the properties of the incoming raw materials.
- Ambiguous specifications of customers.

5. Future Plans for Quality Improvement

- Accreditation by the quality assurance program.
- Establishing formal training courses.

2.1.4 Case study 4

1. Business and Product

1.1 Type of business

- Machine shop, general and precision machining.
- Welding of assemblies and sub-assemblies.

1.2 Turn-over (1989):

- Five (5) million dollars approximately.

1.3 Volume of business with the Corporation:

- Thirty (30%) percent of the annual turn-over.

1.4 Present use of Operating Capacity:

- Approximately 80%.

1.5 Material Specification:

- American Society for Testing and Materials (ASTM).
- Canadian welding bureau specifications:
  - W 59
  - W 47.1
  - W 47.2

2. Manpower

- Total number of workers (staff & hourly paid): 70
- Number of employees assigned to production is: 60
- Number of employees assigned to quality assurance: 3
- ratio QA/production: 5%

3. Quality Management System

3.1 Policies and Objectives

- Quality objectives and policies statement existed and signed

by the president.

- The quality system was described in a quality manual.
- Efforts were underway in order to up-grade the existing program to the CAN3 Z299(85) category 3.

3.2 Planning for quality

- Planning for quality was under the responsibility of the quality assurance manager. The president was consulted occasionally.

3.3 Organization

- Documentation as per the quality manual was complete and well maintained.
- Implementation of elaborate and more complex system of documentation was underway to satisfy the requirements of the more demanding CAN3 Z299(85) category 3 program.
- Communication between departments was generally good.

3.4 Motivation

- No strikes were encountered during the past five (5) years.
- No training or educational courses were given to employees. The company envisaged initiating orientation courses for new employees.

3.5 Control

- Statistical Process Control (SPC) technique was not used. Management knowledge concerning this technique was minimal.
- The costs of quality are not documented.
- The annual scrap rate (internal and external) was about 5% of the total production.

- Senior management review the quality program when the rate of scrap exceeds the allowable limit.

4. Quality Problems

- Failure to meet customer specifications, especially when tolerances are very tight.
- Sporadic increase in number of non-conforming items and the consequence of rework and repairs.

5. Future Plans for Quality Improvements

- Capital investment in order to acquire new modern equipment.
- Up-grading the existing quality assurance program to CAN3 Z299(85) category 3.
- Accreditation to the new program by QMI.

2.2 Data Collection Pertaining To The "Large Corporation"

The procurement services of the corporation is responsible for supplying the different producing plants with their needs of goods and services.

Purchasing is an integral activity of the procurement cycle. This cycle begins with the detection of a certain need and ends with the satisfaction of such need. Figure 6 depicts graphically the quality loop in the procurement cycle.

When such need is born, several steps have to be taken to satisfy, among others, the quality objectives related to this need;

a. Definition of The Need

   The user or his delegate (usually the engineering department) should define precisely the parameters of the need by formulating concise and specific standards, specifications, etc.

   Eventually, these documents will represent a major part of the purchase order or contract. Consequently, they will be legally binding for both the buyer and the supplier.

b. Selection of a Supplier

   The main objective is to select and subsequently adjudicate the contract to a qualified supplier who is capable of fulfilling his contractual obligations.

c. Control and Surveillance

   This step is of great importance after the adjudication. It should be determined what parts or what processes should be

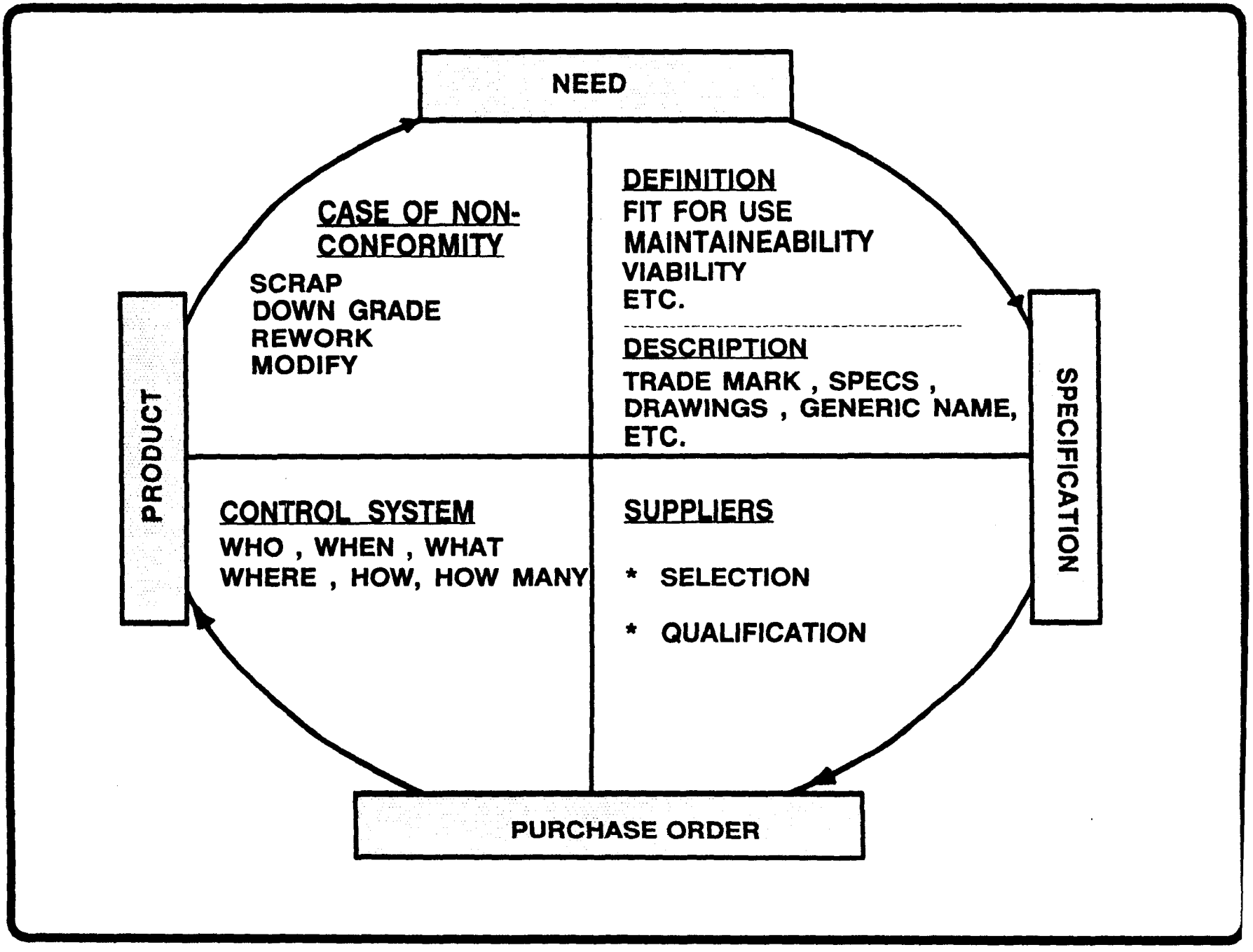


FIGURE 6: THE QUALITY LOOP

controlled or monitored during manufacturing, who should carry out the control, whether the control should be performed on all products or perhaps on statistical samples.

d. Non-conformance

Procedures should be in place to deal with eventualities such as delivering non-conforming materials or products (should these products be scraped, returned to the supplier, down-graded, or reworked and repaired at the supplier' s expense).

In this case of the large corporate customer, the intervening parties in the acquisition are identified as:

* The user
* The engineering department
* The buyer
* The contract administrator
* The quality assurance department

Accordingly, the input of the above personnel/departments was solicited when collecting the pertinent data.

The interface between the procurement department and the other departments within the corporation is represented schematically in Figure 7. For clarity purposes, the activities of each step of the schematic diagram will be explained briefly.

1. Detection of a need by the user.
2. The engineering department has the responsibility of translating this need into technical documents such as technical specifications, drawings, etc. These documents

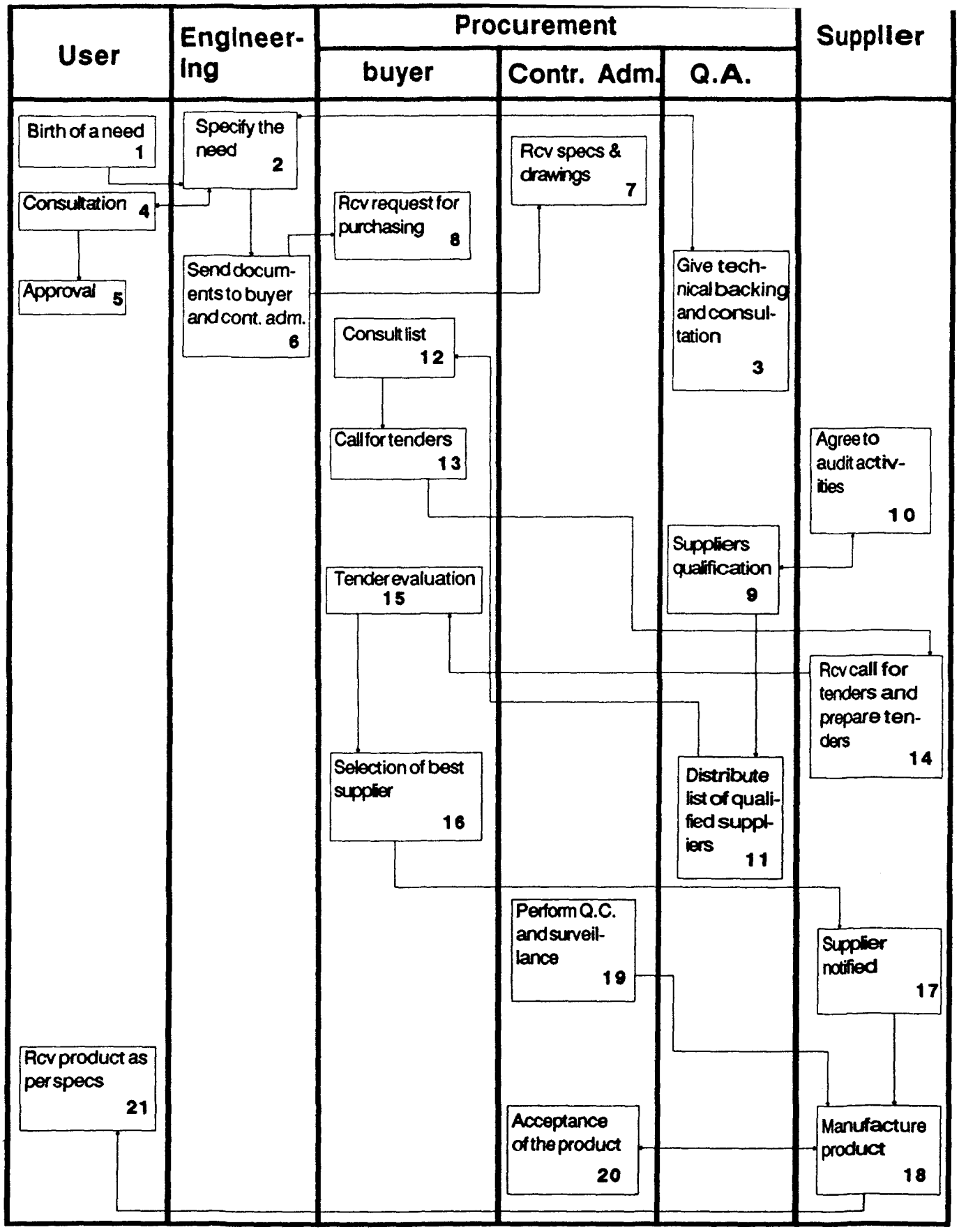


Figure 7: PROCUREMENT CYCLE FLOW DIAGRAM IN THE LARGE CORPORATE CUSTOMER.

should describe clearly the product which will ultimately satisfy the need. For instance, the user may wish to transport a certain material from point (a) to point (b), then the engineer has to chose the optimum means of transportation (conveyor belt, truck, forklift, etc) capable of achieving this goal.

3. Engineering consults with the quality assurance department.
4. Engineering consults with the user.
5. The user approves the concept, drawings, and specifications.
6. Engineering sends a requisition and the relevant documents to the buyer, and also provides a copy of these documents to the contract administrator.

7-8.

Acknowledgement by the buyer and the contract administrator.

9-10.

The quality assurance department performs the activities of qualifying potential suppliers.

11. The quality assurance department is responsible for up-dating and distributing, on a regular bases, a list of qualified suppliers who are capable of accomplishing a specific job.

12-13.

The buyer consults the list of qualified suppliers and prepares the call for tenders.

14-18.

Evaluation of tenders and selection of the supplier. The criteria of selection is usually based on price, service,

quality and delivery schedules.

19-20.

The contract administrator assumes the responsibility of:

> all communications between the corporation and the supplier.

> coordination of all changes or modification to the original contract.

> preparation of surveillance plans during the execution of the contract in order to ensure the conformity of the fabricated products to the specifications.

> accepting or rejecting the final product after consultation with the user or his delegate.

21. The user receives the product as per the criteria established in the technical specifications.

2.2.1 Policies and Objectives

The corporation has a quality assurance program for procurement. At present, the target of this program is supplies purchased according to the corporation's own specifications. Eventually, however, all goods and services will be included under the guidelines of this program.

In this regard, the policy and objectives are summarized as follows:

* After a reasonable period of time (transition period),the corporation will be dealing with those suppliers who are accredited to the CAN3 Z299 national quality assurance systems. Proof that their program is accredited and

registered by the Quality Management Institute (a division of the Canadian Standards Association) would be a prerequisite for dealing with a supplier for almost all products fabricated according to specifications.

* A supplier qualification program has been initiated in order to establish a directory for the qualified suppliers (Thompstone,1990). The intended directory will serve as a basic guide for buyers whenever calls for tenders are needed.
* The corporation offers training courses and technical assistance to suppliers who need help in implementing a quality assurance program or wish to evaluate their current ones. Quality system audits are also offered to suppliers in order to keep track of quality improvements, or lack of it, during the transition period.
* During the transition period, the corporation has no intention of altering the existing procurement practice with respect to the necessity of the supplier accreditation. However, if tenders are equivalent, preference will be given to the supplier who shows proof of the largest degree of advancement towards accreditation to the desired program.
* When the user, or his delegate, submits a requisition, the category of the CAN3 Z299 system should be inscribed on the pertinent specification.
* After adjudication, the assigned contract administrator coordinates all communications between the corporation and

the supplier. This practice is intended to eliminate confusions and errors resulted from multi-channel communications.

* The specifications submitted by the user (or his delegate) must be complete and precise (key characteristics and corresponding tolerances for example). It is the responsibility of the contract administrator with the collaboration of the quality assurance department to review the documents and ensure that they are adequate and manageable.

2.2.2 Quality Problems

According to several statements from the personnel who were interviewed, all quality problems are not necessarily caused by the supplier. As mentioned earlier the acquisition cycle involves several parties, each party having certain responsibilities and obligations in order to complete successfully the cycle.

In this context, quality problems will be categorized as those caused by the corporation's internal system and those caused by the supplier's system.

2.2.2.1 Quality Problems Caused by the Corporation's System

* In many cases a purchased product is used by several users inside the corporation. Occasionally, one of the users may contact the supplier demanding some modification of the product. This action is sometimes done without following the adequate procedure for modifications. The modifications

which were initiated by one user could be undesirable for the other user(s). For the latter, the modified product would become non-conform to requirements.

From the view point of the personnel interviewed, this practice would gradually be eliminated by phasing in the newly created function of the contract administrators.

* Lack of precision when specifying the characteristics of a purchased product, i.e. incomplete specification.

2.2.2.2 Problems Caused by Suppliers

* Occasionally, suppliers attempt to change (without authorization) what they may consider minor characteristics of the product. These unauthorized changes may have a negative impact on the *"fit for use"* criterion.
* Occasionally, a supplier may accept an addenda to the call for tenders, but after adjudication, he may realize that manufacturing according to the previously agreed upon requirements would cost more than the original estimates. He may even discover that his manufacturing processes are not capable of producing the product in conformity with specifications. In such situations the corporation may suffer delays in deliveries and/or inflated cost.
* When users experienced repetitive delays in delivery schedules, they attempted to keep emergency stocks in their plants. This amounts to a waste of cash resources of the corporation.

* Wide deviation from the target value, even though it still is within specification limits, represents considerable problems for fitting parts destined for assembly.

  To avoid these inconveniences, engineers are tightening - unrealistically- the specification limits with no regard to the consequence with respect to cost or the availability of suppliers who are capable of producing such tight tolerances.
* Concerns of possible labor conflicts within the supplier's organization may lead buyers to split critical orders between several suppliers even though their quality ratings are not the same. In other words, it was not possible to purchase from supplier who has the highest quality rating.

2.2.3 Degree of Customer Satisfaction

Measuring perceived quality is necessary for managers to assess the quality of their products relative to competitors. One approach to assessing relative quality is similar to the "multi-attribute" methods which are being used extensively in market research (Buzzeel&Gale,pp103-134). The judgmental ratings are done by summing up the quality scores and then expressing them as percentiles.

In this study however, the quality criteria (attributes) of the evaluation of each case study are:

1. Conformity to requirements (specifications, standards, other contractual clauses, etc).

2. Performance in service.
3. Access to quality records and documents.
4. Respect of delivery schedules.
5. Cost over-runs.
6. Service after sales.

Personnel from the corporate customer's different departments expressed their degree of satisfaction with regard to the pertinent quality criterion mentioned above on a scale from 1 to 10 where a score of 10 represents the highest degree of satisfaction. Where more than one department rated the same attribute, the average of all department ratings was calculated as a "sub-average".

For example, personnel from the engineering and user departments were asked to evaluate each case study organization with regard to the *conformity to requirements* criterion. The purchasing department is much more involved in the *cost over-runs* and thus only personnel from the purchasing department were asked to evaluate this criterion. Then the evaluation scores for the six attributes were averaged and expressed in *"degree of satisfaction"* percentage. The results are compiled in Table 4.

It should be noted that:

* The value of each quality attribute is treated equally and therefore the maximum score rating for each is ten (10) points.
* The number of persons from each department involved in the evaluation is indicated in Table 4 by a digit in brackets

following the the identification of the department.

* These evaluations reflect personal perceptions which are not always based on quantitative data and therefore a certain degree of subjectivity cannot be avoided.

CRITERIA	Case Study # 1 Score 1-10	Case Study # 2 Score 1-10	Case Study # 3 Score 1-10	Case Study # 4 Score 1-10
1. Conformity to requirements				
- Engineering (2)	7.5	8.0	7.0	4.0
- User (1)	5.0	7.0	6.0	3.0
Sub-average	6.25	7.5	6.5	3.5
2. Performance in service				
- User (1)	5.0	8.5	7.0	5.0
- Quality assurance (1)	6.0	8.0	7.0	5.0
Sub-average	5.5	8.25	7.0	5.0
3. Access to quality records and documents.				
- Quality assurance (1)	7.0	8.0	7.0	7.0
- Purchasing (2)	6.0	7.0	8.0	6.0
Sub-average	6.5	7.5	7.5	6.5
4. Respect of delivery schedules				
- User (1)	6.5	7.5	7.0	6.0
- Purchasing (2)	6.5	7.5	7.0	6.0
Sub-average	6.5	7.5	7.0	6.0
5. Costs over-runs				
- Purchasing (2)	7.0	6.5	7.5	5.0
Sub-average	7.0	6.5	7.5	5.0
6. Service after sales				
- User (1)	6.5	8.0	7.0	7.0
Sub-average	6.5	8.0	7.0	7.0
OVERALL AVERAGE(points)	6.38	7.54	7.08	5.50
SATISFACTION (%)	64%	75%	71%	55%

TABLE 4 : DEGREE OF CUSTOMER SATISFACTION.

2.3 INTERPRETATION OF RESULTS

1. The organizations represented by case studies 1,2,3 and 4 are in the process of implementing quality systems based on the requirements of the Canadian Standards Association quality assurance program CAN3 Z299(85) category 3.

Accordingly, the management of all four MSOs are committed to the same program which will be the bases for their quality management systems. However, based on the information provided and our observations during the quality system evaluations(see Appendix 9), it was clear that the extent of implementation of the various elements of the quality system was not the same within the four case studies.

Table 5 summarizes the degree of advancement (extent of the presence) of the quality system elements in each case study.

The results depicted in this Table address one of the objectives of this study which was to investigate the extent to which each one of those elements existed in the quality systems of Medium Size Organizations.

In Table 5, the implementation was measured on a scale of 1 to 10 where 10 represents complete implementation. The average score of each element converted to overall degree of implementation.

It should be pointed out here that:

* each element is considered of equal importance and therefore has a maximum score of ten points.

QUALITY SYSTEM ELEMENTS	Degree of Implementation. Scale 1 - 10. (10 is most advanced)			
	Case Study # 1	Case Study # 2	Case Study # 3	Case Study # 4
1. POLICIES AND OBJECTIVES				
- Written committement from top management.	10	10	10	10
- Published documents outlining policies and objectives.	10	10	10	10
- Awareness by employees.	03	05	06	04
Sub-average(points)	7.67	8.33	8.67	8.0
2. PLANNING FOR QUALITY				
- Responsibilities and Authorities.	03	08	07	06
- Revision by senior management.	04	05	05	04
Sub-average(points)	3.5	6.5	6.0	5.0
3. ORGANIZATION				
- Availability and Maintainability of documents.	07	10	10	10
- Communication.	10	10	10	08
- Staffing.	10	10	10	05
- Structure of quality organization.	10	10	10	07
Sub-average(points)	9.25	10	10	7.5
4. MOTIVATION				
- Existance of incentive programs.	00	05	00	00
- Indoctrination and Training.	00	00	00	00
- Effective participation and involvement of employees	00	00	00	00
Sub-average(points)	00	1.67	00	00
5. CONTROL				
- Operating procedures and safeguards for respecting them.	08	10	08	02
- Use and awareness of the statistical control concepts.	00	00	00	00
- Quality cost analysis as tool for management control.	00	00	00	00
Sub-average(points)	2.67	3.33	2.67	0.67
OVERALL AVERAGE(POINTS)	4.6	5.96	5.5	4.2
OVERALL PERCENT IMPLEMENTATION	46%	60%	55%	42%

TABLE 5 : DEGREE OF IMPLEMENTATION OF QUALITY

* the judgement of the degree of advancement was done exclusively by the author and consequently some degree of subjectivity is inevitable.

It was noticed that management scored the highest degree of advancement in their written commitment to and publishing of their quality policy and objectives. But when sample employees were asked about their awareness of and participation in formulating those policies and objectives, the score changed dramatically.

2. A careful analysis of the data shown in Table 5 indicates that the implementation of the motivation elements of the quality system is the least advanced in all the four case studies. Also, the effective participation and involvement of employees in formulating quality objectives is virtually absent even though the published documents are complete and conform to the requirements of the quality assurance program CAN3 Z299.3 (85). This may explain the lack of awareness by employees with regard to the company's policies and objectives.

Also, it was apparent in the case studies investigated that the concept of control is directed towards the product itself rather than the process. For example, we have noticed during the quality system evaluation that the quality control inspectors were rejecting up to 25% of the product items in order to separate the conforming items from the nonconforming ones. Certainly, the majority of these rejects were re-channeled into the production line for rework and/or repair and eventually re-

inspected and accepted as conformities. This practice tends to increase dramatically the operating costs. These costs are hidden unless there is a rigorous system to account for them. Such a cost system was not in place in any of the case studies.

As mentioned earlier in this study, statistical process control can be an invaluable tool for defect prevention rather than detection. It can also provide the pertinent data concerning the process capabilities so that management can react to and improve these capabilities or perhaps be more vigilant in selecting and accepting future contracts.

Consequently the absence of both the costing system and the use of the statistical techniques contributed to the lower score of the *control* elements throughout the four case studies.

3. The data presented in Table 4 demonstrates that case study #2 enjoyed the highest degree of satisfaction amongst the personnel of the corporate customer with an overall rating of 75%. Case studies 3,1,and 4 followed in descending order with overall satisfaction ratings of 71%, 64%, and 55% respectively. However, according to the personnel of the corporate customer, a 75% satisfaction rate does not imply an acceptable level of the overall performance of the MSO represented in case study #2.

4. The degree of satisfaction expressed by the corporation's personnel *correlates proportionally* with the extent of implementing the quality system elements. For example, the data of Tables 4 and 5 indicate that case study #2 implemented

60% of the system elements and acquired satisfaction rating of 75%; case study #3 implemented 55% of the system elements and acquired a satisfaction rate of 71%; case study #1 implemented 46% of the system elements and acquired a satisfaction rating of 64%; and finally case study #4 implemented 42% of the system elements and acquired a satisfaction rating of 55%. Figure 8 illustrate graphically the direct relation between the degree of satisfaction and the degree of implementation of the quality system.

The degree of correlation is measured mathematicaly by the *"correlation coofficient"* (AT&T Technologies,pp1985). It is calculated according to the following equation:

$$r = \frac{1/n \sum [(x-\bar{x})(y-\bar{y})]}{\sigma_x \sigma_y}$$

Where;

r = the correlation coofficient

x = variable represents the degree of implementation

y = variable represents the corresponding degree of satisfaction

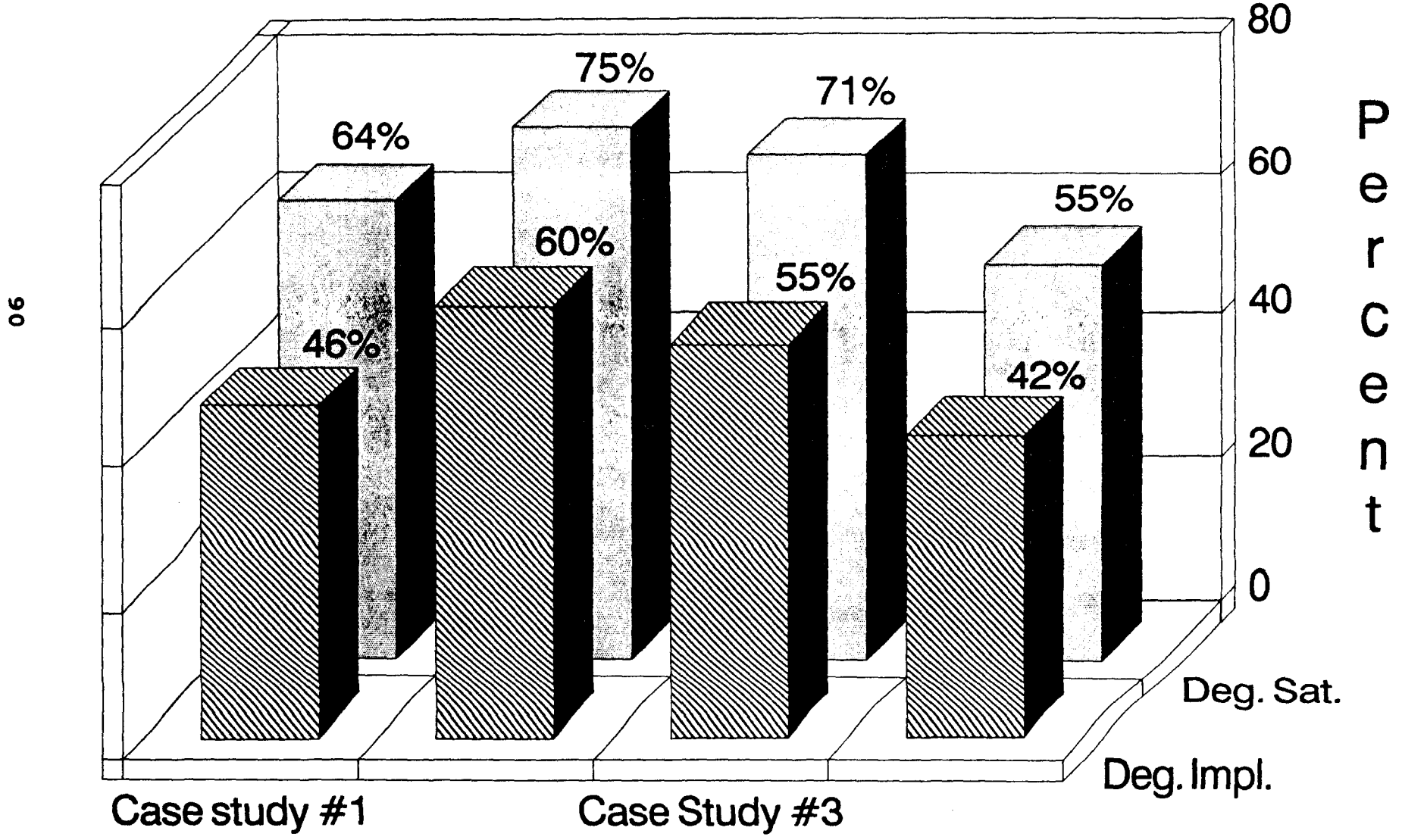
$\bar{x}, \bar{y}$ = arithmetic means

n = the number of pairs of x & y values

σ_x = standard deviation for "x" values

σ_y = standard deviation for "y" values

Figure 8: Degree of Implementarion Vrs. Degree of Satisfaction



Considering the pertinent data of x and y values, the following results were obtained:

$\bar{x} = 51$

$\bar{y} = 66$

$\sum[(x-\bar{x})(y-\bar{y})] = 210$

$1/n \sum[(x-\bar{x})(y-\bar{y})] = 52.5$

$\sigma_x = 7.1$

$\sigma_y = 7.6$

Substituting the above results in the equation, the correlation coofficient "r" = (+ 0.97)

According to AT&T Technologies(1985), this result indicates a strong, positive correlation. In other words, as the degree of implementation of the quality system increases, the degree of customer satisfaction increases.

2.4 CONCLUSION

In the course of this study, the author had the opportunity to discuss the quality issue with personnel representing the customer as well as the supplier. Several observations, recommendations and personal reflections are listed below:

1. A correlation between the degree of satisfaction and the extent of implementation of an individual element of the quality system (extent of its presence or absence) proved to be difficult to attain during this study. In order to achieve this specific goal, one should stabilize all elements throughout the four MSO case studies except one element and then investigate the effect of this particular element on the degree of satisfaction. Further research is necessary to investigate this correlation.

2. A degree of satisfaction short of *"full satisfaction"* is no longer acceptable to customers. The score of 75% satisfaction obtained by case study #2 was not adequate for the majority of people questioned from the large corporation.

Also, the quality of product alone is no longer the determinant factor in selecting a supplier. Other factors such as respect of delivery schedules, pricing, and response to complaints are emerging as factors of importance as great as the quality of the product itself in the qualification and selection processes.

A quality system based only on the technical aspect of quality

will not be complete in addressing the full expectation of customers. The ultimate goal should be the deployment of a company-wide quality system which integrates all the activities of the organization, not just manufacturing. We should not lose sight of the fact that the first impression of customers is the way he or she is treated by a telephone operator or a receptionist.

3. As demonstrated previously, motivation is by far the common weakness among the organizations studied. The majority of workers failed to explain management's policy and objectives regarding quality. This is an indication that workers were not involved in formulating these policies and objectives. We have noticed also the absence of any systematic job training programs that might improve worker's skills and abilities. Perhaps the organizations ought to pay more attention to the human side of the quality issue. People are the makers of quality and they are the most valuable resources in any organization. Certainly the greatest single challenge facing management in the period ahead is how to motivate their workforce.

Why not let people set their personal objectives and take the time to integrate these objectives in the overall objectives of the organization?

Why not put greater emphasis on real two-way communication between management and workers?

Why not sensitizing people to the surrounding economic

realities and how the organization would survive in these realities?

Why not manage our organizations in a participative manner instead of the conventional individualistic approach?

Why not invest in in-house training programs to increase the personal capabilities of workers?

These are some issues worth pursuing in order to motivate people and studying their impact on the bottom line of an organization.

4. The study confirms the fact that the customer has indeed the upper hand in dictating the level of quality expected from a supplier. In our case, the large corporation after realizing the extent of losses resulting from non-quality of purchased items, made it clear that nonquality practices by suppliers will no longer be tolerated. Furthermore, the large corporation specified the accreditation to the quality program CAN3 Z299(1985) as a pre-requisite for continuing business with a supplier. Consequently, the great majority of suppliers from medium-size organizations - the four case study organizations amongst them - declared their intention to abide by the demand.

5. None of the organizations studied apply or has the intention to apply the statistical process control approach in their business activities.

As explained earlier, this technique - if integrated intelligently in a quality system - can offer a formidable tool for measuring the process variability. The basic idea is to find

the real cause of such variation and then take the necessary action to reduce it. As long as variation exists, continual efforts should be expanded to reduce or eliminate this variation (in other words, on-going striving for improvement).

6. Cost control is one of the main tasks of management, and cost control of quality is no exception. None of the organizations studied has in place a comprehensive costing system for quality activities. One wonders how management would be able to:

* evaluate the effectiveness of the quality system and its impact on the overall performance of the organization;
* set realistic targets for future corporate objectives;
* measure the evolution of the corporate quality system.

It was noticed that management of the organizations studied confuse the costs of quality with the cost of rejects (scrap).

Appraisal costs, prevention costs, internal failure costs and external failure costs constitute the overall quality costs. The basic step towards improving an existing quality system should be to accurately examine the quality costs. Accounting and analyzing these costs will reveal areas of potential improvement. Corrective actions initiated in these high cost areas will lead to cost reduction and eventually high profits.

APPENDIX 1

DISCUSSION OF:"THE MEANING OF QUALITY"

Of all concepts in the quality function, none is so far-reaching or vital as fitness for use.

All Human institutions (hospitals, industrial companies, schools,etc) are engaged in providing products or services to human beings. This relationship is constructive only if the goods or services respond to overall needs of the user in price, delivery date, and fitness for use. If the goods and services do respond to these overall needs, they are said to possess marketability or salability.

Among these overall needs, the extent to which the product successfully serves the purpose of the user, during usage, is called its *"fitness for use"*. This concept of fitness for use is a universal concept of *quality* and applicable to all goods and services (Juran,1974).

Fitness for use is determined by those features of the product which the user can recognize as beneficial to him or her, e.g., fresh baked *taste* of bread, clear *reception* of radio programs, *beauty* of painting, *status* of club membership, and so forth. Therefore, fitness for use or "quality" is judged as seen by the user, not by the manufacturer, merchant, or repair shop.

For instance, to a big family, a fancy convertible car is not a quality product. To satisfy their need, a multi-purpose vehicle (MPV) with appropriate power and moderate price is the quality product which would accommodate them in their long trips while

vacationing, shopping, etc. In other words, for this family, a quality car (means of transportation) would be the one which fits their intended use or in other words, which satisfies their need.

Quality characteristics are the corner stone on which fitness for use is built. These characteristics exist in several subspecies:

* Technological,e.g, hardness, inductance, acidity
* Psychological,e.g., taste, beauty, status
* Time-oriented,e.g., reliability, maintainability
* Contractual,e.g.,guarantee provisions
* Ethical, e.g., courtesy of sales personnel, honesty of service shops.

There has been a long range trend to quantify these characteristics. Technological characteristics, notably properties of materials, were extensively quantified beginning several centuries ago with the accelerated growth of instrumentation. The twentieth century has seen a similar movement to quantify the remaining types of characteristics.

Service industry quality characteristics, while including all of the above sub-species, are dominated by the psychological and ethical characteristics. In addition, the service industries generally regard promptness of service as a quality characteristic, whereas the manufacturing industries generally do not. Instead, manufacturing companies regard promptness(i.e., timely delivery of products to customers in accordance with

promised date) as a parameter very different from "quality". The distinction is so sharp that there is a separate organization(Production Control) to set standards for delivery time (schedules), to measure performance, and to stimulate compliance.

Quality characteristics can readily be classified into several useful categories or parameters of fitness for use. This classification helps to understand the nature and interrelation of the major economic forces involved and to define more precisely the needs of the user. The resulting major parameters are :

* Quality of design
* Quality of conformance
* The "abilities"
* Field service

Quality Of Design(Grade)

All human beings exhibit certain basic needs such as nourishment and shelter. The industrial society elaborates these basic needs to include many others such as transportation, communication, etc. In addition the human species has exhibited a timeless, powerful urge for control over the forces of nature, for security, for comfort, for artistic achievement, and for just more of everything.

The resulting imbalance between a high level of human wants and a variable level of human affluence has led to the creation or recognition of *different levels of excellence* of products and

services. For example, transportation may take place via a public bus, a private Volkswagen, a private Rolls-Royce, a private jet airplane. Each of these levels is called a *"grade"*. A difference in grade is a difference in *"quality of design"*, i.e.,design to meet a human need (transportation in the example above).

Grade is a non-technical term. It is widely used and understood by the public to mean a certain level of quality, which relates also to a level of fitness for use and a level of affluence.

Quality of design is a technical term. It can be regarded as a composite of three separate steps in a common progression of activities:

a) Identification of what constitutes fitness for use to the user.

   Curiously, there is no widely used term to describe this activity. Because the the identification is the result of market research, the effectiveness of the activity might be termed *"quality of market research"*.

b) Choice of concept of product or service to be responsive to the identified needs of the user, i.e., *"quality of concept"*.

c) Translation of the chosen product concept into a detailed set of specifications which, if faithfully executed, will then meet the user's needs, i.e.,*"quality of specifications"*.

Quality Of Conformance

The design must reflect the needs of fitness for use, and the product must also conform to the design. The extent to which the product does conform to the design is called "quality of conformance".

Quality of conformance is the resultant of numerous variables such as machines, management, workmanship, etc,.

The Abilities

For products which are promptly consumed (e.g.,fuel, food, etc), the parameter of quality of design and quality of conformance are largely sufficient to determine fitness for use. For long-lived products, some new time-oriented factors come into play: Availability, Reliability, and Maintainability. These abilities are closely inter-related and are vital to fitness for use.

To provide continuity of life in industrial society, much effort has been devoted to discovering how to minimize failure rates of products and how to restore service promptly in case of failure.

Availability

Availability is time-related and is measured by the extent to which the user can secure service when he wants it.

A product is said to be available when it is in an operative state. The total time in the operative state (uptime) is the sum of;

* the time spent in active use;

* the time spent in standby state.

The total time in nonoperative state (is also called downtime) is the sum of;

. time spent under active repair such as diagnosis, remedy, etc.,

. time spent waiting for spare parts, paper work, etc,.

Therefore, availability can be expressed mathematically by the ratio:

uptime / (uptime + downtime)

Reliability

If products never failed, availability would be 100%. However, products do fail, so that an essential subparameter of availability is freedom from failure, for which the accepted technical term is "reliability". The classic definition is "the probability of a product performing without failure a specified function under given conditions for a specified period of time."

Maintainability

The need for continuity of service has also stimulated much effort to improve the maintenance of long-life products. This maintenance takes place in two major ways:

* Preventive or scheduled maintenance consisting of tests and checkouts to detect potential failures, scheduled servicing, and planned overhauls plus replacement of worn or failure-prone parts,

* Unscheduled maintenance consisting of restoring service in event of failure.

Field Service

The foregoing parameters are influenced mainly by what goes on prior to sale of the product to the user. Following the sale, the users' ability to secure continuity of service depend largely on some service organization which should:

* Provide clear, unequivocal service contracts;
* Establish adequate repair equipment capacity and supplies of spare parts;
* Recruit and train a service force competent to diagnose and remedy failures;
* Provide prompt response to service calls;
* Conduct its affairs with courtesy and integrity.

The parameter which includes these after-sale service needs of the user is known as "field service".

The interrelation among the foregoing parameters can be represented by the sketch of Figure 9.

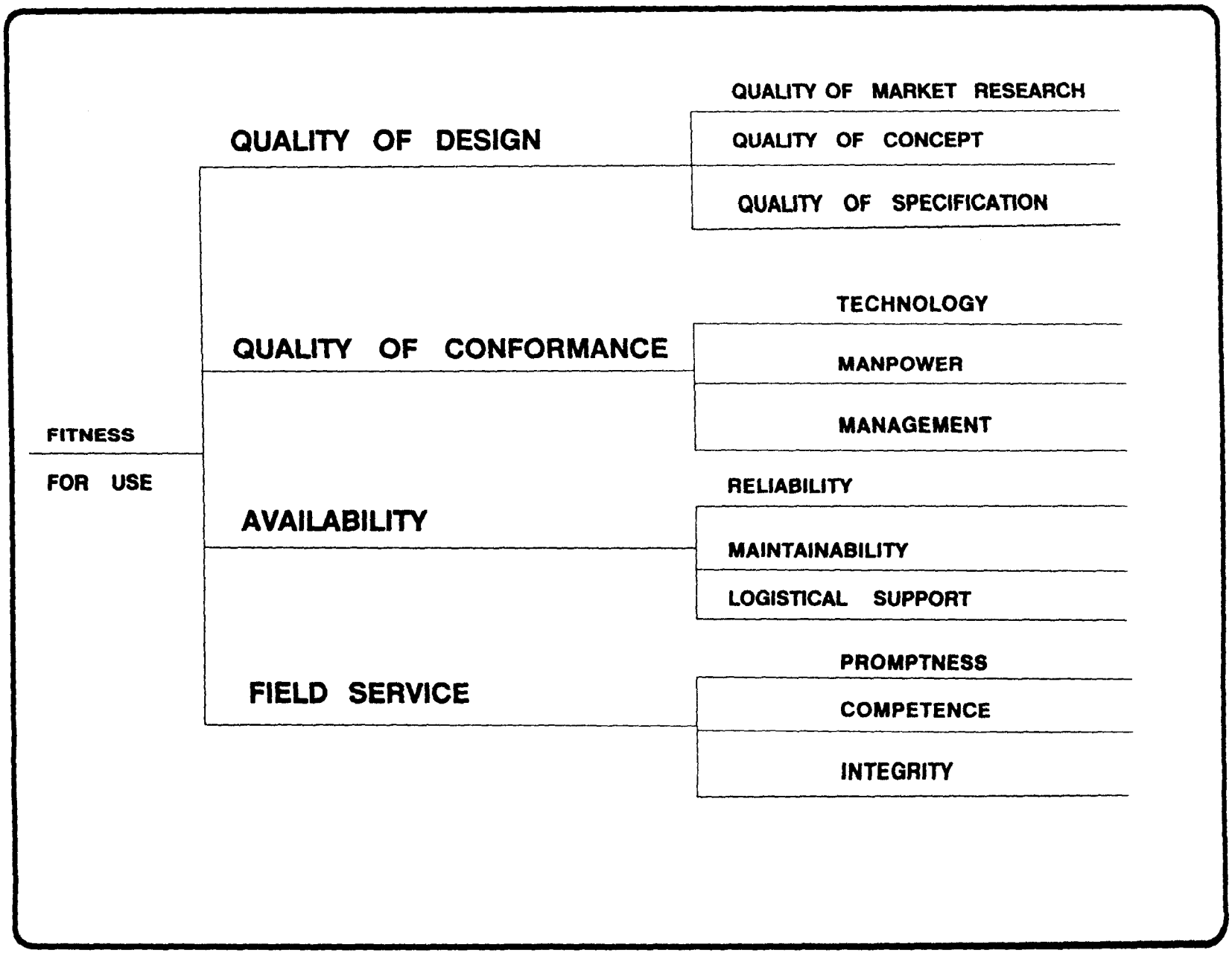


FIGURE 9 : INTERRELATION AMONG THE "FITNESS FOR USE" PARAMETERS

APPENDIX 2

DEFINITION OF THE TERMS: CUSTOMER, USER AND CONSUMER

A *customer* is one who buys from another. The purchase may be for the purpose of re-sale, in which case the customer is commonly a merchant of some sort. Alternatively, the purchase may be for use, in which case the customer is also a *user*. The purchaser of a service is often called a *client*.

A *user* is one who receives the intended benefit of the product. The user may consume the product (e.g., burning of fuel), or he may perform further processing to create a different product for sale. In most organizations, usage is usually done by some individual for the benefit of the organization, e.g., machinist, truck driver, etc,.

A *consumer,* is an individuals or a family who consume goods for personal purposes.

APPENDIX 3

THE MEANING OF THE TERMS: CONTROL, QUALITY CONTROL, AND SELF-CONTROL

Many of our activities are devoted to adherence to standards, which is a form of preventing adverse change.

Biologically this can be illustrated by maintaining body temperature, blood counts, blood pressure, etc.

In industrial terms, it takes the form of meeting standards: delivery according to schedule, expenses according to budget or quality according to specifications.

The process through which these standards are met is called *control*. This process consists of a universal series of steps, which when applied to problems of quality, can be listed as follows:

* Choosing the control subject
* Choosing the unit of measure
* Setting a standard value,i.e, specifying the quality characteristics
* Selecting a sensing device, which can measure the characteristic in term of the unit of measure
* Conducting actual measurements
* Interpreting the difference between actual and standard
* Decision and action

The aforementioned steps is the *regulatory process* by which anything can be controlled(Juran,1964).

THE MEANING OF QUALITY CONTROL

When the universal regulatory process is applied to problems of product quality, it is called *"quality control"*.

This term has also other meanings, including:

* A part of the regulatory process, such as product inspection.
* The name of a department which is devoted full-time to the quality function.
* The tools, skills, or techniques through which some or all of the quality function is carried out.

THE MEANING OF SELF-CONTROL

When work is organized in a way which enables a person to have full mastery over the attainment of planned results, the person is said to be in a state of self-control and then can held responsible for the results. Self-control is a universal concept. It can be applied to a general manager, plant manager,or an operator.

Before a person can achieve the state of self control, several fundamental criteria must be met. He must acquire:

* The knowledge of what he is *supposed* to do
* The knowledge of what he is *doing*
* The means for *regulating* what he is doing in the event that he is failing to meet the established goals. These means must always include the *authority* to regulate and the *ability* to regulate either by varying the process or varying his own conduct.

If *all* the foregoing conditions have been met, the person is said to be in a state of self-control and can properly be held responsible for any deficiencies in performance. On the other hand, if *any* of the conditions have not been met, the person is no longer in a state of self-control and consequently can not be held responsible.

APPENDIX 4

DEFINITION OF THE TERM: QUALITY ASSURANCE

The ultimate responsibility for product fitness for use rests with top management, who are accountable to owners, regulators, customers, etc, for the performance of the company and its products. Historically, top managers have guarded themselves against unpleasant quality surprises by making delegations to trusted subordinates, supplemental personal observation, studying reports from staff specialists, etc. Collectively, these methods were adequate to provide top managers with the confidence in the conduct of quality function.

As quality function has become remarkably more important, there has emerged the concept that managers, as well as customers need an added source of confidence- formal, independent evidence to the effect that all is well with the quality function.

A parallel can be seen in the finance function. This function has always been seen as critical, since a service failure could bankrupt the company. In consequence, managers, owners, bankers, regulators, tax collectors, etc., have made use of independent sources of confidence. A major form has been the "independent financial audit", which provides assurance that:

* The system if followed correctly, it will reflect the true financial condition of the company;
* The system is actually being followed.

The type of evidence being used to provide formal quality assurance is the "quality equivalent" of the financial audit. The

activity of providing this confidence is usually called quality assurance.

Therefore, quality assurance can be defined as, the activity of providing, to all concerned, the evidence needed to establish confidence that the quality function is being performed adequately.

APPENDIX 5

DEFINITION OF THE TERM: STANDARDS

Standards are an essential element of modern society, yet most people understand little about what standards are, what they do, who develops them, and why.

The elaboration of a standard is not an easy task. In the past, emphasis was not placed on education. But suddenly, perhaps because consumer movement has established itself as permanent a force in the economic community, the word *standard* and the process of standard writing are being discussed in many new and significant ways.

More people want to become involved in writing of standards that affects their lives and they are asking the essential question: "Why standards are needed?"

This new interest places upon the standards community a clear responsibility to increase the knowledge and awareness of people about standards.

The Value Of Standards

According to an Editorial (1977),"Our behavior towards one another is governed by standard rules of conduct. Our language is a combination of standard symbols and sounds that represent thoughts in communications. The point is that we are literally surrounded by standards but are so accustomed to their presence as to be unaware of them or their value. The building we work in, the chair we are sitting in, the pen we write with, the clothes on our backs are all manufactured to standards for materials,

design, and performance. The building stands, the chair supports, the zipper zips because standards work when they are properly developed and applied".

Types of Standards

As per the *American society for Testing and Materials (ASTM)*, the world's most prolific standards-writing body, the word *standard* is used as an adjective to describe the following:

* Standard Definitions
* Standard Recommended Practices
* Standard Test Methods
* Standard Classifications
* Standard Specifications

As clearly seen, a specification is only one of five distinctly different types of standards.

Standard definition create a common language for given areas of knowledge. For example, one would hardly think that something so basic as a vacuum cleaner would require a definition. Yet to simplify purchasing, ASTM committee F-11 on Vacuum Cleaners issued this definition in a standard designated ASTM F395:

"A system or device that removes material, usually loose, from surfaces by means of the air flow caused by atmospheric pressure, having an intake intended to be moved in proximity to the surface, a means of separating the material from the air, and a receptacle for collecting the separated material. The inlet may be separated or attached to other equipment and

provision is made for removing the collected material".

Standard recommended practices are procedures or guides that may or may not be auxiliary to a test method or specification. Examples of such documents include instructions for selection, preparation, application, evaluation, inspection, necessary precautions for use, or disposal of materials and installation, maintenance, and operation of testing apparatus.

For instance, ASTM committee E-18 on Sensory Evaluation has developed a Standard Recommended Practice for the Sensory Evaluation of Industrial and Institutional Food Purchases(E461).

This practice provides a means for effecting quality control in the purchase of commercial food products. To do this a panel of 24 untrained volunteer consumers is randomly selected. Their job is to taste and smell food samples under prescribed conditions of light, temperature, and so forth. They then rate the sample on a numeric scale of 1 to 9, with 1 being the "dislike" end of the scale. Pertinent comments are categorized and reported in order to reflect consumer reasons for product rejection.

Standard test method is a concise description of an orderly procedure for determining a property or constituent of a material or an assembly of materials. The directions for performing the test should include all the essential details as to apparatus, test specimens, procedures, and calculations needed to achieve satisfactory precision both by the same operator in separate

tests, or by operators in different laboratories.

An interesting example of a test method is that the manufacturers of *jail bars* and prison administrators would turn to the standards forum to prevent inmates from escaping by cutting their way out. All interested parties got together and came up with a method of testing jail bars for resistance to sawing, cutting, filing, or hacking. ASTM Method A 629 specifies that a jail bar is good enough to hold a prisoner in when it can resist 18000 cycles of cutting with a hack-saw blade.

A standard classification, as applied to materials, products, systems, or services, defines systematic arrangements or division into groups based on similar characteristics, such as origin, composition, properties, or use.

ASTM committee D-13 on textiles, for instance, has devised standard tables for classifying man-made and natural fibers.

A standard specification is a concise statement of requirements to be satisfied by a product, material, or process indicating the procedure by means of which it may be determined whether the requirements given are satisfied. It is desirable that the requirements be expressed numerically in terms of appropriate units together with their limits.

For example, ASTM committee F-17 on Plastic Piping Systems has developed a standard specification for polyvinyl chloride (PVC) sewer pipe and fittings(D 2729). It covers requirements and testing methods for materials, dimensions, workmanship, chemical

resistance, and joint tightness for PVC pipe and fittings for sewers and drains.

WRITING STANDARDS

In the United States, there are more than 400 standard-writing organizations.

In Canada, the National Standard System (NSS) is made up of independent organizations concerned with voluntary standardization in Canada(Standards Council of Canada,p4).

Voluntary standardization includes such activities as standards writing, certification, testing and quality assessment schemes.

The system was created to provide a medium through which Canadian organizations involve in such activities could work together to provide a comprehensive Canadian standardization capability to meet both national and international requirements and responsibilities.

The National Standard System (see Figure 10) currently comprises five accredited certification organizations, forty six accredited testing organizations and the Canadian organizations concerned with international standardization. The system depends on the resources and skills of these organizations who participate in their work. The standards council of Canada, a representative of national non-government agency, provides coordination and support for the system. Other certification and testing organizations will be added to the system.

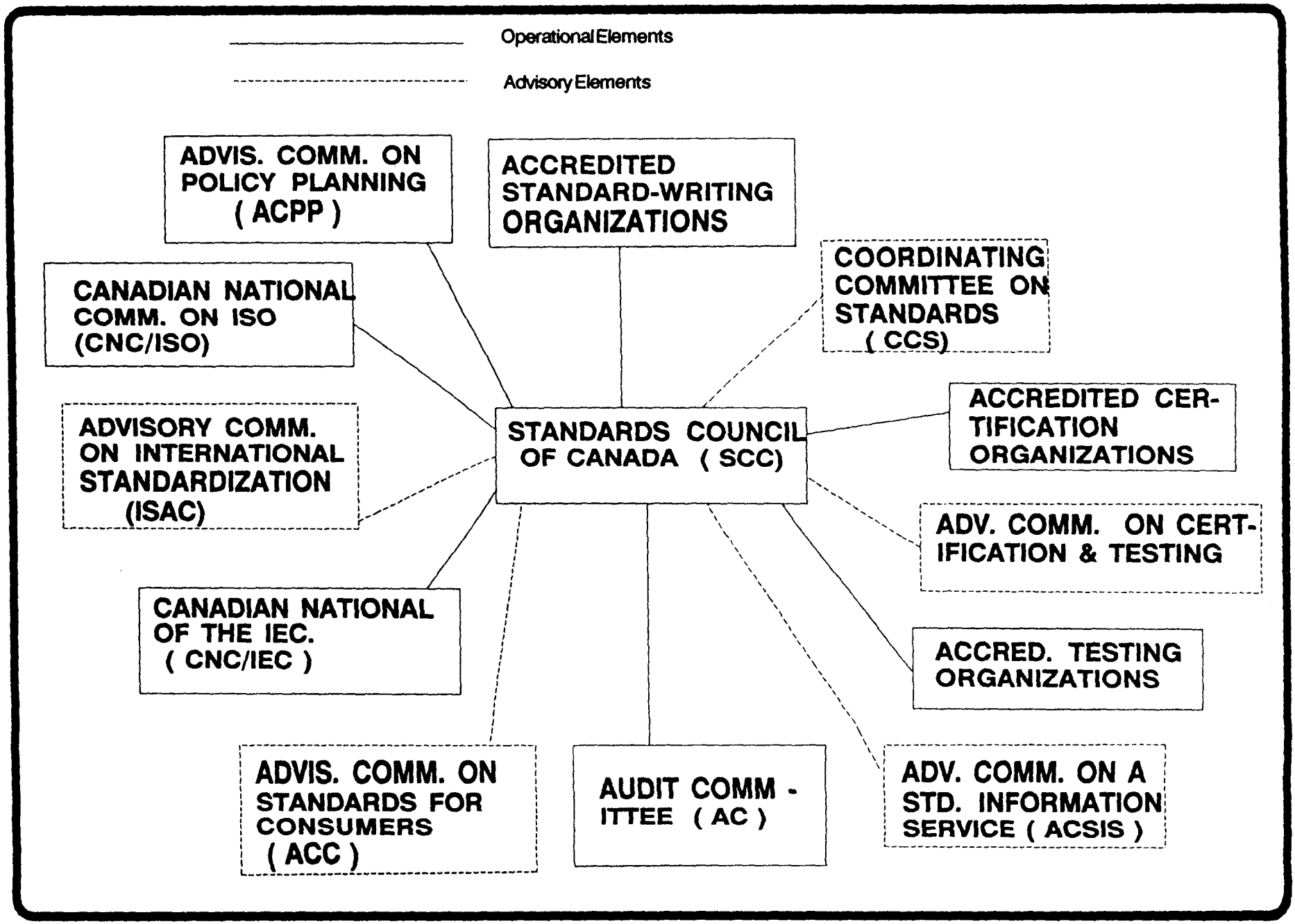


Figure 10: The NATIONAL STANDARDS SYSTEM

The accredited *Standards-Writing Organizations* of the national standard system, as of May 1989, are:

* the Canadian Gas Association (CGA)
* the Canadian General Standards Board (CGSB)
* the Canadian Standard Association (CSA)
* the Underwriter Laboratories of Canada (ULC)
* and the bureau de normalization du Quebéc (BNQ)

These accredited standards-writing organizations publish standards which are prepared by committees made up of experts from industry, government, academics, professions and consumers who provide representation of interests relevant to the subject at hand. These standards are voluntary in nature and are mandatory by the action of governments at any level or through a contractual agreement. During the preparation of these standards, relevant international and foreign national standards are reviewed for possible application in the Canadian context.

International Standardization

Canadian participation in international standards work as an integral part of the national standards system. The standards council of Canada represents Canada as the Canadian member body of the International Standards Organization (ISO) and sponsors the Canadian Committee of the International Electrotechnical commission (IEC). It also maintains liaison with and participates in the work of other international organizations engaged in the formulation of standards.

The Canadian National committee have been appointed to manage Canadian participation in the activities of ISO and ICE. The actual work associated with the various technical committees (CAC's) on ISO Technical Committees (TC's) and Canadian sub-committees (CSC's) of IEC TCs. Over 1200 experts give freely of their time and effort to ensure that Canada has a strong voice in the standards produced by those technical committees of the two international organizations in which Canada has an interest.

Continuing Projects of the NSS

The standard-writing components of the National Standard System (NSS) are co-operating in a number of active projects, on a continuing bases, with the objective of improving the effectiveness of standardization activities in Canada.
These are concerned with:

* **Recognition of Subject Areas**

  Recognition of prime responsibility of subject areas within which standards are developed by accredited standard-writing organizations with a view to eliminating gaps and overlaps;

* **Improving Productivity**

  Improvement of productivity of standards development by reducing the time taken for standards development to a practical minimum without prejudice to the process of achieving consensus;

* **Harmonization**

  Harmonization of Canadian national and Canadian international standards work, ideally to the point where a

single technical committee may have responsibility for responding to both national and international demand;

* **Consumer Interests**

  Ascertaining the interests of consumers and determining and implementing ways to satisfy such interests. Such a program involves communication with consumers and determination of the kinds of information required by them.

APPENDIX 6

DEFINITION OF THE TERM: SPECIFICATIONS

The basic goal of specifications is to communicate a detailed description of a product to interested parties. Successful communication lets groups express and exchange ideas and permits each group to get a desired message across or to accomplish a specific task, while ineffective communication techniques lead to a confused and chaotic state of operation(Quality System Committee,1989).

Setting a specification is the responsibility of the customer in the first place. There are two types of customers: one who knows exactly what is needed and the one who just has an idea of what is needed. When it comes to the task of setting specifications, each has a different role in the exchange of ideas that leads to formal specifications. The former type of customer make the task of who will be responsible is easier; the customer himself will. The latter type, who cannot supply exact specifications, has no choice but to rely on outside help such as a consultant or even the vendor himself.

Whatever the criteria of selecting a specification for the product may be, it has to reflect the ultimate goal of any viable specifications which is *Fitness For Use*.

Historically, in primitive societies there is little need for formal specifications. Producer and consumer are often the same person,e.g., food gatherer, farmer, hunter. Alternatively they are different persons but they live in the same village and

conduct their business in the village marketplace. They trade in products which are familiar to both and which are available then and there for inspection. When the purchased product turn out to be not fit for use, this knowledge can be communicated promptly from consumer to producer. With such short feedback loops, a producer is well provided with the knowledge needed to achieve fitness for use despite the absence of written specifications.

In industrial societies, fitness for use cannot be achieved by such simple collaboration. For any one product, the activities of design, production, sale, use, etc., are carried out by numerous persons employed in different companies and widely dispersed geographically. In complex products the part-time or full-time efforts of hundreds of individuals may contribute to the final result. Of these numerous individuals, only a few are situated such that they can understand how their contribution affects the real goal, which is fitness for use.

Consequently, it is necessary to provide these individuals with a substitute goal, i.e., specifications. Subspecies of specifications(e.g., for materials, processes, products,testing, maintenance, etc.) are available for every activity which contributes to fitness for use.

In general, an effective specification should contain all or some of the following components (Juran, 1974, pp 8-59):

* title;
* historical background;

* definition;
* physical characteristics;
* special information;
* methods of testing and criteria;
* relevant authorities;
* reliability and maintainability;
* role of product packaging and protection;
* references;
* scope for acceptance;
* pertinent conditions.

APPENDIX 7

THE COSTS OF QUALITY

One of the major obstacles to the establishment of stronger quality programs in earlier years was the mistaken notion that the achievement of better quality required much higher costs. Nothing could have been further from the facts of industrial experience(Feigenbaum,1983).

Unsatisfactory quality means unsatisfactory resource utilization. This involves wastes of labor, and wastes of equipment time, and consequently involves higher costs. In contrast, satisfactory quality means satisfactory resource utilization and consequently lower costs.

A major factor in these mistaken past concepts of the relationship between quality and cost was the unavailability of meaningful data. Indeed, in earlier years, there existed widespread belief that quality could not be practically measured in cost terms. Part of the reason for this belief was that traditional cost accounting, following the lead of traditional economics, had not attempted to quantify quality. Accordingly, quality cost did not easily fit into older accounting structures.

Today, quality costs are are essential to management and engineering of modern quality control as well as to business strategy planning of companies and plants. Quality cost provide the common denominator through which plant and company management and quality control practitioners can communicate clearly and effectively in business terms.

Quality costs are the basis through which investments in

quality programs may be evaluated in terms of cost improvement, profit enhancement, and other benefits for plants and companies from these programs. In essence, quality costs are the foundation for quality-systems economics.

Basically, quality costs in plants and companies are accounted so as to include two principal areas(Feigenbaum, 1983, pp 110-112):

* The costs of *control*,and
* The costs of *failure of control* (see the diagram of Figure 11).

The costs of control are measured in two segments:

Prevention costs keep defects and nonconformities from occurring and include the quality expenditures to keep unsatisfactory products from coming about in first place. Also included here are such cost areas such as quality engineering and employee quality training.

Appraisal costs include the costs for maintaining company quality levels by means of formal evaluations of product quality. This includes such cost areas as inspection, test, outside endorsements, quality audits, and similar expenses.

The costs of failure of control, which are caused by materials and products that do not meet quality requirements, are also measured in two segments: *internal failure costs*, which include the costs of unsatisfactory quality within the company, such as scrap, spoilage and reworked material, and *external failure*

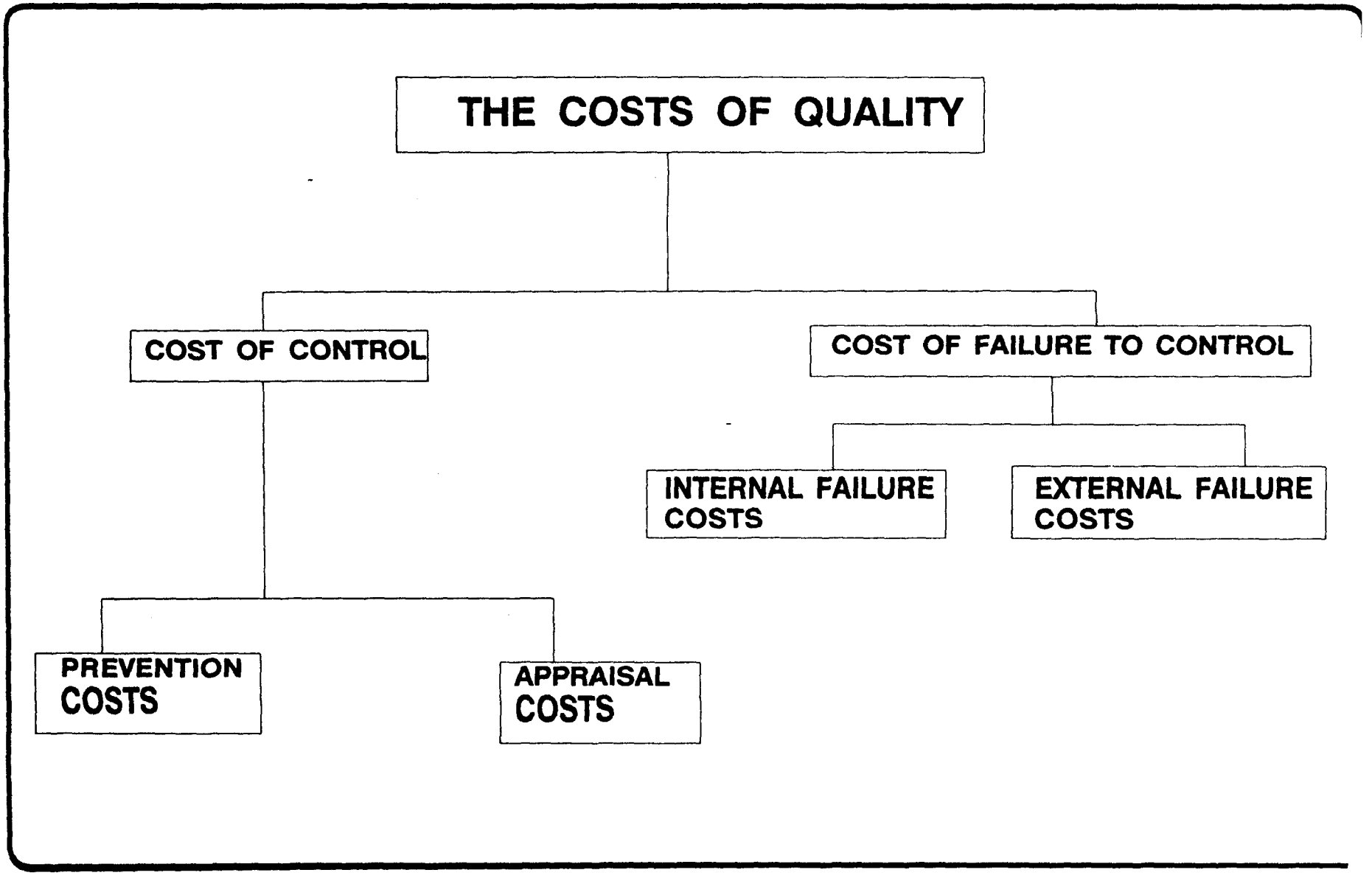


FIGURE 11: THE COSTS OF QUALITY

costs, which include the costs of unsatisfactory quality outside the company, such as product performance failures and customer complaints.

Below are some definitions and examples for the operating quality-cost items(Sohlden,1982; Semich,1982; Teetor,1982):

Cost of prevention

* Quality Planning
* Process Control
* Design and development of quality information equipments
* Quality training and work force development
* Product design verification
* Systems development and management
* Other preventive costs such as maintenance of inspection and test equipment

Appraisal costs

* Test and inspection of purchased materials
* Laboratory acceptance testing
* laboratory or other measurement services
* Inspection
* Testing
* Time spent by labor checking quality conformance, process conformance, formation of lots, etc
* Setup for test or inspection
* Consumables and power for test and inspection equipment
* Quality audits

* Outside endorsements
* Maintenance and calibration of quality information test and inspection equipment
* Product-engineering review and shipping release
* Field testing

Internal Failure Cost

Scrap is the main item responsible for this cost. However, there are several other significant costs that are frequently overlooked.

The major costs of internal failure scrap involve immediate scrap, rework, downtime, yield losses and disposition.

Internal failure cost includes;

* Products found to be scrap.
* In process scrap.
* Production time lost due to material out of specification.
* Costs of repairs.
* Wages of scrap inspector.
* Cost of documents to record scrap.
* Cost of computer time.
* Cost of material handling of scrap.
* Carrying charges on products that cannot be shipped because of quality problems.
* Material procurement costs (costs incurred by the material-procurement personnel in handling both rejects and complaints on purchased materials).

External failure Cost

While customer returns are usually the major component of cost, they may be the least expensive. In addition to the cost of returned products, the most expensive item of all, is the cost of defending a failed product in a product liability suit. Following is a breakdown of external cost;

* Product liability suit settlements and legal costs.
* Returned scrap.
* Cost of checking returned scrap.
* Freight cost of returned scrap.
* Customer charges.
* Cost of customer back charges for repair work.
* Product recall.
* Product service.
* Complaints in and out of warranty.
* Cost of product liability insurance.

Some companies use a multiplier for the cost of returned scrap. The rational is that every failed product represents some amount of customer dissatisfaction that will eventually result in lost orders.

The multiplier has been found to run between four and ten with normal range being six to seven.

External failure is potentially the most dangerous since they generate dissatisfaction, destroy reputations, and eventually lead to the loss of business.

APPENDIX 8

DATA COLLECTION WITH REGARD TO THE QUALITY SYSTEMS APPLIED IN MEDIUM SIZE ORGANIZATION FROM THE MANUFACTURING SECTOR

1. PRODUCT IDENTIFICATION

1.1 Main product(s):

.....

.....

.....

.....

1.2 Material specifications:

- Proprietary:

.....

.....

- National/International:

.....

.....

1.3 Certification awarded by organizations and/or regulatory authorities:

.....

.....

.....

.....

1.4 Annual capacity:

- Maximum: .....
- Minimum: .....

2. MANPOWER

2.1 Number of hourly paid workers: .....

- Union affiliate(if any):

.....

- When the current labor contract is due for re-negotiation?

.....

2.2 Number of staff personnel:

.....

2.3 What is the average working experience of the floor personnel?

.....

2.4 Number of production personnel:

.....

2.5 Number of quality assurance personnel:

.....

3. QUALITY MANAGEMENT SYSTEM

3.1 Policies and Objectives

* Is there a management policy statement regarding quality?

yes no

If yes, who signed this statement?

.....

* Do you have a quality manual ?

yes no

* What type of quality program is implemented in your organization ?

.....

.....

* Is the plant accredited for this program ?

yes no

If yes, the accreditation is done by whom?

.....

.....

If no, are there actions being taken towards accreditation?

yes no

* Are policies and quality objectives explained to employees?

yes no

- In practice, is personnel apply and respect the spirit of these policies?

.....

.....

* Are employees participated in formulating those policies and objectives?

yes no

* If yes, by which means:

> consultation before publication.

.....

> brain storming sessions.

.....

> sought personal objectives.

.....

* Are these policies and objectives published in the plant?

yes no

* If yes, by which mean?

.....

.....

3.2 Planning for Quality

* Who is responsible for planning?

.....

.....

* Does senior management participate in the planning phase?

yes no

* Does senior management review the effectiveness of plans and initiate corrective action if deemed necessary?

yes no

.....

.....

3.3 Organization

* Maintenance and up-keeping of documents related to quality.

.....

.....

* Availability of pertinent documents at work stations.

.....

.....

* Interdepartmental flow of communications.

.....

.....

.....

* Staffing:

  > Sufficiency of personnel to perform quality functions

.....

.....

  > Structure of quality organization

.....

.....

.....

3.4 Motivation

* Number of strikes (if any) during the past five(5) years.

.....

* Existence of some kind of profit sharing programs.

.....

* Does the company permits employee ownership?

yes no

* Training courses given to employees.

.....

.....

.....

* Social programs and/or fringe benefits offered by the company.

.....

.....

* Existence of quality circles or similar activity.

.....

.....

3.5 Control

* Do you have operating standard procedures?

yes no

* Is the statistical process control being used in your organization?

yes no

* If yes, What variables and/or attributes are being controlled?

.....

.....

.....

* Is the organization keeps record of cost analysis with regard to quality activities?

yes no

- If yes, please provide the following data:
  > average annual cost for appraisal activities;
  .....
  > average annual cost for prevention activities;
  .....
  > average annual cost for internal failures;
  .....
  > average annual cost for external failures;
  .....
  > **total average annual cost: .....**
- If no,
  What is the approximate scrap rate per year:
  .....

* According to your estimates, what is the cost of scrap relative to the annual turn-over?

.....

* Does senior management review periodically the effectiveness of the quality program?

yes no

.....

.....

4. Summary of quality problems

.....

.....

.....

5. Future plans for quality improvements

.....

.....

.....

THANK YOU FOR YOUR COOPERATION

APPENDIX 9

QUALITY SYSTEM EVALUATION

CHECKLIST

SUPPLIER S' QUALITY SYSTEM EVALUATION

Evaluation conducted by :	Evaluation date :

SUPPLIER IDENTIFICATION :

Name of supplier :
Address :
Phone : FAX :

PERSONNEL CONTACTED :

Name :	Title :	Phone :
Name :	Title :	Phone :

SUMMARY OF EVALUATION :

Elements evaluated	Evaluation				NOTES
	A	NI	UN	NE	
1. Quality management					
2. Quality planning					
3. Control of documents					
4. Procurement					
5. Inspection control					
6. Measuring and testing equipments					
7. Control of non-conformities					
8. Special processes					
9. Statistical process control					

RECOMMENDATIONS :

Section 1. QUALITY MANAGEMENT		NOTES	EVALUATION A	NI	UN	NE
1.1	Written quality policy and objectives					
1.2	Comprehension and understanding of those policies and objectives by employees directly related to quality functions					
1.3	Quality Organization : * Independence * Authority * Staffing					
	Sectionn 2 . QUALITY PLANNING					
2.1	Check existence of quality program or quality plan covering , as minimum, the following items : * Control of document; * Inspection control; * Calibration of measuring and testing equipments; * Control of non-conformities; * Special processes; * Use of statistical process control.					

			EVALUATION			
Section 3. CONTROL OF DOCUMENTS		**NOTES**	**A**	**NI**	**UN**	**NE**
3.1	Does supplier possess the latest revisions of drawings and specs ?					
3.2	System of precluding the use of obsolete or super-ceded issues.					
3.3	Availability of the pertinent documents at the work stations.					
3.4	System of indexing, maintaining, distributing and up-dating documents related to quality.					
	Section 4. PROCUREMENT					
4.1	System for selecting and qualifying sub-contractors.					
4.2	Selection of the appropriate QA program for purchased materials / articles.					
4.3	Review of contracts againest tenders.					

Section 4. PROCUREMENT (Cont'd)		NOTES	EVALUATION A	NI	UN	NE
4.4	Incoming inspection facility.					
4.5	Availability of specs, stipulations, purchasing documents and drawings at the receiving area.					
4.6	Identification of conforming and non-conforming materials / items.					
4.7	Is material being released to production before : * inspection * verification of certificates and test reports againest applicable standards.					
4.8	Does supplier exert surveillance at sub-contractors facilities ?					
4.9	External audits					
	Section 5. INSPECTION CONTROL					
5.1	Independence of inspection personnel					
5.2	Authority and workmanship					

	Section 5. INSPECTION CONTROL (Cont'd)	NOTES	EVALUATION A	NI	UN	NE
5.3	Check lighting, cleanliness, equipments at inspection area.					
5.4	Availability of test & inspection procedures and accept / reject criteria at inspection areas.					
5.5	Adherence to the inspection & test plans and / or check points.					
5.6	Inspection status (tagging, color code, etc).					
5.7	Sampling techniques and methods.					
5.8	Release on positive recall .					
	Section 6 . Calibration of Measuring and Testing Equipments					
6.1	Identification of gauges and instruments which are being used in production, inspection and testing .					
6.2	Stability, range of each gauge / instrument					

Section 6. Calib. of Test Equipments (Cont'd)		NOTES	EVALUATION A	NI	UN	NE
6.3	Check initial and periodic calibration					
6.4	Availability of calibration procedures.					
6.5	Check if reference standards certified as traceable to national standards.					
6.6	Check existence of tags on each instrument , identifying the calibration date as well as the due date for the next calibration .					
6.7	Check procedure of instrument removal from service when found out of control .					
6.8	Check procedures for environment control when calibrating or using instruments and equipments .					
	Section 7 . Control of Non-conformities					
7.1	Material review system .					
7.2	Identification and segregation of non-conforming items / material .					

	Section 7 . Control of Non-conformities (cont'd)	NOTES	EVALUATION A	NI	UN	NE
7.3	Appropriate approval of repair / rework by the quality group.					
7.4	System for prompt initiation and execution of corrective measures to eliminate a state of non-control or non-conformance .					
7.5	Maintenance of pertinent documents, such as ; > material review > corrective actions > customer approvals > re-inspection					
	Section 8 . Special processes					
8.1	Identification of special processes.					
8.2	Availability of procedures, in the right place at the right time.					
8.3	Procedures for monitoring.					
8.4	Special inspection processes					

	Section 8 . Special processes (Cont'd)	NOTES	EVALUATION A	NI	UN	NE
8.6	Maintenance, retention and review of special process documents.					
	Section 9. Statistical Process Control					
9.1	Type(s) of statistical control applied .					
9.2	What process(s) are being controlled ?					
9.3	What types of control charts ?					
9.4	What variable(s) or attribute(s) are being controlled ?					
9.5	Customer's approval .					
9.6	Indoctrination and training of personnel ; > Management > Operators					
9.7	Policy regarding the use of SPC by sub-contractors					

LEGEND

A : ACCEPTABLE

NI : NEED IMPROVEMENT

UN : UN-ACCEPTABLE

NE : NON-EXISTANT

APPENDIX 10

DATA COLLECTION

THE LARGE CORPORATE CUSTOMER

1. DATA ON SUPPLIERS

* Corporate name:

  .....

* Type of business:

  - Manufacturer

    yes.... no....

  - Distributor

    yes.... no....

  - Other (specify)

    .....

    .....

* Before awarding the contract, has this supplier been qualified?

  .....

* What is the policy regarding supplier s' qualification?

  .....

* Is this evaluation (if any) documented and kept on file?

  .....

* Remarks:

  .....

  .....

2. QUALITY ASSURANCE

* Quality surveillance is done by:

  - quality system audits
  - auto control by supplier

- inspection
- none

* Inspection is usually done:
  - at the supplier s" plant
  - the corporation s'warehouse
  - none

* What type of certification (if any) is required?

  .....

* Are these certificates verified against the standards?

  yes no

* Are certificates kept on file?

  yes no

* Have accept/reject criteria been defined and discussed with the supplier?

  yes no

* What type of problems did you experienced when dealing with this supplier?

  .....

  .....

  .....

3. THE ROLE OF THE USER

* Who define the criteria for a certain need?
  > production personnel
  > technical group
  > others

* Are these criteria documented?

Yes ... No ...

* Describe the approval procedure

.....

.....

.....

4. THE ROLE OF ENGINEERING

* Reception of the user s'need

.....

.....

* Processing of the request

.....

.....

* Assignment of responsibility

.....

.....

* Procedure of communication between the user and engineering

.....

.....

* If engineering inclines to retain the service of a consultant, on what bases the choice is made?

> list of qualified consultant

> reputation

> price

> others

* Is specification discussed with the user?

Yes ... No ...

* Is the user able to criticize and evaluate the work of engineering?

Yes ... No ...

5. THE ROLE OF PURCHASING

* Who initiate the request for purchasing?

.....

* Does the buyer receive the necessary information, explanation, and documents to help him to conduct a successful procurement?

.....

.....

5.1 SELECTION OF THE SUPPLIER

* Is there an established procedure and/or policies for suppliers qualification?

Yes ... No ...

* If yes, do we retain a list of qualified suppliers?

Yes ... No ...

* If qualification procedure does not exist, based on what criteria we select supplier?

.....

.....

* Who attend the evaluation of quotation meeting?

.....

.....

* On what bases the evaluation is being made?

> price

> quality

> others (specify)

5.2 ADJUDICATION

* Does the contract prescribe clearly the following;

> quality assurance criteria

> quality parameters

> inspection and test plans

> holding points for verification

> access to manufacturing area

> guarantee clauses

> claim procedure in case of non-conformance

> etc

* What is the function of the contract administrator?

.....

.....

.....

6. MODIFICATION AND/OR UPGRADING SPECIFICATION

* Is there a procedure for modifications?

Yes ... No ...

* If yes, elaborate on the following;

> distribution of responsibility

> verification and control

> communications (externally and internally)

> documentation

> etc

.....

.....

.....

.....

.....

.....

.....

7. EVALUATION

On a scale of 1 to 10, what would be the degree of your satisfaction (10 is most satisfactory) with regard to the following criteria:

* Conformity to requirements

.....

* Performance of product in the intended service

.....

* Accessibility to the plant, quality records, and relevant documents.

.....

* Respect of delivery schedules.

.....

* Cost over-runs.

.....

* After sales service.

.....

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