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QUALITY RELIABILITY RELATIONSHIPS

by

A F Cone

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QUALITY / RELIABILITY

RELATIONSHIPS

A. F. CONE - 7510

American industry has progressed through numerous phases during its evolution from the individual enterprise of the pioneer to modern, automated, computer-controlled manufacturing. During the growth of mass production following the Industrial Revolution, quality considerations for an item of product or a service were often based on initial cost, ease of obtaining a replacement for an unsatisfactory item, and the effectiveness of advertising claims. It was sometimes quite profitable to make glowing claims for a product, and, at the same time, plan on its replacement or repair at the inconvenience of the customer, if he complained when an item failed. Clever advertising could also make it almost social misconduct to disagree with the popular notion of superiority created by claims for products.

There probably has been more said and written about Quality and Reliability during the past few years than throughout the entire previous history of industry. As with most human endeavors, the nature, direction, and detail of activities leading to value decisions have changed with circumstances and demands. In August 1962, the Standards Committee of the American Society for Quality Control published the following definitions for Quality Control and Quality Assurance:

"Quality Control--The over-all operation required to provide product quality that is what it should be, is referred to as quality control. The aim of quality control is to provide quality that is satisfactory, adequate, dependable, and economic. The over-all operation involves integrating the quality aspects of several related steps including the proper

specification of what is wanted, the production of things in such a way that they meet the full intent of the specification, and the inspection of the things to determine whether they are in accord with the specification. The term quality control is often applied to specific phases in the over-all operation, as for example, process quality control.

"Quality Assurance--An activity whose purpose is to provide assurance that quality is what it should be. To this end, quality assurance provides, through verifications, audits, and other steps, assurance that the over-all quality control job (see Quality Control) has, in fact, been done--that is, is effective.

"NOTE: Broadly, quality control has to do with the over-all job of making quality what it should be, and quality assurance has to do with making sure quality is what it should be."¹

As is generally true in new and developing activities, modern quality control has been an intriguing target for the opportunist and the unknowing. Hardly a self-respecting manufacturing organization exists today that does not have the term "quality" or "assurance" or "reliability" or something similar included in its organizational or management structure. Frequently, the central theme of the "quality" organization has been related to reducing inspection costs and restricting outgoing quality levels to some "practical" number of defective product units. As stated by Frank Nixon:

". . .the apostles of F. W. Taylor. . .have concentrated so much upon output, and its increase, that they have succeeded in so modifying the operative's outlook, and that of many a manager too, that he has come to identify work with output. What they all forgot was that it was good pieces that were required, not just more of them. And they succeeded in large measure in destroying the operator's identity with and pride in his work."²

In an address to the American Management Association, H. Thomas Hallowell said:

"One of the fundamental obstacles that we must hurdle in this country is the continued use of too much production-line thinking in a time that calls for more missile-age thinking. All the parts must now work, regardless of size or relative importance. . . . We can no longer afford to debate the relative merits of quality control as an aid to management. It is and must be considered a vital need, a foremost concern, a way of life at all levels. . . . There must be greater pride of accomplishment than we find in our present-day assembly lines making aircraft, automobiles, and washing machines; most of all, it means management that lives and breathes quality. For quality thinking must emanate from the top in order to permeate the whole organization." ³

Today, more than ever before, management is under tremendous pressure to deliver material that is reliable--and to do it within reasonable time and economic limits. This multiple objective is difficult to achieve, for some of our newer products are incredibly complex, delivery schedules are tight, and contracts are often awarded on a strict low-bid basis. As expressed by Dr. Richard C. Raymond, ". . . in my opinion it is far more valuable to us to produce useful systems, even inefficiently, than to produce useless systems at the lowest possible cost." ⁴

The Minuteman, with extensive testing to confirm very low failure rates, and the recently announced "Zero Defects" objective for the Titan are examples of current high reliability demands. Emphasis is being placed on meeting quality standards that would have been considered unattainable a few years ago. As was stated by K. F. Wasmuth:

"A darned good job no longer is satisfactory. Unless we agree that perfection is possible, some astronaut may not return, our enemies will welcome us at the moon, and, indeed, our very homes may go up in smoke." ⁵

Routine process capability studies and sampling plans that accept as inevitable the existence of some irreducible amount of defectiveness are not sufficient for meeting high quality and reliability requirements. It becomes mandatory to apply objective systematic methods for measuring quality performance, to detect basic causes when defectiveness is observed, and to evaluate the effectiveness of the solutions and actions applied as corrective measures. Charles Emerson summarizes Ford Motor Company's attitude as follows:

"Such common terms (and the ideas they represent) as an industry practice, commercial standards, conditional approval, and unessential dimensions are giving way to a black-or-white-and-nothing-in-between attitude toward quality. Parts are either to specifications or they're not, and this applies to Ford-built parts as well as those purchased outside the company.

"Interpretation of such rigid rules sometimes leads to variations on time-honored manufacturing practices. For example, on a trial run of a piece of new equipment, the company will not allow full engineering specification tolerances on a part. This is because the company knows that changing conditions in the machine, normal wear and other outside factors will not be experienced in anything but a full production run." ⁶

The concept of "acceptable quality level," that is in reality a "condonable defect level" with high customer's risk, is incompatible with the "practical perfection" that is needed in some modern technologies. But, equally unreasonable, is the wasting of exorbitant amounts of time and huge sums of money for unnecessary academic operations when end usage does not demand high product performance levels. Not only is economic waste involved, but the resultant general discrediting of quality and reliability programs can jeopardize success in situations that really require great effort to assure that extremely high quality and reliability performance has been realized.

A quality program should be flexible so that it may be adapted to the varying needs and conditions imposed by wide variations in the demands placed upon it. This rules out the simple application of some statistical or procedural technique or "gimmick" as a cure-all for all sets of conditions.

As stated by A. V. Feigenbaum, "Basic quality responsibility rests in the hands of plant top management."⁷ From this point of view, subcontractors, especially small firms, should have the distinct advantages that come from simple, straightforward communication and management situations, but complications arise from other sources.

During a recent ASQC panel discussion in Albuquerque, the quality managers of small-to-medium-sized manufacturers stated that their most serious problems were in the areas of equipment, personnel, and money. It was their contention that as small manufacturers they could not equip their shops with extensive testing laboratories and equipment, especially when various Prime Contractors imposed different--in fact, sometimes conflicting--testing requirements. Further, they were generally unable to employ specialists in either testing or inspecting fields but rather were forced to rely on individuals who were capable of performing a wide variety of testing and inspecting jobs. Both of these factors were, of course, closely related to costs, and examples were given to illustrate that contracts could be lost to a lower bidder with a poorer quality program. When asked what concerned him most prior to his six-orbit flight, Walter Schirra commented, "Every time I climb up on that couch I say to myself, 'Just think, Wally, everything that makes this thing go was supplied by the lowest bidder!'"⁸

In a paper presented at the 11th Annual ASQC Conference, Frank Nixon stated:

"The reliability of the most expensive aircraft or missile might well depend, in the limit, upon the product of one of the smallest firms. Moreover, small firms, say of not more than 1000 employees, comprise in aggregate by far the greater part of a nation's industry. It is just as important, on economic as well as technical grounds, that these firms should be aware of their responsibilities."⁹

Another problem that faces subcontractors arises from the numerous specifications that relate to quality and reliability. H. L. Wuerffel lists 74 separate government specifications that may be of concern or directly applicable to subcontracts--and 34 of these deal specifically with Quality or Reliability.¹⁰ In addition, most Prime Contractors include quality and reliability requirements in their purchasing or contracting documents--ranging from vague, ineffective, fine-print generalizations and implications of unlimited life-time warranties to quite complete manuals that define the Prime Contractor's quality policy and the subcontractor's responsibilities.

The complications that may be imposed on subcontractors were evident in a study conducted and reported by a task group of the Quality Assurance Practices Committee, Western Branch. This study disclosed that:

- 1** The companies concerned had been "surveyed" an average of five times in the preceding year, ranging from a single survey to one instance of more than twenty surveys during the year.
- 2** The surveys involved an average of one day's time, with a longest time of three days and a shortest time of one hour.
- 3** The average size of a survey team was four people, with a maximum of nine and a minimum of one. (Later, it was learned that one survey party included 28 people.)
- 4** The survey results varied widely, in one case from "excellent" to "unsatisfactory" for one subcontractor when surveyed by two different divisions of one Prime Contractor.¹¹

Even today, there are continuing examples from subcontractors that confirm wide variations in quality and reliability requirements, ranging from minor, annoying difficulties to diametrically opposing demands.

While reliance on a quality system for assurance of quality poses many problems, an intolerable situation develops when each customer insists on specifying the subcontractor's quality program in detail. In such cases, conflicting requirements make compliance virtually impossible. As a general rule, only

basic principles should be specified, and development of a specific quality program left to the discretion of the manufacturer. Any system that assures control of quality should be considered satisfactory.

Each quality system is the product of its specific environments, personnel, and problems, and what proves to be a model system in one plant might not work at all in another. An evaluation of a quality system should be a review of a unique set of policies, techniques, and practices, as they relate to basic guiding principles, and the purpose of such an evaluation should be to ascertain (1) that an adequate control program has been established, and (2) that this control system is effectively operated.

Every quality control program needs a carefully formulated, comprehensive quality philosophy. A program without philosophy and objectives is as aimless as a society without constitution and by-laws. The philosophy and objectives of management combined with the needs and demands of customers determine the nature of the quality control program.

The philosophy is a framework of basic principles which express management's convictions on such essential points as the scope of quality control's responsibility and authority, the nature of the program involved and its relationship to and place within the over-all organization, the standards of quality desired, the methods of operation, and the results to be obtained.

The objectives of the quality control program are the philosophical principles reduced to specific aims. They are the guide lines and check points along the course of the program.

The management of an organization should be free to determine and develop its own quality philosophy and quality control objectives, as long as these are consistent with the needs of the customer and consistent within themselves. The organization and allocation of supervision and personnel should follow logically from the philosophy and quality control objectives.

In evaluating a quality control program, the philosophy and objectives bear the same relationship to the evaluation procedures as they do to the operation of the program. The entire evaluation is a kind of judgment of the extent to which

the philosophy and objectives of the quality control program are consistent with the needs of the producer and the customer that the program seeks to serve and satisfy, and it is a ratio of accomplishment, i.e., a measure of the extent to which the quality control program is actually achieving what it is properly trying to achieve. Again quoting A. V. Feigenbaum, "If you correct product defects after they occur, your quality control system may be the defect that needs correcting."¹²

Typically, the plan for an adequate quality system will include, as a minimum, the following parameters:

- 1** Control of quality management. There must be adequate planning, forceful direction, and control in the sense of measurement and evaluation of the effectiveness of the quality program.
- 2** Control of design information. Obviously, without control of the governing specifications, control of product is impossible.
- 3** Control of procurement. Starting with correct materials is an essential step toward achieving satisfactory end product.
- 4** Control of material. Not only must the right material be procured, but it must be properly identified, stored, issued, and used.
- 5** Control of manufacture. Many characteristics of product can be verified only at the time and point of manufacture. Uncontrolled processes are likely to result in excessive defectiveness and product variability.
- 6** Control of acceptance. Verification that the finished product meets design intent is a requirement of any quality program.
- 7.** Control of measuring instruments. The validity of inspection and testing is contingent upon the use of accurate and reliable measurements.

8 Use of quality information. Systematic utilization of information from control areas (2) through (7) above is necessary to assure that deficiencies affecting quality are promptly detected and corrected and that improvements are made in the over-all quality program.

Conformance to these guiding principles is the minimum that should be expected from any quality system; and failure to observe any one of the principles will compromise ability to assure the manufacture of product of consistently high quality.

The key to the management of quality lies in having quality philosophy, objectives, organizational structure, and operations that are established on a foundation of basic principles. The philosophy forms the primary policy and should include the broad principles common to good quality programs. The objectives should be clearly stated in specific terms and should provide operating procedures which guide the activity of the quality program. The organizational structure should clearly define lines of authority and responsibility for quality from top management down to the operating levels so that the output of day-to-day operations is the kind and quality of product that is "what it should be."

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