

Quality Costs

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Abstract — In recent years, competitive environment of companies has been getting harder and harder. [13] In order to ensure its place at the market an organization has to produce such products and services that meet wishes and expectation of customers. It has to meet demand of customers and other interested parties (workers, owners, suppliers, community). However, due to strong competition and increased customer's requirements for higher quality, the organization could lost its place at the market if fails to make continuous improvements.

Continuous improvements are not possible without knowing how to correctly implement both tools and methods. Task of management is to recognize the importance of tools and methods for management of quality. One of the important activities of optimizing operations and increasing competitive ability is the costs management. In the framework of cost management systems, an important place is occupied by the quality costs. Besides being an indicator of the quality management system, allow extra profit. The quality costs and their description are presented in appear profile in this paper.

Keywords: Cost, quality, companies, consumers.

I. INTRODUCTION

Many companies promote quality as the central customer value and consider it to be a critical success factor for achieving competitiveness. To improve its product or service quality, an organization must agree on a definition of the term. Originally, after the Industrial Revolution helped manufacturers to increase output and decrease cost, quality was defined as conformity to designated specifications. Conformity determination was left to quality control inspectors. [1]

The definition of quality depends on the role of the people defining it. Most consumers have a difficult time defining quality, but they know it when they see it. Today, there is no single, universal definition of quality. Some people view quality as "performance to standards". Others view it as "meeting the customer's needs" or "satisfying the customer". [9] Some of the more common definitions of quality are: [2]

"Quality is a fitness for use," according to Joseph Juran

"Quality is a conformance to requirements", according to Philip Crosby

"Quality is predictability", according to W. Edwards Deming

"Quality is the customer's opinion", according to Feigenbaum

"Degree to which a set of inherent characteristics fulfils requirements", according to ISO, 2000

Generally, there are two types of product quality:[4]

1. Quality of design refers to quality differences of products that serve the same function but have different design specifications, such as the type and quality of materials used in the product. Usually higher design quality results in higher manufacturing costs and higher selling prices. For example, 14 karat gold jewelry has higher design value than the same jewelry that is gold plated.

2. Quality of conformance is a measure of how a product meets its design specifications. Is the product manufactured as the design specifies?

When quality experts refer to improving quality, they are referring to reducing the incidence of nonconformance. Quality refers to doing it right the first time.[4]

II. QUALITY COSTS

A. Defining Quality Costs

There are several reasons why the cost of quality should be explicitly considered in an organization. These include the following: [5]

1. The increase in the cost of quality because of the increase in the complexity of manufactured products associated with advances in technology

2. Increasing awareness of life-cycle costs, including maintenance, spare parts, and the cost of field failures

3. Quality engineers and managers can most effectively communicate quality issues in a way that management understands.

Generally speaking, quality costs are those categories of costs that are associated with producing, identifying, avoiding, or repairing products that do not meet requirements. [5] More specifically, quality costs are the total of the costs incurred by (1) investing in the prevention of nonconformances to requirements; (2) appraising a product or service for conformance to requirements; and (3) failure to meet requirements.[8] Quality costs represent the difference between the actual cost of a product or service and what the reduced cost would be if there were no possibility of substandard service, failure of products, or defects in their manufacture. [11]

These costs are significant in amount, often totaling 20 to 25 percent of sales.

B. Types and Analysis of quality costs

The first step toward quantifying quality cost is to agree on what is meant by “quality costs”. This is done by identifying and defining those categories of cost which are associated with making, finding, repairing, or avoiding (preventing) defects. Many manufacturing companies have gone through this process, resulting in a rather standardized set of core categories. [7] Quality costs are classified into three broad categories: prevention, appraisal, and failure costs. Failure costs are divided into two subcategories: internal and external.

1. Prevention costs. (The costs incurred to keep failure and appraisal costs to a minimum.)
2. Appraisal costs. (The costs incurred to determine the degree of conformance to quality requirements.)
3. Internal failure costs. (The costs associated with defects found before the customer receives the product or service. It also consists of cost of failure to meet customer satisfaction and needs and cost of inefficient processes.)
4. External failure costs. (The costs associated with defects found after the customer receives the product or service. Also includes lost opportunity for sales revenue.)
5. Total quality cost. The sum of the above costs. It represents the difference between the actual cost of a product or service, and what the reduced cost would be if there was no possibility of substandard service, failure of products, or defects in their manufacture.[3]



Figure 1. Classification of Quality Costs

1. **Prevention costs:** Costs incurred to prevent the occurrence of nonconformances in the future. Examples of prevention costs include: [7]
 - **Quality planning.** This includes the broad array of activities which collectively create the overall plan, the inspection plan, the reliability plan, the data system, and the numerous specialized plans. It includes also preparation of the manuals and procedures needed to communicate these plans to all concerned. As in the case of inspection and test, some of this work may be done by personnel who are not on the payroll of a department called Quality control. The decisive criterion is again the type of work, not the name of the department performing the work.
 - **New products review.** Includes preparation of bid proposals, evaluation of new designs, preparation of test and experimental programs, and other quality activities associated with the launching of new designs.
 - **Training.** The costs of preparing training program for attaining and improving quality performance, no matter which department is to be the recipient of the training. Includes the cost of conducting formal training programs as well.
 - **Process control.** Includes the part of process control which is conducted to achieve fitness for use, as distinguished from achieving productivity safety, etc.

- **Quality data acquisition and analysis.** This is work of running the quality data system to acquire continuing data on quality performance. It includes analysis of these data to identify the quality troubles, to sound the alarms, stimulate study, etc.
 - **Quality reporting.** Includes the work of summarizing and publishing quality information to the middle and upper management.
 - **Improvement projects.** Includes the work of structuring and carrying out programs for breakthrough to the new levels of performance, i.e. defect prevention programs, motivation programs.
2. **Appraisal costs:** Costs incurred in measuring and controlling concurrent production to assure conformance to requirements. Examples of appraisal costs are: [5][7]
- **Inspection and test of incoming material.** Costs associated with the inspection and testing of all material. This subcategory includes receiving inspection and test; inspection, test, and evaluation at the vendor's facility; and a periodic audit of the quality-assurance system. This could also include intraplant vendors.
 - **Product inspection and test.** The cost of checking the conformance of the product throughout its various stages of manufacturing, including final acceptance testing, packing and shipping checks, and any test done at the customer's facilities prior to turning the product over to the customer. This also includes life testing, environmental testing, and reliability testing.
 - **Materials and services consumed.** The cost of material and products consumed in a destructive test or devalued by reliability tests.
 - **Maintaining accuracy of test equipment.** The cost of operating a system that keeps the measuring instruments and equipment in calibration.
3. **Internal failure costs:** Costs generated before a product is shipped as a result of nonconformance to equipment. Examples of internal failure costs include: [5][7]
- **Scrap.** The net loss of labor, material, and overhead resulting from defective product that cannot economically be repaired or used.
 - **Rework.** The cost of correcting nonconforming units so that they meet specifications. In some manufacturing operations rework costs include additional operations or steps in the manufacturing process that are created to solve either chronic defects or sporadic defects.
 - **Retest.** The cost of reinspection and retesting of products that have undergone rework or other modifications.
 - **Failure analysis.** The cost incurred to determine the causes of product failures.
 - **Downtime.** The cost of idle production facilities that results from nonconformance to requirements. The production line may be down because of nonconforming raw materials supplied by a supplier, which went undiscovered in receiving inspection.
 - **Yield losses.** The cost of process yields that are lower than might be attainable by improved controls (for example, soft-drink containers that are overfilled because of excessive variability in the filling equipment).
 - **Downgrading/off-specing.** The price differential between the normal selling price and any selling price that might be obtained for a product that does not meet the customer's requirements. Downgrading is a common practice in the textile, apparel goods, and electronics industries. The problem with downgrading is that products sold do not recover the full contribution margin to profit and overhead as do products that conform to the usual specifications.
4. **External failure costs:** Costs generated after a product is shipped as a result of nonconformance to requirement. Examples of external failure costs include:[6]
- **Repair or replacement costs.** Repair or replacement of returned products. Costs to handle customer complaints and returns. Salaries and administrative overhead of the customer service department; allowances or discounts granted for poor quality; and, freight charges for returned products.
 - **Product recall and product liability costs.** Administrative costs to handle product recalls, repairs, or replacements; legal costs; and settlements resulting from legal actions.
 - **Lost sales and customer ill-will due to defective outputs.** Lost contribution margins on canceled orders, lost sales, and decreased market shares.
 - **Costs to restore reputation.** Costs of marketing activities to minimize damages from a tarnished reputation and to restore the firm's image and reputation.

Quality costs can be used for measurement of progress, for analyzing the problem, or for budgeting. By analyzing the relative size of the cost categories, the company can determine if its resources are properly allocated.[10]

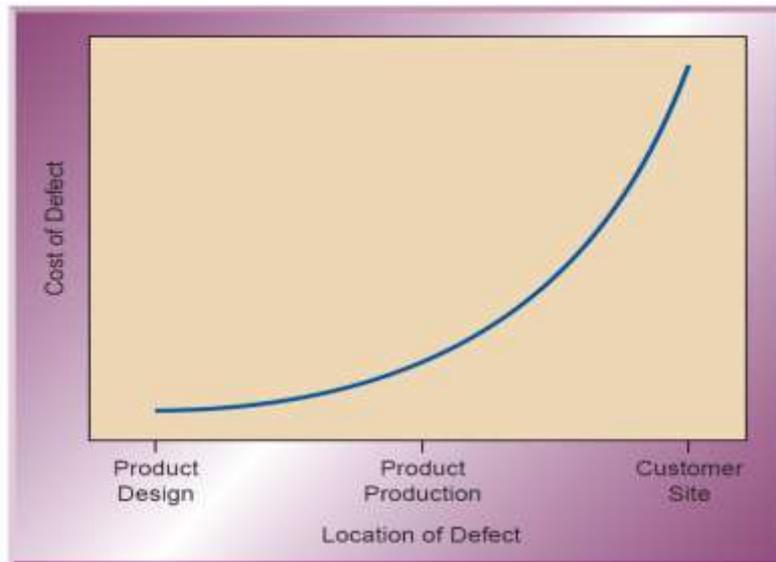


Figure 2: Cost of defects [9]

Companies that consider quality important invest heavily in prevention and appraisal costs in order to prevent internal and external failure costs. The earlier defects are found, the less costly they are to correct. For example, detecting and correcting defects during product design and product production is considerably less expensive than when the defects are found at the customer site. This is shown in Figure 2.[9]

The lowest cost is generally obtained when nonconformances are prevented in the first place. If nonconformances occur, it is generally least expensive to detect them as soon as possible after their occurrence. Beyond that point there is loss incurred from additional work that may be lost. The most expensive quality costs are from nonconformances detected by customers. In addition to the replacement or repair loss, a company loses customer goodwill and their reputation is damaged when the customer relates his experience to others. In extreme cases, litigation may result, adding even more cost and loss of goodwill. [8]

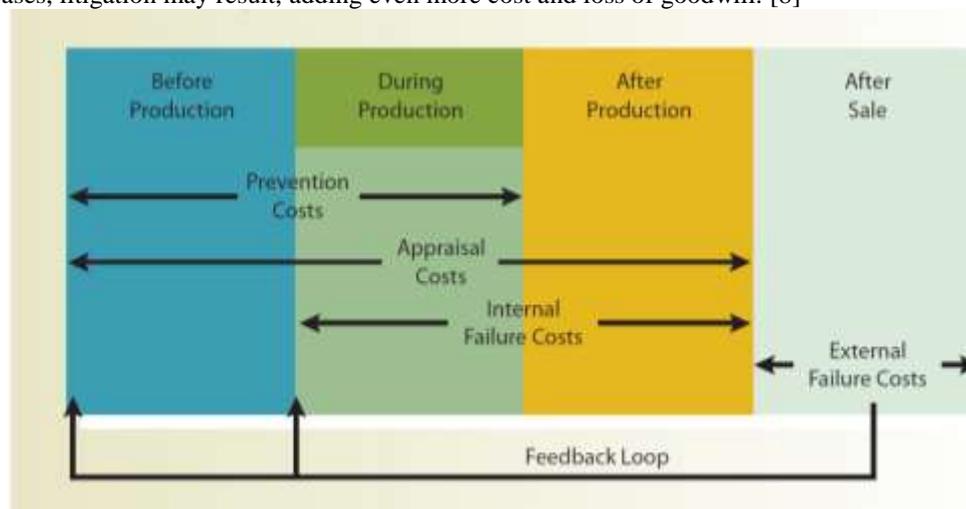


Figure 3: Time-Phased Model for Quality Costs [12]

Quality cost classification can be grouped in time periods (Figure 3). Prevention costs encompass the stage of both pre-production and during production. Appraisal costs cover the three stages of production – preproduction, production and after production stage. Failure costs are divided into two subtopics which internal failure costs and external failure costs. Internal failure costs encompass the period of both production and after production stages. External failure costs just related with the stage of after sale.[13]

Figure 3 also shows that an information feedback loop should be in effect to link the types and causes of failure costs to future prevention costs. Alert managers and employees continuously monitor failures to discover their causes and adjust prevention activities to close the gaps that allowed the failures to occur. These continuous rounds of action, reaction, and action are essential to continuous improvement initiatives for products currently in production and related products in the design stage.[12]

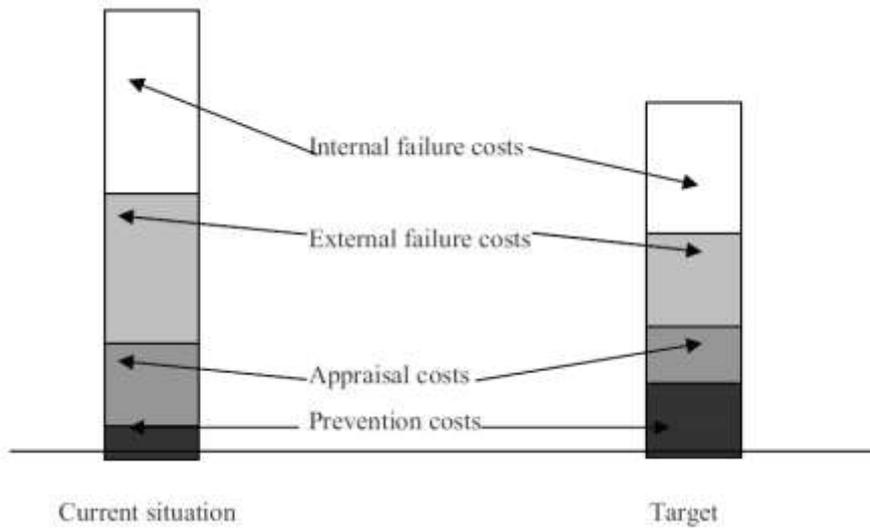


Figure 4: Reducing total quality costs by investing in prevention activities

Figure 4 shows the expected results of the total quality management system on quality cost. It shows that by increasing prevention costs, that is, doing things that will prevent problems, reduces the cost of appraisal and failure and gain a net cost benefit to the organization.

Figure 5 summarizes the quality-related costs expressed as a percentage of total construction costs. Through the implementation of a proactive quality system costs about 1% of the project value (the prevention cost), the expenditure as a result of repair, and so forth (failure cost) drops from 10% to 2% representing a saving of 7%. These categories of costs may represent an increase of cost in one area and a reduction of cost in another.[10]

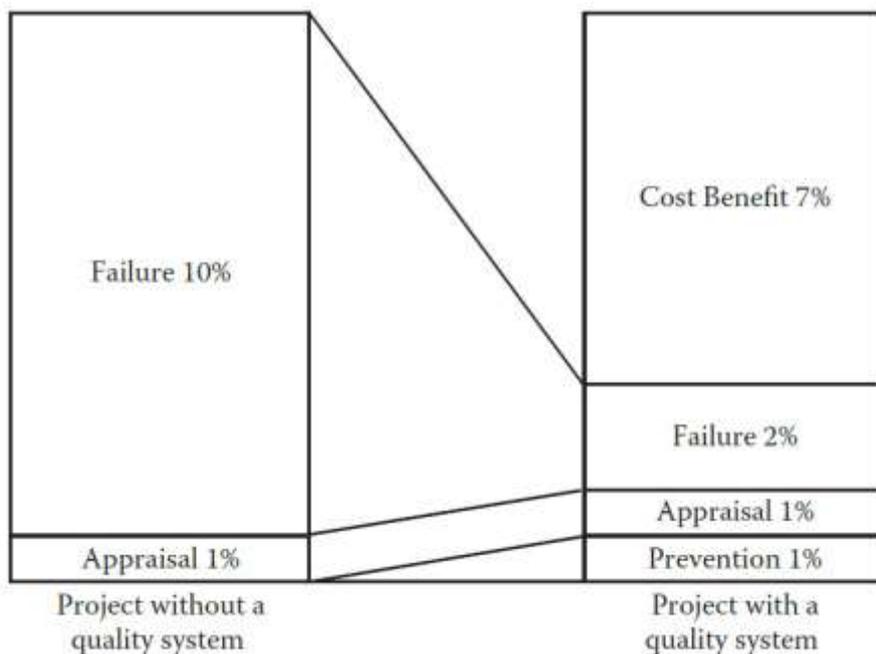


Figure 5: Implementation of quality management [10]

In some organizations quality costs are 4% or 5% of sales, whereas in others they can be as high as 35% or 40% of sales. Obviously, the cost of quality will be very different for a high-technology computer manufacturer than for a typical service industry, such as a department store or hotel chain. In most

organizations, however, quality costs are higher than necessary, and management should make continuing efforts to appraise, analyze, and reduce these costs.

III. CONCLUSION

Customers are demanding higher-quality products and services. Improving quality may actually be the key to survival for many firms.

Quality costs should be reviewed for each major product line, manufacturing area, service area, or cost center. The fundamental principle of the cost of quality is that any cost that would not have been expended if quality were perfect is a cost of quality. This includes such obvious costs as scrap and rework, but it also includes many costs that are far less obvious, such as the cost of reordering to replace defective material. Specifically, quality costs are a measure of the costs specifically associated with the achievement or nonachievement of product or service quality—including all product or service requirements established by the company and its contracts with customers and society.

The objective of quality cost management is to find ways to minimize total quality costs. Increasing prevention and appraisal quality costs decrease failure costs and maximize value of a company.

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