

Quality Costs - The Only Measure That Really Counts

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Many ways are being used today to measure the effectiveness of what is termed "the quality system." Among them are the calculation of number or percentage of nonconformances produced; measurement of process performance such as CP Index, Cpk or capability ratios; customer returns; first-time-through capability; level of internal rejects; or any of a myriad of others. While these methods have value in manufacturing, the only one that has any lasting effect on the future viability of an operation is that of *quality costs*.

While management generally has a good handle on the costs of overtime, raw material, utilities, overhead, number of pencils purchased, etc., current management generally has little or no idea of the costs of quality as a percentage of sales. Many companies that embark on a quality-improvement process have no idea of the potential for savings until they begin to accurately analyze the costs of (non)quality. They may estimate quality costs at about 5 percent of sales, scoff at those who remark that they may be as high as 10 percent, and are astounded when they find the costs at a level of 20 percent (or more) of sales. This number is not as uncommon as it may seem.

If quality costs are such a significant percentage of sales, what do they consist of? Generally, quality costs fall into four major categories: prevention, appraisal, internal failures and external failures. When determining these costs, the salary and overhead of the quality group will fall into one or more of these categories at one time or another, and the distribution will change as the system evolves into a mature program.

Early on, one can expect a significant percentage in the areas of appraisal and failure, but as good preventative measures occur, these areas will taper off when compared to preventative costs. One comment: Do not try to find a theoretical balance between prevention, failure, and appraisal costs; find the balance that provides the overall lowest costs. This balance should result in prevention costs being somewhat higher than the failure and appraisal costs, but more on this later.

How do the four major cost categories break down into subcosts? What makes up prevention, appraisal and failure costs? It goes far beyond scrap, rework and salaries. Let's take a look.

The following definitions of prevention, appraisal, internal failure and external failure are taken from *Quality Costs-What & How*,

prepared by the Quality Costs-Cost Effectiveness Technical Committee of the American Society for Quality Control (ASQC):

Prevention. Costs associated with personnel engaged in designing, implementing and maintaining the quality system. The latter includes auditing the system. Prevention costs include (1) review of designs for the ability to be manufactured and inspected, such as design reviews; (2) design and building or purchasing equipment to be used to accept or test product; (3) development and design of inspection and test procedures; (4) vendor evaluations or surveys to ensure capability to produce goods/services to requirements; (5) development of personnel-training programs; (6) personnel-certification programs; (7) development and performance of internal audits; (8) quality planning and engineering activities; (9) process-control engineering; (10) tracking and reporting of quality costs; (11) design of acceptance-sampling plans; (12) preparation and maintenance of the quality system manual; (13) qualification/ requalification of equipment used for production and product acceptance; (14) development of standards and specifications for product acceptance; (15) process-potential and process-capability studies/experiments; (17) prototypes, trial runs, related tests and analysis; (18) design, generation and retention of quality records; and (19) reliability analysis and testing on new designs and proposed changes.

As you can see, the duties and costs associated with prevention are those activities designed to ensure that nonconformances are not generated. If properly performed, these efforts will result in relatively low internal- and external-failure costs.

Appraisal. Costs associated with measuring, evaluating or auditing products, components and purchased materials to assure conformance with quality standards and performance requirements.

Appraisal costs include (1) maintenance and calibration of inspection and test equipment; (2) miscellaneous and raw materials for tests and inspection; (3) qualification of product for production; (4) incoming inspection and material testing, including inspection of material at the vendor's plant; (5) laboratory evaluation of materials made by a production process, or used in a product; (6) equipment used in process setup; (7) evaluation of processes for conformance to requirements; (8) in-process inspection; (9) final inspection and testing; (10) audit of currently approved vendors to assure their continual compliance with requirements; (11) testing and assessment of product; (12) statistical quality

control; (13) audit of completed product; (14) inspection and calibration of production tools used for the acceptance of product; and (15) inspection and testing of packaging and shipping materials.

Appraisal costs, therefore, are the costs that a company incurs in assuring that the manufactured material meets requirements. If we have done our job in setting up a good system of prevention, we should be able to reduce our dependency on appraisal costs. High appraisal costs are a reflection of the inability (except for customer contractual requirements) to assure that nonconformances will not be produced. When a company relies too heavily on appraisal to assure quality, it must expect that a certain percentage of product that passes appraisal will fail either later in the plant or, worse yet, in the hands of the customer.

Internal failures. Costs associated with nonconforming (defective) products, components and materials that fail to meet quality requirements and cause manufacturing losses. Some of these costs are associated with (1) redesigning and retooling due to nonconformances attributable to design or tooling that was inadequate to meet requirements; (2) review, analysis and disposition of incoming nonconforming material and other related supplier-caused difficulties; (3) internal scrap and rework; (4) reinspection and testing of product previously rejected in-house; (5) failure analysis of in-house rejections; (6) review and troubleshooting of processes yielding nonconforming product; (7) 100 percent inspection and testing to determine the degree of conformity of rejected product; (8) excess inventory kept as an in-house bank due to the inability to manufacture predictable yields; (9) creation and maintenance of a material review board; (10) price corrections, such as the sale of seconds due to nonconformances; and (II) downtime, reinspection of product/material in inventory, additional inspection/tests and related costs due to nonconforming, or suspected nonconforming, material.

Costs associated with internal failures are several orders of magnitude higher than those associated with preventing nonconformances. Production costs are not recoverable (for the most part) if the product is nonconforming, and any additional costs such as rework, repair, sorting, reinspection and administrative time, all increase product cost without adding value.

External failures. Costs generated by nonconforming (defective) products being shipped to customers.

While some of these costs are apparent, others may not be clear at the outset, but are very relevant. Some costs associated with external failures are due to (1) engineering errors that result in replacement costs (these errors can be a result of the wrong specification being generated, unclear requirements or drafting errors); (2) redesign of product, or changes in set points, resulting from improper determination of customer requirements or specifications; (3) support of field representatives or services because of nonconformances being generated; (4) replacement of nonconforming or substandard materials; (5) product liability; (6) internal investigations of customer complaints; (7) contract penalty costs due to inability to meet performance requirements; (8) upkeep of equipment in the field needed to support customer equipment; (9) shipping of nonconforming material to and from the customer; and (10) any other related field quality failures.

While data classifications for the four major cost categories are numerous, data collection may prove difficult. To do so, some close work with the accounting department may be required. You may find that, in some cases, costs for scrap, rework and repair time are already being collected, but it may be difficult to separate them from other costs that are out-of-the-ordinary expenses and have nothing to do with scrap or rework.

Another caution: Be wary of the term *scrap*. There are times when excess material from production, such as waste from stamping or chips from metal cutting, are defined internally as scrap and sold to salvage dealers. Unless the quality-data-collection system is sensitive enough to differentiate waste from scrap due to nonconformances, the dollar values may be grossly overstated. This type of care is critical to the success of the quality-costs program, because actual quality costs may be so large that they will not be believed in any case, and one obvious error may lead certain people to attack the entire program for political reasons.

Remember, the quality-costs system will be a political hot potato; and certain personnel may not cooperate because the higher the actual costs, the worse (in their eyes) they will look to upper management. In some cases, upper management may not want to see the numbers because they may feel that the person collecting the data is out to make them look bad as a manager. So be careful in your approach.

I would be remiss at this point if I didn't bring up one of the finest articles I have ever seen on the effect that short-sighted managers can have on a quality system. The commentary is titled *The Shangri-La Syndrome*, and was written by Dave Crosby of The Crosby Co. and printed in his *Quality Improvement News*. Discussed are some of the erratic swings that quality systems go through based on such factors as the customer's threshold of pain. He comments on how great efforts and expenditures may be put into improving a system that has deteriorated to the point of unacceptability for the customer. After a time, the system is in excellent shape and conformance is at such a level of excellence that there are relatively few external or internal failures; and the cost of appraisal has also been drastically reduced.

Then the financial manager (one of my favorite targets after the production-control guys), who no doubt has his MBA from Cost Cutting University, performs an analysis on the quality system. He notices the obvious waste of funds on prevention measures and maintenance of a quality system when the company doesn't seem to have any serious problems with internal failures. In fact, it hasn't had a serious customer complaint in a significant period of time. Based on his extraordinary insight, he manages to reduce the quality department's unnecessarily high budget. The low budget results in a lack of prevention activity, and failure costs go through the roof, customers get angry and the cycle is repeated once again. It is a real effect that must be guarded against.

While Dave wrote on the Shangri-La-Syndrome in 1987, it is still appropriate 15 years later. If you would like a copy of his article contact Bob Dovich at Field Fastener Supply.