

## GENERAL ASPECTS OF QUALITY COSTS

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### ABSTRACT

*The goal of this study is to presents different approaches of quality costs and the quality cost elements. It discusses different models describing the relationships between the major categories of quality costs.*

### 1. STRUCTURE OF THE QUALITY'S COST

Quality costs represents the expense of non-conformance; the cost of doing things wrong. Quality costs can be segregated into four major categories:

- Prevention costs;
- Appraisal costs;
- Internal failure costs;
- External failure costs.

Prevention costs: costs of activities that are specifically designed to avoid or prevent errors. These costs include: buying materials and technical documents, market analyses, training and evaluation the employees, planning and predicting, verifying the documents and the data, controlled stocks, etc. Investing in preventive costs has the following effects: defects and failure costs go down, customer satisfaction goes up, the need for inspection and inspection costs goes down, productivity goes up, competitiveness and market shares increase, profits go up.

Appraisal costs are referred to as monitoring costs or inspection costs. Typical examples of these costs include the expenses of maintaining the quality control department, evaluation of methods, materials, processes and product samples used in testing.

Failure costs: costs that result from poor quality, such as the cost of fixing bugs and the cost of dealing with customer complaints. Failure costs usually account for the major proportion of quality costs in companies that do not have an effective quality program. The failure costs are the sum of variable costs, indirect material costs, depreciation, other fixed production costs and contribution to administration costs.

Internal failure costs: these are costs which accrue when defects and problems are discovered inside the company, as: scarp, rework, redesign, defect analysis, modification, corrective action, work interruption.

External failure costs: costs, which accrue when the defect is first discovered and experienced outside the firm. The customer discovers the defect, and this leads to costs of claims and, as a

rule, also a loss of goodwill corresponding to the lost future profits of lost customers. It is much cheaper to fix problems before shipping the defective product to customers.

External failure costs for seller: these are the types of costs absorbed by the seller that releases a defective product. Examples of external failure costs for seller: investigation of customer complaints, added expense of supporting multiple versions of the product in the field, technical support calls; discounts to resellers to encourage them to keep selling the product, refunds and recalls, lost sales; penalties.

External failure costs for customer: these are the types of costs absorbed by the customer who buys a defective product. Examples of external failure costs for customer: wasted time, lost data and/or business, cost of replacing product, cost of tech support, frustrated employees quit, injury / death.

Total cost of quality is the sum of following costs: prevention, appraisal, internal failure and external failure.

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 manufacture.

In order to calculate total quality cost, the quality cost elements should be identified under the categories of prevention, appraisal, internal failure and external failure costs. The methodology usually used is for each department, using a team approach, to identify quality costs elements which are appropriate to them and for which they have ownership. Several techniques, such as brainstorming, nominal group technique, Pareto analysis, cause and effect analysis, fishbone diagrams, and force field analysis, can be used to effectively identify quality costs elements. The quality cost measurement system developed will improve with use and experience and gradually include all quality cost elements.

One of the goals of total quality management (TQM) is to meet the customer's requirements with lower cost. For this goal, we have to know the interactions between quality-related activities associated with prevention, appraisal, internal failure and external failure costs. It will help in finding the best resource allocation among various quality-related activities. In the literature, there are many notional models describing the relationships between the major categories of quality costs. Generally speaking, the basic suppositions of these notional models are "that investment in prevention and appraisal activities will bring handsome rewards from reduced failure costs, and that further investment in prevention activities will show profits from reduced appraisal costs" (Plunkett and Dale, 1988). Plunkett and Dale (1988) classify these notional models into five groups, which are further aggregated into three by Burgess (1996). After a critical review, Plunkett and Dale (1988) conclude that "many of the models are inaccurate and misleading, and serious doubts are cast on the concept of an optimal quality level corresponding to a minimum point on the total quality-cost curve". Besides, Schneiderman (1986) asserts that, in some circumstances, if enough effort is put into prevention, no defects at all would be produced, resulting in zero failure costs and no need for appraisal (also given in Porter and Rayner (1992). Thus, in these circumstances, the only optimal point is "zero-defects".

However, Burgess (1996) integrated the three types of quality-cost models, derived from reducing Plunkett and Dale's categories (1988), into a system dynamic quality-cost model displaying dynamic behaviour consistent with published empirical data. According to the simulation results, Burgess concludes that the simulation provides support for the classic view of quality-cost behaviour that an optimal level of quality exists only in certain time-constrained situations. If the time horizon is infinite, or above a particular cut-off value, then spending on prevention can always be justified, i.e. the modern view prevails.

There are a number of criticisms of this model, described as follows:

- it is difficult to decide which activities stand for prevention of quality failures since almost everything a well-managed company does has something to do with preventing quality problems;
- there are a range of prevention activities in any company which are integral to ensuring quality but may never be included in the report of quality costs;
- practical experience indicates that firms, which have achieved notable reductions in quality costs, do not always seem to have greatly increased their expenditure on prevention.

It is sometimes difficult to uniquely classify costs into prevention, appraisal, internal failure, or external failure costs. The classic view of an optimal quality level is not in accordance with the continuous quality improvement philosophy of TQM.

Crosby (1984) divides quality costs into two categories: the price of conformance and the price of non-conformance

The price of conformance (POC), including the explicitly quality-related costs incurred in making certain that things are done right the first time; and

The price of non-conformance (PNOC), including all the costs incurred because quality is not right the first time.

Juran advocates a categorisation of quality costs including: tangible factory costs, which are measurable costs such as scrap, rework, and additional inspection; tangible sales costs, which are measurable costs such as handling customer complaints and warranty costs; intangible costs, which can only be estimated, such as loss of customer goodwill, delays caused by stoppages and rework, and loss of morale among staff.

Juran's categorisation scheme focuses on the costs of product failures and emphasises the importance of intangible quality cost elements, which in the long term are of greater importance than cost reduction.

Another alternative, proposed by Dale and Plunkett, is to consider the activities relating to supplier, company (in-house) and customer under the PAF (prevention, appraisal, failure) categorisation. This approach has the merit of new categories, which closely relate to the business activities while retaining the advantages of the PAF categorisation.

It seems that the identification of quality cost elements into prevention-appraisal-failure is somewhat arbitrary. It may focus on some quality-related activities, which account for the significant part of total quality cost, not on all the interrelated activities in a process.

Under the philosophy of process improvement in TQM, analysts should place emphasis on the cost of each process rather than an arbitrarily defined cost of quality. It recognises the importance of process cost measurement and ownership. The process cost is the total of the cost of conformance (COC) and the cost of non-conformance (CONC) for a particular process. The COC is the actual process cost of providing products or services to the required standards, first time and every time, by a given specified process. The CONC is the failure cost associated with a process not being operated to the required standard (Porter and Rayner, 1992). According to this definition, we know that the content of this categorisation (COC and CONC) is different from that of Crosby's and Xerox's mentioned previously.

The process cost model can be developed for any process within an organisation. It will identify all the activities and parameters within the process to be monitored by flowcharting the process. Then, the flowcharted activities are allocated as COC or CONC, and the cost of quality at each stage (COC + CONC) are calculated or estimated. Finally, key areas for process improvement are identified and improved by investing in prevention activities and process redesign to reduce the CONC and the excessive COC respectively.

A process modelling method, IDEF (the computer-aided manufacturing integrated program definition methodology), can be used to construct the process cost models for the processes within an organisation (Marsh, 1989). This method utilises activity boxes with inputs, outputs, controls and mechanisms to depict the activities of a process. However, experts for system modelling develop the IDEF method for use. It seems to be too complex if departmental manager and staff were to be responsible for identifying the elements of process costs. Thus, Crossfield and Dale (1990) develop a more simple method called quality management activity planning (Q-MAP) for the mapping of quality assurance procedures, information, flows and quality-related responsibilities.

Chen and Tang (1992) present a pictorial approach to measuring quality costs, which is patterned after that used in a computer-based information system design. The variables considered in this approach include direct variables (prevention-appraisal-failure costs and quality-related equipment costs) and indirect variables (customer-incurred costs, customer-dissatisfaction costs and loss of reputation). It includes two major steps:

1. Specifying the variables as well as the significant relationships among the variables, and mapping the variables and relationships into an “influence diagram” showing the structure of a quality costs system;
2. Converting the structure into a well defined “entity-relationship diagram” showing the input-output functions and their associated properties.

Generally speaking, there are the following deficiencies in measuring quality costs (QC). The aspect of overhead allocation in calculating QC is seldom discussed in the literature. In practice, some companies add overheads to the direct cost of labour and material on rework and scrap, while other companies do not. If they do, “rework and scrap costs become grossly inflated compared with prevention and appraisal costs which are incurred via salaried and indirect workers” (Dale and Plunkett, 1991).

Most of QC systems in use are not (there are some exceptions) intended to trace quality costs to their sources (O'Guin, 1991) such as parts, products, designs, processes, departments, vendors, distribution channels, territories, and so on.

### **3. CONCLUSION**

Quality costs have origin in the services and the products of a lower quality than the quality they should have been manufactured and delivered to the customer. Control of total quality costs requires that accountants understand the relationship between internal and external failure costs, prevention and appraisal cost.

Costs can be cut and quality enhanced by setting up continuous improvement teams to improve the internal manufacturing processes. One should also work with suppliers to reduce the costs of purchased items. These frequently make up a large proportion of the total costs. The long-term objective should be to develop a relationship with a supplier based on trust. It should lead to co-operation on quality improvement projects, which drives down costs and improves quality.

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