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Quality Costs and their Financial Implications on the Performance of Organisation

Rodica AILOAIEI[1]*, Elena HLACIUC[2], Petronela VULTUR[3]

Abstract

Lately, quality has become a fundamental variable in the performance of organisations. But efforts to increase revenue often lead to partially abandoning product quality. The effect is often disastrous for the organisations – from additional costs incurred in an attempt to remedy defects to losing their market share. Good quality management results in avoiding unwanted costs. Quality control is focused on the method used to achieve each component of the final product, while having a compliance standard as guideline. Therefore, it is obvious that by acting on the causes that lead to a decrease in quality, considerable savings can be made, both financially and in terms of market share. To ensure the effectiveness of this approach, we need to identify the quality-related costs, as detailed below.

Keywords:
Quality, accounting, quality costs, performance.

JEL Classification:M40, M41

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1. Introduction

The general concept of quality-related costs is presented in the firstquality control manual published by Dr. J. M. Juran (McGraw-Hill, 1951). The majority of works and articles of the time dealt with narrower economic applications. Among the earliest articles on the quality cost systems that we are familiar with nowadays, we would like to mention the ones penned by WJ Masser (1957), "Quality Manager and Quality Costs", Harold Freeman (1960), "How to Make Available Quality Costs", and Feigenbaum's classic paper, "Total Quality Control" (McGraw-Hill, 1961). These works were among the first to classify quality costs, a classification that can be found in the literature even today.

The term „quality costs" was first used in Western Europe in the early 1960s, originating in Fiegenbaum's study of prevention, evaluation, and failure costs. The most valuable work in the field, although not identifying all the components that can be attributed to quality costs, is "Quality Costs - What and How", published in 1967 by the American Society for Quality Control (ASQC) and subsequently revised several times. Quality management systems can take the form of a whole range, from mere inspections to systems that include all management functions, having effects on the quality of the product or of the service.

The concept of quality-related costs achieved international popularity with the ISO series, as it has an important role as a quality improvement tool and as a measure of quality management.

As an appreciation, *the cost of quality is an indicator that expresses in a synthetic way the efforts made to maintain and improve quality*.

There are two fundamental aspects in terms of quality [1], which will be discussed in this paper:

- *design quality,*
- *compliance quality*.

Design quality refers to how close a product's characteristics are to the needs and expectations of the customer.

Compliance quality characterises the product from the point of view of the model's specification.

Even if a product conforms to the technical design specifications, it may eventually be of poor quality and not meet the customer's requirements.

Figure 1 illustrates the demarcation between these two facets of quality.

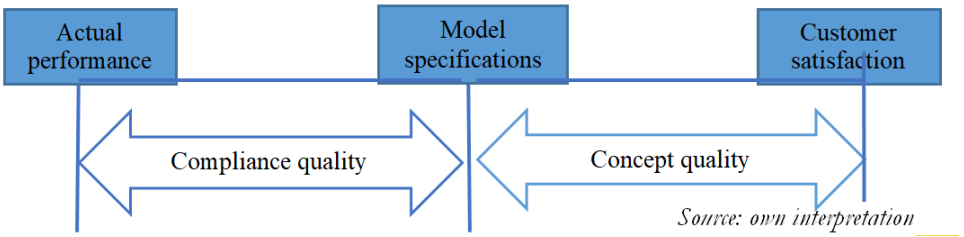


Figure 1. Concept quality and compliance quality

Quality-related costs are incurred precisely to prevent low-quality production [4]. They concern compliance issues and are present in most phases of production.

There are four categories of quality costs in a technological flow (Table 1):

Table 1 Categories of quality-related costs

Quality cost	Explanations
Prevention costs	These are incurred to prevent the manufacture of products that do not meet the specifications
Detection costs	These are incurred to identify the product units that do not meet the specifications
Internal non-quality costs	These are incurred for products detected before their delivery to the customer
External non-quality costs	These are incurred for non-compliant products identified by the customer, after delivery

Source: own interpretation

Each category of quality costs has subcategories, such as:

Prevention costs: studies and product developments, studies and development of manufacturing methods, professional training;

Detection costs: control of the finished product, cost of checked samples that have been destroyed following the control;

Internal non-quality costs: Corrected products, scrapped products

External non-quality costs: complaint handling, repairs during the warranty period, court proceedings.

Douglas Wood states, in one of his papers [2], that:

> „Quality costs, as points of entry used to focus on promising areas, aim to reduce defects, meet customer requirements and maximise financial business flows. It is the first line of defense in the fight to maximise one's ability to beat the competition."

Once the areas targeted for improvement are identified by a quality cost study, a series of models are identified to improve and redistribute the processes available to implement the solutions.

2. Quality management and calculation of quality costs.

The emergence of quality management (imposed by international quality standards) has created the premise for the increase of responsibility in terms of quality requirements and for the possibility of a systematic monitoring of the evolution of quality costs.

A model used to prevent unwanted effects in terms of quality and which has spread in most highly performing organisations is the use of **quality costs to control suppliers**.

2.1 Quality costs in supplier valuation programs.

Beyond price rebates offered by suppliers to maintain their business, a buyer has to decide which related costs will be reduced.

Comparing the relative size of quality costs by category and items should be the first step. The cost program of the buyer's company could be of invaluable help to perform the analysis.

For example, let us assume a situation where the rejection of the purchased materials is the buyer's most significant problem. If the buyer has reasons to believe that the quality costs will be reduced by improving the rejection rate of the purchased materials, this is an important issue for this company. A Pareto[4] analysis, for example, could determine that a relatively small number of providers cause most problems. Now the buyer can focus their efforts on "less vital" suppliers and can take the appropriate measures.

But what is the right course of action? The buyer could convince several vital suppliers to set up quality programs, if the situation calls for it. Discretion is advised before insisting on this issue. Some companies may be too small to support a quality costs program [3]. There may be special

[4] The Pareto analysis is a rigorous and pragmatic activity, which turned out to be very effective for group activities. It analyses the main categories of causes and identifies the contribution of each of them to the global issue, contributing to it by specifying the areas where efforts are needed to maximise results. Pareto charts are useful for processes where measurable parameters can be highlighted so as to record each occurrence of a given parameter. The Pareto chart helps guide the interventions in a methodical fashion, through action plans built around the major causes of emerging issues, being a visually-oriented instrument used to make the decision. It is a qualitative analysis instrument because it focuses on process parameters, taking into account the frequency of their occurrence. The defined parameters can be events, errors, features etc.

circumstances at play in other companies that would prohibit this action. However, if a supplier finds that the launch of such a program is feasible, the quality costs most likely to be identified by the buyer will be reduced. If these costs are reduced by analysing the causes, the hidden costs, consumed by both the buyer and the intermediary suppliers, will also be reduced. The result will be an improvement of the quality of the supplier's product/service and of the buyer's product/service. This should increase profits for both, and the improved profitability of the supplier could ultimately result in lower prices for the buyer, on a competitive market.

What other actions could be taken if we are aware of the extent of the supplier's quality costs? These costs may be incorporated into a buyer's rating system. In addition to the traditional contributions in terms of delivery rates and rejection rates, the supplier rating system should also include the supplier's quality costs, as noted below.

As an *evaluation* method, we can use *the quality cost performance index of the supplier* (QCPI) based on the following formula:

$$QCPI = \frac{supplierqualitycost\ +\ purchasecost}{purchasecost}$$

where the supplier quality cost is the cost incurred with any possible market research, studies etc.

We can also calculate, in the supplier evaluation, the Refusal Processing Costs (RPC) for the received refusals:

RPC = number of rejected lots x price per rejected lot

The cost of complaint investigations. The special study undertaken to determine the time required to investigate complaints cannot be estimated with any degree of accuracy [2]. The total cost of the complaint investigations can be estimated as the investigation time for that supplier, multiplied by average hourly wages.

E.g,

Total cost of the investigations = time allotted for investigations (in hours) x average wage

The processing cost during the reception inspection. This cost could be estimated by using the appropriate work standard, the average hourly wages and the perceptual benefits of a recipient-inspector and the number of batches processed for a particular supplier.

E.g,

Processingcost = number of hours × average hourly wages × number of processed lots

The cost of a defective product after inspection

This was difficult to assess, as a defective product could be either rebuilt or disposed of. If it is removed, recovering the cost from the supplier may not be possible, if liability cannot be clearly attributed. Sorting the other parts of the lot may be the best alternative. Therefore, this cost has been estimated for each supplier by multiplying the number of defective parts identified after the inspection, using the original purchase price of the part.

E.g,

Cost after inspection = number of rejected parts x purchase price/part

The quality cost of the supplier quality can be determined as followes

+ Refusal processing cost + Cost of complaint investigations. + Processing cost during the reception inspection. + Cost of a defective product after inspection
= The quality cost for the purposes of the evaluation of the supplier

Many variations and innovations can be developed to use the quality costs to assess the performance of the suppliers. The way in which this is done is less important than recognising the extent and impact of the supplier's quality costs. Once recognised, steps can be developed to measure, compare, and analyse so that they can be improved. The following example, that includes four suppliers, is given as a determination method:

supplier	Supplier Quality Cost (CQ)	Purchase Cost (CS)	Index (QCPI)
A	2.500	45	**1.055**
B	3.500	46	**1.076**
C	3.000	20	**1.150**
D	**6.000**	**10**	**1.600**

Example of Index Calculation for Supplier A:

$$QCPI = \frac{CQ+CS}{CS} = \frac{2,5+45}{45} = 1.055$$

For the purposes of the evaluation, the company can develop its own method to interpret the quality cost performance index. A perfect supplier would not have quality costs because there would be no

investigation related to refusals or complaints, and inspection would not be necessary. Therefore, the index for a perfect supplier would be:

$$QCPI = (CQ + CS)/CS = (0 + CS)/CS = 1.000$$

The actual evaluation used would be:

Index (QCPI)	Interpretation
1.000 – 1.009	Excellent
1.010 – 1.039	Good
1.040 – 1.069	Satisfactory
1.070 – 1.099	Poor
1.100+	Corrective action needed

Using this assessment, a first priority is to implement immediate corrective actions for the provider D, indicated above.

Many variations and innovations can be developed to use the quality costs to assess the performance of the suppliers. The way in which this is done is less important than recognising the extent and impact of the supplier's quality costs [4]. Once recognised, steps can be developed to measure, compare, and analyse so that they can be improved.

2.2. Identification of quality issues and financial implications

Quality costs are not provided by the company's usual accounting system; a specific calculation system is therefore necessary [6].However, such a system must be based on the accounting records of the company that provides the amount of certain expenses.

Thus, analytical accounting can provide information on workforce value, costs attributed to services, costs of machine hours [5]. The figures obtained through this process must be analysed and supplemented by estimates based on certain conventions - it is agreed that a certain cost should be recorded in a particular chapter. All the parties that participate in the accounting and estimates must observe the same conventions and refer to to the same definitions. Assessments have more weight if they are accepted by all parties; it is advisable that valuations are made at minimum values, in which case underestimated values are better than overestimated values, and the calculation method must be indisputable. Certain consequences of defects whose estimation would be delicate (such as missed

opportunities or losing an unsatisfied customer) are just mentioned, without figures. Quality costs contribute, in a high proportion, to the overall costs of an organisation, and their importance is all the more significant as they cannot be fully reflected in the accounting records, as many of them cannot be quantified in a concrete manner. Thus, some costs can be calculated, such as costs incurred during the warranty period, others, caused by scrapped parts or further processing, can be identified in the accounting records, while others cannot be measured in practice, such as cars idling [6].

The calculation of the quality cost involves five stages, using a variant of the ABC method:

Stage 1 consists of tracking all activities that are related to quality. One of these activities is the technical control at the end of manufacturing.

Stage 2 is determining the number of units of each activity that are related to quality. Typically, the unit of measurement here is the number of control hours, as the main cost inductor.

Stage 3 focuses on the cost per unit of work.

Stage 4 is the total calculation of quality-related costs.

Stage 5 determines the share of quality costs in the total turnover. This percentage indicates whether the products are of high quality.

We have unified the five steps in a model, separating direct costs from indirect costs (**Tables 2 and 3**).

It is worth noting that all the figures below are used exclusively to demonstrate the financial implications of these quality-related costs.

Table 2 Direct quality-related costs

A. Direct quality-related costs				
Cost category (1)	Number of units (2)	Unit cost (assumed value) (3)	Total quality-related cost (4)=(3)x(2)	Share of the cost in the total turnover[5] (5)=(4)/EUR 5,000,000
Prevention costs:				
-studies and product developments	1,300 hours	EUR 40	EUR 52,000	1.04
-studies and	1,350 hours	EUR 30	EUR 40,500	0.81
				1.85

[5] We have assumed that the turnover amounts to EUR 5,000,000

development of manufacturing methods			EUR 92,500	
Total prevention costs				
Detection costs: -technical control	8,000 hours[6]	EUR 18	EUR 144000	2.88
Internal non-quality costs: -corrections	102 products with corrections [7]	EUR 1,500	EUR 153,000	3.06
External non-quality costs - **Complaint**complaint resolution	200 products with complaints [8]	EUR 20	EUR 4,000	0.08
		1,400	EUR 280,000	5.6
-repairs during the warranty period of the product	200 products[9]		EUR 284,000	5.68
Total external costs				
Total direct quality-related costs			**EUR 677,500**	**13.55**

Source: own interpretation

[6] We have assumed that the facility manufactured 4,000 units of product, and that the technical control per product unit required two hours, therefore 4,000 units x 2 hours = 8,000 hours
[7] Assumed quantity
[8] We assumed that 15% of the products were in the warranty period
[9] Idem 4

Table 3 Indirect quality-related costs

B. Indirect quality-related costs	Number of lost sales	Variable cost unit margin (assumed values)	Lost variable cost	% of turnover
Estimated lost margin	200 units[10]	EUR 1600	EUR 320,000	6.4

Source: own interpretation

In many organisations, quality costs represent 10-20% of their turnover [7], in optimal conditions. Quality improvement programs result in conservative savings which, if not increasing turnover, at least contribute to maintaining it. As seen above, quality-related costs represent 13.55% of the turnover. This demonstrates that the entity manages its quality according to acceptable parameters [8] As regards the indirect quality-related costs, they are difficult to assess and are not found in the accounting records. However, they can be substantial and can help improve quality.

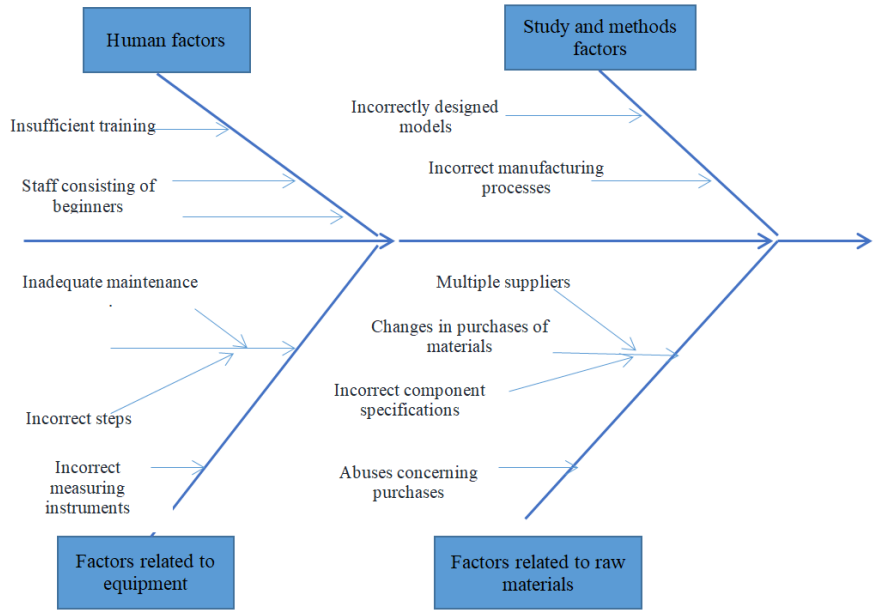
Improving quality also has non-financial effects that lead to changes in the long-term results [9].

There are techniques that can be used to identify quality issues. Besides Pareto's chart and control diagrams, an interesting technique is the causal relationships tree or the cause-effect diagram .This diagram highlights the possible defects.

Using the previous example, the causes of the defects that occur frequently are analysed.

Figure 3 presents this diagram, while also analysing the main factors that can result in quality or the lack thereof.

[10] We assumed that the quantity subject to complaints as being lost



Source: Horngren and al., Contrôle de gestionetgestionbudgétaire, 2016

Figure 2. The Causal Relationships Tree

The analysis of the causal relationship tree indicates that a number of factors are inevitable.

According to some authors, the following factors contributing to quality improvement (ranked in order of importance) [1]:

- the best design-stage concept of the model,
- the improvement of manufacturing methods,
- the improvement in terms of the professional training of staff,
- the selection of suppliers,
- the investment made in technology and equipment.

3. The method used for the presentation of the results

The presentation of the results depends on the intended purpose. In addition to the analytical expression of quality costs, there is a possibility of presenting representative indicators. The number of products (in this case, the quality cost is expressed per product) or the weight thereof (quality costs in total turnover) can be taken into account.

In order to make a comparison over time or between units, or to indicate the cost-cutting possibilities, for convenience these costs should be expressed as a percentages of the turnover, which is eloquent for everyone.

Quality-related costs can also be expressed as a percentage of the value added for the enterprise; this calculation method is even more significant. *In the example that we have presented previously we have determined the weight of the quality-related costs in the turnover.*

Regrouping costs by types of defects, by types of products or by types of activities is useful in terms of guiding the subsequent action to reduce quality-related costs. The existence of a summary that includes all the **quality-related costs** of the enterprise allows for the use of the partial calculations that it includes for certain defects [3]. It also makes it possible to regroup the costs depending on accountability centers. However, a fair distribution is difficult, because many non-compliaces have multiple causes and the liability is shared among several departments of the organisation.

Some enterprises track the relative evolution of the different cost categories: prevention costs, detection costs, costs of internal non-compliances, costs of external non-compliances.

Generally, an active quality construction policy leads to a global cost reduction. The portion corresponding to the prevention costs, which was diminutive in the beginning, increases progressively. The portion corresponding to the detection costs slightly increases at the beginning of the program, as a measurement effort is being made; afterwards, this portion diminishes, as prevention gradually replaces many controls [6]. Through this process, the enterprise can make comparisons over time and across sectors.

A simple, and often sufficient, presentation method,is it avoid summing up the costs incurred due to the lack of quality, but to emphasise the costs incurred due to a particular type of defect.

4. Conclusions.

Being aware of the level of the quality-related costs allows enterprises to draw comparisons, both in terms of the total costs of the activity, and regarding other cost categories, thus providing a basis for many decisions, as well as a motivation for the activities conducted by organisations.

By analysing and evaluating the elements of quality-related costs by activity, by product or by product group, we seek to identify each cost category (i.e. Prevention costs, detection costs, internal and external non-quality costs).

Through this analysis, we also aimed to identify, in detail, the causes that lead to the occurrence of these costs, thus favoring the adoption of appropriate measures in order to prevent and reduce them at their respective hierarchical levels. An improvement action can be accomplished by

following internal procedures, starting with a supplier analysis (and we refer here to the raw material purchased) and ending with the final product (the accuracy of the internal quality control).

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