

Cost-based analysis of quality in developing countries: a case study of building projects

Aynur Kazaz^{a,*}, M. Talat Birgonul^b, Serdar Ulubeyli^a

^aFaculty of Engineering, Department of Civil Engineering, Akdeniz University, 07200 Topcular, Antalya, Turkey

^bDepartment of Civil Engineering, Middle East Technical University, 06531 Ankara, Turkey

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Abstract

This paper examines construction quality costs in Turkey. First, background information is presented on quality costing, on the prevention, appraisal, and failure (PAF) approach, and on PAF components. Secondly, a model is presented for determining the optimum level of total quality cost. Finally, a case study in which the costs of quality in a mass-housing project were collected and evaluated is presented. For the case study, the data were obtained in two stages: (i) during the construction period and (ii) after the delivery of residences. During the construction period, data were collected in collaboration with quantity surveyors and site engineers. During the delivery of residences, a questionnaire was administered to 655 householders, using face-to-face interviews. The importance of construction quality in a developing country was clarified by means of a cost-based analysis, in which the percentages of quality costs in the total cost to client were calculated separately, as was the optimum cost value of total quality. © 2004 Elsevier Ltd. All rights reserved.

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1. Introduction

Completing a quality work on schedule is one of the most important factors in minimizing the cost of civil engineering projects. The detailed planning and prevention of non-conformance usually represent a secondary priority in developing countries, such as Turkey. The approach “solve the problem as the problem appears” is commonly preferred in the management of the most construction projects. On other hand, quality (including aesthetic value) is perceived as one of the most important features in developing countries. Achieving high quality is a fundamental way of meeting the needs of customers and reducing non-conformance. High quality is therefore always more cost effective than poor quality in the long term.

2. Quality costing

Juran and Gryna [1] defined quality as ‘fitness for purpose’, whereas Crosby [2] defined it as ‘conformance to requirements’. According to Deming [3], quality is uniformity with respect to a correct target. In the construction sector, quality is understood as the ability to meet the requirements contracted with clients. The concept of quality costs was first mentioned by Juran [4] and this concept was applied in the manufacturing industry in the early 1950s. In the construction industry, increasing attention has been given to improve the overall construction quality since the early 1980s. Quality costs are a measure of costs specifically associated with the achievement or non-achievement of product quality, as defined by all product requirements established by the company and its contracts with customers and society [5]. Juran [4] has suggested that the cost of quality can be understood in terms of the economics of the end-product quality or in terms of the

*Corresponding author. Tel.: +90 242 3237073;
fax: +90 242 3232362.

E-mail address: akazaz@akdeniz.edu.tr (A. Kazaz).

economics of the conformance quality. There is a direct correlation between quality and profitability: higher quality results in lower costs, and profitability therefore increases [6]. Producing quality products and services is cost effective, and auditing the cost of quality is one of the most important parameters of achieving quality. Cutting the expenditures for quality might lead to undesirable quality levels. In contrast, increasing expenditures unnecessarily decreases the profit margin. As a result, the optimum level of quality expenditure should be determined by having information concerning the quality costs, because the cost of quality cannot be manageable unless it is measurable. Oliver and Qu [7] underlined the importance of quality cost reporting. Furthermore, it should be noted that quality costs and their methods of collection vary across industries and between companies. The other advantages of measuring and classifying quality costs are as follows:

- It ensures that the project tasks are completed correctly from the beginning, and warrant the effort required.
- It helps to identify the problems that reduce the overall cost of quality.
- It allows cost quantification of failure events and thus helps to reveal the anomalies in cost allocation, which might otherwise remain undetected.

An action based on a plan is more cost effective than an unplanned one. In this regard, a manager can determine the effect of investing in a process, changing a standard operating procedure, or revising a product design.

Results from the quality cost analysis can be used in all types of input selection processes. However, Deming [3] has stated that cost analysis for quality is not effective and that measuring quality costs to seek optimum defect levels is evidence of a failure to understand the problem. Crosby [2] argued that quality costs need to be measured not for management control, but for the development of quality thinking within the organization. The more popular approach is that of Juran [4], who advocated the measurement of costs on a periodic basis as a management control tool.

3. The prevention, appraisal, and failure (PAF) approach

The most widely accepted method for measuring and classifying quality costs is the prevention, appraisal, and failure (PAF) model. Although PAF is universally accepted for quality costing, it also has some drawbacks described by Aoieong et al. [8] and Porter and Rayner [9].

3.1. Prevention costs

The key to improving quality and profitability is prevention of non-conformity. Prevention costs are those

resulting from quality activities used to avoid deviations and errors [10]. Examples of such costs are design reviews, education, training, supplier selection, capability reviews, and process improvement projects. Harrington [11] provided an extensive list of the overall content of each cost type. Several measures of quality cost are also listed in Johnson's [12] study of *engineering-type settings*. Preventing non-conformity before a product is manufactured or prepared to serve the customer is clearly the most appropriate action in reducing appraisal and failure costs because it is always the least costly, least time consuming, and least troublesome approach for providing a quality product. Prevention efforts also try to determine the causes of problems and eliminate them at the source, because an organization can determine when and where it wants to implement such efforts. Prevention expenses can be recovered many times over through reduced appraisal and failure costs. This means that more feedback is procured using prevention methods. Roberts [13] found that by spending 1% more on prevention efforts, the failure costs of construction can be reduced from 10% to 2%.

3.2. Appraisal costs

The second less expensive expenditure in quality management is to incur the appraisal means. Appraisal costs include all costs associated with measuring, evaluating, or auditing products to determine whether they conform to their requirements [2]. Examples of appraisal costs include inspections, material reviews, and calibration of measuring and testing equipment. The most important characteristic of appraisal costs is that they are associated with managing the outcome, whereas prevention costs are associated with managing the intent. Prevention and appraisal costs, however, are unavoidable costs that must be borne by the construction companies and consultant firms if their products are to be delivered on schedule. Hays [14] and Ledbetter [15] reported that providing quality control in construction requires an expenditure ranging from 1% to 5% of total project costs. Gunneson [16] asserted that the appraisal costs gradually diminish as failure costs decrease because there is less need for inspection. In other words, appraisal costs can be reduced when the quality of the product reaches high levels. High appraisal costs combined with high internal failure costs signal that poor quality products are being produced.

3.3. Failure costs

Failure costs are incurred when it is necessary to correct the products that fail to satisfy the customer or do not meet company quality specifications [17]. The costs can be divided into internal and external costs. Internal failure costs are those costs associated with

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