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Safety and Quality in the Portuguese Construction industry

H. P. Moura¹, J.C. Teixeira², B. Pires²

¹ – Estradas de Portugal, EPE, Almada, Portugal
² – University of Minho, Guimarães, Portugal

ABSTRACT

Most construction projects in Portugal do not fully achieve the main management functions, namely safety and quality. Accordingly, the competitiveness of the Portuguese construction industry has been ranked fairly low. A survey was conducted among the main construction stakeholders to help clarify the reasons for this problem. The inquiry used for the survey focused on the characteristics of major projects concluded in the last years and on specific data on the achievement of quality and safety objectives. Research revealed that clients invoked poor task preparation, lack of specific training and the lack of individual protection as the main reasons for construction accidents, while contractors attribute responsibilities to the high risk of the activity. Both clients and contractors indicate that poor work execution and inadequate design solutions are the main reasons for the lack of quality in construction. Additionally, contractors also attribute external factors and the inadequacy of materials or products a major contribution for the lack of quality in construction.

KEYWORDS: Safety, Quality, Portuguese Construction Industry.

1. INTRODUCTION

A construction project can be considered successful when it achieves its predetermined goals and objectives. There is no unique definition for project success, particularly in the construction sector, although the concept has been explored for a long time. Project performances in time, cost and quality management functions are currently used for measuring project success. Accordingly, Atkinson (1999) has identified these three
components of project performance as the “iron triangle”. Various other key components may be found in literature, for instance, quality, health and safety, environmental performance, user expectation/satisfaction, actor's satisfaction and commercial value (Chan & Chan, 2004).

Fulfilling these management functions has been reported internationally as a measure of the competitiveness of the construction industry. However, measuring it is a difficult task due to its dynamic and heterogeneous nature. One measure may satisfy the perspective of one stakeholder but fail to recognize viewpoints of other key stakeholders, namely, investors, clients, employees and society as a whole.

Lack of safety in the Portuguese construction sector continues to be unacceptably high. Although responsibilities of all who intervene in the construction process have been reinforced by recent law amendments on risk prevention at work, numerous violations continue to occur with dramatic consequences. Costs related to work accidents as well as health problems related to this profession affect not only injured workers but also the employer, insurance companies and society in general.

Construction workers worldwide have 3 times more chances of dying and 2 times of getting injured than any worker of other economic activity (Sousa & Teixeira, 2004). In Portugal, 197 fatalities occurred in all economic activities during 2004, without considering transportation accidents to and from the work place and 101, or 51%, of those fatalities were in the construction industry. This represents an average of 25 deaths per 100,000 workers, twice as much the European rate, and the same happens with injuries (above 50,000/ year) (Moura & Teixeira, 2006).

More important than statistical data on labour fatalities is the analysis of available information on the causes for these unfortunate events and find solutions to for their mitigation.

On the other hand, debate on the need for better quality in the Portuguese construction sector has impelled proposals for the revision of legislation, namely increasing the guarantee period of buildings. Shorter life-cycles of construction materials and components cause unexpected expenses that new end-users have to endure. However, to help mitigate these intolerable costs leaving end-users more satisfied, it is necessary to improve the quality of construction materials and its components.

Lack of quality prevention rarely receives the necessary attention, especially in the conception phase of the project. This often leads to the appearance of defects from the start of the construction phase and exorbitant costs for rectification/reconstruction work that according to some researchers account for 12.4% of the total cost of the project (Love et al, 2000).

Comprehending the causes and formulating methods to better manage and control these issues is essential for improving the competitiveness of the Portuguese construction industry. In order to better understand and clarify the reasons behind these lack of achievements of the main management construction functions, a research project was launched, named “Reasons for lack of accomplishment of schedule, costs and safety objectives in construction”, financed by the Science and
Technology Foundation (FCT). Results from the project will be used to recommend measures to increase competitiveness of the Portuguese construction industry. This paper presents the results obtained so far on safety and quality functions.

2. RESEARCH METHODOLOGY

2.1 The inquiry

Gathering relevant information for the study initiated with the creation of a database composed of projects launched between 1998 and 2004, with an initial contract value over €10,000,000. Investigation began with researching public construction projects in official journals where information on the procurement phase of these projects is available. However, gathering information on private projects proved difficult leading the research team to abandon efforts in this sense.

Figure 421.1 illustrates the types of public construction works that made up the 500 projects identified in the database.

Figure 421.1 Types of construction works represented in the database

Simultaneously, a questionnaire for an internet based inquiry was prepared to gather information from relevant clients and contractors of the construction industry on the projects surveyed.

The questionnaire would focus on the characteristics of each project and on specific evidence of the lack of achievement of cost, time, safety and quality management functions.

The first part of the questionnaire aimed at gathering specific information on the construction project under assessment. Information on the description of the project, client and contractor(s) identification, initial contract value, type of contract according to the Portuguese public project regulations (unit-priced, lump sum, cost percentage, design/build), starting date and initial project duration was requested.
Respondents were then asked to quantify the lack of fulfilment of each management function. Information on the final cost of the project, final project duration, number of accidents (fatal and non-fatal), number of workers, number of work-hours, days lost and the number of non-compliances or claims due to quality problems was requested.

For each project, respondents were then asked to point out and graduate in a scale of 1 (less important) to 4 (most important) the possible causes for the lack of fulfilment for each management variable found in literature. Tables 422.1 and 422.2 illustrate the main causes for the lack of safety and lack of quality depicted in the questionnaire. Obviously, it was given the chance for repliers to identify other causes not mentioned in the questionnaire, and possible actions that should have contributed to the mitigation of problems detected.

Table 421.1 Cause for lack of safety in construction

| 1.          | lack of individual protection |
| 2.          | lack of collective protection |
| 4.          | lack of specific training     |
| 5.          | high risk activity            |
| 6.          | lack of equipment maintenance |
| 7.          | insufficient and inadequate task preparation |
| 8.          | direct orders from client/client representative |
| 9.          | inadequacy of selected materials and/or equipments |
| 10.         | force majeure (unforeseen or inevitable situations, for example earthquakes, epidemics, floods, cyclones) |

Table 421.2 Cause for lack of quality in construction

| 1.          | inadequate design solutions |
| 2.          | poor work execution or construction errors |
| 3.          | inaction or errors in clients decisions and performance of project managers |
| 4.          | inaction or errors in clients decisions and performance |
| 5.          | inadequate materials, products or construction processes |
| 6.          | inadequate or poor inspection to site conditions |
| 7.          | external factors (adverse weather conditions, force majeure, legal and regulatory amendments, licence authorization). |

Clients and contractors involved in the construction projects assessed were then contacted by email and fax. Information on the ongoing project was given together with the questionnaire and/or link to the Internet based inquiry.
2.2 Reply from the industry

Although approximately 500 projects had been identified, only 66 answers were received after a 6 month period of inquiries. The percentage of answers received according to the type of construction project is represented in Figure 421.2.

![Distribution of projects by type of construction](image)

Figure 421.2 Distribution of projects by type of construction

Responses were only obtained after several diligences. The research team had to resort to persisting phone calls, resending emails, resending fax, letters to the board of directors and personal contacts with key personnel of contractors and clients. According to the project team’s perception of the respondents’ behaviour, various reasons were behind the lack of responses from the industry: conservative behaviour of the industry, personnel involved in the projects no longer in the company, fear that data would be misused in some way against respondents, data too hard to retrieve or missing. This last evidence, e.g., the absence of quantitative and qualitative data about past projects, must be signalled, as possibly being the first reason for the lack of competitiveness of Portuguese construction industry (Moura & Teixeira, 2006).

In addition to the above answers, two inquiries were received from two key construction contractors. These inquiries represented the global opinion of the constructors on a total of 53 construction projects.

3. DATA ANALYSIS

The following results and important conclusions on the most relevant reasons for the lack of achievement of quality and safety management functions in Portuguese construction projects were drawn from the survey.
3.1 Safety function

The number of accidents, number of workers involved in the construction projects, number of work hours and the total working days lost due to any accident occurred was the data surveyed for the safety management function.

However, the most reliable data is in fact the labour accidents which are reported to the authorities. The 3 fatal and the 159 non-fatal accidents occurred in the projects surveyed are represented in figure 421.3.

![Figure 421.3](image-url) Occurrence of labour accidents in projects surveyed

According to the aggregate answers given by clients and contractors, the most invoked reasons for the occurrence of these labour accidents were insufficient task preparation, lack of training for the activity, lack of individual protection and high risk activities. The frequency of all the causes indicated for the lack of achievement of the safety function is represented in figure 421.4.

![Figure 421.4](image-url) Frequency of accident causes
To measure the importance and the intensity of these causes, as perceived by all respondents, an index \( I \) is used given by the following expression,

\[
I = \sum_{i=1}^{4} x_i a_i
\]

(421.1)

where \( a_i \) is a constant that expresses the weight given to \( I \) (range from 1 = less important to 4 = most important) and \( x_i \) is the frequency of the answers.

According to figure 421.5 the intensity of the main causes for the lack of safety in construction projects is ranked, with the exception to the greater importance given to the high risk activity, instead of the lack of individual protections.

![Figure 421.5 Intensity of accident causes](image)

### 3.1.1 Client’s and contractor’ individual perceptions

Analysing separately clients’ and contractors’ opinions on the causes for lack of safety in construction projects, we denote they have uniformity of understanding of these problems, with the exceptions of the causes related to the inadequacy and lack of maintenance of the equipments, significantly more referred by contractors.

Lack of training for the execution of the activity (22%) and insufficient task preparation (22%) and lack of individual protection were the main causes listed by clients. As for contractors, the main causes of unsafe situations in construction projects are related to the high risk of the activities (28%), lack of training for the execution of the activity (24%) and insufficient task preparation (24%). Figure 421.6 illustrates these opinions.
Regarding the intensity of these causes, contractors insist in the high risk of the activities, something that normally is beyond their control, while clients attribute a higher degree of severity to contractors, once they indicate insufficient task preparation and the lack of specific training to do the activity (figure 421.7):
3.2 Quality function

The quantitative analysis of project's quality function was made by evaluating the number of non-compliances presented during the construction and operation period of the constructed facility.

The conclusions indicated in figure 421.8 illustrate an abnormal frequency distribution as non-compliances vary from 0 in 26% of the projects, from more than a 1,000 in 3% of them, while 45% had no data available to provide.

![Figure 421.8 Project's non-compliances distribution](image)

This abnormal frequency distribution must be handled with some care as it might not explain the real situation of the Portuguese construction projects, but the consequences and the inexperience in dealing with the recent implementation of quality management systems.

Considering the reasons indicated by respondents for the lack of quality in construction projects, the deficient work execution with 33% and the inadequate design solutions with 29% are the more frequent causes, as represented in figure 421.9.

![Figure 421.9 Reasons for lack of quality](image)
The application of formula 421.1 to calculate the intensity of those causes maintained the same rank (figure 421.10).

### 3.2.1 Client’s and contractor’ individual perceptions

Proceeding the same way as described for the safety function, clients’ and contractors’ opinions on the causes of deficient quality of Portuguese construction projects were surveyed separately, to conclude they rank first the same causes identified in the aggregated answers, namely the deficient work execution and the inadequate design solutions, with relevance to contractors opinion on it’s own low performance (figure 421.11).
Regarding the intensity of these causes, the outcome of the application of formula 421.1 indicates that clients maintain the preceding rank, as detailed in graph 421.12, but contractors also attribute great importance to external factors and the inadequacy of materials or products.

Figure 421.12 Comparison of clients and contractors opinions on the intensity of causes for lack of quality

4. CONCLUSIONS AND FURTHER RESEARCH

The aim of this paper is to report the results of an ongoing research on the lack of achievement of safety and quality management functions in Portuguese construction sector, and its relation to the competitiveness of this industry. To achieve that goal, an inquiry has been addressed to the main construction stakeholders in order to survey relevant projects concluded in the last few years in this country. The inquiry aimed at obtaining quantitative data about the level of fulfillment of each management function, and the graduation of the causes contributing to its lack of achievement.

The shortage of voluntary answers from the industry denotes the absence of quantitative data about past projects adequately treated and filed. This obviously contributes for the low rank of competitiveness because knowledge acquired with past project can not be used efficiently. Insufficient task preparation, lack of specific training on a specific activity and the lack of individual protection were the main reasons pointed out by clients for the lack of safety in construction. On the other hand, contractors attribute main responsibilities to the high risk of the activities.

Poor work execution and inadequate design solutions were the most invoked reasons pointed out by clients and contractors for the lack of
quality in construction projects. Although clients and contractors recognize their own fault in the matter, they also point out external factors and the use of inadequate materials or products.

Further research results shall be presented in forthcoming conferences as well as purposed methodologies to improve the achievement of safety and quality functions, and consequently increase the competitiveness of the Portuguese construction industry.

5. REFERENCES


