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Dealing With Cost and Time in the Portuguese Construction Industry

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ABSTRACT

Most construction projects in Portugal do not fully achieve the main management functions, namely cost and time. 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 attainment of cost and schedule objectives. Research revealed that clients and contractors agree that major causes for cost overruns were due to design errors, direct changes ordered by the client and different site conditions due to geological and geotechnical obstacles. Client liability, design problems and the project specifics were the main causes indicated by clients and contractors for project delays. However, clients also specified main responsibilities for project delays to inadequate construction management.

KEYWORDS: **Cost Overruns, Delays, 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) initially identified these three components of project performance as the “iron triangle”. Various other key

components may be found in literature, for instance, Chan & Chan (2004) have proposed the following illustrated in figure 422.1.

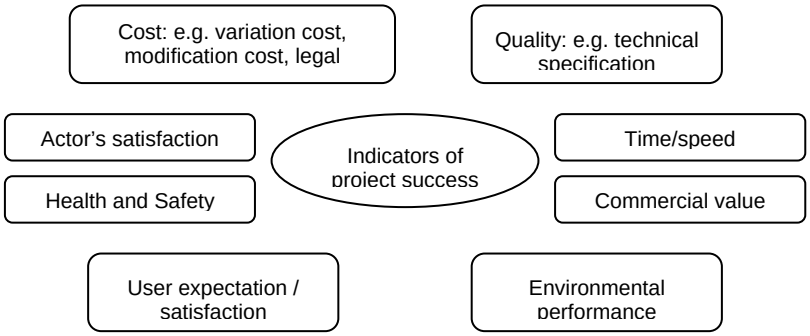

Figure 422.1 Indicators of project success according to Chan& Chan

Fulfilling the above 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.

The lack of fulfilment of cost and time management functions often leads to project overruns producing immediate effects on construction stakeholders and on the country's economy. International research on cost overruns in the construction industry is abundant and a vast number of relevant causes have already been identified (Marcos, 1985; Kaming, 1997)

In Portugal, auditing reports on public projects published by the National Court of Audit have revealed the following (N.A.C.L, 2000):

- The average cost overrun in 26 major motorway projects, from 1985 to 1997, reached 39%, due to incomplete design at the procurement phase, deficient contract documents, cardinal changes due to the change of scope, direct changes, different site conditions and delayed site disposal.
- In underground projects launched between 1985 and 2000, cost overruns averaged 311% due to contracting direct awarding, insufficient data to allow for design/build contracting system, direct and scope changes and design omissions.
- The Expo 98 projects revealed that cost overruns averaged as much as 41%, due to design errors, omissions and inappropriate options, inadequate contract systems (unit price and direct awarding), premium clauses, late site disposal and direct and cardinal changes.
- Parallel to cost overruns, time overruns are also very frequent and very costly, unfortunately. Causes for time overruns have also been thoroughly studied internationally. However, from journalistic investigations and media coverage on the main public projects, data

and research on time overruns and its causes are rare at the national level.

The research conducted by one of the authors on the type of construction claims in railway projects concluded that in 29 railway construction projects with an average initial contract value of 21.000.000€, the average time overrun reached 85% (Moura & Teixeira, 2005).

The consequences of the examples reported above have been repeatedly pointed out, particularly in the media. Recurrent and alarming occurrences have highlighted these as the main reasons for the lack of competitiveness of the Portuguese construction industry. Although, these consequences are known to be severe, and almost hardly resolved, no relevant studies on the subject have emerged in Portugal yet. Causes identified tend to be general and chiefly backed by specific characteristics of the construction industry.

Comprehending the causes and formulating methods to better manage and control these issues is essential for improving the competitiveness of the Portuguese construction industry. More specifically, this influences the credibility of the construction professionals and the country's image in this sector.

In order to better understand and clarify the reasons behind the lack of achievement 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 cost and time 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 422.2 illustrates the types of public construction works that made up the 500 projects identified in the database.

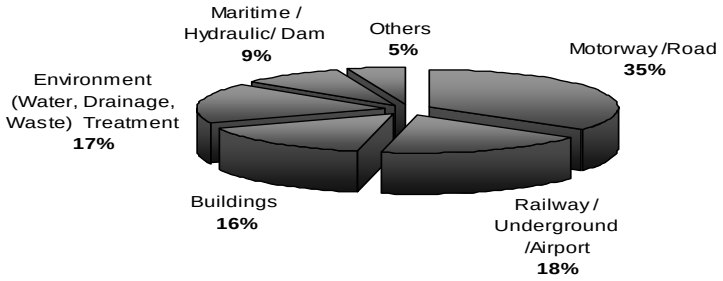

Figure 422.2 Types of construction works represented in the database

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, 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 time and cost delays depicted in the questionnaire. Obviously, it was also 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 422.1 Cause for delays in construction

	Category	Reasons for delays	
1.	Materials	- changes in specifications - poor quality - poor planning	- delivery - market scarcity
2.	Equipment	- poor planning - low productivity - break-down	- insufficiency - inadequacy

3.	Workforce	- poor planning - low productivity - lack of motivation	- insufficiency - absenteeism - lack of skills
4.	Contractor management	- poor coordination - poor supervision - construction errors	- unqualified technical personnel - late mobilization
5.	Client responsibility	- late response to requests - unrealistic initial duration - excessive bureaucracy - site unavailability	- job suspensions - job interference - change orders - late payments
6.	Design	- error and/or omissions - lack or delayed response - extreme complexity of the project	- inexperience - inadequacy - norm violations
7.	Project manager	- inexperience - incapability - delayed actions and decisions	- unavailability - inflexible attitude
8.	Financial problems	- suppliers/subcontractors payments	- low cash availability - lack of financing
9.	Contract	- non-delegated or inefficient penalties - lack of premium	- contract award on the basis of “lowest price”
10.	Institutional relations	- difficulties in submitting or obtaining licences, permissions and statements	
11.	Project specifics	- other contractors on site - site access difficulties - site restrictions	- utility reposition - traffic deviation
12.	External factors	- adverse weather conditions - cultural, social and environnemental obstacles	- legal & regulatory amendments - accidents - force majeure

Table 422.2 Cause for cost overruns in construction

Category		**Reasons for cost overruns**	
1.	Design errors and omissions	- errors in measurements - document incompatibilities	- inadequate solutions - inadequate materials
2.	Site conditions	- unforeseen geological and geotechnical conditions	-
3.	Client responsibility	- Direct change orders	-
4.	Cardinal changes imposed by third parties	- Utility replacement - archaeological findings - environmental obstacles	- obligations of local or national authorities
5.	External factors	- adverse weather conditions - force majeure	- legal and regulatory amendments

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 422.3.

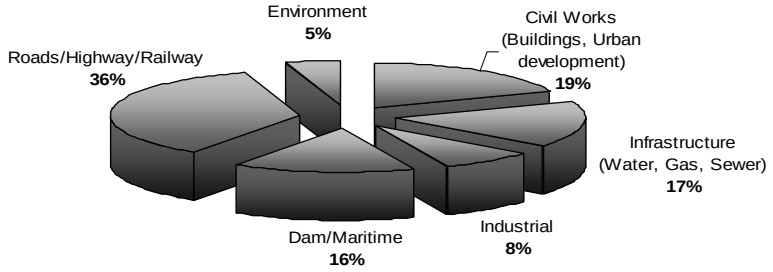

Figure 422.3 Distribution of projects by type of construction

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 work 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 time and cost functions in Portuguese construction projects were drawn from the survey.

3.1 Time function

The quantitative measure for the time function was the actual delay experienced in each project, expressed in calendar days, in relation to its original duration. Data analysed showed that the average initial contract duration was 512 calendar days and that the actual duration was 713 days, leaving an average delay of 201 days, approximately 40% above the expected duration period. The distribution of time function by project is illustrated in figure 422.4.

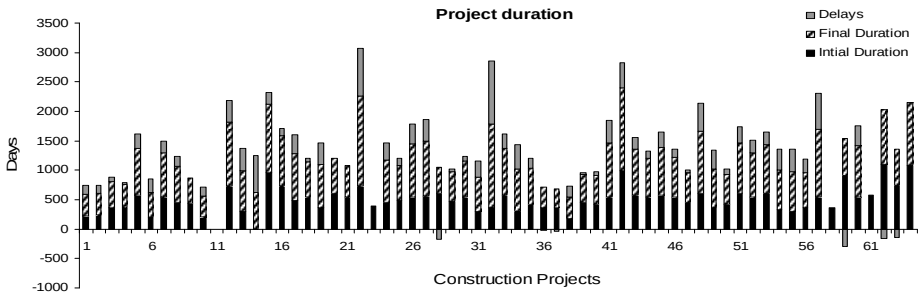

Figure 422.4 Distribution of project delays

The most invoked reasons for these delays were owner and design responsibility, referred in 62% and 61% of the projects, respectively, followed by the causes related to the project specifics, contractor responsibility and external factors, with 45%, 39% and 36% of responses.

The frequency of all the causes indicated for the lack of achievement of project's time function is represented in figure 422.5.

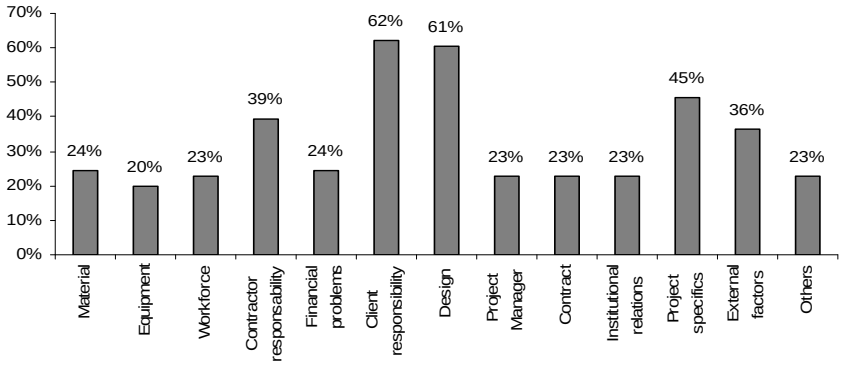

Figure 422.5 Frequency of delay causes

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,

$$I = \sum_{i=1}^{4} x_i a_i \qquad (422.1)$$

where a_i is a constant expressing 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 422.6, the intensity of delay causes ranks similarly to the reason frequency signalled by participants for the lack of achievement of project's time function. Owner and design responsibility reach 120 and 110 points, respectively, followed by the project specifics with 71 points and contractor responsibility with 66 points.

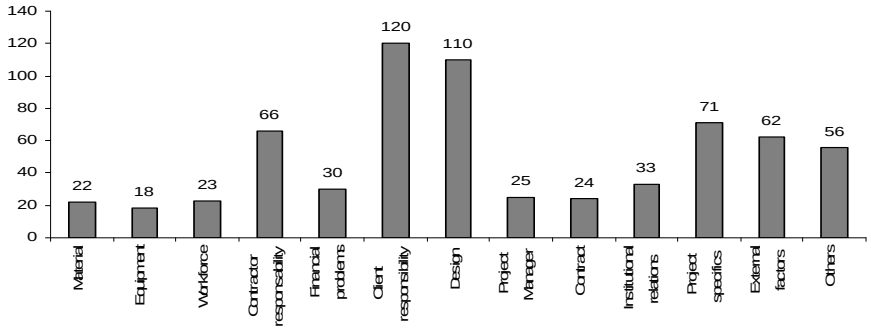

Figure 422.6 Intensity of delay causes

3.1.1 Client's perception

According to the clients surveyed, the main causes for delays in construction projects are design responsibility (61%) and client responsibility (58%). This is an interesting detail because clients are actually aware that they contribute significantly to the delays and thus low performance of the project. Contractor responsibility comes in third with 50% of responses from clients and project specifics have 44%. Figures 422.7 and 422.8 illustrate the frequency and intensity of delay causes from the clients' point of view.

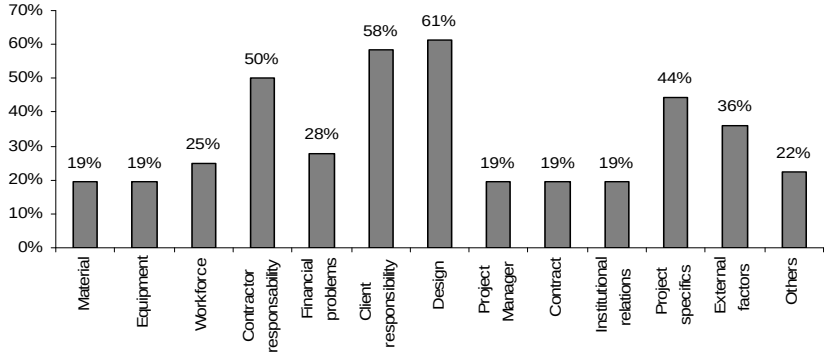

Figure 422.7 **Frequency of delay causes as perceived by clients**

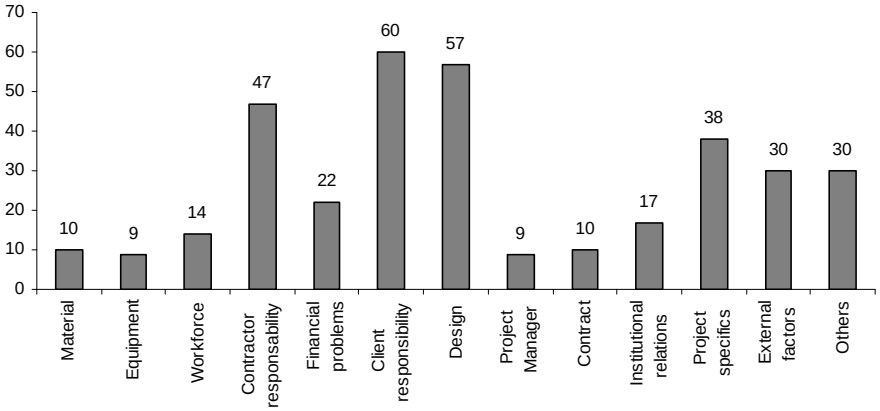

Figure 422.8 Intensity of delay causes as perceived by clients

3.1.2 Contractor's perception

The main reasons signalled by contractors surveyed for delays were the same as clients. Contractors mostly blame the clients (60%), followed by design responsibilities (52%). Project specifics come in third with 44% of responses and contractor responsibility only comes afterwards with 20% of responses. Figures 422.9 and 422.10 illustrate the frequency and intensity of delay causes from the contractors' point of view.

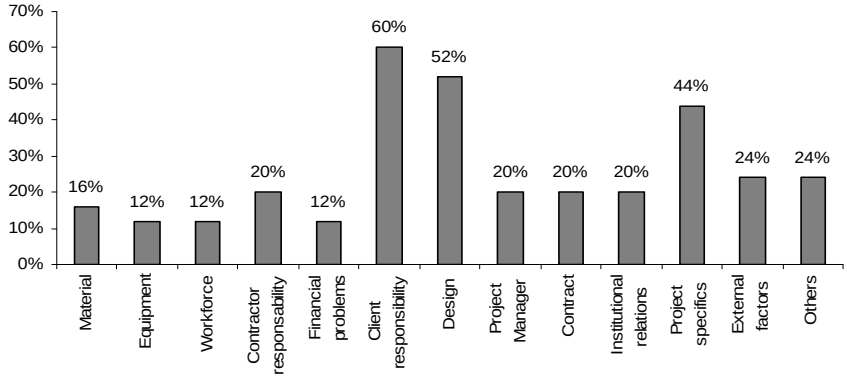

Figure 422.9 Frequency of delay causes as perceived by contractors

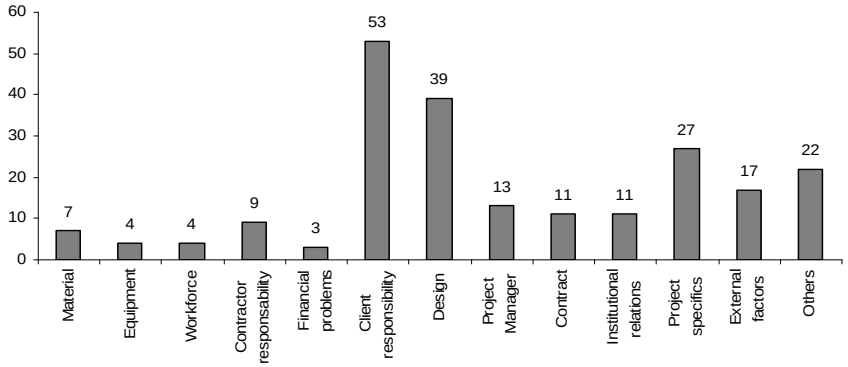

Figure 422.10 Intensity of delay causes as perceived by contractors

3.2 Cost function

Analysis of the cost function was done by comparing the final cost of the project with the initial contract value.

Data received from the 66 construction projects surveyed indicate that the average initial contract amount was € 16.530.674, while the average final costs of those projects reached € 18.584.954, leaving an average cost overrun of € 2.054.280, or 12% of the initial average cost. The cost overruns of projects surveyed are represented in figure 422.11.

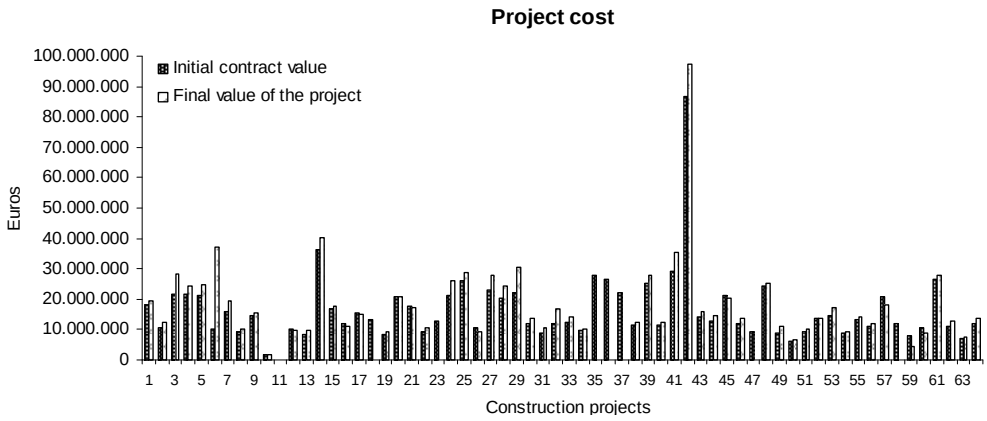

Figure 422.11 Cost overruns in projects surveyed

Taking into account the Portuguese practise and expectations, the above scenario can be considered near-optimal, as traditionally cost overruns in public projects normally reach the maximum permitted by construction laws (50% for projects launched up to 1999 and 25% afterwards). However, some caution must be taken when analysing these results, as the reasons

behind this low rate of cost overruns can be due to scope changes, especially on those projects experiencing final cost reduction.

Considering the reasons for cost overruns previously identified by the research team, respondents pointed out with nearly the same frequency design errors, different site conditions and direct change ordered by clients, as represented in figure 422.12.

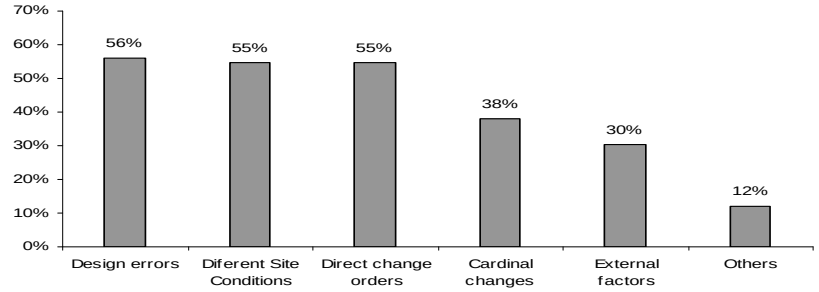

Figure 422.12 Frequency of cost overrun causes

Using the formula 422.1 to calculate the intensity of those causes, yields the graph of figure 422.13, where the same causes referred above contribute with greater severity to the lack of achievement of project's cost function, although prevailing the design errors cause.

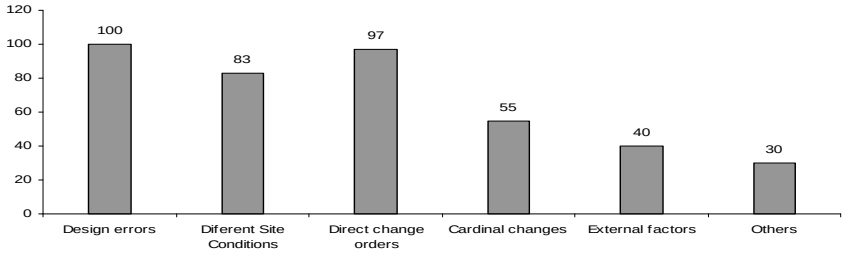

Figure 422.13 Intensity of cost overrun causes

3.2.1 Client's perception

Proceeding the same way as before, client's opinions on the causes of construction project overruns were analysed separately, to conclude they rank first and attribute greater significance to the same causes identified in the aggregated answers (figures 422.14 and422.15):

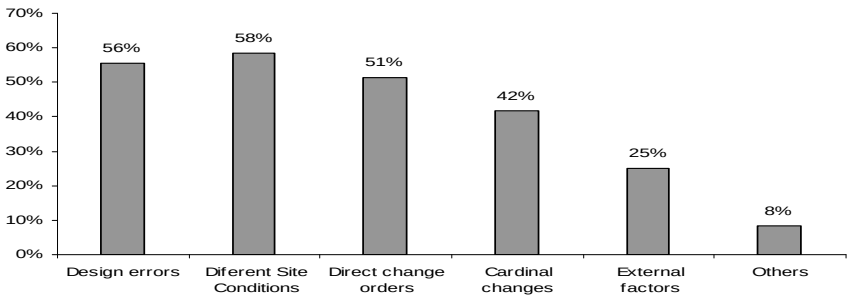

Figure 422.14 Frequency of cost overrun causes as perceived by clients

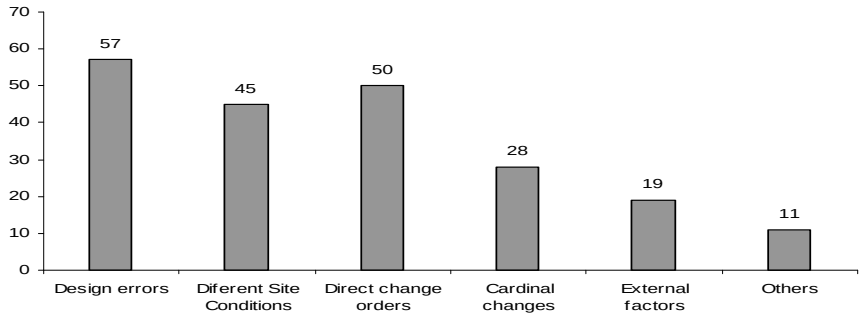

Figure 422.15 Intensity of cost overrun causes as perceived by clients

3.2.2 Contractor's perception

The analysis of contractors' responses identifies direct changes orders issued by clients as the most frequent and severe causes for cost overruns in the projects surveyed (figures 422.16 and 422.17):

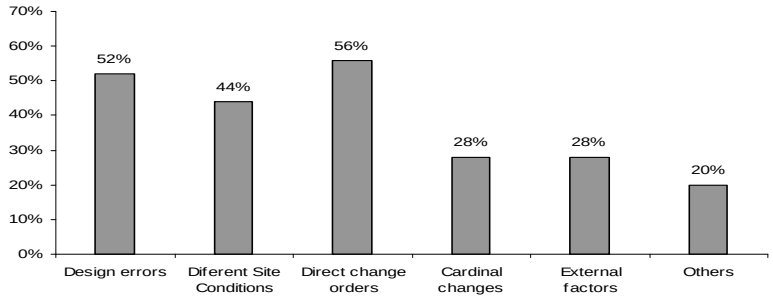

Figure 422.16 Frequency of cost overrun causes as perceived by contractors

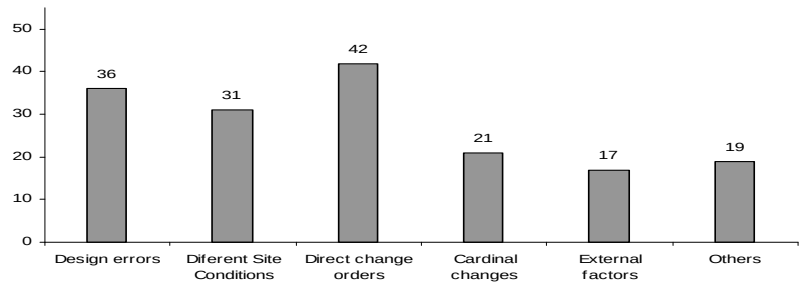

Figure 422.17 Intensity of cost overrun causes as perceived by contractors

4. CONCLUSIONS AND FURTHER RESEARCH

The aim of this paper is to report the results of an on going research on the lack of achievement of time and cost management functions in the 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 fulfilment 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 projects cannot be used efficiently.

The results of the survey on project delays indicates that both clients and contractors agree that major causes are owners and design responsibilities, followed by inadequate construction management (for clients), and project specifics (for contractors). As for, cost overruns, both clients and contractors ascribed major causes to client liability (design errors, different site conditions and direct change orders), although the quantitative measure used is not as low as initially expect.

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