

INDUSTRIAL REVIEW AND DEVELOPMENT OF A COST MANAGEMENT SYSTEM FOR THE GREEK CONSTRUCTION INDUSTRY

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The Greek construction industry is considered as the engine of the Greek economy. Although there is an evidence of prosperity and financial growth of the Greek economy, this has only partially affected the Greek construction industry (GCI). For the past 20 years the construction industry has suffered from decreasing profitability, competitiveness and market share. The majority of the construction contractors are unable to cost, manage and control projects especially in terms of completing and delivering the work within budget, time and final product quality. Therefore, the GCI needs to restructure itself especially in terms of cost planning, monitoring and control. The objective of this paper is to review current practices of cost management and control for public construction projects (i.e. schools, hospitals, industrial units, public offices, etc.) in Greece. The data were collected using the 'Semi-Structured Interviews' and a number of Greek construction contractors were participated. The results of the interviews have specified the problematic issues that GCI facing today in tendering, cost planning, monitoring and control as well as identified the expectations of the GCI experts for better financial management and cost control. In addition the paper briefly presents a new approach for cost management and control which is based on the real needs of the GCI contractors for better cost planning and control.

Keywords: Greek Construction Industry, industrial review, semi-structured interviews, cost management, cost control.

INTRODUCTION

The Greek construction industry (GCI) is a major contributor to the state economy and can be characterised as a financially revived sector of the Greek economy. However, the industry's performance in terms of cost management and quality of the end product has been found to be poor. The majority of construction projects in Greece are completed and delivered with 30% to 50% of cost and time overruns (discussed further in the industrial review). This caused extra financial burdens on the GCI and consequently to the state's economy. Therefore, the implementation of an efficient and appropriate cost planning and control system for contractors in Greece will improve their cost and time performance, which will ultimately increase their profitability and competitiveness.

The authors designed and initiated an industrial review to identify current cost management and cost control issues in conjunction with a number of Greek construction experts. The results and conclusions of the industrial investigation were used to justify the development of a new cost control methodology for the Greek contractors and a case study was used to validate the methodology. Due to the size of the paper the case study was not discussed here. The remainder of this paper discusses

the data collection methodology, results and conclusions of the industrial review. Also, a new cost control methodology, applicable to the GCI, was outlined and briefly discussed.

INDUSTRIAL REVIEW

There are various data collection methodologies, such as observations, case studies, mail questionnaire and interviews (Yin 1992 and Creswell 1998). The authors have used interview techniques for implementing the industrial review and data collection. Interviews seem to be the best way for acquiring data from industrial practice. Dawood and Neal (1990) concluded that interviews are data collection methodologies capable to assess the gathered information in terms of accuracy and reliability as well as able to follow up in depth analysis at any point of interest that arise from the session. The interview method used was based on an opened-ended type of questions. Semi-structured interviews were utilised where in such methods the interviewer will produce specific questions to be investigated but the wording of the response is left to the participants (Dawood 1993 and Tah *et al.* 1994). The use of the semi-structured interviews aid the industrial investigation to collect specific, pragmatic and actual information about the current practices of construction management and cost control in Greece. Furthermore, the authors had the opportunity to visit and meet face to face with professionals of the GCI and build proper rapport with them.

Interview objectives and design

The aim of the interview was to collect industrial information with the intent to identify current cost management and cost control practices in the Greek construction market. The main objectives of the interview were to:

Identify the procurement routes used in the GCI and in particular for construction contracting firms.

Identify the current cost control methodologies including factors that influence cost escalation and utilisation of IT in construction planning and cost control.

Identify cost planning and control elements and their operations, for example processes of cost coding, data organisation, data collection, work breakdown structures, earn-value (EV) concept, processing, reporting and storing of historical data and corrective actions.

The questionnaire used in the interviews was designed within two main parts where part 'A' was inquiring 'How they do it now?' and part 'B' was inquiring 'What systems needed to be developed?' (see Figure 1). The first part of the questionnaire aims to identify the current cost management and control practices that used during tendering (secondary objective) and construction phase (main objective) of a project lifecycle. The second part identifies the expectations of the participated experts about a better and improved cost control methodology.

Figure 1 presents the structure of the questionnaire, including the descriptions of the main objectives of the industrial review. The questionnaire list is presented in appendix 2.

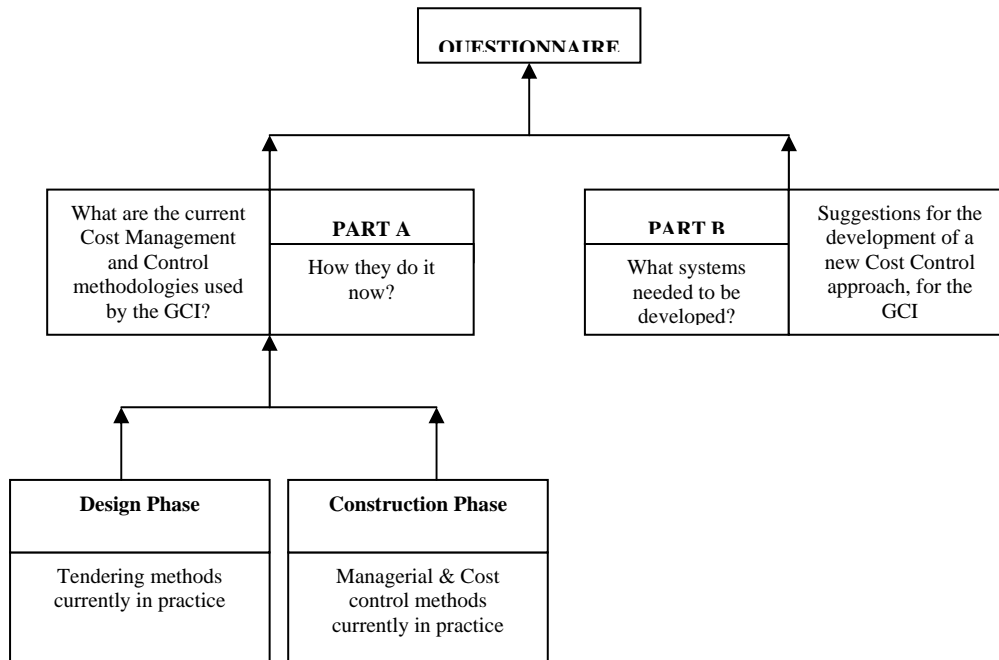


Figure 1: Structure of the Questionnaire

The protocol followed in the interviews was based on following standards:

The interviews were conducted between the author and an expert representative from each participated construction firm.

The interviews took place at the main offices of each participated firm.

The duration of each session was between one to two hours.

Every interview session was recorded using a tape recorder. All information or particular data were stored on individual tapes.

Every session (Recorded Tape) was analysed and appraised subsequently.

For every question a summary of qualitative responses were documented and analysed. Agreements and differences between participants for each question were highlighted, investigated and documented. The authors' experience in the industry was important to the analysis and appraisal of the responses. The following section makes a brief introduction on the participated firms.

Selection of the firms

Contracting firms, which have the capability to undertake public construction works were invited to participate to the interviews. It was a major aim of the industrial investigation to include a broad variety of construction experts in respect of gathering pragmatic real data and consequently form a realistic and in depth picture of the GCI's current cost management and control practices. The interviews were carried out in Greece for a period of one month, where thirty construction firms were invited. The invitation was issued and followed up by a telephone conversation to elaborate on the objectives. The response was good and thirteen companies participated in the interview. One contractor mailed his answers, which was limited on elaborating only the tendering practices used by the GCI. The table presented in the appendix 1, details the thirteen participated firms and identifies their financial and professional status.

INTERVIEW RESULTS AND DISCUSSIONS

The summary of the results obtained by the semi-structured interviews is as follows:

State or local government, including public agencies, is fully responsible for designing, budgeting and tendering public work projects. Consequently, contracting firms enter a direct contractual arrangement with the public authorities where the works are supervised by governmental organisations or selected private consultants.

The procurement routes that are usually followed by the GCI for public construction work, are based on 'Turnkey' and 'Bill of Quantities' contracts. Additionally, these contracts include provisions for financial compensation for change orders.

To secure a contract a budget discount is estimated and offered by contractors at the bidding stage of a project.

The majority of the contractors use accounting cost control based on evaluating overall profit or loss at the end of the project. In essence the operational cost is monitored, evaluated and corrected (cost control) using judgmental and subjective approaches.

The majority of small medium enterprises (SME) contractors in Greece contractors rely on the managerial ability and social status of the owner engineer.

For the majority of infrastructure projects (small or medium budget contracts) it is common that the work is delivered with a considerable delay, but most importantly with a significant financial loss (more than 70% of the projects are completed with time and cost overruns). In particular, the participated contractors recognised the fact that the majority of public construction projects are more likely to be completed within 30% to 50% loss over the budget. On the other hand, the contractors agreed that these financial adversities are to be blamed, in majority of the cases, because of incorrect design and cost estimation which is the responsibility of the public authorities (client).

One of the main contributors, as identified from the interviews, to the economic downfall of the GCI, is the total lack of efficient construction management applications and limitations on utilising appropriate cost control methodologies. However, there is a traditional accounting system for collecting, processing and storing construction information but lacks details and in depth evaluations.

The traditional procurement practices currently being used by the GCI are limited not only to provide or guide an adequate cost management and control approach but also to compensate for financial loss during production.

Utilisation of IT is an expensive and abandoned commodity for the majority of the Greek contractors. However, applications of IT will happen in order to sustain position and market shares as the Greek construction industry is opting for EU certification.

Based on the interview analysis, it has been concluded that the GCI is dictated by three particular characteristics that reflect the nature of the industry's registered contractors in terms of their ability to manage and control the production of the project lifecycle. These GCI characteristics are summarised as follows:

In general the contracts or procurement routes used in the GCI have limited the resources given for cost control as well its unconventional discount bidding de-values

budget and quality of the work. Furthermore the time lags between design and construction causes prices to change and produces high out-turn cost.

Relationship between contractors and suppliers is somewhat adverse. Contractors often delay payments to their suppliers mainly because of delay payments by the client (Greek State).

The standard project in the GCI is smaller or equal to 50 Million GDR (=£100,000). Hence, the SME firms cannot accumulate profit, expand and enter medium or large contracts

The above three characteristics have resulted in the following:

- Forcing the GCI contractors to continue the traditional old accounting cost control method.
- On-site cost control can be limited by the irregularities in design, raw materials, workforce and land conditions.
- Quite often, the GCI contractors tender/bid very aggressively and irrespectively to real cost considerations in order to attain financially viable contracts.

It was concluded that the GCI contractors are able to manage operational cost, for medium to small budget projects (for the majority of the GCI contracts) but only in terms of covering operational cost with a small marginal profit. This situation in Greece has deprived the construction industry from capacity, technical characteristics and expansion to other foreign markets while decrease considerable EMU (European Monetary Union), or even private investments.

The experts have strongly emphasised the need to adapt an efficient and appropriate cost planning, monitoring and control methodology. This could be a fundamental construction and cost management innovation and its implementation should make the industry attractive to investors. Furthermore, the improvement or initiation of adequate cost control methodologies is a crucial and elementary factor for the GCI to adjust to the new construction era in Greece which is partially dictated by state legislation and approved new engineering and managerial standards by the European and International partners.

The following section introduces and briefly discusses an outline of the proposed cost control methodology, which has been developed in conjunction with the industrial review.

A PROPOSED COST CONTROL METHODOLOGY

A cost control methodology was proposed based at the industry's current practices and ideas from the industrial experts. Figure 2 shows an overall description of the elementary processes used for the development of a new cost control methodology that is compatible/suitable to the GCI. These processes are described in subsequent paragraphs.

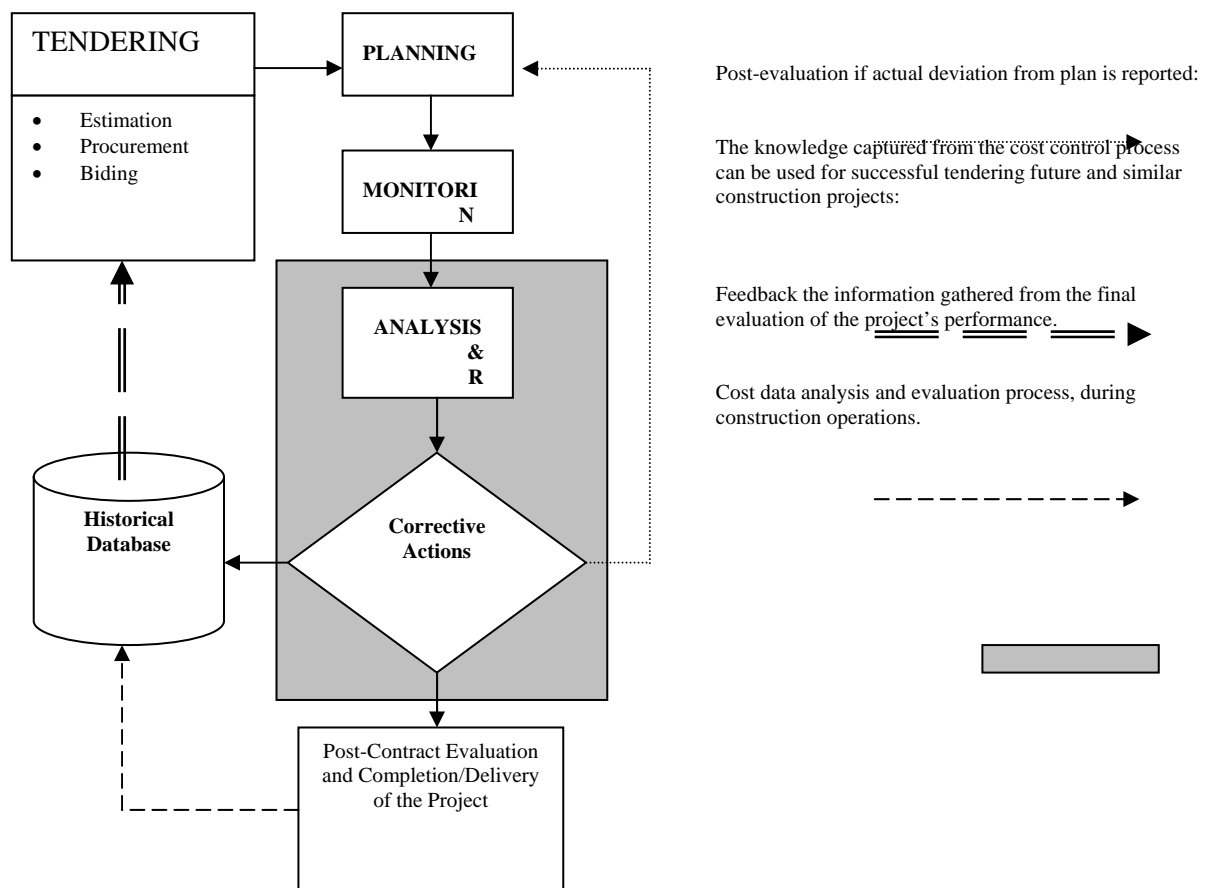


Figure 2: Elementary processes of the Cost control methodology

The following are fundamental components or processes of the developed cost control methodology:

Utilise appropriate planning and monitoring processes. The methodology must be able to schedule resource usage and activity duration as well as capable to produce a budget baseline (cost planning). Also, a systematic monitoring system must be applied in order to supervise the construction operations.

Use appropriate evaluation processes with quantitative/measurable output. These processes, also known as data analysis, must be able to track construction expenditure relative to the estimated production cost or planned budget baseline. The aim here is to compare budget cost with operational or actual cost, measure variances or deviations from the planned (estimated cost or duration) and evaluate cost performance and construction progress.

Produce updated and in depth reports. The results of the analysis and evaluation process must be promptly reported where negative fluctuations of the production cost and time are identified and detailed. In addition the report must include adversities or faults in the designed and engineering quality (end product quality).

Produce appropriate and in time corrective actions. These actions are undertaken during the construction operations and mainly dictate a framework of cost and time adjustments that are appropriate to the site operations.

The planning process constitutes two operations. The first operation provides a scheduling framework of the resource usage and activity duration and the second

determines the budget baseline. The network analysis techniques are proposed to be used for scheduling resource usage (creation of work calendar), activity duration (creation of work timetable) and aid to calculate budget baseline.

An additional element to planning and creating a budget baseline is the utilisation of an appropriate cost coding system. Such systems are able to classify all work or cost pertaining items on a given construction project and provide a cost code numbering process that initially defines the work breakdown structure (WBS). Also cost coding systems aid the creation of plans and schedules, bringing the cost control system on the way and effectively reporting where time spent. Basically, such systems are able to produce a work index of the project's cost control, which enables the categorisation of every function of the construction planning, monitoring and control. Furthermore, a cost coding system provides an easy access to the operational information (production cost, time and quality data) and storing processes were able to download to a database and used for providing a baseline for future projects. The authors have proposed the use of the 'CSI Masterformat Cost Coding System' for a unilateral and standard format of cost coding system in the GCI.

Monitoring as an individual cost control process, provides work supervision over the plan of the project. Supervision in practice constitutes processes for collecting actual data of production cost and time to be later compared with the planned budget and duration.

The most valuable element to the proposed cost control is the cost analysis and evaluation process which constitutes three operations (see Figure 2). The first operation concerns with the analysis of the cost data in terms of comparing the collected actual expenditure with the budgeted estimates and aim to identify favourable or unfavourable deviations. The method used for the analysis is the 'Earn Value' method, which is based on an integrated concept and provides a methodology for tracking construction expenditure and progress relative to project budget. This technique is the most useful measuring performance and progress on construction tasks that include a mix of sub-tasks, which do not require the same level of effort and are not accomplished simultaneously. This is considered to be a novelty when applied to the construction industry in Greece.

Basically the schedule and cost performance is evaluated measuring the schedule and cost variance respectively (CV and SV). The method, by using simple mathematical calculations, is able to compare the budgeted cost (budgeted cost of work scheduled) with the budgeted cost of the work performed (Earn Value). If the budgeted cost is more than the earned value then, less was accomplished than the planned and the construction work is behind schedule (the SV is negative). Equivalent arithmetical calculations are performed for evaluating the cost performance.

Using a status report process within a systematic time frame promptly identifies the results of the cost analysis and evaluation process, preferably to coincide with the monitoring and analysis and evaluation time frame. The main objectives of reporting the production status of the work is to highlight significant cost and time overruns in terms of budget escalation. In addition notes about the quality performance can be recorded simultaneously where design faults or inconsistencies are identified.

The firm's project managers and top-level management will critically appraises the status report. They can discuss the basic causes of the variations or deviations and approve immediate corrective actions to restore performance to desired levels and correct standards (see Figure 2).

The above cost control processes have been justified through the interviews and validated through a case study on a construction project, currently being conducted. It should be mentioned that the application being proposed here, that is the utilisation of EV concept in cost control is considered to be a new managerial approach in the GCI.

CONCLUSIONS

This paper introduced and discussed current cost management and control practices in the GCI. A semi-structured interview was used as a methodology for data collection and subsequent analysis.

One of the main conclusions, identified from the interviews, was that the economic downfall of the GCI, is caused by the total lack of efficient construction management applications and limitations on utilising appropriate cost control methodologies. The majority of the public work contractors in Greece use traditional techniques for monitoring and controlling construction expenditure (SME, more than the 80% of the GCI contractors), which are systems that suited more to business cost control than to construction cost control.

The paper discussed an outline proposal for a new cost control methodology applicable to the GCI. It was concluded that the proposed cost control methodology will not only be an essential element for appropriately manage and control (financially or otherwise) a project's construction operations but also a vital requirement for the economic growth of the industry and consequently for the growth of the state's economy.

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APPENDIX 1

Table presenting financial status and description of the participated contracting firms and interviewees

Company Name	Interviewee Name	Company Size	Company Type
Most of the participated contractors are S.A. companies, which regards a Society Anonymous. This is equivalent to the Limited (Ltd) companies.	Name and qualification of the interviewed expert, including his position to the firm.	The numbers below are multiples of 1 Billion Greek Drachma (GDR) (£1 = 550 GDR)	
EGNATIA Odos S.A.	Mr. M. Agious BEng. Civil Engineer Divisional Project Manager	120.00	Consortium of GCI Medium and Large Construction Sub- Contractors
EYKLEIDIS S.A.	Mr. T. Vinatselas BEng. Civil Engineer Division of Discount Estimation	11.00	Large GCI Contractor or Sub-Contractor, able on Tendering Self-financed Projects
J & P HELLAS	Mr. S. Vasileiou BEng. Civil Engineer Divisional Project Manager	10.00	Large GCI Contractor or Sub-Contractor, able on Tendering Self-financed Projects
Pantexniki S.A.	Mr. P. Savoulidis BEng. Civil Engineer Managing & Executive Director	9.50	Large GCI Contractor or Sub-Contractor
S. Sigalas S.A.	Mr. M. Giovanoglou BEng. Civil Engineer Construction Supervisor	6.00	Large GCI Contractor and Sub-Contractor
Dalakleidi Bros. S.A.	Mr. S. Zarris BEng. Civil Engineer Managing & Executive Director	4.00	Medium to Large GCI Contractor and Sub- Contractor
Olybia Hellas S.A.	Mr. D. Stamatiou BEng. Civil Engineer Chairman & Managing Director	3.00	Medium to Large GCI Contractor and Sub- Contractor
Ergodynamic Patras S.A.	Mr. N. Athanasopoulos HND Civil Engineer Chairman & Managing Director	2.50	Medium to Large GCI Contractor and Sub- Contractor
ERKAT S.A.	Mr. V. Karababas BEng. Civil Engineer Chairman & Managing Director	1.20	Medium GCI Contractor and Sub-Contractor
Arcadia Construction S.A.	Mrs. H. Tsoli BEng. Civil Engineer Technical Director	0.90	Medium to Small GCI Contractor but mainly Sub-Contractor
Technical Company of Korinthos T.C.K. Private Company	Mr. M. Vlassis BSc. Surveying Engineer Technical Director	0.80	Medium to Small GCI Contractor but mainly Sub-Contractor
Construction & Technical Private Company	Mr. N. Tsirigotis BEng. Civil Engineer Financial & Technical Director	0.30	Small GCI Contractor mostly Sub-Contractor
A. Liogas Private Company	Mr. A. Liogas/ BEng (Civ.Eng) Chairman & Managing Director	0.20	Small GCI Contractor mostly Sub-Contractor

APPENDIX 2

Questionnaire list (see also Figure 1).

- **For Part ‘A’ and Before Construction:**

Tendering methods currently in practice (before construction, design phase).

1. What is your current budget estimation and procurement processes (Tendering)?
2. What is your current bidding process? (Contract Nomination)

- **For Part ‘A’ and During Construction:**

Managerial and cost-control methods currently in use (during works, construction phase).

3. What are the factors that effect cost escalation and why?
4. What are the current cost-control methodologies in use?
5. What is the current I.T. software in use for cost-control?
6. What are the specifications of the current cost-control methodologies in use?
(Data and collection methods, cost-indices that are in use, the current management and construction control specifications, etc.)
7. What is the value of collecting and storing historical data?

- **For Part ‘B’:**

Suggestions for development a new system for construction management and cost-control. (New approaches of cost-control, regarding GCI)

8. What sort of cost-control methodology you like to use?
9. What sort of cost coding system you like to used?
10. What is your opinion about the WBS method?
11. What is your opinion for ABC method?