Exploratory Study on Construction Project Management in Southeast Mexico

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Abstract
There is evidence that small and medium size construction companies in Mexico dedicate great deal of effort to cost estimating, paying little attention to the planning aspects of their projects. Such practice leads to overruns in both time and cost. Lacking a thorough planning those firms are less likely to achieve comprehensive project control, so they could take timely decisions to keep projects on track. This paper presents the results from an exploratory study upon current project management practice by those firms. The study consisted on a survey to identify their problems, needs, and requirements. Findings show that only 78% of those companies plan their projects, and that only 61% allocate staff for such task. Furthermore, most of them do their planning manually and empirically: 75% use improper management methods not taking advantage of current information technologies. The study also shows that those companies lack a comprehensive system to integrate and automate the great amount of information commonly generated during the project management process. Last, the authors propose an overall solution to this problem, consisting on a general scheme that systematically will lead those firms to select and use the proper tools to improve their project management practice.

Keywords
Project management, project planning, project control.

INTRODUCTION
There is evidence that small and medium size construction companies (PYMES) in Mexico dedicate great deal of effort to cost estimating, paying little attention to the planning aspects of their projects. Currently, it appears that while evaluating bidders, owners pay attention primarily to economic issues of bids and completion dates of projects, minimizing the importance of the planning function. Without detailed planning is less likely to achieve comprehensive project control, so builders could take timely decisions to keep projects on track. Such practice leads to overruns in both time and cost.

It is important to consider the structure and the organization of the construction industry in Mexico. According to CMIC (Cámara Mexicana de la Industria de la Construcción – Mexican Chamber for the Construction Industry) 93% of the firms are classified as either micro or small (CMIC, 2004), or...
PYMES as defined in this paper. That is equivalent to the 90% of the so-called small firms in United States, firms ranging from the self-employed entrepreneurs to organizations housing 15-20 employees (Loria and Vanegas, 2005). Those are the firms dealing daily with the problems posed by planning and control practice.

Construction Project Management practice has been a major topic of interest at the School of Engineering of the Autonomous University of Yucatan (FI-UADY). Its Construction Graduate Program has undertaken a research program to help firms to improve their project management practice. As part of such program, an exploratory study was designed to identify problems, needs and requirements of PYMES regarding project management. The objective of the study was to gather information to know their current practice and, based on it, to propose a conceptual framework for a comprehensive system, or prototype, to help them in this respect. A sample of 23 companies from the Yucatecan Chapter of the Mexican Chamber for the Construction Industry (CMIC) was included in the study.

Other studies conducted at FI-UADY in the same topic have resulted in an “Automated Cost Control Comprehensive System for PYMES,” by González and Domínguez (1998), and a “Materials Management System for Large Low Cost Housing Developments,” by González and Tirado (1998). In this study, prior information from PYMES was updated to address more specifically key aspects of the planning and control management functions.

**METHODOLOGY**

This research effort focused mainly on “what” questions. Namely, what are the ways this company manages its projects? What are the tools this company uses to manage its projects? According to Yin (1994), these types of questions provide a justifiable rationale for conducting an exploratory study, since the goal is to develop pertinent hypotheses and propositions for further inquiry. Furthermore, meets all the conditions to select survey as the research strategy (Yin, 1994):

<table>
<thead>
<tr>
<th>Strategy</th>
<th>Form of research question</th>
<th>Requires control over behavioral events?</th>
<th>Focuses on contemporary events</th>
</tr>
</thead>
<tbody>
<tr>
<td>Survey</td>
<td>who, what, where, how many? how much?</td>
<td>No</td>
<td>Yes</td>
</tr>
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Therefore, a structured personal questionnaire was designed to identify problems, needs and requirements of construction PYMES based in Yucatan, Mexico, regarding project management practice. This type of instrument allowed direct interaction with the interviewees facilitating clarification of doubts arising during the interview. In addition, it was possible to observe the interviewees’ reactions while responding the questions, as a double check to validate their answers.

The unit of analysis was the construction companies based in Merida, Yucatan. Actually, at the time of the study, 291 construction companies were registered at CMIC. The sample size was calculated considering: a) population, b) degree of certainty required in the study, c) time constraints, and d) resources available for the research project. The procedure consisted of the following steps:
• Literature review regarding construction planning and control.
• Design of the questionnaire.
• Pilot testing of the questionnaire.
• Identification of errors and deficiencies, and adjustments to the questionnaire.
• Large scale application of the questionnaire.
• Analysis and interpretation of results.
• Conclusions.

The sample size was determined according to the guidelines provided by Cochran (1986), whom deems adequate the formulae posed below since: a) are the proper ones for exploratory studies, b) allow establishing the limits of error permissible based on the availability of resources, and c) allow adjustment for small samples. Therefore, the sample size was computed as follows:

\[ n_0 = \frac{t^2PQ}{d^2} \]

Where:

- \( n_0 \) = Sample size (Number of construction companies to interview)
- \( t \) = Abscissa of the standard normal distribution function for the percentage of acceptable error (\( t = 1.645 \) for an acceptable error of 10%)
- \( P \) = Population’s percentage in class C
- \( Q = 100 – P \) (percentage )
- \( d \) = Percentage of permissible error

The value of \( P \) was assumed: roughly 10% of the companies have and use (proper) tools to carry out planning and control functions for their projects. The value of \( d, 10\% \), was chosen considering two factors: 1) the magnitude of the study, e.g. exploratory, and 2) the resources available, primarily manpower, to conduct the research. The resulting number of firms, 24.4, had to be adjusted due to small sample conditions, as suggested by Cochran, with the following formula:

\[ n = n_0 / (1 + (n_0 / N)) \]

Where:

- \( n \) = Final sample size
- \( N \) = Population size

This resulted in a final sample size of 23 companies, selected randomly from the 291 registered at CMIC.

In order to obtain valuable data, the questionnaire of the survey was designed consulting literature related to project planning and control. A tree diagram was developed to help break down important information regarding all aspects of project execution. A preliminary draft of the questionnaire was elaborated containing 140 questions. The final version of the questionnaire consisted of 65 questions selected from those that could help to obtain valuable information for the study. The 65 questions cover four major areas: 1) General Data -4 questions, 2) Construction Planning -31, 3) Construction Control -28, and 4) Willingness to collaborate in the development of a proposal -2 questions.
A test pilot was conducted to calibrate the questionnaire; four professors at FI-UADY, selected among those that had managerial experience in the construction industry, and a senior manager from a construction company were included in the pilot.

Upon arrival at the firm, the interviewer requested the collaboration of someone knowledgeable to respond the questionnaire. A copy of this instrument was handed out to the interviewees in order to expedite the process and avoiding tiring them. Most participants were either owners or general managers from those firms, all of them kind and cooperative. Interviewing required 4 weeks.

The analysis of the answers is summarized in Figure 1, portraying actual planning and control practice. A conceptual scheme was derived from it, shown in Figure 2, aimed to provide a comprehensive solution to the problems found.

RESULTS

General Data

The average age of the companies is 10.4 years. The types of construction they are involved is distributed as follows: building 40.5%, housing 26.2%, facilities 14.3%, roads 9.5%, and “other” 9.5%.

Regarding their size, according to CMIC’s criteria, based on annual production volume, the companies were distributed as shown in Table 2.

<table>
<thead>
<tr>
<th>Year</th>
<th>Micro</th>
<th>Small</th>
<th>Medium</th>
</tr>
</thead>
<tbody>
<tr>
<td>1997</td>
<td>36.8%</td>
<td>21.1%</td>
<td>42.1%</td>
</tr>
<tr>
<td>1998</td>
<td>42.1%</td>
<td>36.8%</td>
<td>21.1%</td>
</tr>
<tr>
<td>1999</td>
<td>52.6%</td>
<td>21.1%</td>
<td>26.3%</td>
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The survey also revealed the way companies obtain their contracts: 63.8% primarily through negotiations (ranging from 20% up to 100% of their total contracting); other 39.9% through public competitive bidding (5-80%); 31.0% through private competitive bidding (10-60%); and 21.7% through the build-operate-transfer option (10-35%). The prevailing contract types are unit price, 82.4%, and lump sum 33.6%.

Construction Planning

It was found that 78.3% of the PYMES undertake some formal construction planning and the 21.7% remaining do not. From those PYMES that plan, 61.1% has a planning team primarily integrated by civil engineers; the remaining 38.9% do not have specific staff allocated to that function. It was also found that scheduling is primarily done through Gantt charts, 75% of the firms, and that only 25% schedule their projects using network diagram methods (CPM or PDM).
This section of the questionnaire was designed for a twofold purpose: 1) gather information about current project management practice, and 2) identify willingness from interviewees to adopt a new system model that could help them to develop a more comprehensive planning phase.

Construction Control

All interviewees mentioned they control the construction phase of their projects. However, do not have means to evaluate the quality of results. Near half the PYMES, 47.8%, have a specific control team, integrated primarily by civil engineers; the remaining 52.2% do not have specific staff allocated to this function, project managers, field engineers, or foremen, are responsible for controlling time, cost, and quality of the construction project under their responsibility.

Regarding the level of satisfaction that companies have about their current control systems, interviewees answered the following: very high 13.0%, high 30.4%, 43.5% good, not sufficient 8.70%, and bad 4.4%. Their answers allowed to infer that those control systems are mostly empirical and mainly based on experience only, not on strong data generated from comprehensive planning and control practices. It was also inferred that control is primarily focused on getting to know the final performance results of their projects, as useful information for future projects but not for taking timely decisions during the execution of the projects.

Several computer programs are used for controlling projects in 74.0% of the companies, the remaining 26.0% does it manually. Among PYMES with an automated control tool, SINCO (Sistema Integral de Costos -Integrated Cost System), a program developed by faculty at FI-UADY, is the software most used. However, it only includes a few simple automated control tools. SINCO is primarily aimed to help contractors to cost estimate and budget their projects, and to document progress payments as well not for control purposes. Most interviewees using SINCO said they have a good knowledge and experience handling it.

PYMES carrying out control manually are focused on the following aspects: project’s delivery time, allocation and consumption of materials, cost comparison (actual vs. planned), labor, equipment, and supervision costs. Most of them, 83%, do not consider necessary automated control, while 17% mentioned that do not have qualified personnel to use computers for projects’ control.

This section of the questionnaire was also designed to gather information to develop a new system model that could help them to establish a more comprehensive control phase.

Collaboration to Develop a Control System

It is worth mention that 87% of the interviewees indicated that they are willing to collaborate in a research project focused on the improvement of construction control practice. Sixty four percent of them mentioned they could provide their own experiences, 28% were interested in testing any automated control system derived from the project, and 8% expressed that could provide financial support.

Results Analysis
Results show that most construction companies are concerned with planning and controlling their construction projects. However, they carry out those tasks in an overly simplified way, as shown in Figure 1; and not as suggested by theory described on the literature review, summarized in Figure 2.

Figure 1. Current local practice on execution of construction projects

request of proposals, drawings, specifications and contractual documents

PROJECT ANALYSIS

(1)

COST ESTIMATING

(2)

SCHEDULING (SIMPLE CHART)

(3)

CONTRACT AWARD

(4)

RESOURCES MANAGEMENT

(5)

PROJECT CONTROL USING SIMPLE SYSTEMS (TO KNOW PROJECT’S FINAL COST)

(6)

Figure 2. Project planning and control, theoretical scheme

THEORETICAL SCHEME

REQUEST OF PROPOSALS, DRAWINGS, SPECIFICATIONS AND CONTRACTUAL DOCUMENTS

PROJECT ANALYSIS

(1)

PROGRAMMING AND SCHEDULING (USING NETWORK DIAGRAMMING METHODOLOGY)

(2)

COST ESTIMATING

(3)

CONTRACT AWARD

(4)

PRE-CONTROL AND SHORT-TERM SCHEDULING

(5)

COMPREHENSIVE PROJECT CONTROL BASED ON NETWORK DIAGRAMS AND COST AND TIME FORECASTING (TO KNOW NOT ONLY CURRENT PROJECT PERFORMANCE BUT TO TAKE ON TIME DECISIONS)

(6)

DISCUSSION

The local market share of PYMES is rising. The authors believe that it is a good idea for the Construction Program at FI-UADY to undertake a research project aimed to help those companies to be more competitive; Project Management must be one of the important areas of such project.

Even though construction planning in local companies is actually done, it is plagued with errors. It is mainly based on experiences from past projects, and only occasionally is made with rigorous analysis of information. This is probably because their first priority is cost estimating, since owners
pay attention primarily to the financial aspects of bids. Therefore, contractors dedicate a great deal of effort to cost related matters. Once they get a contract, the time they have prior to start construction is very short; and again, they do not focus in the planning aspects of projects because they have no time for it. It could be easily inferred then that, PYMES are not able to do planning comprehensively. The authors wonder if this situation is similar to other parts in Mexico or to other countries in Latin America. If that is the case, it will be worthwhile to share findings from this research.

Theory upon Management recognizes that planning is the function that supports the other ones. Therefore, it will never be a waste of time to try to improve it, looking to increase the probabilities of success for a project. Olusegun et al. (1998) already recognized that “there is a need to examine actual planning practices and develop strategies to improve planning efficiency in the construction business.”

Regarding control, interviewees also mentioned they carry out construction control. However, the authors concluded that it is mainly focused in knowing past performance of projects; they cannot make use of it to take timely decisions. We assume they only have a vague idea of the potential use of construction resources’ control. Hence, a key question is: How could they implement comprehensive control if they do not rely on comprehensive planning?

**CONCLUSIONS**

It is urgent to help PYMES to do a more comprehensive planning and control of their construction projects. To reach this goal it is necessary to introduce some processes for those companies that have been awarded with contracts. The overall processes is shown in Figure 3. The authors propose to substitute steps 5 and 6 on Figure 1 for steps A to D on Figure 3.

Figure 3. General proposal for improvement in the execution of construction projects.

Companies will have to carry out these processes in an expedite way for every project, otherwise they would not achieve comprehensive project programs and required information to take timely decisions. Moreover, it can also be inferred that companies lack a comprehensive system to integrate and automate the great amount of information that is usually generated during the project management process. The authors assume that PYMES cannot afford to develop systems suited for their own specific needs because of cost reasons primarily. Therefore, it seems a good idea to develop a prototype to integrate planning and control in a system that could automate the management of information. The system should be developed in such a way that every company could easily adapt it to its own needs.
REFERENCES


