DEVELOPING A MODEL FOR PLANNING AND CONTROLLING PRODUCTION IN SMALL SIZED BUILDING FIRMS

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ABSTRACT

Construction planning and control is a managerial process that is closely related to the aim of improving the effectiveness of construction projects. Despite its importance, there is growing concern over the failure of construction planning and control to achieve its goals.

The main objective of this article is to present the development process of a model for planning and controlling production in small sized building companies, as well as a method for implementing it. The model involves three different levels of planning and control: (a) weekly basis operational planning, using the concept of shielding production, at the lower level; (b) lookahead planning at the intermediate level; and (c) tactical planning concerning the whole production stage, at the higher level.

The development of this research project is based on the conceptual framework of the New Production Philosophy (Lean Production). The applicability of its concepts and tools has been tested on the development of the production planning and control process.

KEY WORDS

Construction planning and control, shielding production, information systems.

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INTRODUCTION

The production planning process is extremely important to construction management. Some authors consider it a basic managerial function (Laufer and Tucker 1987; Sink and Tuttle 1993). Despite its importance, in some construction firms which operate in the residential and commercial sector, this process has been limited to the production of cost estimates and bar chart schedules. In the construction industry, the planning and controlling process tends to focus on the project control, while in other industries such process emphasize production control

A research project concerned with these problems has been taking place since June 1996, at the Federal University of Rio Grande do Sul. This research project aims at developing a production planning model for small sized building companies. This model is based on some background research related to production planning (Ballard and Howell 1997; Melles and Wamelink 1993; Laufer and Tucker 1987, Laufer and Tucker 1988; Koskela 1992). The research project is to have a duration of three years, two thirds of which have already been completed, and is based on the development of case studies on six house building firms from the state of Rio Grande do Sul, Brazil.

The six construction firms were chosen because of their interest in establishing a partnership with the University for developing a research project in the field of construction planning.

CHARACTERIZATION OF BUILDING COMPANIES

All six construction firms have been involved in quality improvement programs for several years. The majority of these firms have been working mostly in the residential and commercial building market. They are small sized companies, employing less than one hundred employees. They use both their own work force and also subcontracted teams. In general, the companies have relatively small managerial structure. In some cases there is only one site engineer taking care of as much as five different construction sites. Although there were differences between the companies in terms of organizational structure, it is possible to identify a number of entities involved in the planning process which were common to all of them:

a) Administrative manager: responsible for the administrative and financial aspects of the firm. In general, it is the firm's link to external clients. When the company has a larger structure, divided in departments, there might be a specific entity responsible for assisting clients;

b) Production manager: responsible for technical decisions and site management. Sometimes it has to exchange information with the administrative management so as to establish common goals for the company's cash flow;

c) Cost estimator: there are two different manners through which this function is carried out in the firms, either by the internal staff or by an external cost estimator;

d) Production planner: carried out most of the time by the site engineer, who, in some firms, is the technical and administrative director at the same time. This function tends to be very informal. Bar chart schedules are usually the only formal plan produced by this entity;

e) Purchaser: in most firms there is an employee responsible for this area. This person exchanges a large amount of information with the technical director and with the site engineer and the foreman;

f) Site engineer: in all companies the site engineer is usually overloaded, for reasons explained above;

g) Foreman: each construction site of any firm has one foreman, who is the main link between the site engineer's decisions and the workforce;

h) Trainee: most sites have civil engineering undergraduates who supports the work of site engineers, especially on production control. In some firms, for example, there is one trainee per site, as a compensation for the small number of engineering staff.

DESCRIPTION OF THE RESEARCH METHOD

The research method is presented in figure 1. The planning model has been developed in four phases which overlap: diagnosis, development, implementation and evaluation.

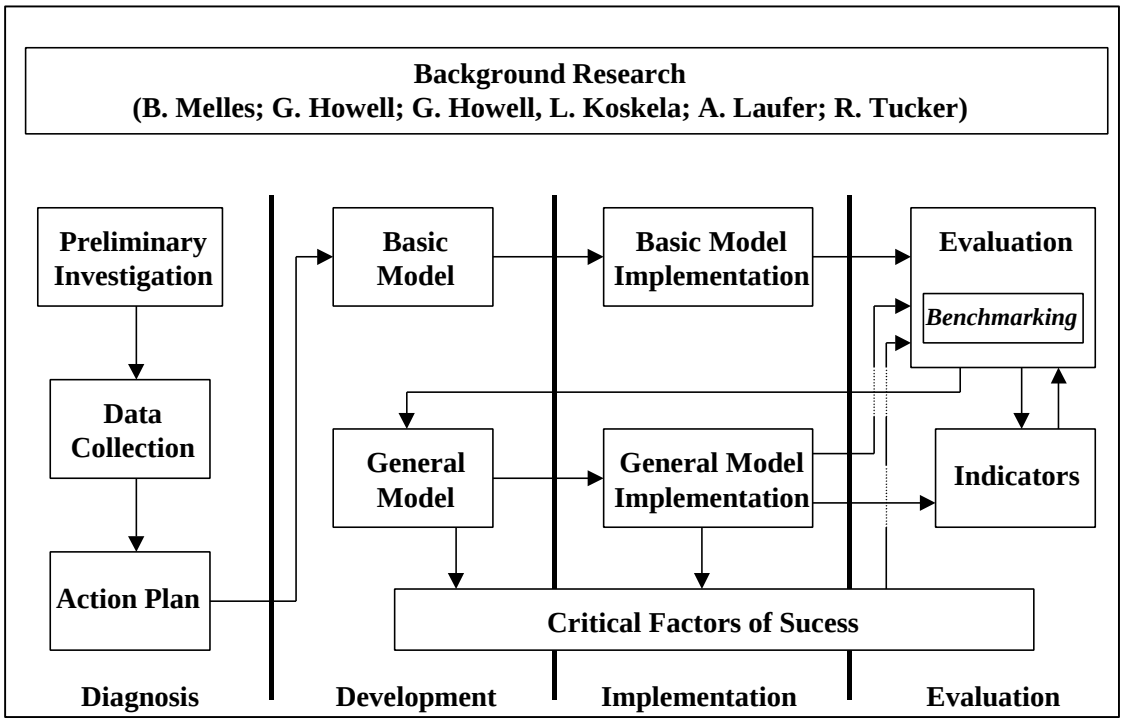

Figure 1: Research Method

Through the development of the method, the researchers have tried to identify the factors which are crucial for the success of the implementation of the production planning model. In the development phase, the crucial question is the flexibility that the model must have in order to be adaptable to small sized construction firms. One of the main hypothesis on this research study is that the model should be developed at a general level, presenting the minimum necessary information for its implementation, since firms have different structures. Evidently, the firm should decide how it will define responsibilities or how it will identify additional information for its own models. During the phase of

implementation, the best way to build the proposed model is discussed within the company. The managing directors of the firms should participate in this discussion, as emphasized by Oglesby, Parker, and Howell (1989). The evaluation of the implemented model is carried out in the last phase where some indicators related to the process of production planning and the production process itself are identified.

DIAGNOSIS

In this phase, a method of analysis of the production planning process through the study of its information flow, proposed by Bernardes and Carvalho (1997) is applied. The method consists of three steps: Preliminary Investigation, Data Collection and Action Plan.

The Preliminary Investigation aims at giving the research team an initial understanding of the production planning process and its relation to other areas of the firm, such as cost estimating, purchases, purchaser, and top management. A number of interviews were made with the company directors and staff. Based on that a DFD was build according to the company own perception.

In order to obtain a more effective model of the production planning process, the second step of Diagnosis was performed. It consists of collecting actual data on the amount of information exchanged between people. Based on that another DFD was built (Bernardes and Carvalho 1997).

The last step refers to a proposition for change in the production planning system. After comparing the results of the first and second steps, the model was evaluated, according to some theories and models proposed in the background research. After that, a new DFD for the planning process was proposed..

The main problems found on the diagnosis stage were:

a) Development of the planning process on a very informal basis;

b) Lack of accomplishment of the schedule;

c) Schedule preparation based on the experience of the site engineer and not on the firm's own data;

d) Lack of a systematical short term plan;

e) Lack of resource scheduling.

The proposed actions were defined taking into account the need for pursuing short term results in order to encourage the firms to participate in, the phases of the method. Thus, the development phase begun with an intervention in the firms' resource scheduling system together with the implementation of shielding production (Ballard and Howell 1997).

DEVELOPMENT

In this phase, some actions were taken in order to organize the necessary information flow for the planning process. Initially, two levels of planning were developed: a medium and short term planning. A DFD, called Basic Model (figure 2), was developed, which presents the necessary information and entities involved in those plans. Based on the implementation and evaluation of the Basic Model, the requirements for the development

of the following phase of the method, the elaboration of the General Model (figure 2), were identified.

According to figure 2, the general model comprises long, medium and short term horizons for production planning. The first step of the model is the identification of the project content, such as time restrictions, available resources, production milestones, control procedures and construction techniques.

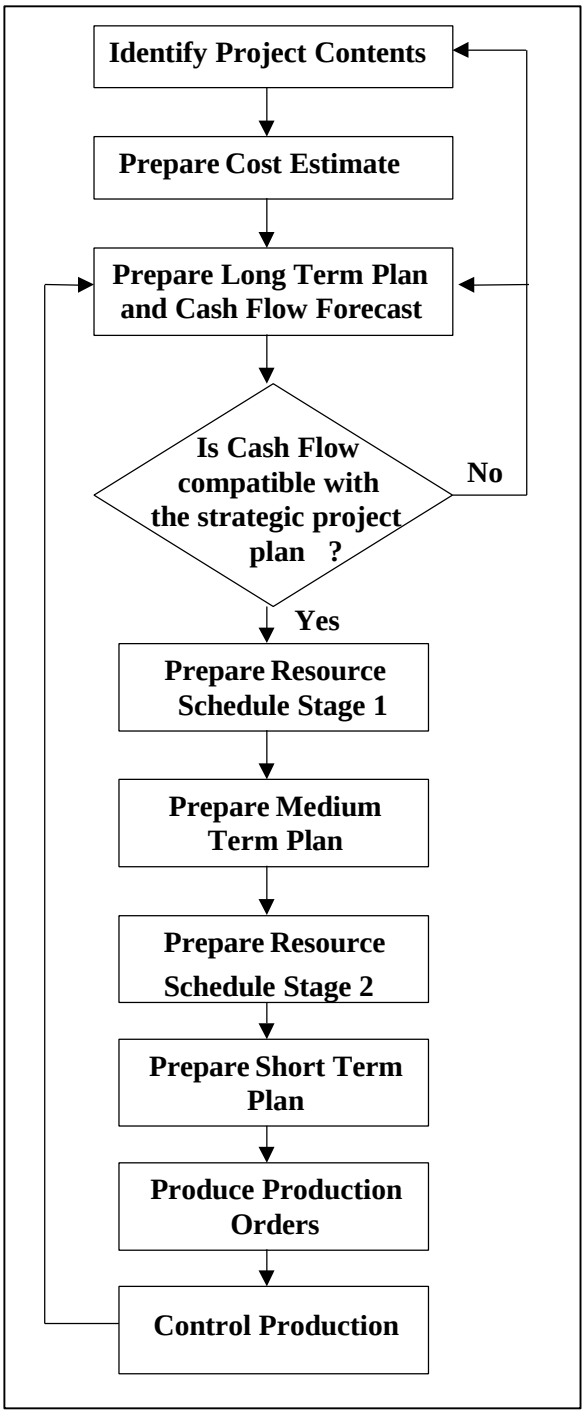

Figure 2: General Model Proposed

The next step is to prepare a cost estimate. It must be done according to a work breakdown structure defined in order to make production control easier. After that, the long term plan will be produced, which is the basis for generating the cash flow forecast. If the cash flow is compatible with the project strategic plan, the next step, which is the phase 1 of resources scheduling, is carried out. In resource schedule, an allocation of materials, equipment and work force is made, and the delivering dates for some materials, such as lifts and ceramic tiles, are defined.

Based on the resource schedule, a medium term plan (lookahead) is produced. In this phase, production orders are prepared, in which a description of the task package is presented, including the team who will carry out, starting and finishing dates, and location.

The next step is, the production of a more detailed resource schedule (stage 2). It defines the resources which will be scheduled on a daily basis, such as cement and sand. The lookahead plan will be used as a basis for the preparation of weekly plans. In the weekly plan there is a column that contains the service order code, which allows to establish a relationship between the assignments of the weekly plan and the ones from the lookahead plans. During site weekly meetings, production orders will be given to different teams.

IMPLEMENTATION

In this phase, training for the implementation of the basic model and for the general model was provided for the employees in order to enable everyone to understand the procedures. Usually, a model description manual is given to the engineering staff. Some kind of resistance occurred due to the following problems:

a) The site engineers and directors were overloaded. Thus, they usually do not give priority to the planning activities;

b) The directors did not commit themselves enough to the model;

c) It was difficulty to perceive concrete benefits of the model, since it works with a time scale and not with costs.

EVALUATION

In this phase, some actions were made aiming at increasing the commitment of the engineering staff:

a) Meetings at the construction site, using the brainstorming technique in order to identify the causes of the problems and to propose an action plan;

b) Develop a behavior training process, conducted by a psychologist in order to understand the cause of the problems;

c) Seminars with the whole group of construction companies, in which they were asked to present the work that was being developed in each of them.

In spite of these actions, it was observed that some of the firms had difficulties in implementing the model.. However, it is a common agreement that, after two years of work, the main elements of the model have been successfully implemented in some of the companies.

RESEARCH STRATEGY

The research strategy is presented in figure 1. This strategy allowed deviations to be corrected, improving the model for the application in the companies 3, 4, 5, and 6.
The model was implemented in the six companies in steps. It was initially implemented in one company (pilot study 1), and only a few months later, the implementation in the second company started (pilot study 2).

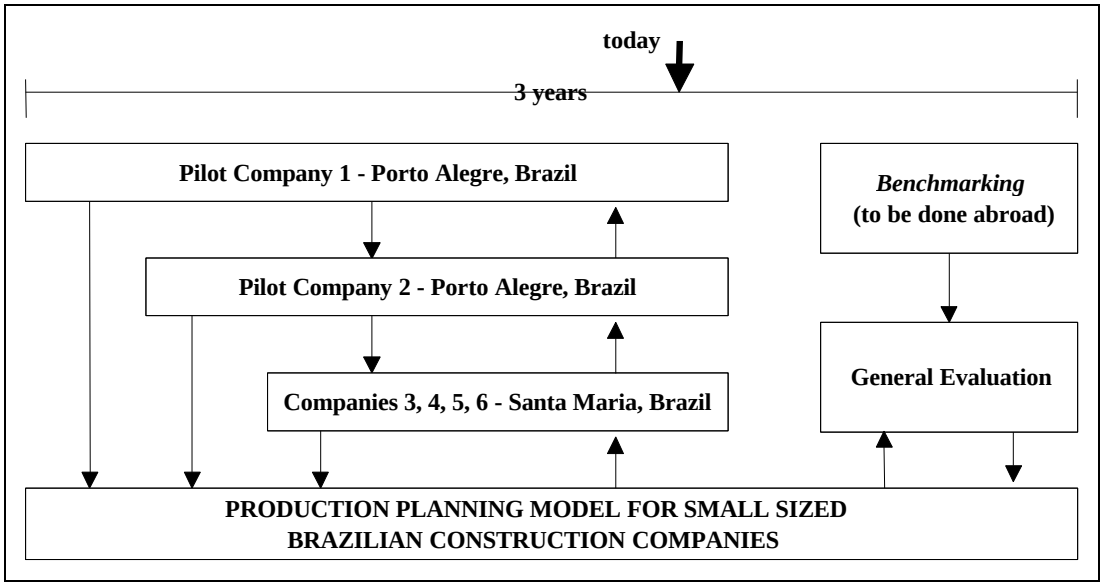

Figure 3: Research Strategy Adopted

In the third year of the project, the researchers intend to do a benchmarking of models used by construction companies abroad.

CONCLUSIONS

At the moment, the proposed model is in its final stage of development and has been prepared for implementation. The difficulties faced in the first two years of the project allowed to identify some requirements which the companies ought to have in order to be able to implement the model. These requirements cannot be interpreted as restrictions for model implementation, but as a need for making it more effective.

In final year of the research, the aim is to implement and refine the general model. Another strategy, that will be adopted in the development and implementation phases, is the use of learning organizations concepts in order to overcome difficulties mentioned above.

ACKNOWLEDGEMENTS

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