SELECTING LONG-TERM STRATEGIES FOR CONSTRUCTION FIRMS

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ABSTRACT: A methodology to analyze construction firms' long-term strategies is described. This methodology provides a systematic approach to study and analyze external and internal scenarios for a construction firm doing strategic planning. A conceptual model that is a simplified model of the variables and interactions present in the analysis of strategic decisions in the construction industry is built. An analytical model designed to predict the impact of strategic decisions supports the analysis process by integrating expert knowledge and assessments of the strategic planning team into a mathematical model. This model uses concepts of cross-impact analysis and probabilistic inference to capture risks and uncertainties present in the strategic scenarios. Strategies for long-term company development such as marketing programs to emergent markets, systems to implement total quality, etc., can be evaluated using criteria selected by company management. The model allows management to test different combinations of company long-term strategies and predict expected sales, market share, or other measures of company performance. The case of a Chilean construction company is used to illustrate the methodology.

INTRODUCTION

Strategic decisions in a scenario such as that of the construction industry, require the identification, consideration, and analysis of many risk factors, tangibles as well as intangibles, for which a methodology that manages them adequately does not exist. The economic theory, in which the main part of strategic literature that supports this type of process is based, is not easily applicable to construction. Organizational theory, on which the main part of strategic theory is based, has been formulated mainly for manufacturing companies, whose reality differs greatly from construction firms (Male and Stocks 1991).

In response to these challenges, the writers developed a methodology to support the strategic decision-making process in a construction firm, based on previous work on project strategic decisions (Alarcón and Ashley 1996). This methodology overcomes some of the limitations that have prevented the adoption of a strategic approach in this industry. For example, a model, that describes interactions between construction industry players, is integrated with an organizational model that reflects individual interrelationships at the interior of an organization of this type. A modeling approach for decision-making that incorporates risks and uncertainties in cause-effect types of structures is used to develop company development forecasts, as a consequence of the adoption of individual or combined strategies. A comparison of different strategy results and associated interaction mechanisms constitutes the base for decision-making.

The principal objective of this methodology is to support construction executives' decision-making processes, by analyzing the implications of a strategic decision and alerting potential losses and/or risk sources. The work described in this paper specifically addresses the strategic decision-making approach, which is part of a comprehensive methodology for strategic planning developed by the writers (Fig. 1). A detailed discussion of other steps of the entire methodology is developed (Venegas 1997). The methodology has been applied to two construction companies during its development, and is currently being applied to two other companies. The application of the methodology to one of these cases is used here to illustrate the examples.

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BACKGROUND

STRATEGIC DECISION-MAKING PROCESS

The strategic decision-making process can be defined as an act of election, between a set of feasible and available action courses, tending to improve the competitive positioning of an organization (Martino 1993). This process is presented continuously throughout the productive life of construction companies. However, it has lacked a formal structure within these organizations due to the fact that their implementation has been relegated only to executive levels without defined requirements for their development. On the other hand, the inability of construction executives to collect all relevant information pertaining to their decisions, makes this process notoriously complex, novel, uncertain, open, and endless. Decision makers begin with little understanding of the situation and select a quick solution, having only a vague idea of what the alternative can mean, and how it could be evaluated when implemented (Mintzberg et al. 1976).

According to Friedman (1984), this behavior can be expected since a planned development (in these growth conditions) is perceived as a loss of time. However, an adequate understanding of the decision process in the strategic area is probably the key of the entrepreneurial success. For this reason, any model intended to implement a strategic position must contain in its structure some mechanism to help construction executives understand the variables, impacts, and effects involved in their decision.

Strategic planning has demonstrated to be a useful model for leading decision processes of this type, showing flexibility and adjustment capacity to the various stages in which it has been used (Hax and Majluf 1993; Mintzberg 1994; Betts 1994). Strategic planning involves, in its essence, four essential steps: (1) To define the current position of the organization, creating a vision of the internal and external organization environment; (2) to define the future position expected by the organization, translated by mission, objective, performance indicators, and goals definition; (3) to propose, study, and choose action courses intended to reduce the existing gap between current and expected position, that involves a whole stage of strategies formulation, evaluation, and selection of action options; and (4) to elaborate the necessary plans and programs so that these action courses are translated into harmonic tactic and operative decisions system within the organization. This last step involves programming annual and short-term planning stages considered in any one of the strategic planning

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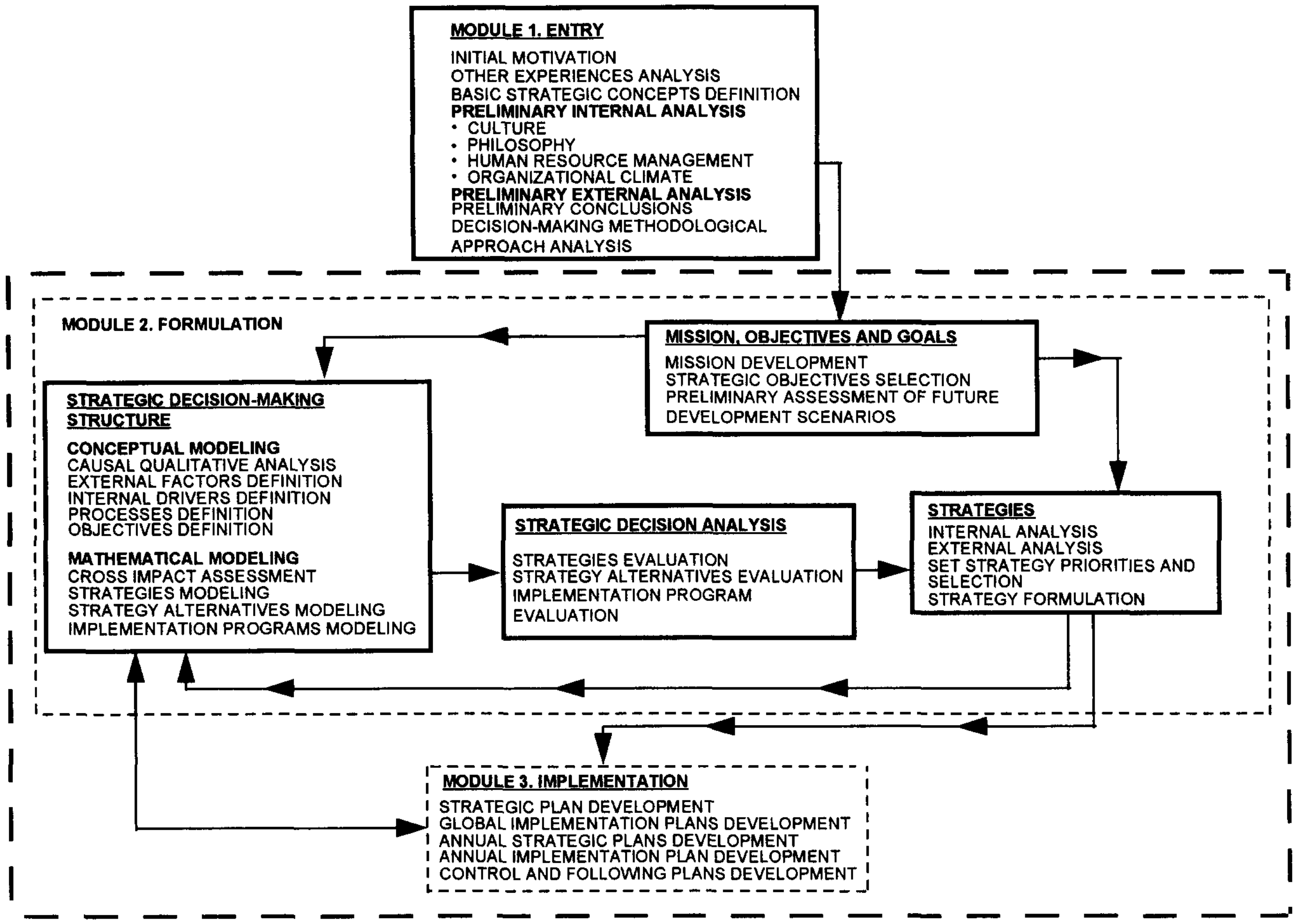

FIG. 1. Proposed Methodology for Strategic Planning Process

models proposed up until now (Hax and Majluf 1993; Mintzberg 1994; Whittaker 1978).

Existing Modeling Approaches for Strategic Decisions

The strategic decision-making process has been studied extensively by numerous authors. However, most have focused on the problem solution rather than the process itself (Kenny and Downey 1987). They have tried to build models for decision-making, concentrating in some areas described previously. For example, several authors have developed causal models to describe qualitatively variables and interactions involved in a particular decisional process (Al-Sinan and Hancher 1988; Porter 1985; Hax and Majluf 1993). Deterministic models have been used mainly for short- and long-term projects evaluation (Tung 1988). Probabilistic models have been developed to estimate future conditions through results that deliver possible value ranges and their probabilistic distribution, thus incorporating uncertainty in its estimates (Martino 1993; Al-Sinan and Hancher 1988; McNamee and Celona 1987). Simulation models for the evaluation of decisional alternatives have been proposed to reduce the uncertainty and costs associated with their selection (Alarcón and Ashley 1995; Martino 1993; Enzer 1972).

The reviewed models contribute to the reduction of analysis efforts and make strategic decision-making more rigorous. However, they suffer one or more of the following limitations: (1) They require a considerable effort to be used, due to high information demands; (2) their causal structure is highly complex for someone that it is not familiarized with the processes of formal strategic decision-making; (3) they are not appropriate for practical use due to their conceptual complexity; and (4) their use is limited to one or two steps in a strategic planning process. The review of existing models for strategic planning shows that there is a need for models that gather the following characteristics: (1) Structures that adequately link organizations with their environment; (2) explicit incorporation of the existing interactions between conceptual model variables that show the problem causal structure; (3) explicit incorporation of uncertainties and existing risks in the construction industry and its environment; (4) flexibility to specify a set of measures that reflect the performance objectives of an organization in a quantitative way; and (5) transparency to show a causal structure compatible with the forecasts obtained in the implementation of a strategic decision.

Modeling and Methodological Approaches

Modeling Approach

Alarcón and Ashley (1992, 1996) working with the Construction Industry Institute (CII), developed a simplified methodology for the evaluation of strategic decisions in construction projects, which is suitable to develop an individual or combined analysis of strategic alternatives. This methodology combines experience gathered from experts with assessments of the project management team, and it is composed of a qualitative conceptual model and a mathematical model. The conceptual model, called a general performance model (GPM), is a simplified model of variables and interactions that influence project performance. The mathematical model applies concepts of cross-impact analysis and probabilistic inference to capture the uncertainties and interactions among variables of the causal model, allowing the explicit incorporation of these elements in the decision analysis process. This modeling ap-

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proach provides a methodology to forecast the effects that selected decision alternatives would have on the behavior and results of a complex decision-making system. Initially, Alarcón and Ashley (1996) used this methodology to forecast and analyze the effects that project options (such as construction incentives, project organization and team-building alternatives) have on project performance. Subsequently, computer implementation of this methodology has led up to the application to decision problems such as the evaluation of environmental policy impacts (Alarcón and O'Ryan 1994), analysis of owner-contractor relationships (Alarcón et al. 1995b), and the prediction of integration impacts on engineering-procurement-construction processes (EPC) and industrial facility quality (Ashley and Teicholz 1994). The work presented in this paper has adapted and extended this modeling approach to suit the needs of strategic planning in construction.

Methodological Approaches

Hax and Majluf (1993), Mintzberg (1994), and Warszawski (1996) proposed methodologies for companies strategic planning, establishing a common hierarchic relationship between objectives, strategies, and plans. This model suggests a decisional process characterized by the following elements: (1) Decisions derived from an elaborated and formal process, which can be decomposed in clearly defined stages, each one delineated by critical routes, and supported by techniques and tools for strategic analysis (Mintzberg 1994); (2) a decision process under the responsibility of a group of executives nominated by the organization for such effect (Mintzberg 1994) and (3) generated strategic decisions represent a risk, because there is uncertainty about the impacts that are derived from their implementation within the organization.

GENERAL DESCRIPTION OF PROPOSED METHODOLOGY

The work of Alarcón and Ashley (1992, 1996) methodologically faces the problem of incorporating risks and uncertainties in cause-effect models, and delivers appropriate structures to model the problem. This approach is used to incorporate the critical variables identified in the strategic planning process. This is achieved through techniques that allow the systematic study of critical variables in the formulation, development, and evaluation of a strategy. The planning process acts as channel and catalyst of the experience and knowledge of those involved in decision-making.

This modeling approach incorporates new forms of capturing and integrating the knowledge of the different actors that participate in the decision process. The methodology is formalized through a hierarchical process with clearly defined stages, each outlined by critical routes, and supported by techniques and tools for strategic analysis (see Fig. 1). These stages make it possible to organize and focus the planning efforts in interdependent work modules. This characteristic has important impacts for the quality of the process and practical use of the methodology, because it provides a necessary flexibility to adapt the process to the organization resource offer, characterized mainly by the availability of the executives involved in the process.

The methodology is structured according to three modules that define a hierarchical relationship between objectives, strategies, and strategic decisions. The "entry" stage is designed to motivate and obtain the commitment of strategic team members to the efforts demanded by the strategic analysis process. It is conceived to educate and enrich the knowledge of the participants about the internal and external organization environment. In this way, internal surveys, historical data analysis, and market research (among others) are considered to collect data from the company and its external environment. The "formulation" stage is designed to establish a set of objectives; to estimate the difference between the present and the expected position of the organization, to propose and select one or more action courses, and to close the gap between the expected and the current position. In this stage, a model for the evaluation and selection of strategic options is proposed. The model consists of two basic structures: one conceptual and one mathematical. The conceptual model identifies the more important variables and interactions present in the implementation of a strategic decision and explains how the risk characteristics of a decision propagates toward the final objectives of a construction company. The analytical capacities of the methodology can be used to accomplish a comparative analysis among those decisions that impact a given objective of the company. the third stage, called "Implementation," has the goal to translate the elements obtained in the previous phase into plans, activities, and programs for effective implementation of the planned action courses. This phase involves the process of making annual activity plans, implementation plans, control and follow-up programs, alternative programs simulation to fix intermediate milestones, and short-term goals for each one of the stages involved in the plans.

STRATEGIC DECISION-MAKING STRUCTURE

Fig. 2 shows a real-world macromodel developed by the authors with the strategic team of a construction company, integrated with top executives and owners of the firm, to support the strategic decision-making process (Fig. 2). This model exhibits the variables and interactions that influence the strategic decisions in a construction firm and it is a model used to identify how a strategy impacts the firm's results. It has five levels: (1) External factors; (2) strategies; (3) drivers; (4) processes; and (5) goals. In the strategies level, each layer represents a strategy such as the implementation of a quality management system, or the establishment of a marketing program to penetrate emergent markets. Each layer contains a set of alternatives of the strategy, defined by the characteristics specified by the strategic team.

Following the strategies level, there is a set of variables that are directly affected by these strategies, these are called drivers. Each alternative within a strategy is assessed as to its probable impacts on drivers. Those variables, in turn, propagate the effects through interactions among themselves and with the processes. The model then, is defined as a set of variables whose effects propagate from left to right, where each variable is modeled internally as a set of five mutually exclusive and collectively exhaustive events. The events represent the existing range of performance for each variable.

The external factors are variables whose effects propagate from the external to the internal variables. Some examples of these variables are (1) a macroeconomic environment; (2) a technological environment; and (3) a competitive environment.

The model description and definitions that follow are very simple in nature because they have an illustrative purpose. The definitions only represent the common understanding of the strategic team members about the meaning of the variables and elements of the model, and they do not pretend to be accurate or general definitions.

Identification of Strategies, Strategy Alternatives, and Strategic Implementation Programs

Strategies, strategy alternatives, and strategy implementation programs represent the elements under evaluation in the model. The strategies follow a classical model to determine them (Hax and Majluf 1993; Venegas 1997; Mintzberg 1994). The strategy alternatives are elements derived from the strat-

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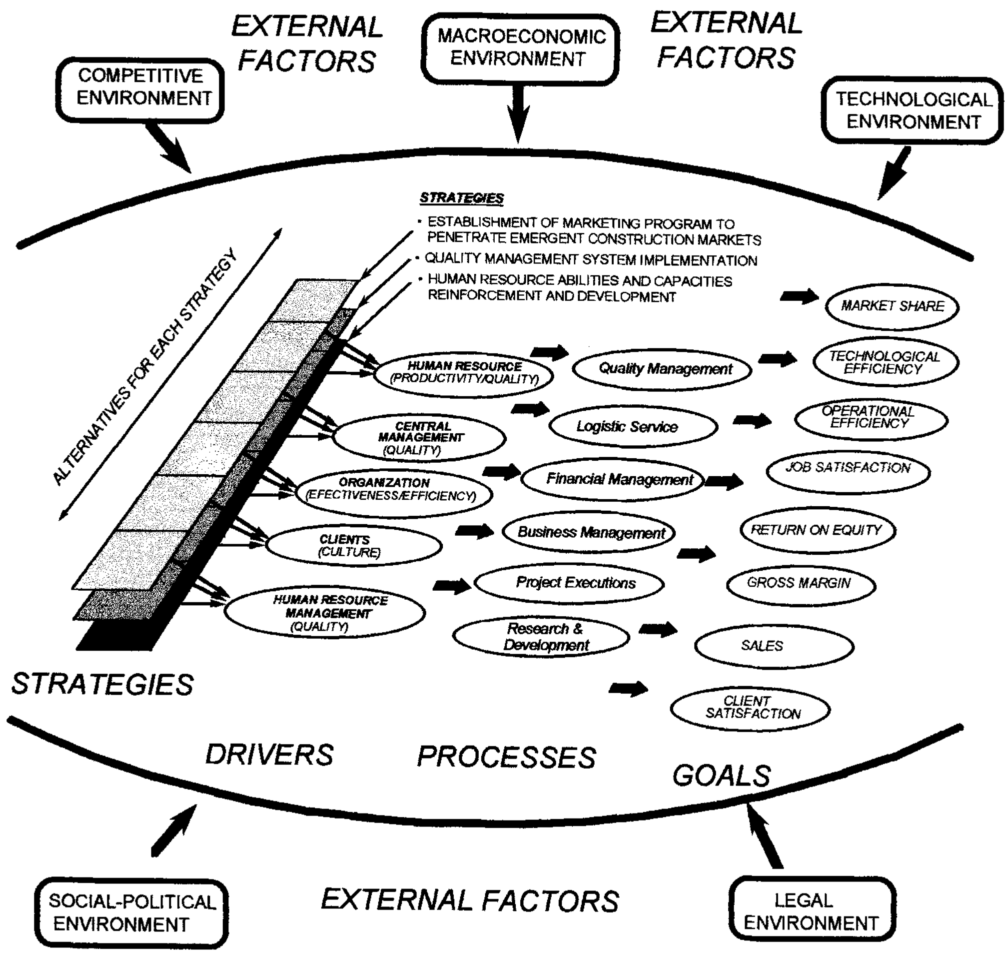

FIG. 2. Conceptual Model

egy, and represent specific choices to formulate the strategy. The strategy implementation programs are action plans alternatives for each strategy. These action plans consist of activities, sequences, resources, and timing. A detailed discussion of the strategies, strategy alternatives, and strategic implementation programs was developed by Venegas (1997). One strategy is described in the following section as an example.

Establishment of Marketing Program to Penetrate Emergent Construction Markets

During the strategic planning process, one of the most ambitious strategies was the program of market penetration. The company strategic team members believed that Chilean's north mining projects could be a market with stable perspectives. Important questions about the strategy were modeled with the methodology. They were grouped into three main characteristics: (1) Temporal or permanent resource location in the area; (2) sophisticated or basic level of infrastructure to allocate in the market; (3) independent or dependent management from the central office. The combination of these characteristics allowed for six alternatives for this strategy.

Drivers

Drivers are variables directly impacted by the implementation of the strategy alternatives that spread their effects to the corporate goals. A driver generally has a performance element associated with it (such as quality and/or productivity), that reflects the potential of the driver to perform. The ability to realize this potential is one of the key elements that can be impacted by the strategies. In general, a number of factors could affect the level of realization of the driver's potential. In this modeling process the following variables were considered:

- Central management (quality): this driver refers to the management team that participates in the main office of the company. It includes aspects such as management efficiency in the central administration and response capacity to environmental conditions.
- Human resource (quality and productivity): all personnel involved in the production of the company. This variable considers factors such as (1) training level; (2) motivational level; (3) team-work potential; and any other relevant dimension in the expected quality and productivity of the company functions.
- Clients (culture): the customer pool of the company. It includes factors such as (1) size of the customer pool; (2) market knowledge; (3) profitability; (4) strength in negotiations; and (5) investment potential in infrastructure projects.
- Organization (effectiveness and efficiency): the characteristics that describe the way in which the company produces. It includes factors such as (1) size of the human group; (2) organizational structure; (3) response capacity; (4) integration level between different units; and other aspects.
- Human resource management (quality): this driver influences all functions in charge of attracting, training, selecting, controlling, promoting, developing, motivating, and rewarding the human resource.

Processes

Processes are typically used to describe the key function of construction firms and are useful in identifying key informa-

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tion and resources within a construction company. The processes included in this model are the main functions required to develop the construction company production. In this way, processes are variables which, impacted by the drivers, directly affect the corporate goals of the firm. The following variables were selected:

- Logistic service—in charge of supporting the construction process by managing key resources. The activities considered are (1) acquisition management; (2) procurement; and (3) equipment management.
- Project execution—in charge of the construction process. It includes activities such as (1) project planning and control; (2) operations management; (3) construction operations; (4) scheduling; (5) safety management; and (6) contract administration.
- Business management—in charge of supporting the company profitability. Activities involved are (1) bidding; (2) sales; and (3) marketing.
- Financial management—in charge of improving the portfolio of economic resources. It includes activities such as: (1) financial management; (2) accounting; and (3) treasuring.
- Research and Development—in charge of developing, comparing, adopting, and implementing technologies and new knowledge in the firm.
- Quality management—in charge of planning, controlling, coordinating, directing, and organizing activities that guarantee the quality of projects.

Corporate Goals

The goals are useful to reflect the impact of strategies on the firm performance. The balanced scorecard, proposed by Kaplan and Norton (1993), was used to set corporate objectives. This is a management system that can motivate breakthrough improvements in areas such as operations, customer service, research and development, and market development. At this company, the strategic team members selected a set of goals that have an equilibrium between financial performance, clients perspective, innovation and improvement approach, and internal environment. This set of goals is an essential part of the strategy, because it provides company executives a comprehensive framework that translates the company's strategic objectives into a coherent set of performance measures. A brief description of the selected variables is presented in the following text. The definitions represent the common understanding of the members on the meaning of the variables and elements of the model.

Financial Goals

- Annual sales—the sum of the total company sales in the fiscal year
- Gross margin—defined by (1):

$$\text{GROSS MARGIN} = \frac{\text{AFTERTAX PROFITS}}{\text{ANNUAL SALES}} \times 100 \quad (1)$$

- Return on equity, defined by (2):

$$\text{RETURN ON EQUITY} = \frac{\text{AFTERTAX PROFITS}}{\text{EQUITY}} \times 100 \quad (2)$$

- Market share—the result of the company annual sales divided by the total market annual sales.

Internal Goals

- Job satisfaction—this indicator is obtained from a survey applied to all personnel of the firm.
- Technological efficiency, defined by (3):

$$\text{TECHNOLOGICAL EFFICIENCY} = \frac{\text{SALES OF NET SERVICES}}{\text{TOTAL M-H}} \quad (3)$$

- This indicator tries to reflect the impact of technological innovations. If the index grows, this means that the firm is selling more services per man-hours (M-H).

Innovation and Improvement Goals

- Operational efficiency—this indicator is obtained from

$$\text{OPERATIONAL EFFICIENCY} = \frac{\text{NUMBER OF CLIENT CLAIMS}}{\text{DIRECT M-H} \times 100} \quad (4)$$

- This index tries to reflect the impact of quality improvement strategies on the projects. If the index decreases, it is possible to conclude that there is a decrease in client claims, and so the quality efforts fulfill the objective.

Client Goals

- Client satisfaction—this indicator is obtained from a survey applied to all the clients of the firm.

External Factors

The external factors are environmental variables that impact the performance of the model internal variables. It is necessary to incorporate these influences, because any action from a construction company is conditioned by the environmental characteristics. The following external factors are included in the model:

- Macroeconomic environment: this element considers all economic variables that have an impact on the next planning cycle. It involves factors such as (1) economic growth; (2) inflation; (3) interest rates; (4) unemployment rate; (5) money exchange rate; (6) private investment; (7) foreign investment; (8) public investment; (9) growth of key industries; and (10) Chilean commodities price performance.
- Competitive environment: this refers to the characteristics of the competition pool, and involves factors such as (1) number of competitors; (2) price structure; (3) competitive strategies; (4) technological investment; (5) size and growth; and (6) differentiation level.
- Social-political environment: considers all aspects derived from the political and social system. It includes stability on factors such as (1) economic policies; (2) government regulations; (3) social; and (4) training and educational level of the company target group.
- Legal environment: refers to factors such as (1) juridical environment; (2) arbitration system; (3) contract system; and other aspects that could stimulate or inhibit the company's behavior in the market.
- Technological environment: reflects the level of applied knowledge systematization in the company's market for controlling, arranging, and altering the physical and social environment. The factors involved are (1) competitors and clients tendency in technological innovations; (2) accessibility of information systems; and (3) the availability of execution and construction systems.

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ASSESSMENT PROCESS

Strategic Scenarios

To analyze the model, it is necessary to build scenarios for each strategy, each strategy alternative, and each strategy implementation program. A scenario can be defined by the presence or absence of certain strategy characteristics. The effects of each scenario on the model drivers can be assessed using a probabilistic scale. This scale uses five symbols to cover the range of possible outcomes: high negative (NN), medium negative (N), no impact (O), medium positive (P), and high positive (PP). Each symbol is conventionally defined by the strategic team members and linked with a range of performance. In this case, each symbol represents a range of performance with a 20% probability of occurrence. For example, a high positive impact (PP) on a driver could be defined as one in the upper 20% of the impact scale, while (NN) represents the lower 20% of the impact scale. The assessments are collected using tables that contain impacts of strategy alternatives or strategy implementation programs on drivers, for each specific strategy. Fig. 3 shows a portion of a table used to summarize assessments of the effects of a strategy implementation program on drivers in different stages of a quality management system implementation. The strategy implementation program is modeled by a Gantt chart schedule, which contains specific activities defined for the implementation.

Mathematical Model

Modeling concepts developed in previous research have been adapted in response to the demands for mathematical analysis within the strategic decision-making process. The mathematical model uses concepts of cross-impact analysis (Gordon and Hayward 1968; Honton et al. 1985) and probabilistic inference. Cross-impact analysis (CIA) is a technique specifically designed to study how the interactions of events (present in a mathematical model) affect the probabilities of those events. The general notion was first suggested by Gordon and Hayward (1968) with the game "futures" created for the Kaiser Corporation, and later expanded to a number of forecasting areas (Enzer 1972, Honton et al. 1985; Alarcón and Ashley 1995). This technique is designed to analyze the numerous chains of impact that can occur, to determine the overall effect of these chains on the probability that each event will occur. The cross-impact concepts have been adapted and extended (Alarcón and Ashley 1996). Among the extensions, a method to combine probabilistic inference, first proposed by Kim and Pearl (1983), is applied in this model to perform probabilistic inference. Moreover, a method to combine dynamic assessment, first proposed by Kane (1972), is also applied to forecast the effects over time. The result is a powerful, but easy to use, modeling methodology. The mathematical model uses a Monte Carlo simulation approach to carry out the cross-impact analysis and to perform probabilistic inference. The results of this analysis are thousands of scenarios that are used as the universe for the analysis of the impact of the company strategies. More detailed discussion of the mathematical model is developed in the referenced literature and in Venegas (1997).

Cross-Impact Information Demands

Once the variables have been identified, as portrayed in the conceptual model, it begins a process to establish the relevant influences among them. These assessments are obtained from the strategic team members.

Fig. 4 shows a partial representation scheme to collect information in the form of a simplified cross-impact matrix. The strategic team members answered the following question: "If changes were to occur in the column states, how would this affect row states?". The answer indicates the strength and direction of the "impact" according to the scale shown on the right of Fig. 4. This simplified questioning process (described earlier) is used to collect the basic information for the mathematical model. A method to convert the assessment to the numerical level, first proposed by Alarcón and Ashley (1992), is used in this methodology. Details on the procedure and testing of these assumptions can be found in Alarcón and Ashley (1992).

Outcome Measures

In the next step of the modeling process, the strategic team members define the outcome measures they want to use to evaluate their strategic decisions. The outcome measures are associated with the firm corporate goals described previously. Once the measures are defined, the strategic team members are required to provide assessments about the variability of the

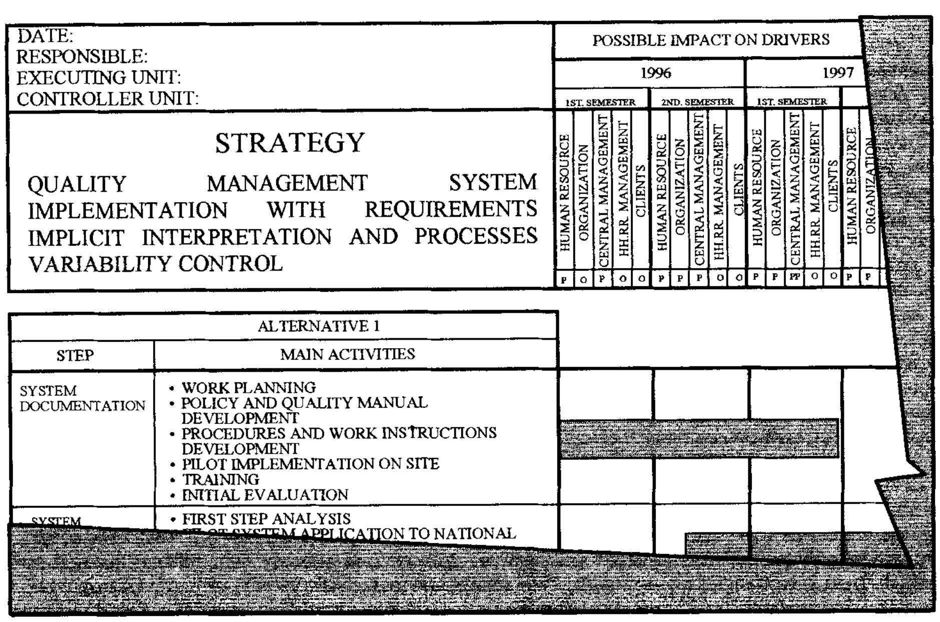

FIG. 3. Impact of Implementation Program for Specific Strategies

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	COMPETITIVE ENVIRONMENT	MACRO-ECONOMIC ENVIRONMENT	TECHNOLOGICAL ENVIRONMENT	SOCIAL-POLITICAL ENVIRONMENT	LEGAL ENVIRONMENT
HUMAN RESOURCE	MOD-	SLI-	MOD+	SIG+	NO
CENTRAL MANAGEMENT	SLI-	SIG+	SLI+	SLI+	SLI+
ORGANIZATION	NO	NO	NO	NO	NO
CLIENTS	MOD-	SIG+	SLI+	SIG+	SLI+
HUMAN RESOURCE MANAGEMENT	SLI-	SLI-	MOD-	SIG+	NO

SIG+ SIGNIFICANTLY IN THE SAME DIRECTION
MOD+ MODERATELY IN THE SAME DIRECTION
SLI+ SLIGHTLY IN THE SAME DIRECTION
NO NO EFFECT
SLI- SLIGHTLY IN OPPOSITE DIRECTION
MOD- MODERATELY IN OPPOSITE DIRECTION
SIG- SIGNIFICANTLY IN OPPOSITE DIRECTION

FIG. 4. Cross Impact Matrix (Partial Representation)

TABLE 1. Outcomes Variability Assessment

Goal (1)	Assessment (2)	1996 (3)	1997 (4)	1998 (5)
Sales	Lowest	167.000 U.F.	167.000 U.F.	200.000 U.F.
	Likely	220.000 U.F.	270.000 U.F.	300.000 U.F.
	Highest	290.000 U.F.	350.000 U.F.	400.000 U.F.
Return on equity	Lowest	0%	0%	0%
	Likely	16%	22%	22%
	Highest	44%	46%	47%
Gross margin	Lowest	0%	0%	0%
	Likely	7.5%	7.5%	7.5%
	Highest	15%	15%	15%
Job satisfaction	Lowest	43%	43%	43%
	Likely	80%	80%	80%
	Highest	90%	90%	90%
Technological efficiency	Lowest	25 U.F./100 × M.H.	25 U.F./100 × M.H	25 U.F./100 × M.H
	Likely	36 U.F./100 × M.H	36 U.F./100 × M.H	36 U.F./100 × M.H.
	Highest	40 U.F./100 × M-H	44 U.F./100 × M-H	50 U.F./100 × M-H
Operational efficiency	Lowest	13 items/1000 M-H	13 items/1000 M-H	13 items/1000 M-H
	Likely	10 items/1000 M-H	9 items/1000 M-H	8 items/1000 M-H
	Highest	8 items/1000 M-H	6.5 items/1000 M-H	4 items/1000 M-H
Market share	Lowest	1%	4.5%	7%
	Likely	2%	6%	8%
	Highest	2.5%	7%	8.5%
Client satisfaction	Lowest	16 points	19 points	22 points
	Likely	24 points	27 points	30 points
	Highest	28 points	31 points	35 points

outcomes in the next three years, using an approach similar to that used in Project Evaluation and Review Technique (PERT). These assessments were approximated to a Beta distribution to represent the variability of the outcomes in the mathematical model calculations. Some assessments were made in UF, a monetary equivalent of the Chilean currency (1 U.F. = US$30). Table 1 summarizes the results of this assessments process.

ANALYSIS, EVALUATION, AND SELECTION OF STRATEGIES

The strategic decision-making process is an essential part of the methodology, because it concentrates on the main choices of the organization, in terms of the ways used to achieve the desired position. In fact, in this step, the decision-makers analyze, evaluate and select strategies, alternative decision elements, and implementation programs. The capabilities of the conceptual and mathematical model allow the relative comparison of the effects of these types of elements on goals, and they provide sensitivity analysis capabilities that can identify the most important variables for company performance. They also help strategic management to obtain a better understanding of factors that affect performance, to identify opportunities in the environment, and then take effective actions. The purpose of the following examples is to illustrate the analysis results rather than obtain conclusions about the strategies; therefore, only a limited discussion is carried out. Nevertheless, the discussion tries to show how the model results can be used to identify the best strategic actions and the most important characteristics of those strategies for the firm.

Discrete Sensitivity Analysis

Fig. 5 shows the sensitivity of return on equity to external factors' performance in 1996. The graph shows the expected return on equity for different performance levels of the external factor under analysis, ranging from the least favorable conditions (NN) to the most favorable conditions (PP). Each graph data point was obtained by selecting scenarios with a common external factor setting (NN, N, O, P, or PP) and estimating the expected return on equity from the mean value of those scenarios in 1996. The steeper the slope of the curve, the higher the sensitivity associated to the external factor. This type of

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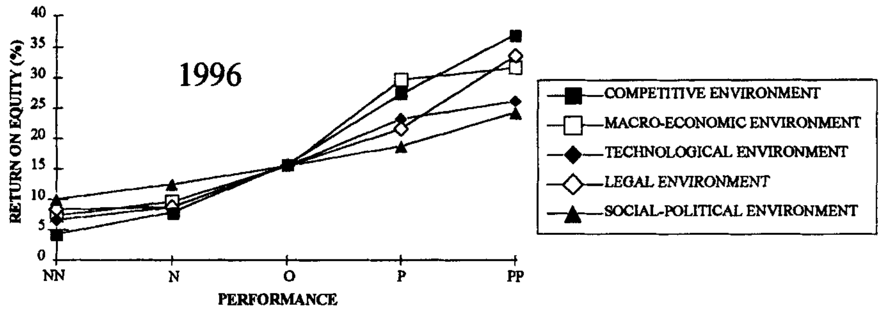

FIG. 5. Sensitivity of Return on Equity to External Factors in 1996

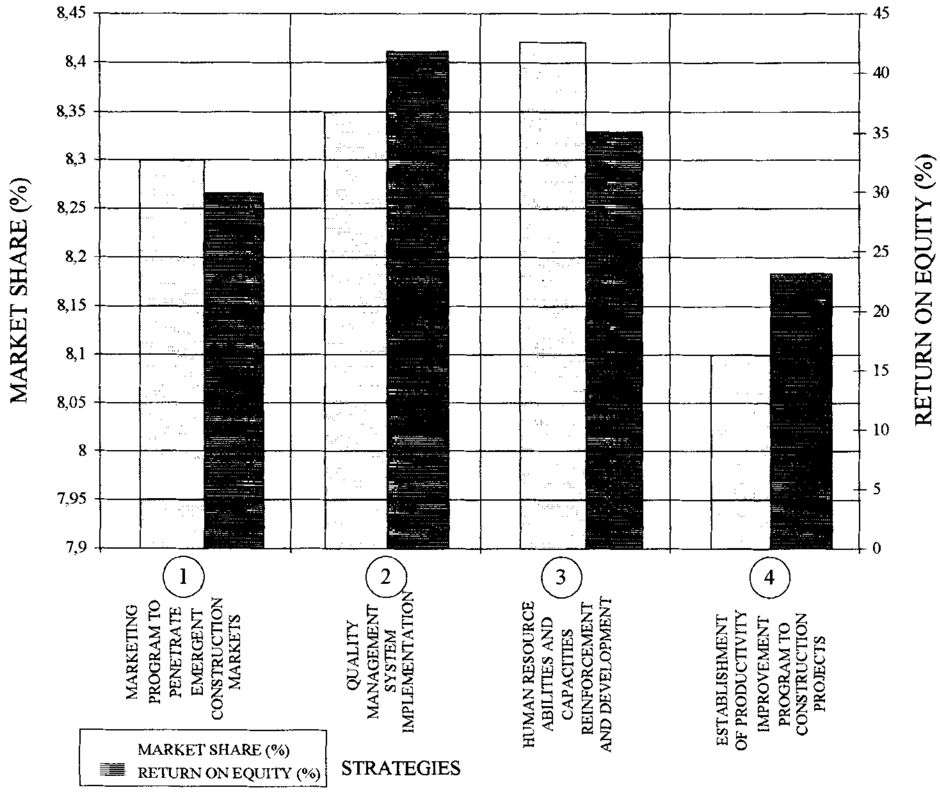

FIG. 6. Benefits of Strategies

analysis can be repeated for every performance outcome and for every year of the strategic planning cycle.

Global Impact of Strategies on Goals

Fig. 6 shows the impacts of an initial list of strategies, described in global terms, on market share and return on equity goals for 1998. The results are expected values for 1998. The methodology assumes that in 1998 the strategies will be fully implemented and the external scenarios performance will be the most likely for 1998. In addition, a sensitivity analysis can be carried out to test the effect on the strategies of external scenarios variations. The results allow decision-makers to make a preliminary selection of strategies to be analyzed in more detail in further stages of the analysis process. In this way, the decision-makers can reduce analysis efforts, eliminating alternatives that represent low benefits and/or more risks.

Impact of Strategy Alternatives on Corporate Goals

The methodology was used to evaluate every existing strategy alternative. In fact, the strategic decision-making structure provides the analysis capabilities to help decision-makers evaluate the relative effects of the strategy characteristics. For each strategy alternative, the methodology provides an estimate of the expected value for each corporate goal (Fig. 7).

Example: Strategy Alternatives for Marketing Program

Fig. 7 shows a rank order of strategy alternatives in descending order of benefits for 1998 (year of full operation). The alternatives were ranked according to their return on equity and compared with the expected sales. Both results are expected values for 1998 but the methodology can provide the full set of outcomes frequency distributions to review the risk associated with each strategy.

A careful review of the preceding results can help the strategic team members gain a better understanding of the implications of program characteristics and the gains or losses that may result from making changes in the penetration strategy. At the same time, this information can help to design more efficient monitoring and control procedures within the company.

Dynamic Impact of Strategy Implementation Programs on Corporate Goals

Fig. 8 shows the performance of specific goals over a time period. This performance is affected by the implementation

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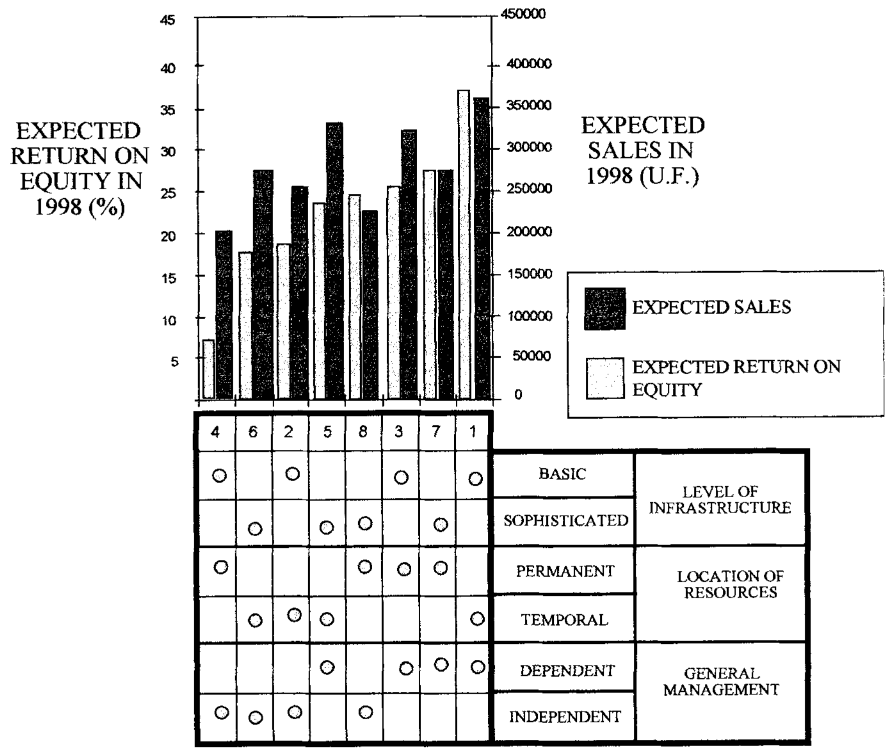

FIG. 7. Benefits of Marketing Program to Penetrate Emergent Construction Markets

process of a strategy. In this case, Fig. 8 shows a performance forecasting of technological efficiency and operational efficiency under two alternative quality management system implementation programs. This analysis is obtained by assessing the impact on drivers of each implementation program step. In this way, the analysis provides a control structure, which includes a set of expected indicators for each step in the implementation process. With this tool, it is possible to analyze the expected change in the organization, the reaction capacity, and adaptation velocity when prompt response is required. An interesting analysis feature (usually very difficult to perform with existing models) can be applied here: the sensitivity of these forecasts to different external scenarios can be easily examined allowing the decision makers to check the stability of the strategies with different external conditions.

Other Analysis Capabilities

This is a limited example of the analysis capabilities of this approach to strategic planning decision analysis. The results of the simulations can be used to perform several other analyses in the strategic planning process, such as comparative analysis of the effects of different combinations of strategies, for instance, the combined effect of a market penetration program and a quality management program; dynamic sensitivity analysis of corporate goals performance to changes in performance of model variables (such as external factors, drivers, or processes); explanatory capabilities through the model causal structure; etc.

SUMMARY AND CONCLUSIONS

A general framework to support construction firms' strategic planning that provides a structured path and tools to carry out the planning process has been developed and tested as part of a research project in this area. This paper was focused on a methodology for the analysis and evaluation of strategies, one of the key aspects of this planning framework, which has been tested in a real case.

So far, the validation of the model has included applications to two companies. During this process the companies' executives were required to evaluate the different aspects of the methodology. Some of these results are discussed next. The methodology has shown to be flexible enough to be adapted to particular company characteristics and a strategic planning method. The model used in the analysis is unique for each company even though it has a similar structure. Currently, this methodology is being applied to two new companies and there are others interested in future applications; therefore, a continuous validation process of the methodology will be carried out.

The example application discussed in this paper demonstrated that the GPM modeling approach can be applied with many advantages to support strategic planning decisions, providing the planners unique analytical capabilities that are currently not available in existing strategic planning methodologies. The methodology provides a structure to organize and collect construction executives' knowledge and experience, expert opinions, and empirical data, using decision analysis modeling techniques and cross-impact analysis formalism.

The mathematical model is able to predict the impact of a given strategy or combination of strategies on selected outcomes of the firm, allowing a relative comparison of alternatives for decision making. The value of the analysis does not rely on the accuracy of the predictions of the models but relies instead on a more rigorous process to analyze and compare alternative decisions in relative terms, collecting judgment and information available and providing consistency checks. The model's open architecture allows the user to verify the soundness and veracity of the information provided in each stage of the modeling process. This guarantees that the methodology does not replace the judgment of the decision maker, but rather helps to structure, enrich, and validate it. Members of the construction firm's strategic team, (using the methodology), recognized the cognitive value of the systematic and structured process for a strategic team discussion implicit in the modeling methodology.

The original GPM methodology has been adapted and extended, both conceptually and mathematically. The most significant adaptations and extensions to the original concept are as follows:

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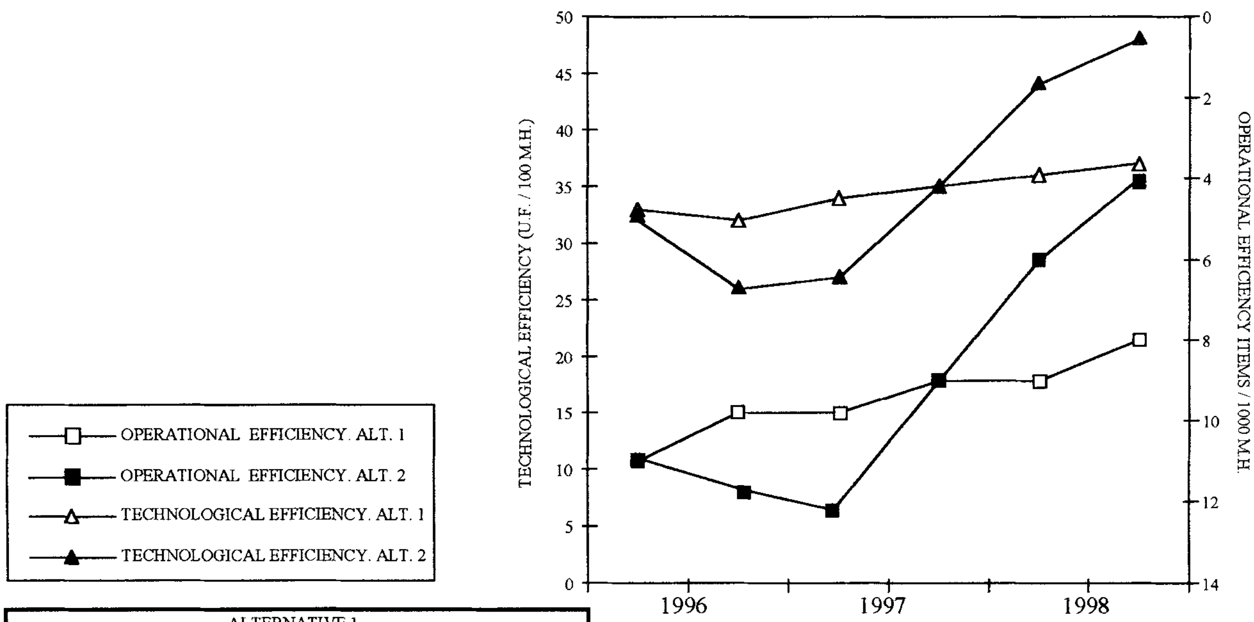

ALTERNATIVE 1	
STEP	MAIN ACTIVITIES
SYSTEM DOCUMENTATION	• WORK PLANNING • POLICY AND QUALITY MANUAL DEVELOPMENT • PROCEDURES AND WORK INSTRUCTIONS DEVELOPMENT • PILOT IMPLEMENTATION ON SITE • TRAINING • INITIAL EVALUATION
SYSTEM GENERALIZATION	• FIRST STEP ANALYSIS • PILOT SYSTEM APPLICATION TO NATIONAL CONSTRUCTION PROJECTS • GLOBAL INTENSIVE TRAINING • FINAL DIAGNOSIS • ISO-9002 CERTIFICATION

ALTERNATIVE 2	
STEP	MAIN ACTIVITIES
COMMITMENT AND EXPLORATION	• QUALITY PHILOSOPHIES EVALUATION AND SELECTION • PROJECT MISSION DEFINITION • LEADER AND STAFF QUALITY DEFINITION • CORPORATE TRAINING PLAN DEVELOPMENT AND APPLICATION
PREPARATION AND PLANNING	• MIDDLE MANAGEMENT INVOLVEMENT • KEY PROCESSES DEFINITION • PLAN DEVELOPMENT TO APPLY BASIC TOTAL QUALITY • TRAINING PLAN APPLICATION • INFRASTRUCTURE AND PROCESSES CHECK AND ANALYSIS FOR WORK TEAM COORDINATION • WORK TEAM ESTABLISHMENT
IMPLEMENTATION	• EXECUTION PROGRAMS REDESIGN FOR QUALITY WORK • WORK TEAM FORMALIZATION • WORK TEAM TRAINING • QUALITY PLAN START-UP IN PILOT PROCESSES • PILOT PLAN EXTENSION AT OTHER PROCESSES • OBTAINED RESULTS PUBLISHING • MARKETING PLAN FORMULATION AND APPLICATION TO COMMUNICATE RESULTS AND BENEFITS TO THE CLIENTS
SUSTAINING	• ANNUAL PLAN DEVELOPMENT FOR WORK TEAM SYSTEMATIC OPERATION • CONTINUING TRAINING AT ALL LEVELS • CLIENT SATISFACTION EVALUATION

FIG. 8. Dynamic Impact of Quality Management System Implementation

- A conceptual model for the analysis and evaluation of strategic decisions was developed by collecting information about the variables that explain how a strategic decision propagates its effects on specific corporate goals. These data included both industry data and strategic team data.
- The concept of external factors (not available in the original GPM) was incorporated into the conceptual model and a way to introduce them into the mathematical model structure was developed.
- A modeling approach to analyze the dynamic effect of strategies was developed adding significant analytical power for the analysis of the evolution of effects of strategies over time, in particular, when they require long processes of implementation.
- New types of analyses were proposed to identify the most important external variables for company performance, to recognize opportunities and threats in the external environment, and to analyze stability of strategies.

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A summary of the features of the methodology presented in this paper is the following: (1) It has predictive capabilities to help establish performance corporate goals; (2) it incorporates risks and uncertainties, usually present in the environment of strategic decisions, in the analysis; (3) it allows a comprehensive performance evaluation; (4) it provides sensitivity analysis capabilities to identify the most important variables for company performance; (5) it can help strategic management to obtain a better understanding of factors that affect firms performance, to identify opportunities in the environment, and then take effective actions; and (6) it provides important measures for the strategic control of management, in terms of expected values in the long process of implementation.

The availability of this methodology offers new approaches to the study and exploration of a construction firm's strategies and can provide valuable information on the mechanisms, interactions, and the most effective ways of achieving corporate objectives.

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