ESTIMATION, VALIDATION AND STOCHASTICITY IN A MODEL OF ORGANIZATIONAL STRATEGY

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ABSTRACT

This paper reports results of research on model building and validation applied to a complex system immerse in an environment of permanent change.

A model was built in the context of an organization operating under a highly centralized structure but with poor institutional integration and poor information technology tools. The conveniently articulated strategies chosen to dilute institutional problems are: decentralization, leadership and implementation of information systems.

1. INTRODUCTION

In the search of a methodology capable to represent dynamic and adaptable systems immerse in uncertain environments, it is necessary to incorporate dynamic parameters estimation, prospective validation, and stochastic components.

The main interest then focuses on the internal system structure and on the possibility of system intervention by means of political decisions in order to introduce the planned behavior.

The proposed parameter estimation technique must be dynamic, prospective and flexible, characteristics which stimulate the search an incorporation of additional information.

It is advisable to use some appropriate index to measure the "goodness of fit" between the wanted trajectory and the simulated one. Besides, the gap must be calculated through time and corrective measures must be taken.

If random effects take extreme unfavorable values with high frequency, this could lead the system to a possible crisis. Besides, even if this frequency is not high, a sequence of extreme happenings could lead the system to an unfortunate low performance level making impossible its recuperation, which would produce an imminent catastrophe.

2. THE SYSTEM

According to Dyner and Díaz (1992) it is necessary to design strategies on decentralization, leadership and information systems for highly centralized organizations but with poor institutional integration and poor information technologies. These ideas are based on the institutional evaluation methodology proposed in Suchman (1967).

The mechanisms of decentralization and the recognition of leadership as the main strategies will imply structural changes, the redefinition of authority levels, assignment of appropriate functions to the personnel and modifying processes and procedures.

The extensive incorporation of information technologies supports structural changes and the acquisition and use of information. The suitable information flow through flexible and reliable channels facilitates the timely decision making.

Ackoff (1981) makes references to the fluctuations between centralization and decentralization as something that a good number of organizations suffer.

Jacobsen and House (1992) sketches the characteristics of a social situation that leads to the charismatic leadership and describes the cycle that reverts to the beginning situation that supported this charismatic leadership. Such cycle seems appropriate to our case of study.

Brooke (1992) recognizes the importance of central administration to coordinate local authorities and to solve possible local disputes. The central level should assume the task of formulating general policies, to distribute functions and attributions and to establish agreements with other entities.

In the following section a general model to represent a system operating under the described environment is presented. The model incorporates the strategies being examined in order to evaluate their impact in the organization.

3. THE MODEL

The purposes pursued with the model developed are described as follows:

- To understand institutional behavior.

- To examine organizational behavior under new polices and strategies.

- To analyze the manner in which the system structure respond to external disturbances.

- To establish the effect of unsuccessful projects and the impact of uncertainties.

- To understand the training effects on the system behavior.

- To examine the incidence of resources on the institution results.

Figure 1 shows structural relationships of the selected strategies. The model represents an organizational system of general nature, however it was conceived for a particular institution.

As may be observed resources increase according to the level of leadership and decline with the financing appraisal of projects. These projects will be financed if their total costs are feasible with the assigned budget during each period; otherwise they will be taken to a waiting list or will not be considered. Some amount of resources are used for personnel training.

Leadership is included in a positive cycle along with resources and training. Projects formulation generates two cycles: A positive one reinforcing the level of leadership through successful projects, and a negative one due to unsuccessful projects which increases resistance to change.

The activities related to personnel training strengthen leadership by two mechanisms, directly as well as through diminishing resistance to change.

Decentralization directly forms a negative cycle which tenders to its stabilization. Additionally, this cycle is connected with the ones corresponding to leadership. Besides, its growth is reinforced with the increase of training which reduces resistance.

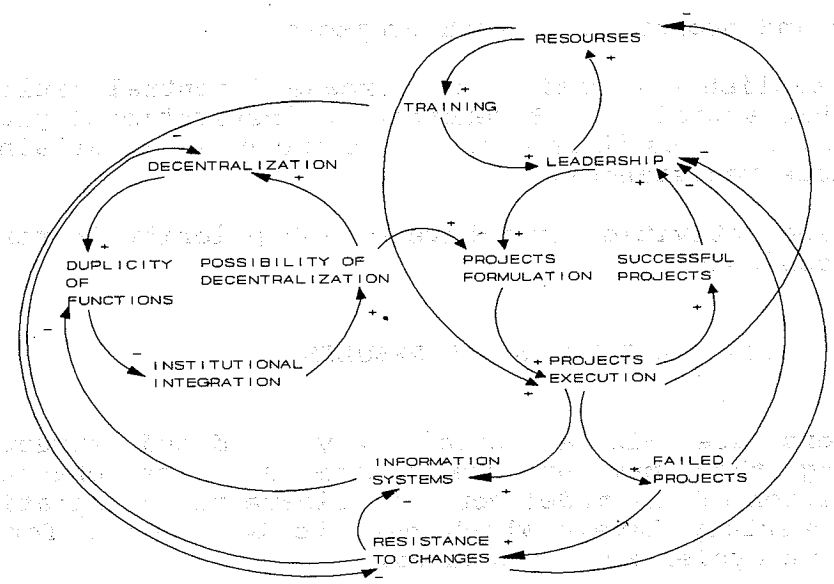


FIGURE 1. A Support Model for institutional strategies.

The variable resources form a negative cycle: They make possible projects formulation and evaluation but reduces resources availability.

Some susceptible points to produce structural sensibility on the system will be introduced next.

The positive cycle conformed by leadership - resources - training. Such levels and particularly the variable leadership can strengthen the structural behavior.

Training leads to reduce the resistance levels which at the same time reinforces leadership and information systems (increased as well by successful projects). And therefore strengthen the decentralization cycle.

By suitable decisions making it would possible to reverse the system declining tendency. Some of the recommended measures are listed next.

- To increase the proportion of successful projects. Its adequate control can be conceived as an institutional commitment to establish some mechanisms that facilitate

success and promotion of such projects.

- To establish a campaign to increase decentralization and leadership appraisals. Strengthening institutional presence on the lower units it is possible to increase its attainments and reduce resistances.

- Training activities must have a high priority in terms of budget assigned.

4. ESTIMATION, VALIDATION AND RESULTS

Parameters are -in a certain way- reduced structures; modifying them may produce system dynamics changes. A redefinition of the model could implicate the elimination of some elementary levels which need to be replace for more complicate cycles and structures.

If the simulated time horizon is very extensive a lot of quantities tend to be variable more than constant values. Through the modeling process some parameters can become flexible in order to reproduce the system behavior.

Considering that past does not condition future on a significant way the tendential stages will be less probable every time and the model validation will have to incorporate the idea of model utility in order to plan and control the system.

4.1 BASIC SCENARIO (Figure 2)

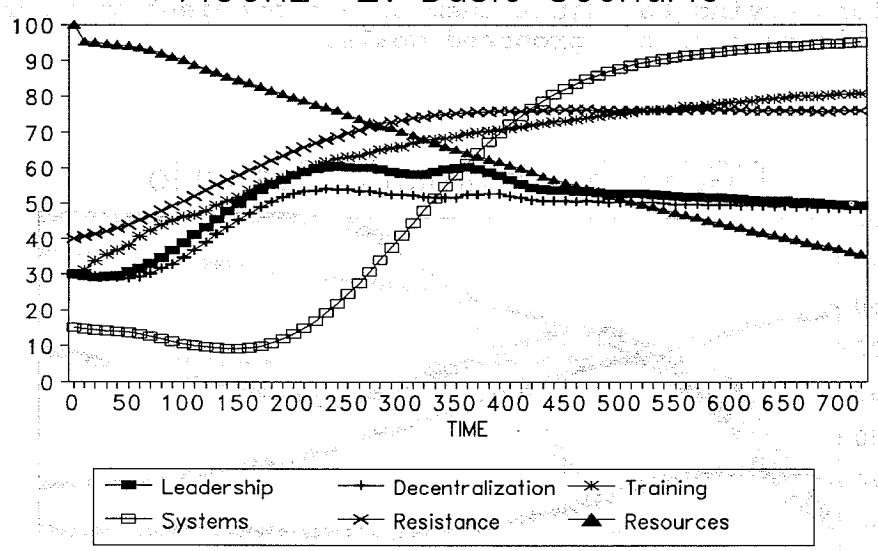
Supposition: Low decentralization levels, leadership to train personnel and to develop information systems. Considerable level of resistance and acceptable probability to obtain successful projects.

Figure 2 shows the behavior followed by the system. Leadership starts with a slow declination. It increases as a result of the impact of the successful medium and long term projects. Its appraisal falls with the apparition of unsuccessful projects and the increment to the resistance to change. At the end it shows a softly declining tendency with a small peak during the period in which it stabilizes the change resistance.

Decentralization increases on an accelerated way during the time in which there is a wide gap between management concentration and decentralization. Then its increment appraisal starts diminishing because the gap begin to close.

The levels of decentralization and leadership show a strong positive correlation.

FIGURE 2. Basic Scenario



The resistance to change increases with the unsuccessful projects and declines with the successful ones. Information systems decline at the beginning because of their own obsolescence. They grow with successful projects and their increment are soften with unsuccessful projects and with the increase of the resistance to change.

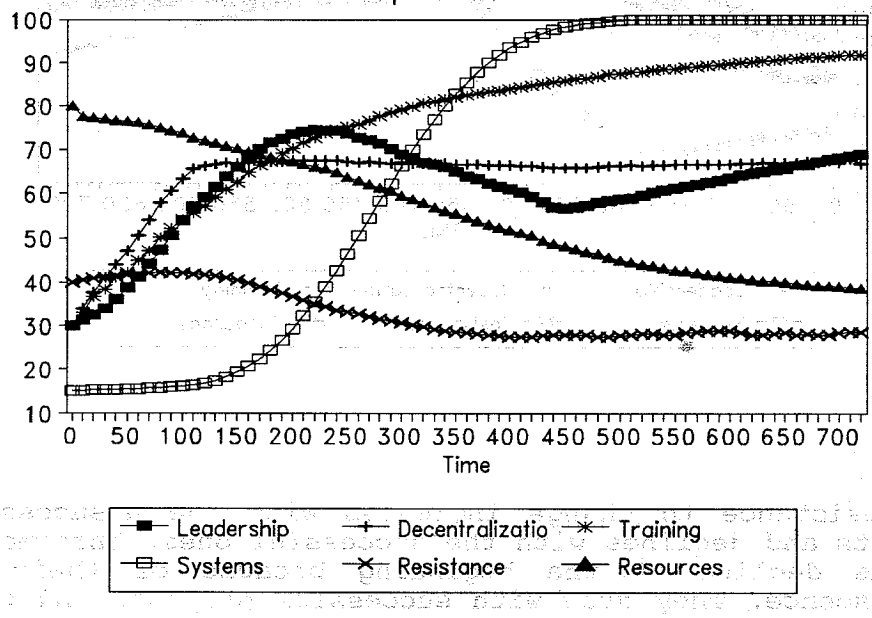
The training process presents a growing behavior during all the simulation horizon, however its growing appraisal is increasingly reduced and latter presents a tendency toward its stabilization.

The level of resources presents during a short time a rough fall because of the money needed to finance the new projects and the low leadership level. With the increase of leadership, this fall presents a slow period of decay and latter it comes down more rapidly. The level of resources is not a planning object itself but a consequence from other variables on the system and its environment.

4.2 OPTIMIST SCENARIO (Figure 3)

The techniques of prospective and dynamic estimation considers parameters as functions of time or other variables. The flexible estimation uses the objectives as internal functions of the systems results. The controllable estimation interpret these parameters as planning and control functions trying to adjust them on a convenient way for the accomplishment of the proposed goals.

FIGURE 3. Optimistic Scenario



It is important to notice how resources decrease gradually, specially very slowly during the time intervals when leadership shows a growing tendency.

The "Goodness of fit" between the values produced by the model and the objectives of the system is measured by the index of tendency. That is the percentage of data variation (the objectives) reproduced by the corresponding variable of the model (the simulation results).

This index tries to measure the utility of the model with respect to knowledge if the established objectives are feasible or not. The calculation for this exercise give the

following results: Leadership, 94.1%; decentralization, 87.6%; information systems, 97.2%; training, 97.0% and resistance, 81.9%.

4.3 UNCERTAINTIES (Figures 4 and 5).

The basic scenario, Figure 2, shows a similar behavior to a deterministic one where random variables have been removed. It is supposed that the last one presents an average behavior of the system under normal conditions of operation.

To illustrate the system behavior under stochastic variations alternative scenarios were considered with different random generator seeds. Results show a specially critical behavior (between the weeks 200 and 400 which approximately correspond to the years 5 and 9).

Figure 4 shows the presence of a sequence of unfortunate consecutive events which lead to catastrophe in the system. Figure 5 shows the effects of several consecutive unsuccessful events. However such behavior is more gradual.

FIGURE 4. Unfortunate Scenario

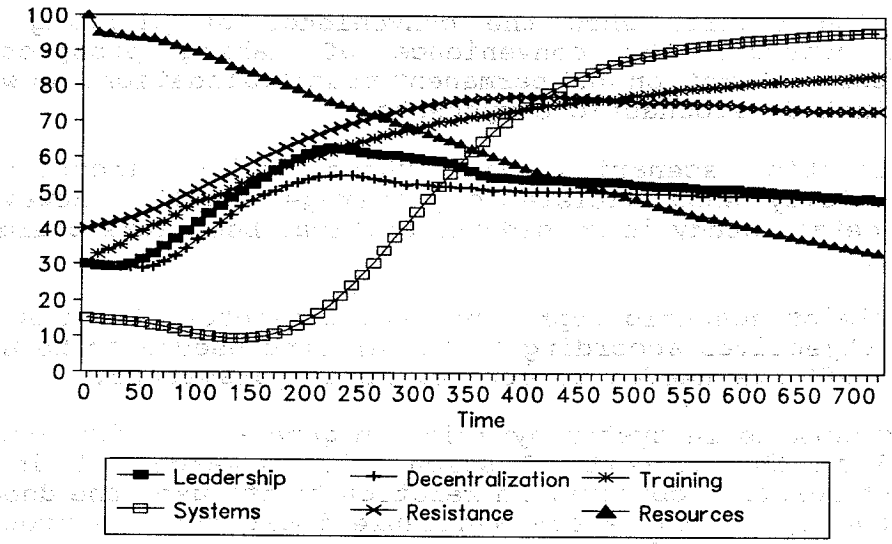
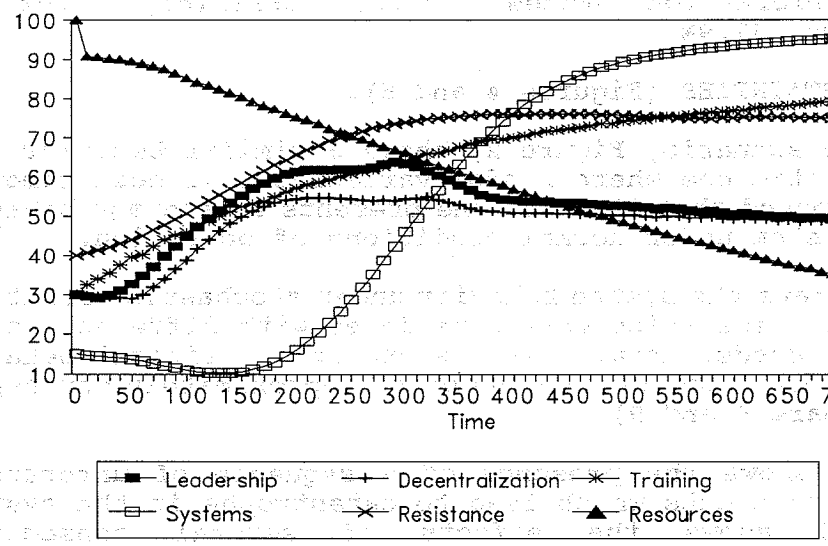


FIGURE 5. Unsuccessful Scenario



5. CONCLUSIONS

Simulation results show the convenience of planning and system control, the convenience of making prospective parameters estimation and permanent model validation, as well as to include stochastic components.

Deterministic scenarios and those which incorporate stochasticity show satisfactory average results. However, when a detail study is considered critical behaviors could be observed.

The optimist scenario represents the trajectory towards the system objectives according to the efforts needed to be made and the efforts needed to control model parameters.

In this work as in system dynamics in general, validation is focused in the context of scientific research. It is an inherent relative concept. In relation to its use, the debate still continues; there are available tools but the problem depends on the modeler.

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