THE REPRESENTATION OF VALUES IN SYSTEM DYNAMICS MODELS OF ORGANIZATIONAL PERFORMANCE

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ABSTRACT

A theoretical framework from the field of Organizational Theory called the "Competing Values Approach to Organizational Effectiveness" was used to analyze five System Dynamics models of organizations. This framework is a perceptual ordering of criteria that are often used to evaluate organizational performance. An example of the procedures involved is discussed using Richmond's "Organization Evolution" model. The purpose of the exercise was to (1) determine if it was possible to express the behavior of a dynamic model in terms of the Competing Values Framework, (2) discover what conceptual and technical problems might arise, and (3) draw some conclusions about the usefulness of the Competing Values Approach to system dynamicists and the usefulness of System Dynamics to organizational theorists. It was found that it is possible to formulate dynamic models in terms of the Competing Values Framework. However, conceptual and technical problems arise since organizational theorists and system dynamicists tend to work at different levels of abstraction. The Competing Values Approach may be used as one of many theoretical frameworks by system dynamicists as an aid to organizational inquiry. Organizational theorists, on the other hand, can make use of System Dynamics since it allows a researcher to study structure and complex interactions over time.

INTRODUCTION

The study of organizational performance involves value-based judgments. This is the lesson of a framework called "The Competing Values Approach to Organizational Effectiveness" [1]. This framework is a perceptual ordering of eight sets of criteria which are often used to measure organizational performance. These criteria can, in turn, be shown to be related to a certain view of organizations which is held by those who study them. This approach was applied to five selected system dynamics models of organizations. The application of this framework showed that most of these models focus on only a few sets of performance criteria and that these sets varied with each model. This is not surprising since most models of organizational effectiveness in the literature are narrowly focused and the method of system dynamics also encourages such a focus. Most of the dynamic models examined either ignored or only implied that there might be a broader spectrum of criteria used to measure organizational performance.

The application of the "Competing Values Approach" also demonstrates the conceptual difficulties involved in translating the constructs and operationalizing the concepts of organizational theorists in order to present something useable to the system dynamicist. Each can make use of the other's insights.

However, one should understand that there is not a perfect complementarity between the method of System Dynamics and the field of organizational theory. Research that may be useful to both the system dynamicist and the organizational theorist will have to proceed with some caution and care. In this paper I will (1) explain "the Competing Values Approach to Organizational Effectiveness," (2) give an example of its application to a dynamic organizational model, (3) show the results of its application to other models, and (4) summarize some of the issues raised by this exercise.

THE COMPETING VALUES APPROACH TO ORGANIZATIONAL EFFECTIVENESS

This approach attempts to bring order to a field that is noted for its confusion. "Organizational effectiveness" has as many meanings as there are theories of the organization. Much of the effectiveness literature centers on "goal accomplishment." Others criticize the goal paradigm. Some would judge an organization effective if it is "efficient." Still others see the most important criteria for effectiveness as how smoothly the organization runs. Approaches and opinions continue to multiply. Growth is often considered the sign of a successful organization. Those in the human relations school evaluate organizational performance on the basis of how well off the employees perceive themselves to be. How one approaches the study of organizational effectiveness depends on which criteria one is using.

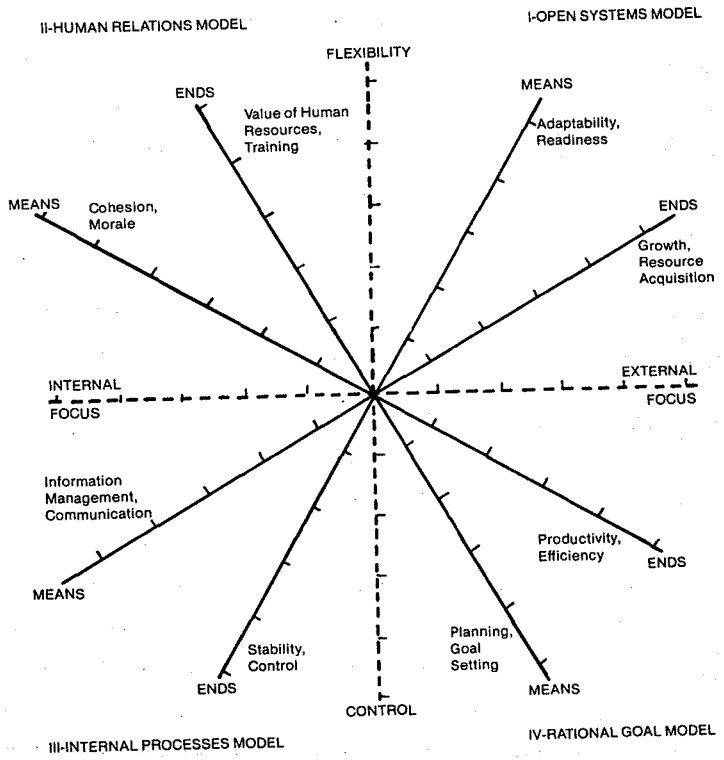
The problem demonstrated by the use of so many different criteria is that "organizational effectiveness" is a construct or an abstraction that cannot be objectively specified. The criteria for effectiveness are concepts which may be operationalized in specific terms. But, when a model of organizational effectiveness is presented in terms of a few criteria, only a small part of the total construct space of "organizational effectiveness" is examined. An organization may be effective on the basis of one criterion and ineffective on the basis of another. Thus, no clear idea of "organizational effectiveness" emerges. We see parts, but not the whole [2, pp. 107-112].

The effort to map the construct space of organizational effectiveness with proper criteria has been, until recently, a largely intuitive or "arm chair" effort. Following Pennings' and Goodman's call for an empirical approach [3, p. 165], Quinn and Rohrbaugh conducted a series of studies which involved gathering judgments about organizational effectiveness from recognized experts in the field. Using a modified list of Campbell's [5] criteria for measuring organizational effectiveness, they impaneled experts who gave judgments about the similarity and dissimilarity of every possible pair of sixteen items. With these comparison ratings, it was possible to identify the cognitive dimensions by which these comparisons were made. Using multi-dimensional scaling, it was possible to identify three dimensions which were most prevalent in explaining the variance among comparisons [1, pp. 122-130].

Quinn and Rohrbaugh found that the three dimensions which emerged can be taken as independent axes or continua that represent core values shown in Figure 1. The vertical axis represents a set of values ranging from an emphasis on flexibility to an emphasis on control. The horizontal axis indicates a continuum ranging from an internal focus to an external focus. Bisecting both axes, and running through the third dimension is the axis which represents a set of values ranging from an emphasis on means to an emphasis on ends. This axis is represented in two dimensional space by having these means and ends imbedded in each of the four quadrants. These three axes taken together represent the three sets of core values of the Competing Values Framework.

Associated with means and ends in each quadrant formed by intersection of the horizontal and vertical axes are eight sets of performance criteria, sixteen in all, which were drawn from Quinn and Rohrbaugh's study. Figure 1 presents the distribution of these criteria along with the core values. In Quadrant I, the two sets of criteria are adaptability - readiness and growth - resource acquisition. The former is a means, while the latter is more of an end. In Quadrant II, cohesion - morale is a means, while training - value of human resources is an end. In Quadrant III, information management - communication is a means, while stability - control is more of an end. Finally, in Quadrant IV, planning - goal setting tends to be a means, while productivity - efficiency is an end.

FIGURE 1
Three dimentional representation of effectiveness criteria



Listed in the four corners of Figure 1 are four general models which encompass the major classifications of organizational models found in the literature. Examination of the organization as an open system center on its sensitivity to the environment, hence the value on an external focus is shown. This view of the organization also concentrates on the organization's effort to acquire resources from the environment in order to grow. To deal with the environment, the organization must be adaptable which requires a high emphasis on the other core value of flexibility.

The human relations model has, as its central concern, the people inside the organization. Thus it has an internal focus. Group cohesion and morale are valued as means to the end of making employees feel more satisfied with their work. The value of human resources and the training of individuals require the organization to emphasize flexibility in its policies rather than rigid rules.

The internal processes model shares the internal focus of the human relations model , but also emphasizes control rather than flexibility. The model concerns itself with the technical side of the socio-technical system. Means include information - communication that is used to provide stability and control within the organization.

Finally, the rational goal model of quadrant IV emphasizes control through planning and goal setting in order to produce goods and services efficiently. These goods and services are

then to be delivered to customers who form part of the "task environment" of the organization [4, p. 203]. This view of the organization also emphasizes the external focus of the open systems model.

As can be seen by the above description, each of the four general models has two complementary or neighboring models that share the same part of the control - flexibility or internal - external continuum. Each model also stands in obvious contrast to its counterpart in the opposing quadrant with which it shares no common part of these two continuua. For instance, the open systems model is obviously different from the internal processes model in environmental orientation, control values, and performance criteria. By the same token, Figure 1 suggests that a researcher who is strongly attached to the goal paradigm of quadrant IV is more likely to pay attention to issues involving planning processes rather than group processes which is the focus of the human relations model in quadrant II.

In summary, the "Competing Values Approach to Organizational Effectiveness" as presented in Figure 1 provides an integration of theories found in the organizational literature in general. More specifically, it provides a framework for observing how different performance criteria are associated with different views and models of the organization. Because of its comprehensiveness and parsimony, the framework is useful for a variety of purposes including generating hypotheses, studying the work of other researchers, field research, and organizational diagnosis.

Example of an Application

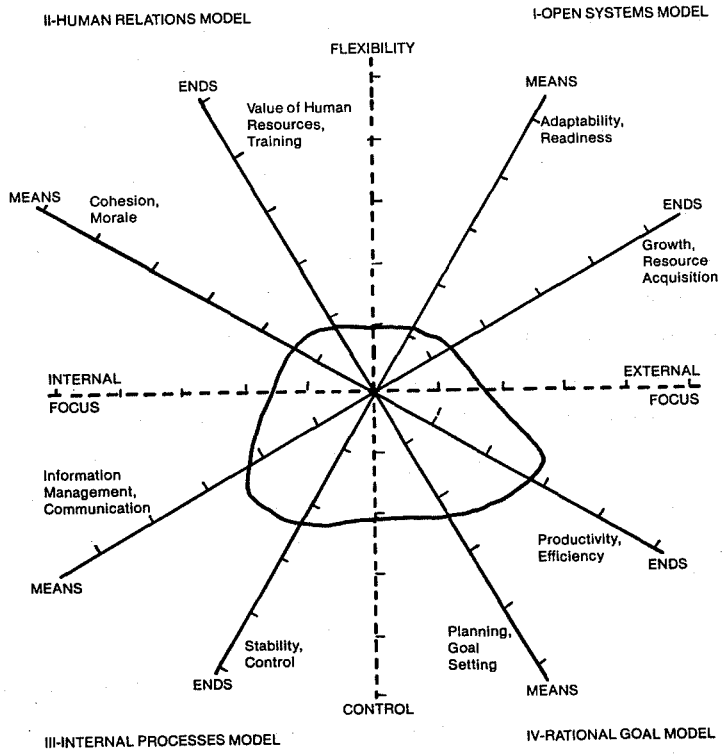
The latter two purposes have been the subject of recent attempts to examine what performance criteria and values are perceived by Employment Service employees to be emphasized in their organization. Employees answered questionnaires that tentatively explored issues involving the eight sets of performance criteria of the Competing Values framework. Using an appropriate scaling and after aggregating and averaging, it was possible to plot scores directly on Figure 1 [5]. What emerges is the employees' general perception of the organization's value profile. A generic example of a typical study's output is given in Figure 2.

This particular profile would suggest that people in the organization under study perceive that a strong emphasis is placed on control of internal processes for the purpose of efficient delivery of good and services. Since every organization has different goals and processes, the operationalization of performance criteria would vary with each organization studied. But, although specific items would vary, the general framework would remain the same. The "Competing Values Approach" gives the researcher a tool which allows the examination of a broader spectrum of organizational performance areas than that which might be covered had the organization been approached on a more intuitive basis.

APPLYING SYSTEM DYNAMICS TO THE COMPETING VALUES APPROACH

The procedure for the application of the Competing Values Approach to dynamic models involved operationalizing as many of

FIGURE 2:
Example of an operationalization of the Competing Values Approach



the sixteen performance criteria of the framework as possible in in terms of a model's variables. Equations defining the relevant performance criteria as a function of an original variable, or set of variables, were added to each model and functioned as simple output variables with no feedback interactions.

An Example

The system dynamics model most amenable to this approach was Barry Richmond's effort which illustrates an organization undergoing structural change [6]. Richmond addresses system dynamicists in this study. His purpose is to suggest that there is a justification for using special limiting functions to model significant changes in a broad range of social and physical phenomena [6, p. 1]. Traditionally, these functions are considered to be poor technique. His specific example is of interest to organizational theorists.

Richmond draws on Greiner's paper, "Evolution and Revolution as Organizations Grow" [7]. Greiner suggests that organizations undergo structural changes as they grow from shoestring enterprises to large, product-diversified entities. At some point, this growth will cause problems within the organization. Richmond starts from this point and develops a model of a generic organization.

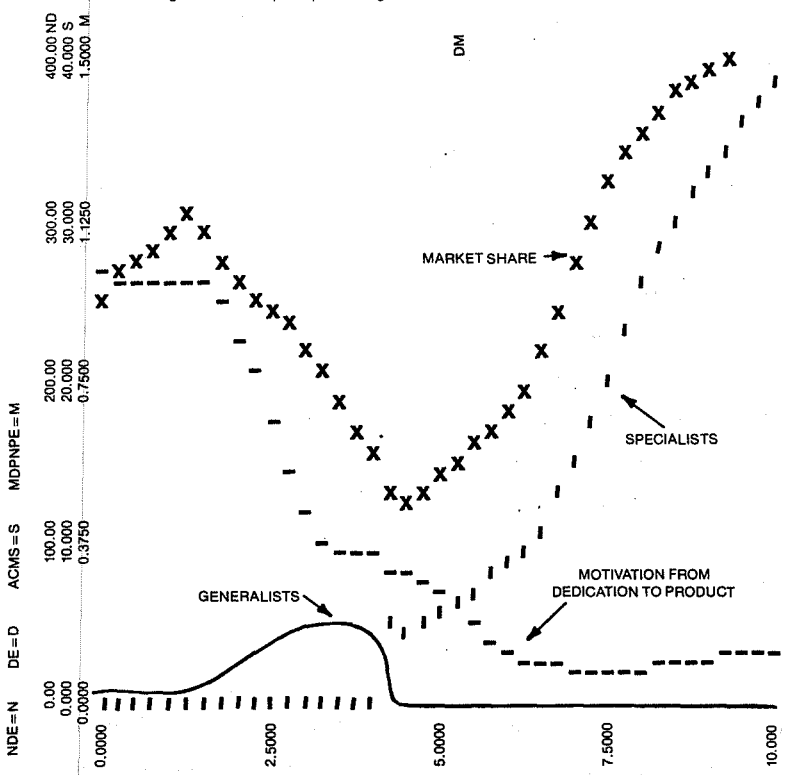
Base Run

The firm is founded by a few technically oriented entrepreneurs who have little liking for formal management

activities. The time available is distributed among four major activities which include sales, research and development, manufacturing, and formal internal communication which is used to coordinate the other activities and to motivate a small group of employees who are able to identify with the product. There is no problem as long as the firm holds a steady market share and the firm resembles a large group rather than an organization. There is no formalization of procedures under these conditions, and no need to move toward functional specialization or professional management.

Figure 3 summarizes the behavior of the firm. As the market share of this organization begins to grow. The employment of general workers surges and the problems of the firm begin. In the absence of other managerial initiatives in the face of a growing workforce, identification with the product falls, leading to a fall in group motivation. Manufacturing costs climb while the initial surge in sales depletes inventory. With the addition of more employees, none of whom are specialists, more time is needed for informal communication to keep up morale and to provide control and stability. Yet, less time is available for each employee. The larger absolute amounts of time required for other activities also increases yet efforts at all activities must be spread more thinly in relation to total output. Falling morale on the production line and inattention to research and development leads to a decline in product quality which, in turn, leads to falling market share [6, 14-18].

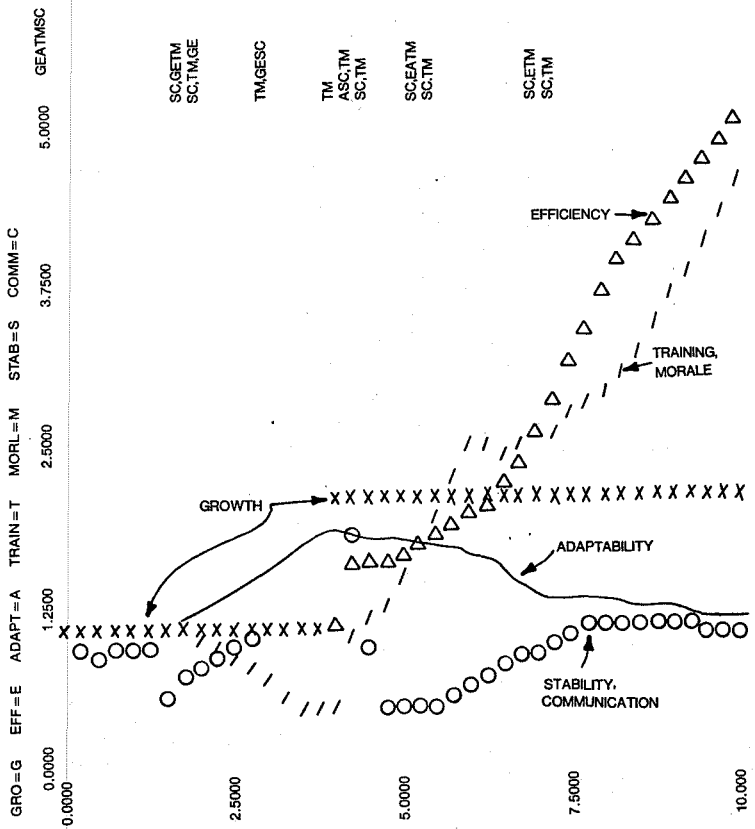
FIGURE 3: Original model output representing the firm



At year 3.5 a combination of the owners' perceptions of a need for change and their bias toward growth (two exogenous constants in the model) triggers a policy change. The firm transfers general employees to specialized functions and hires and trains new employees in specialities. The number of specialists depicted in Figure 3 is the summation of specialists in research and development, sales, manufacturing, and functional managers. With this change, the inefficiencies of past operations are eliminated, more time is available for communication and the firm regains and eventually exceeds its original market share [6, pp. 18-24].

Figure 4 illustrates the growing firm's changing value profile as policy is changed. At year 3.5 the emphasis on adaptability begins to fall since the firm is now beginning to use functional specialists. As this use proves more successful with time, the need for change declines. The emphasis on growth climbs from a "normalized" value of "1" to "2" at year 3.5 which represents the firm's owners predeliction for the policy change. The emphasis on efficiency rises as the hiring of more functional specialists and professional managers reduces manufacturing costs. Stability and communication initially fall as many general employees are hired. It initially rises as these employees are transferred. It then falls as the firm suddenly finds itself with many new functional specialists. After this point, it slowly climbs as production efficiencies allow for an increasing proportion of the total time available to be devoted to communication and the maintenance of stability which communi-

FIGURE 4: Output representing emphasis on "Competing Values" criteria



cation brings. Training of employees can be emphasized after functional specialities are delineated and worker morale climbs due to increased communication.

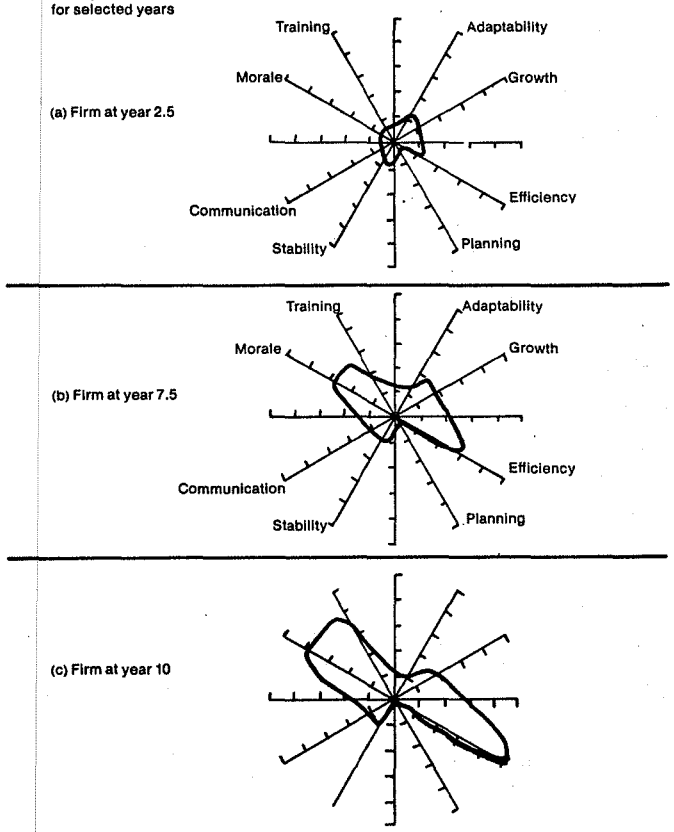
Figure 5 illustrates a cross-sectional analysis of the firm's value profiles for years 2.5, 7.5, and 10 respectively. The plotting units for this figure have a maximum of five points. The values are plotted using the output from Figure 4. Plotting from Figure 4, we see that the profile of the firm at year 2.5 indicates a low level of emphasis in all quadrants because of present policies. But, by year 7.5, a new growth policy has been put into effect and the emphasis on growth is twice what it was at year 2.5. Emphasis on morale and training also differs dramatically. By year 10, it can be seen that there are significant differences in the firm's value profile from that of year 2.5. Adaptability is down, growth and efficiency have increased, all criteria in quadrant II have high emphasis, and criteria in quadrant III are building toward "normal" levels.

Formulations for Criteria Variables

The formulation for each criterion variable or set of criteria variables is the ratio of the sum of the model variables that could be translated into a criterion of the Competing Values Framework at any given time over the sum of these same variables at time zero. This ratio is expressed generically as:

$$\frac{\text{Sum of criterion variable(s) at time X}}{\text{Sum of criterion variable(s) at time 0}}$$

FIGURE 5:
Value profile of firm for selected years



Such an expression allows the initial values of each criterion or set of criteria to be "normalized" at a value of "1" at time zero. In the case of Richmond's model, only one variable was selected to represent at least one of each criterion in each criteria set of the competing values framework with the exception of planning - goal setting.

Space limitations prevent a full discussion of the rationale for the choices of model variables which represent the seven sets of criteria for organizational effectiveness that are depicted in Figures 4 and 5. However, listed below are the equations which were added to Richmond's model which indicate one criterion from each of seven criteria sets and the model variable used to operationalize this criterion.

ADAPT.K = PNTCA.K

ADAPT - emphasis on ADAPTability

PNTCA - Perceived Need to Take Corrective Action

GRO.K = SRGO.K

GRO - emphasis on GROwth

SRGO - Switch Reflecting Growth Orientation

MORL.K = LEM.K

MORL - emphasis on MORaLe

LEM - Level of Employee Motivation

TRAIN.K = LEM.K

TRAIN - emphasis on TRAINing

LEM - Level of Employee Motivation

COMM.K = ICHPT.K

COMM - emphasis on COMMunication

ICHPT - Internal Communication Hours as a Percentage of Time available

STAB.K = ICHPT.K

STAB - emphasis on STABility

ICHPT- Internal Communication Hours as a Percentage of Time available

EFF.K = DE.K

EFF - emphasis on EFFiciency

DE - Differentiated Employees

Planning and goal setting are not specifically addressed in the model.

CONCEPTUAL DIFFICULTIES

The formulations shown above are by no means the only ones which may have been used to express the performance criteria of the Competing Values Approach to organizational effectiveness. Richmond's model has over three hundred equations and over two hundred and fifty variables. Many different combinations of these variables may have been used to produce formulations. To ask why these particular formulations were used and not others is to begin to explore some of the difficulties that arise when attempting to build "crosswalks" from one field to another.

Table 1 lists those models which were examined using the Competing Values Framework and specifies, through the use of "plus" signs those criteria which seemed to be conceptually easy to operationalize in terms of each model's variables. At the bottom of Table 1 is the arrangement of the three core criteria to indicate where the performance criteria appear in terms of the Competing Values Framework. The lesson of Table 1 is simply that these models tend to focus on a relatively narrow range of performance criteria compared to what might have been treated explicitly. As stated at the beginning of this paper, such a focus is characteristic of most organizational models from all fields. In many cases, this narrow focus is proper since many dynamic models tend to be problem specific in their level of inquiry.

Table 2 indicates those performance criteria that were either difficult to operationalize in terms of a model's variables and those criteria which appeared to be totally missing. Those criteria which appear to be completely missing, shown by a double "minus" sign, indicate for the most part, that these criteria wouldn't be considered relevant to the problems being defined or the questions being asked. Of more interest are those criteria which are indicated by a single "minus" sign. These indicate a difficulty in moving from a level of abstraction to a more concrete level that is often characteristic of system dynamics models.

Each of the criteria listed in the Competing Values Framework is relatively easy to operationalize provided one is

TABLE 2

SCALE OF CONCEPTUAL DIFFICULTY-CRITERIA EASILY OPERATIONALIZED

Non-existent in model: −−

Some Difficulty in Operationalization: −

Model	Adapt-ability, Readiness	Resource Acquisition, Growth	Morale, Cohesion	Value of Human Resources, Training	Information, Communica-tion	Stability, Control	Planning, Goal Setting	Productivity, Efficiency
Roberts' "Simple R&D	−	−−	−	−−			−	
Roberts' "Complex R&D"			−		−		−−	−
Hall's "Saturday Evening Post"	−−	−	−−	−−	−−	−	−−	−
Richmond's "Organiza-tion Evolution				−			−−	−
Lyneis' "Corporate Planning & Policy Design"	−	−	−		−		−−	−
	Means / External	Ends / External	Means / Internal	Ends / Internal	Means / Internal	Ends / Internal	Means / External	Ends / External

Flexibility——Control

TABLE 1

SCALE OF CONCEPTUAL DIFFICULTY-CRITERIA EASILY OPERATIONALIZED

No Difficulty in operationalization: ++

Little Difficulty in operationalization: +

Model	Adapt-ability, Readiness	Resource Acquisition, Growth	Morale, Cohesion	Value of Human Resources, Training	Information, Communica-tion	Stability, Control	Planning, Goal Setting	Productivity, Efficiency
Roberts' "Simple R&D					+	+		++
Roberts' "Complex R&D"	+	+		++		++		
Hall's "Saturday Evening Post"		++						
Richmond's "Organiza-tion Evolution	++	++	++		++	+		
Lyneis' "Corporate Planning & Policy Design"				++		++		
	Means / External	Ends / External	Means / Internal	Ends / Internal	Means / Internal	Ends / Internal	Means / External	Ends / External

Flexibility——Control

already aware of this outlook. Then, as shown in Rohrbaugh's [5] study, one can direct research to properly inquire about each criterion. However this exercise, as represented in Tables 1 and 2, began with the restriction of taking other people's view of the organization as a given. From this restriction, it is relatively easy to provide a classification of other people's work, a form of which appears in Table 1. But, since the performance criteria are really presented at the level of abstraction of a general concept, they may be only tenuously identified in an organization's own terms (i.e., model variables) unless a model is focused on an area of performance that is directly associated with these criteria.

CONCLUSION

A discussion of the differences between the outlooks and methodological approaches of System Dynamics and Organizational Theory is beyond the scope of this paper. Important differences are implied in the description of this study. However, some tentative conclusions can be drawn from this particular effort and they are discussed below.

The results of Tables 1 and 2 do not suggest that system dynamicists should not study organizations. The short history of System Dynamics contains many examples of insightful inquiry into the workings of businesses and institutions. The results of this effort only suggest that, while it is possible to create formulations which express dynamic organizational models in terms of a different framework, this particular type of exercise

may only be of limited usefulness to system dynamicists. Those who work with dynamic modeling may legitimately continue to use theories from other fields in order to construct models and the Competing Values Approach could be another useful framework with which to work when inquiring into some facet of organizational behavior.

This effort also suggests that organizational theorists could find more uses for System Dynamics. The fact that it is possible to create the kinds of formulations demonstrated in this paper indicates that the methodology of System Dynamics could be more widely used among researchers who wish to study organizational problems. System Dynamics is eminently suited for the study of structure and complex interactions that produce changes over time. Dynamic modeling allows the researcher to posit important relationships among variables in a sequential fashion without losing the ability to observe and examine the final results of these relationships. The ability to formulate these relationships and the ability to use theory-driven models to produce a convenient form of longitudinal analysis would be a valuable asset. It is also possible that this approach would help to explain some of the inconsistencies that appear in much of the organizational research that uses standard data analysis to generate hypotheses about certain "key determinants" that explain organizational behavior. So, while the methodology and outlook of System Dynamics is not entirely compatible with the field of Organization Theory, more use of the possibilities that do exist could benefit both fields.

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