A SCIENCE OF GOAL FORMULATION

American and Soviet Discussions of Cybernetics and Systems Theory

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CHAPTER

16

CYBERNETIC TOOLS FOR MANAGEMENT: THEIR USEFULNESS AND LIMITATIONS

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1 GENERAL SYSTEMS THEORY, CYBERNETICS, AND MANAGEMENT

When Stuart Umpleby called to invite me to participate in this meeting, he suggested that a useful contribution would involve a discussion of the application of the systems approach and Management Cybernetics in my consulting experience. Of course, to do so in the allotted time of 20 minutes will force me to commit the cardinal sin of systems thinking, that is, to be a ruthless reductionist. I thus stand the unfortunate chance of doing a great disservice not only to the principles and methods, but to the actual cases themselves.

Nevertheless, I shall try to simplify without completely trivializing and use a number of management related cases to highlight a few ideas concerning approaches that are rooted in systems thinking and cybernetics. As I go along, I shall comment about their usefulness, effectiveness, and limitations. Although the context of my comments pertains specifically to management, many underlying ideas have been touched upon during the last two days in one way or another by speakers concerned

with other seemingly unrelated topics. This fact in itself should give us some cause for satisfaction, validating, as it does, the unifying potential of the systems approach.

First, by way of orientation: I see systems thinking and cybernetics as two inextricably related bodies of thought that, not withstanding their precise history (concerning which, Professor Zeleny earlier shed some intriguing light), have burgeoned in the West since the forties and early fifties, largely due to the work of Ludwig von Bertalanffy and Norbert Wiener. These gentlemen, together with their associates and followers, laid the foundations for a new conceptual orientation and an intellectual tradition, many implications of which have still to find their way into guiding the manner in which we manage organizations and govern national and international affairs.

I choose to make the distinction between the systems approach and cybernetics in order to highlight the emphasis on general systems characteristics on the one hand and the more specifically focused attention on mechanisms of regulation on the other. Thus, if I were to distill the essence of each as pertinent to our discussion I would evoke some of the following ideas.

In relation to General Systems Theory there is the emphasis on wholeness and the relation of wholes and parts; the idea of connectivity; nestability; interdependence; synergy; and irreducibility. All of these point to fundamental characteristics of systems in general and highlight the idea that in dealing with systems strategies quite different from those effective in dealing with clock-like mechanisms are essential.

Cybernetics on the other hand focuses on the relationship between the structure of systems and their behavior, thus bringing to the fore the issues of structure, process, and organization. It also formulates general laws of regulation focusing on underlying mechanisms and, most recently, has concerned itself with recursive processes where the implications of self-observation and self-reference have to be taken into account.

The literature in both fields is vast and there is little purpose in dwelling on any particular aspect of it here. The point, however, is this: Over the last few decades a considerable body of thought related to the "system sciences" has evolved. It now ranges in scope from the philosophical and general to the methodological and specific. Taken as a whole it offers many useful tools for tackling problems encountered in Management situations. Note, incidentally, that I use the term Management with a capital M meaning the governance and proper guidance of human affairs—from the personal to the managerial and societal.

Here, if I may make use, or, since it was intended in a different context, possibly a misuse, of the framework suggested earlier by Professor Sadovsky, I would characterize the range of this chest of tools as follows:

- On the Philosophical level we have that particular conceptual framework usually referred to as systems thinking or the systems view of the world.
- On the General Scientific level we have the formulation of general laws, for example, in cybernetics, the laws of control, as exemplified by Ashby's Law of Requisite Variety.
- On the Specialized Scientific level we have, for example, the well developed mathematics of servo-mechanisms.

- Finally, on the level of "Methodics," there are various system-related techniques such as System Dynamics simulations, various methods of operations research, and the like.

This, of course, is only a crude way of saying that much is available on different levels. Yet, there are important limitations. Thus, for example, while the "philosophical" and "general scientific" levels offer particularly powerful guiding principles that help orient our thinking when dealing with complex systems, the more specific and well developed techniques are sometimes useful, but often not potent enough. Many non-trivial management situations involving high complexity, a high rate of change, the need for integrating many conflicting forces, and, in particular, the need for genuine innovation, creativity, and novel design, still defy most of the available analytical tools. The problem is not in the least one of lacking the appropriate epistemology. We still attempt to tackle complexity by reducing it to simple manipulable components. Therein, I suspect, also lies the cause for the emergence of baffling paradoxes of the kind referred to earlier by Mitroff.

Ultimately, the consultant, was well as the manager, depends on an approach that combines an art with a science. Assisted by available techniques, both have to find their way by relying on "feelings," intuition, and experience. I suspect, however, that managerial instincts could be sharpened significantly by effective exposure to systems thinking.

2 SELECTED CASES OF MANAGEMENT INTERVENTIONS

In describing our own experience at The Cybertec Consulting Group, with projects in which systems thinking and management cybernetics were particularly useful, I chose three cases, all carried out in the field of health care. One involves the assessment of the impacts of a proposed new program on the operations of a teaching hospital. The second involves the design and implementation of a comprehensive strategic planning effort at a leading academic medical center, and the third has to do with a management organization study at that same medical center and a number of other similar institutions. Let me touch briefly upon each.

a. The first case involved a major teaching hospital in New York City. Management in that institution developed some innovative program ideas intended to contribute to the overall quality of patient care, as well as to a cost reduction in hospitalization. The key feature of the new program related to the construction of a new sub-acute care facility to which patients would be transferred near the end of their stay, prior to discharge. The main argument was that given an average length of stay of ten days in the acute hospital, a transfer of convalescing patients for the last two or three days of their stay to a non-acute facility, where medical technology and nursing care would not be as intense, would reduce the overall cost of hospitalization.

At the same time, patients would benefit by staying in a more relaxed, less institutionalized environment where, together with a friend or a family member, a "care-partner," they could receive special education about their condition. Overall, the program would ease the transition from hospital to normal routine and ensure better post-hospital care at home.

The cost reduction argument appeared logical enough since, at the time, the reimbursement system in New York paid hospitals a set amount per patient day regardless of the intensity of service required. Thus, over an average of ten days, seven will be spent in the acute, costly facility and three in a less acute, less costly environment, thus reducing the average overall cost for the hospital for the given level of reimbursement.

This straightforward, linear view ignored the underlying systemic dynamics of the situation, which could potentially produce unintended results, some with serious financial implications. In fact, a patient transferred to the new sub-acute facility would result in an empty bed at the main hospital. Because this particular institution had a significant queue of patients waiting for admission, an empty bed would be immediately filled with a new admission representing a type of patient that normally requires considerable resources. The rate of patient throughput would accelerate and, as a result, the new program could actually translate into a considerable intensification in utilization of services. Thus, while average cost per episode would decline, the overall cost of operations could expand significantly. Since reimbursement levels remain unchanged, the resulting impact on the "bottom line" could be intolerable.

This was clearly a systemic problem because the actual level of intensification of services would largely depend on patterns of admissions and patient mix, and these, in turn, were likely to change with the introduction of the new sub-acute facility. Under different circumstances, different shifts in admission patterns and patient mix might result, giving rise to different levels of service intensification with related cost implications.

It became apparent that different management policies and patient protocols could greatly affect the outcome. Therefore, a better understanding of potential impacts, as well as the underlying dynamics of the various forces at play, were important if the clinical and economic viability of the whole program were to be assured. Further study was, therefore, encouraged and the vehicle used was a System Dynamics simulation model that made possible the study of impacts given various scenarios of patient profiles and management policies.

An extensive analysis of the critical factors affecting patient flows and occupancy balance between the two facilities was undertaken, revealing the intricate interactions among the key variables. Figures 1 and 2 highlight the underlying structure and dynamics of the system involved.

The model as a whole was conceived as a series of linked levels, shown in Figure 3. The first represented the underlying dynamics of critical factors affecting the flow between the two facilities. The second translated sets of simulated conditions into utilization patterns as manifest in operating room time, intensive care beds, diagnostic procedures, nursing services, and the like. The third computed the impact of changing utilization patterns on resource requirements and the last produced the resulting financial picture.

All in all, the development and use of the model enhanced management's understanding of the direct and indirect impacts of the new program. It was critical to the redefinition and refinement of some of the original concepts, it greatly facilitated

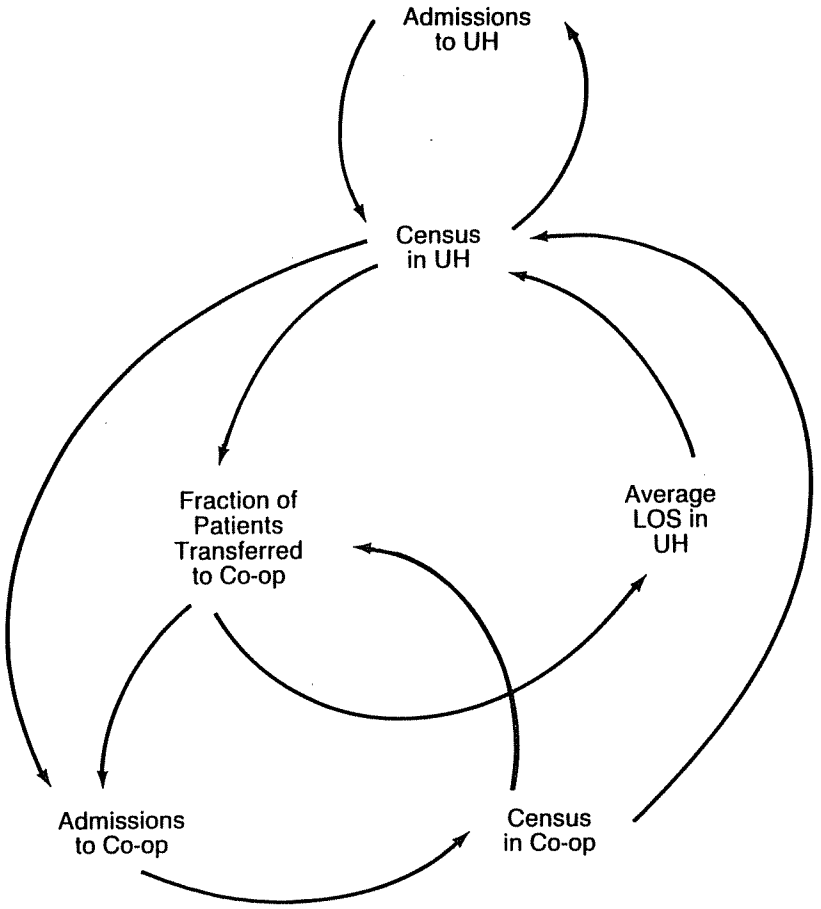

Figure 1 Several feedback loops affecting the census in University Hospital (UH) and the co-operative care facility.

implementation planning, and helped educate various groups in the hospital about the new program and its implications. The process of developing the model, undertaken closely with management, was particularly important in itself, since it forced key participants to clarify their thinking, allowed them to test continuously their assumptions, and produced an ongoing forum for dealing with differences of opinion and evolving an institutional consensus. All of these were as significant, perhaps ultimately even more so, as the actual numerical results of the simulations. This, in summary, was a clear case of a management problem where a systems approach backed by a well developed systems technique contributed greatly to understanding and guiding action.

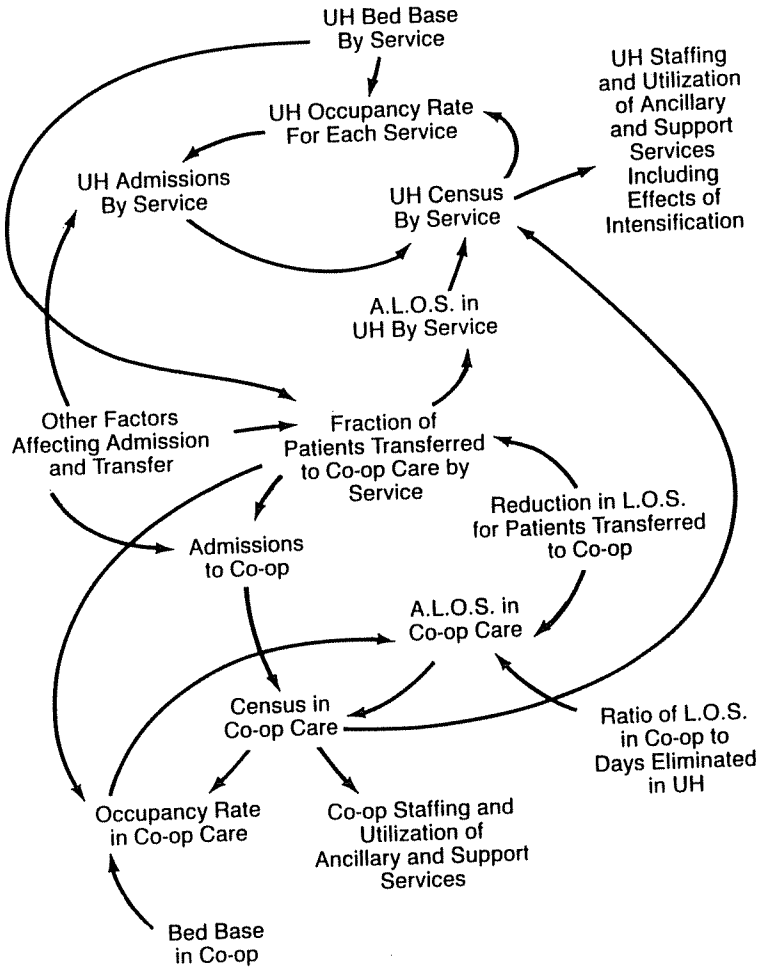

Figure 2 Examples of factors affecting occupancy balance and intensification of services.

b. The second case involved the design and subsequent implementation of a strategic planning process at a large academic medical center, also in New York. This particular institution consisted of a 1,200-bed hospital where some 36,000 in-patients where discharged each year, and some 250,000 clinic visits and 60,000 emergency visits were recorded annually. The center operated a medical school in which some 460 medical students were enrolled, it offered both Ph.D. and M.D./Ph.D. programs and was managing, on the average, some 900 funded research projects at any given time. The management of this complex institution, having just completed a three-year

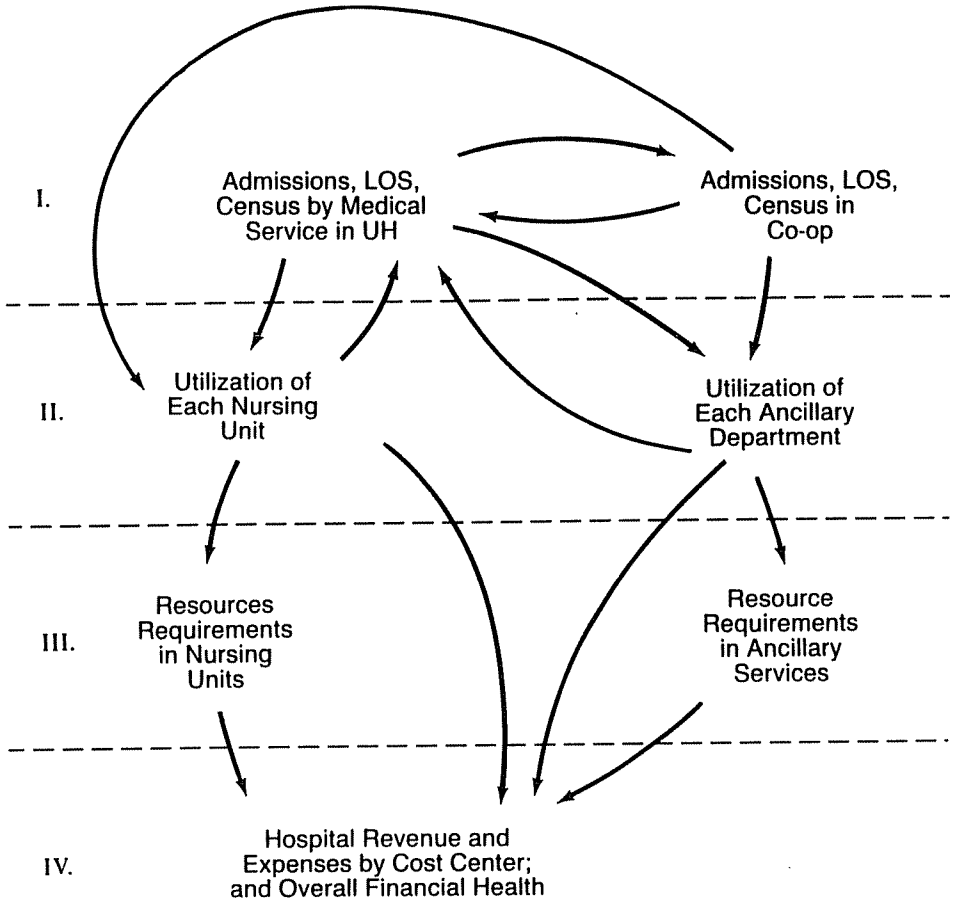

Figure 3 Model overview.

effort of stabilizing and shoring up operations, was ready to orient its views to the future. We were retained to assist them in developing their long-range plans.

The following concepts emerged as important guiding principles in designing and carrying out this strategic planning assignment.

- **A Whole System View of the Institution**

Early in the planning process, the tendency of various key players was to focus narrowly on isolated problem areas. Different groups of participants would emphasize this or that specific problem as being critical to the future and thus the most important to resolve. An important consideration in laying out the planning process, was,

therefore, to shift the emphasis at the outset to a whole-system view of the institution, highlighting the key factors that affect its well-being and the way these interact. This was done by developing a series of visual diagrams, "system images," an example of which is shown in Figure 4. Single planning issues could thus be viewed as parts of a totality presented in such a way that the overall complexity and interdependency of key components was explicitly recognized. This was extremely useful in scoping out the planning effort, understanding its proper boundaries, and developing a consensus concerning the critical areas which ought to come under review.

- **The Planning Process was Issue Driven**

A complex institution such as the one involved is an extremely active "living" organization with its own tradition, internal culture, many, sometimes conflicting, constituencies, competing interests, and "a way of doing things." The momentum of its ongoing processes cannot be halted to await the development of a "master plan," nor can all institutional problem areas be dealt with at one time. Accordingly, the planning process was issue driven, meaning that very early attention was focused on identifying the most critical issues requiring long-term resolution, thus defining the targets for the planning process itself. By separating the critically important from the secondary and even imaginary problems, the early identification of key planning issues saved valuable time as the process unfolded.

Issue identification, incidently, derived from the usual type of external environment analysis on the one hand and an exhaustive analysis of various institutional profiles on the other. Perhaps the most important step at this phase, however, was dealing with the issue of purpose—the institutional mission. This was resisted at first as being a trivial pursuit, but was acknowledged to be of vital importance as soon as it was realized that fundamental differences of opinion existed among key players about policy issues concerning the institutional mission. Resolving these differences facilitated decision making later on when issues of program priorities, resource allocation, and the like had to be resolved.

As part of a competent planning process, the issue of institutional purpose, is, in my view, probably the most important. Around it revolves the whole question of institutional identity, its internal cohesion, and the very reason for its being. While this statement may appear to be too obvious to be of any consequence, the fact is that too often planning processes are data driven. The focus is on "information gathering" and the forest is easily lost for the trees. Data is useful for testing, validating, calibrating, and refining, but the underlying purpose provides the framework that gives it meaning. Purpose, after all, is a central driving force in social systems that by their very nature are "ideal-seeking." Confronting the issue of purpose may, at times, be painful, but dealing with it effectively can ultimately contribute significantly to the strength of the institution as a whole.

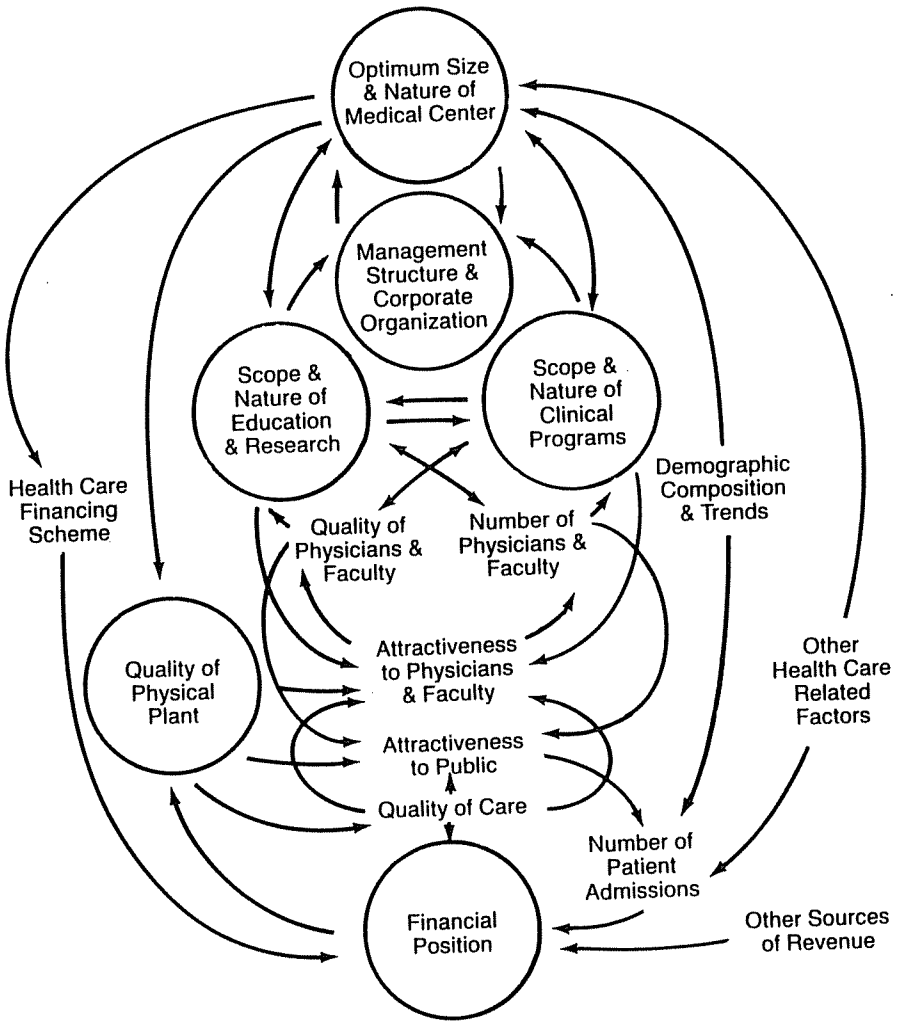

Figure 4 A system view of the medical center showing the interaction of some key variables.

- **The Concept of Levels of Management**

In meshing the planning process with the existing fabric of management the concept of levels of management, differentiating between logically and operationally distinct domains of management concern, offered a useful guiding principle. It is graphically depicted in Figures 5 and 6. The distinction between such levels of management

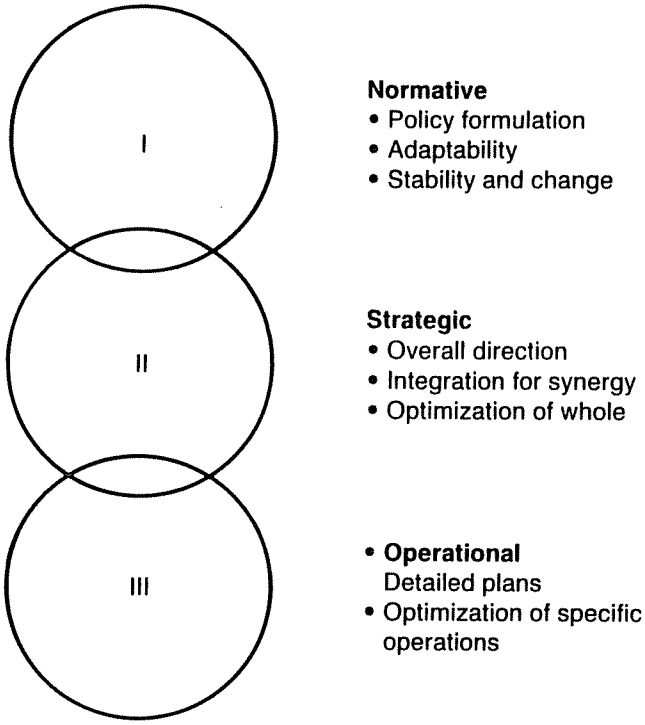

Figure 5 Levels of management/planning.

concerns, ranging from mission and policy to strategy and operations provided an important concept in structuring the planning process; organizing the content and sequence of issues to be dealt with; and defining the key fora for study, discussion, formulation of recommendations, and decision making.

In its essential features the concept of levels of management follows Stafford Beer's insights into the general anatomy of viable organizations. The underlying point, pertinent to structuring planning processes, is that approaching problems related to each such level requires a different conceptual orientation, a different method of handling, a different emphasis, a consideration of information at different levels of detail, and, more often than not, a different group within the organization.

With this view in mind planning issues can be organized as a two dimensional matrix: By functional type, such as financial, organizational, product related, and the like, as well as with respect to the proper level of management to which they logically belong—normative, strategic, or operational. Such a careful sorting out can be time consuming, but it serves well in helping to avoid the type of confusion that often results from inappropriate mixing of focus, logic, and language as they pertain to different levels of management concern.

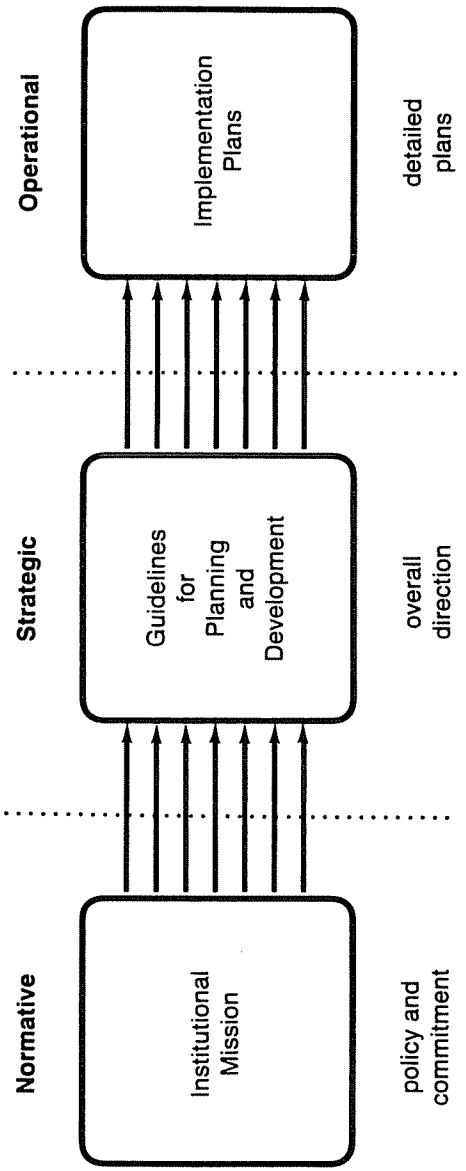

Figure 6 The planning process: conceptual sequence.

• **Participation and Underlying Structure**

Academic medical centers tend to be highly diversified pluralistic organizations where decision making and authority are diffused and where many key individuals play a number of different, sometimes conflicting, roles. This characteristic only reinforced our conviction that in order to be effective, the planning process should be organized to allow for a high degree of participation. An important element in the approach underlying this particular project was provided by the idea that key players—decision makers and those responsible for implementation alike—should be the actual authors of the plans, and that extensive open participation in formulation and refinement of ideas at all stages of the planning process were essential for building the consensus and the commitment required for successful implementation.

Some two hundred individuals ranging from board members and management to faculty, other important constituencies, and various specialty consultants were involved at one time or another. Orchestrating their work and harnessing their various contributions into a coherent effort was in itself an important task in the planning process.

Though popular in recent management literature, the idea of participative management or participative planning is not easy to apply. Beyond mere lip service it requires discipline, patience, and structure. To be effective, the energies such processes release must be carefully and thoughtfully channeled in ways that enhance creative results. From the view point of cybernetics, of course, broad based participation relates directly to the concept of making full use of an organization's potential variety and enhancing its own self-organizing capabilities.

The idea of underlying structure is also important. The structure is the vehicle through which the process actually takes place. Too often a well-functioning institutional structure for planning simply does not exist. It must be deliberately designed, put in place, and continuously reinforced. The functions of various groups involved need to be defined and the mode of their interaction specified. In this particular case a mechanism consistent with the concept of levels of management and reflecting the various functions and tasks required by the planning process was constructed. Essentially it consisted of a governance level steering committee, a senior management and faculty planning group, special institutional task forces, and a core group of planning staff and consultants providing the technical support and the overall management of the process itself. Overlapping membership was used to ensure continuity.

Properly designed and competently managed such a structure provides both for the necessary individual activities and for their continuous integration. It can act, in fact, as a giant homeostat mediating the various processes involved, facilitating the settlement of issues and the formation of institutional consensus.

In summary, the process as a whole proceeded in a sequence of four reiterative steps, moving from the general and open-ended to the ever more specific and committed. Planning issues were defined, their implications analyzed, a strategic direction was agreed upon, and was then given sharper focus in the formulation of a strategic plan. Implementation planning in all the essential areas of programs, facilities, finance, management, and organization followed. All in all, this project, unlike the

previous one, did not rely on a specific system methodology alone. Here, a general systems orientation and the cybernetic view of management planning and control provided a guiding framework for the overall design and actual conduct.

c. The third case, which I can only touch upon very briefly, involved the redesign of an organization's management structure. This assignment was also carried out in the health care industry. I would only mention that this particular project relied heavily on using Beer's very powerful Viable System Model in diagnosing the weaknesses of a medical center's existing organization and synthesizing a design for a new one, more compatible with its future needs. For those of you who are familiar with Beer's work I would add that this particular project involved an overall system unification on a corporate level with some specific design interventions on levels III, IV, and V of the Viable System Model.

3 LIMITATIONS AND POSSIBILITIES

I hope that these brief examples are sufficiently convincing in buttressing my own conviction that general systems theory and cybernetics offer many important conceptual tools for dealing with management situations. But there are some difficulties. One in particular was alluded to earlier. It has to do with the notion that while some system techniques are too limited to be useful in complex management situations, others are too general to offer precise prescriptions for unambiguously resolving specific problems. The issue, it appears, is essentially an issue of requisite variety, namely, a poor match between existing models and the realities to which they pertain.

Two different attitudes are possible in this regard. One would assume that all we need are better, more refined theories, models, or equations, which will offer more powerful tools for prediction and control. With the aid of these, it can be argued, the difficulties and paradoxes encountered in dealing with complexity will eventually disappear. The other approach, more correct, in my view, would hold that there is an inherent uncertainty involved in genuine complexity that cannot be completely removed.

There are a number of reasons for such a claim. One has to do with the idea that management activities are exercised in the domain of social systems, a domain that is characterized by an enormous internal variety that negates the possibility of a single model or one single truth. Another reason relates to the relativistic aspect of the notion of "system." Systemic entities do not exist as an entirely objective part of an external reality. They are invoked, in fact, by observers and, therefore, their very definition is subject to myriad individual perceptual sensitivities, interpretations, motivations, and other "subjective" influences. Yet another reason pertains to the recursive characteristics of management processes whereby the observers practitioners are in fact elements of the system itself.

There are other perhaps more pragmatic and less esoteric difficulties that have manifested themselves in my own experience. One, for example, relates to the fact that in spite of half a century of developments in systems theory, the field is still somewhat peripheral to the mainstream of orthodox science. It certainly does not feature significantly in management education and its terms are considered too theoretical or

too intellectual and are, therefore, regarded with some degree of suspicion. The system dynamics modelling effort described earlier, for example, was regarded from the outset as being somewhat eccentric, "experimental" at best, and although it ultimately helped shape important management decisions, it was funded as a special research activity and thus placed outside normal administrative operating costs.

In addition, there is the inevitable situation that much of the dynamics of management processes is dictated by considerations of power, internal politics, needs for self-preservation, and other motivations which, at times, have little to do with the problem at hand. While such forces may ultimately involve their own wisdom, they bear little sympathy to the rational problem solving orientation that is inherent to the systems approach. Last, but not least, is the somewhat sad observation that the mainstream of our management culture profoundly dislikes "problems"—the very term carries a negative connotation—perhaps since problem identification and subsequent resolution is likely to "rock the boat."

Notwithstanding these and possibly other difficulties, it is still my conviction that systems thinking and cybernetics can contribute even more than they already have to the understanding and management of human affairs. This would be done not necessarily by providing a calculus for predicting single events, but rather, by constructing qualitative "principles of explanations" (in the sense of von Foerster and Bateson), conceptual handles, with which one could come to grips with complexity that otherwise would elude one's understanding.

In the face of a world that is seemingly becoming ever more complex, many old approaches have been rendered useless. Evidence of mega-management failures are all around us. In the ever accelerating arms race, in chronic instability in the world economy and the monetary system, in the widening gap between the developed and the very poor countries, in the existing inequities of human rights, in the increasing destruction of vital parts of the planet's eco-system, and more. We could clearly benefit from a qualitatively new conceptual orientation, a new epistemology, and fresh new paradigms. Systems Theory and cybernetics could contribute greatly to their development.

In this context, it is important that we emphasize the need to learn to deal with complexity in an effective manner. We must become psychologically and culturally comfortable with the fact that complexity is a genuine, well nigh essential, part of our world. We must learn to relax insecurity-driven compulsions always to reduce complexity by imposing woefully inadequate low variety controls. We must learn to manage our enterprises, our society, our economy, and our planet as a whole, without trivializing them.

Ultimately, all this bears upon the chance of shaping a world where current and future generations can live safely, abundantly, and creatively, progressively increasing degrees of freedom and potential self-realization for all. In this regard, the underlying purpose, the vision, and the leap of faith, are often far more significant than any special case technique or analytical methodology.

Much has been said by other contributors about epistemology, about knowledge, and about the paradoxes which arise due to an inevitable incongruity between the

world and our mental constructs of it. In the context of management and governance of societal affairs in particular, our conceptual/managerial tools are still far from adequate. For alas, or thankfully, perhaps, there is more to heaven and earth than is dreamt of in Horatio's philosophy.

I would like to close with a pertinent quote from Chapter Three of the Lankavatra Sutra, an old Buddhist text, much of which deals with epistemological issues. When asked by an aspiring Buddhisattva to talk about the nature of reality, the Buddha makes the following observation: "Things are not as they are seen, nor are they otherwise..."

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gladly withdraw the analogy, still pointing out though that contributions in our field range from the philosophical to the technical/methodological.

Mitroff

Philosophy leads the social and behavioral sciences, but philosophers are also led.