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The Hierarchy of Objectives: Toward an Integrating Construct in Systems Science

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Abstract—The field of systems suffers from theoretical fragmentation. Different researchers and practitioners seem to understand and use the phrase "systems approach" in somewhat unrelated senses. This state of affairs bothers the theoreticians who themselves preach integration and unity. It disturbs the practitioners who are confused about which version of the approach to employ in a given situation. Finally, it gives the enemies of the systems approach a potent weapon to use against it. This paper offers a conceptual synthesis. First, it identifies the various concepts of the systems approach found in the literature. Emphasis is placed on those concepts which emerge from various applications of the systems approach. These concepts are classified into three broad categories, with examples from each category cited. The notion of the hierarchy of objectives is then explicated, and it is argued that the proposed framework is capable of integrating the various approaches to the systems approach.

INTRODUCTION

ONE OF the most profound and yet controversial concepts permeating much of the intellectual tenor of our time is that of systems. There has certainly been no shortage of frameworks within which this concept has found expression: systems analysis, systems theory, systems engineering, systems methodology, systems approach, etc. Neither has there been a lack of skepticism regarding its theoretical validity and practical utility. In Dearden [20] and Phillips [39] we find two of its staunchest critics.

Most criticism is well-deserved for two reasons. First, there are so many diverse formulations of the systems approach (let alone systems engineering, systems theory, etc.) that even the sincere practitioner desiring to utilize it becomes confused as to what really and truly constitutes the systems approach (S.A.). Sooner or later, one is struck by the frustration, if not the irony, of witnessing highly varied and seemingly unrelated formulations of S.A.—an approach that itself preaches integration, relatedness, and unity! Second, these variegated expressions hardly offer any meaningful guide to action under specific sets of circumstances. Somehow, the dictum "look at the whole and not just the parts" stops short of providing concrete insights into problematic situations for people charged with the responsibility of ameliorating them. "Systems approach" has indeed become a buzzword. Worst yet, it has been turned into a ploy for marketing books and articles which, otherwise, may have more difficulty catching the readers' attention. Some (e.g. Roman [45]) use the phrase in the title of their work without any justification, while others (e.g. Silverman [48]) employ it in a sense left to the reader to figure out.

The misuse of S.A. tends to diminish its significance and add weapons to its enemies' arsenal. But, on the other hand, all this compulsive obsession with S.A. attests to the fact that this approach is fast becoming part and parcel of the world-view dominating our age. The point has been independently and convincingly argued by the founders of the systems movement, particularly by Ackoff [2, 4] and Churchman [18, 19]. What we call systems "science" has largely been systems heuristics so far. But the lack of theoretical integration in any field is symptomatic of its relative youth; and the field of systems is no exception. We have now reached a point where conceptual synthesis is not only desirable but is also feasible.

This paper is unlikely to be of interest to those who already have a very profound understanding of S.A., and for whom applying it to real-world situations has become second nature. These true systems scientists may find the value of this paper only in its explication (i.e. making explicit) of their own rather subconscious conceptual map. Unfortunately, these systems experts, the most practical-minded of whom resemble the Moliere character who discovered that he had been speaking prose all his life without knowing it, are few and far between. More typically,

we tend to encounter either those who are intrigued by S.A. and have a genuine desire to learn more about it in a systematic fashion, or those who have made up their mind that there is nothing of substance to S.A. and that the whole thing is a farce. This paper is more likely to attract these two groups—the "student", and the "enemy".

This paper has a threefold purpose. First, to examine those sources in the literature which explicitly claim in their title to be applying S.A. to a topical area. Second, to describe the broad categories that emerge from the above analysis. Third, to integrate the various approaches to S.A. within the proposed framework of "hierarchy of objectives".

THE VARIETY OF SYSTEMS APPROACHES

To capture the variety of S.A.s, one may start by looking at how different people have defined and conceptually developed the idea. However, to somewhat ease the practitioner's worry about the lack of its applicability, a more fruitful approach would be to look at what different people have done with S.A. In the terminology of Argyris and Schon [6], this would amount to examining the various systems researchers' "theories in use" rather than their "espoused theories". We will be interested more in theories emerging from useful applications than in those desperately in search of relevance to the real world. Therefore, this section will examine different formulations extracted from a collection of some 20 sources which explicitly claim in their title to be applying S.A. to a topical area. A thorough literature search reveals that these sources are about the only ones which explicitly claim (in their title) to be application-oriented.

Three broad categories of formulations of S.A. emerge from the literature referred to above. Within each category we find, not surprisingly, varying nuances. But the commonalities are sufficiently great to justify inclusion within the same category. All the sources within the same category share the same basic steps, once minor terminological discrepancies (such as "option" vs "alternative", and "internal process" vs "internal transformation") are removed through conversion into a standardized terminology. These categories are distinct but closely related. It is indeed the purpose of this paper to explore the manner in which they are interrelated.

In the first broad category, S.A. is regarded as an approach to problem-solving and decision-making. The fundamental steps here are: (1) define the problem, (2) generate alternate solutions, (3) evaluate the alternate solutions and select the "best" one, (4) implement it, and (5) monitor and evaluate the process. Examples of this approach to S.A. can be found in the following sources: Zeira [56], who applies these steps to management development. Robertshaw *et al.* [44], who establish a broad framework for problem-solving based on the above steps. Chakraborty [15], who applies this approach to strategic problem solving in telecommunications.

The second broad category views S.A. as an approach to the planning and design of social systems. The basic theme here is: (1) scan the environment to identify an unfulfilled need, (2) define the system's mission/function/objectives in connection with the larger environmental need, (3) identify the system's components necessary for performing this function, and (4) integrate these components into a coordinated and unified whole. The following sources contain examples of this approach: Tilles [52], who is concerned with the nature of the manager's job, and states that the manager's work divides into four basic tasks: defining the company as a system, establishing system objectives, creating formal subsystems, and integrating these subsystems. Morasky [33], who focuses on the function of goals in making the above steps more effective. Specifically, he maintains that goals should serve to facilitate the evaluation of system effectiveness and the control of system behavior. Warren [53], who applies the above steps to the design of training programs within the broader context of developing human resources in industry. Gottesman [24], who describes effective curriculum planning through the establishment of interrelationships among its components. Fox [21], who utilizes the above steps to derive a checklist of questions to be asked by the managers in their effort to improve the effectiveness of their organizations. Garrett [23], who offers a creative reconceptualization of hospitals in terms of a five-step process: environmental analysis, analysis by system, preliminary design, intermediate design, and system implementation. Mockler [32], who examines how a business can operate more successfully through the design of effective information flows among its components.

An interesting variation of the theme expressed in the second broad category emphasizes the need to look at things in relation to other things. This ties in with steps 3 and 4, namely the identification of relevant components and their proper integration. Examples can be found in: Holzer and Chandler [26], who point out that in coping with the problems of accounting in developing countries, one ought to fully recognize the interrelationships and interdependencies among four components: the accounting function in indigenous enterprises, the local accounting profession, the accounting function of governmental agencies, and the teaching of accountancy in educational institutions. Melcher [30], who insists that to understand behavior in

complex organizations, it is necessary to acknowledge and integrate the various contributions made by different fields, the perspective of these fields constituting the various "components" of the "system". Blake and Mouton [11], who demonstrate that their well-known "managerial grid" possesses a multi-disciplinary character, in the sense that it brings together insights from different fields of knowledge. Ross and Murdick [46], who urge functional managers not to think of their specialized functions (marketing, production, finance, etc.) as the most important, but to realize the need for integrating all of them as they all contribute to the successful operation of the business. Charles [16], like the above source, emphasizes the need to integrate the specialized functions of management, specifically management development, compensation, and performance appraisal. Krippendorff [28], who points out that we ought to go beyond the simple two-person model of communication and explore models involving many-valued relations among a large number of communicators.

The third broad category regards the S.A. as an approach to describing and explaining complex systems and/or their behavior. It consists of the following steps: (1) identify inputs, (2) identify internal processes, (3) identify outputs, and (4) establish feedback control mechanisms. In this genre we find: Smith [50], who describes an open-systems model of the firm by identifying its various human and nonhuman inputs, its internal processes/transformations, its outputs, and its internal/external feedback loops. Rath [42], who takes an S.A. to accounting by identifying the inputs/processes/outputs/controls in the accounting system in some detail. Freed [22], who offers a model for explaining human behavior in terms of input stimuli, internal processes, output behavior, and feedback mechanisms.

TOWARD AN INTEGRATING CONSTRUCT: THE HIERARCHY OF OBJECTIVES

This section will explicate the notion of the hierarchy of objectives (H.O.), thus paving the way to demonstrating, in the next section, its potential for logically unifying the various approaches to S.A. expounded in the previous section. The concept of hierarchy, being an integral part of systems theory, has received a general treatment in the works of prominent systems scientists such as Bertalanffy [10], Kuhn [29], Ashby [7], and Weinberg [55]. However, explicit discussions of H.O. can be found in Granger [25], Morell [34], Richards [43], Simon [49], Sommerhoff [51], and Weihrich [54]. Perhaps the most thorough—but unfortunately not the most recognized—analysis of H.O. can be found in Nadler's IDEALS concept [35–37]. However, he does not refer to it as the H.O., and does not explicitly aim at exploring its promise for unifying S.A.s, which is what this paper is about.

The H.O., also known as the ends/means chain, is essentially an approach to the production (or creation) of desirable future states (or objectives). Any contemplated act of producing a desirable future involves three fundamental questions: What? Why? and How? It is the iterative posing of these questions at all levels that generates the entire H.O. The "*What*?" question involves the identification of the nature of desired outcomes in as specific a way as possible. The "*Why*?" question addressed to an objective involves the determination of higher, more distant future states relative to which the objective is but an intermediate station or means. The "*How*?" question addressed to an objective involves the determination of lower, more immediate future states relative to which the objective is an end. Figure 1 shows a portion of a H.O.

A H.O. can be constructed in three different ways: upward, downward, and both ways. Starting with current action, one may subject it to a sequence of "Why?" questions, thereby generating higher and higher objectives, culminating eventually in a limiting ideal state. Or, beginning with the ideal state and applying a sequence of "How?" questions, one will generate a chain of actions reaching down to the present. Finally, and more typically, we may find ourselves starting somewhere in the middle of the chain, and then move both upward and downward to generate the entire hierarchy. The "Why?" and the "How?" questions call for further explication.

The "Why?" question constitutes the characteristic feature of an explanatory act. To explain, in a technical sense, is to answer a question in the form of "Why...?" However, in a nontechnical sense,

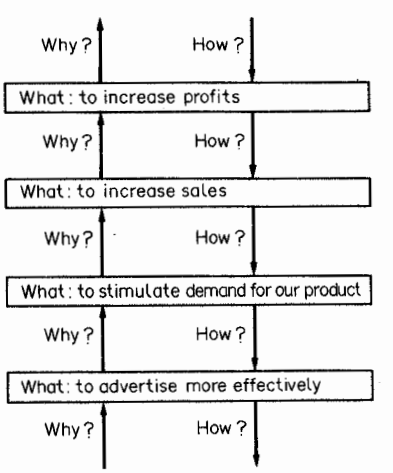

Fig. 1. A portion of a hierarchy of objectives.

"explanation" covers a very broad spectrum of uses [14], and hence the confusion surrounding the term in ordinary English. In ordinary usage, the verb "to explain" is employed in a variety of senses, such as

—to describe (as in "explain how this machine works");
—to clarify (as in "explain this equation to me");
—to justify (as in "explain your coming so late");
—to elucidate (as in "explain Japan's industrial strategy");
—to interpret (as in "explain his silence");
—to explicate (as in "explain the notion of justice").

The sense in which "Why?" appears in H.O. is different from all of the above uses of explanation. Even in a more strict sense, the "Why?" question takes on two different—indeed opposite—forms: whence, and whither. The causal explanation of an event seeks to identify prior events which individually or collectively produced that event. On the contrary, the teleological explanation of an event seeks to identify posterior events towards which that event is seen to be aimed. The "Why?" in H.O. is strictly of the teleological type.

In constructing H.O., the "Why?" question is bound to generate another complication, unless we take into account the distinction between extrinsic and intrinsic values [3]. The extrinsic value of an objective (or action) is its instrumentality in producing a higher objective. As such, it is measured by its efficiency as a means of producing that higher objective. The intrinsic value of an objective (or action) is the immediate satisfaction derived from pursuing (or undertaking) it. It is valued because it is an end in itself. For instance, playing tennis would be intrinsically valued if one did it simply because one enjoyed it. On the other hand, it would be extrinsically valued if one did it as a means of (say) keeping in shape. Of course an objective (action) could be of value both intrinsically and extrinsically. We eat not only in order to quiet hunger pangs and survive (extrinsic value), but also because we usually enjoy the very process (intrinsic value). Having made this clarification, we must now stipulate that the "Why?" question can be applied teleologically only to those objectives (actions) which are of extrinsic value. When addressed to an objective (action) which is of purely intrinsic value, the "Why?" question would lose its relevance.

It was previously pointed out that H.O. is sometimes referred to as the ends/means chain. Perhaps the imagery of the chain is misleading in that it is unidimensional. The "Why?" question may point to more than one higher objective. On the other hand, the "How?" question always points to a system of lower subobjectives. That is why the imagery of a "chain reaction" may be more accurate. Going back to the example in Fig. 1, for instance, increasing sales will not automatically produce higher profits except in proper balance with another coproducing subobjective, namely "To maintain or reduce total costs". Likewise, increased demand will not automatically produce an increase in sales except in proper balance with another coproducing subobjective having to do with the price variable.

Conceptually, it is not difficult to make a distinction between complementary and competing (alternative) objectives (actions). Two objectives are said to be complementary if they coproduce the higher objective relative to which they are both means; i.e. if the accomplishment of the higher objective requires the successful attainment of both. By contrast, two objectives are said to be competing if they represent alternative modalities of resource allocation. For instance, "To drive one's own car" and "To listen to the automobile's stereo" represent complementary, coproducing (sub)objectives aimed at "To have a pleasurable ride to destination X"; whereas "To drive one's own car" and "To take public transportation" represent competing objectives aimed at "To reach destination X". What we regard as a course of action on the macro level is, on the micro level, really a set of interrelated subactions—a system of actions. What may appear to the designer of H.O. as an either/or decision may, upon further scrutiny, turn out to be a both/and situation.

Having shed some light on the construction aspects of H.O., we are now prepared to explore the logic underlying the transition from one level of the hierarchy to another. The essence of this logic is captured by a system of assumptions. Before articulating the specific nature of these assumptions, it is useful to point out the general role played by assumptions in shaping human behavior. Boulding [13] argues that our behavior is based on the "image" we have of the world. We are guided through the complexities of a situation by the "cognitive map" we have of it. As Kelly [27] contends, the individual is his or her own scientist, generating hypotheses, testing them against reality, and using them to predict and anticipate consequences of alternative courses of action. Our behavior is the product of our assumptions. The work of Mitroff [31] represents perhaps the most profound—and yet the most applied—treatment among systems scientists of the role played by assumptions in shaping human behavior.

More specifically, in terms of H.O., the relationship between any two adjacent levels is characterized by three sets of assumptions. First, teleological assumptions, which state that the higher level objectives are indeed desirable to accomplish. An assumption of this type states that it is necessary

to accomplish a certain objective in order to achieve the one above it. For example, in terms of Fig. 1, a teleological assumption would be that we need to advertise more effectively (rather than, say, improve our product quality or cut price) in order to stimulate demand. Teleological assumptions pertain also to situations we consider undesirable.

Second, causal assumptions state that lower-level subobjectives (regarded as courses of action) will/will not produce the intended, higher-level objectives. For example, to believe that heavier advertising will stimulate (rather than slacken or leave unaffected) demand would amount to a causal assumption. In general, a causal assumption states that two variables are (not) correlated, such that a deliberate change in one (the controllable/independent variable) would (not) produce a desired change in the other (the dependent variable). As such, a causal assumption may also be called a "correlational assumption". In terms of the above example, the causal assumption is to the effect that there is a correlation between the advertising (independent) variable and the demand (dependent) variable.

Third, factual assumptions are those that take certain past, present, and future "realities of the case" for granted. Referring again to our example, a factual assumption would be that, for instance, our customers (target market) share certain personality traits or life-styles which make them respond favorably to our commercials. Factual assumptions pertain not only to what we take to be the case, but also what we take not to be the case. Needless to say, a factual assumption is not necessarily a fact: it is only assumed to be a fact and is treated as a datum (literally: what is given). Some researchers [1, 17], even argue that all data are actually the result of inferential processes, and are not "given" as such. This raises the interesting point that assumptions themselves exhibit a hierarchical structure: the more immediate ones are inferred from, and rooted in, the more fundamental ones.

Earlier, we referred to the logic underlying the transition from one level of H.O. to another. Now we are in a position to articulate that logic. The logic governing the transition from any level of the hierarchy to the lower one is as follows:

(A) It is good/desirable to accomplish objective Y (in that Y is the optimal, or at least necessary, means of accomplishing the higher-level objectives). This is the teleological assumption.
(B) Under circumstances C_i $(C_1, C_2, \ldots, C_n)$, action X would produce outcome Y. This is the causal assumption.
(C) Circumstances C_i $(C_1, C_2, \ldots, C_n)$ do indeed prevail. These are the factual assumptions.

Therefore:

(D) Take action X.

The following would be an example of how the above assumptions work. Suppose our firm has set itself the objective of improving its corporate image. As a course of action, we have chosen to donate generously to the public broadcasting system. The teleological assumption is that we need to improve our corporate image in order to reach the higher objective relative to which this is only a means (such as, say, to improve our stock performance). The causal assumption is that donating generously to public broadcasting will indeed improve our corporate image. Two critical factual assumptions being made here are that we have an image problem, and that the public broadcasting system will accept our donation.

TOWARD A CONCEPTUAL INTEGRATION

This rather sketchy explication of H.O. is sufficient to establish the groundwork for the integration of the various S.A.s. The proposed strategy will be to derive from H.O. three other hierarchies which stand in the "shadow" of, and are parallel to, H.O. and to demonstrate how these three shadow hierarchies are capable of assimilating the three broad categories of S.A.s.

First, the shadow hierarchy of problems. This can be formally derived from H.O. by prefixing each objective with "How?" For instance, the objective "to stimulate demand" gives rise to the corresponding problem, "how to stimulate demand?" Each step in the first broad category of S.A.s (namely, S.A. as an approach to problem-solving and decision-making) can be assimilated within the hierarchy of problems as follows. The first step is to formulate the problem correctly. Suppose one sees the solution to declining profits as one requiring an increase in sales. Thus one may formulate the problem as "How to increase sales?", and answer it thus: "By stimulating demand". However, one may stimulate demand (say through advertising), increase sales, and still not achieve higher profits. At this point, one would realize that perhaps the problem of declining profits may not have been one of declining sales, but one of soaring costs. In other words, the real problem may have been "How to lower costs?" rather than "How to increase sales". Hence, the necessity of formulating the problem correctly which amounts to solving the right problem, i.e. addressing the H.O. at the right level. The systems approach to problem-solving thus places a great deal of emphasis on formulating not the problem but a system of problems—or a mess, in Ackoff's [4] terminology—covering the entire hierarchy of objectives.

The second step is to generate alternate solutions. This amounts to identifying alternate lower-level objectives, each of which would be a means to the accomplishment of the higher objective. For example, the problem "How to stimulate demand?" may give rise to the following alternate solutions: (a) advertise more aggressively, (b) improve product quality, (c) cut price. The systems approach to problem-solving offers two significant insights here. First, that these "alternate" solutions may really be compatible and not as mutually exclusive as they appear at first sight. In fact a radical solution to the above problem would be to improve product quality, cut price, and reflect both of these in an aggressive advertising campaign. In other words, the thrust of the systems approach would be to design integrated solutions to problems rather than to generate quasi mutually exclusive courses of action. The second significant insight into problem-solving offered by S.A. is that solutions become problems from the standpoint of lower objectives. For instance, the "solution" of producing better-quality products becomes a "problem" when subjected to the "How?" question. The new problem is, "How to improve product quality?", and this in turn gives rise to lower-level problems such as "How to implement quality circles?". Hence a problem is never fully solved until it is converted into subproblems covering the entire gamut of H.O. below it. An explicit discussion of how the shadow hierarchy of problems, derived from H.O., can assimilate within it the remaining steps to problem-solving can be found in Odiorne [38]. Figure 2 depicts the logical relationships between H.O. and its shadow hierarchy of problems.

The second shadow hierarchy is that of organizational levels. This hierarchy is linked with the H.O. through the following proposition: The higher (lower) levels of H.O. correspond to the higher (lower) levels of organizational structure. A classic framework within which the preceding proposition finds support is that by Anthony [5], where he proposes a three-part division of managerial activities based on organizational levels: strategic planning (top level), management control (middle level), and operational control (first line). In this vein, "to advertise more effectively" may be an objective of the advertising department of a corporation, whereas "to increase ROI by 20% within three years" is more an objective of the higher echelons of decision-making.

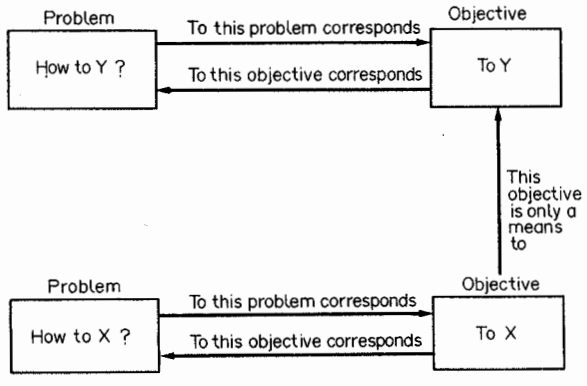

Fig. 2. The logical relationships between H.O. and its shadow hierarchy of problems.

The various steps in the second broad category of S.A.s (namely S.A. as an approach to the planning and design of social systems) can be assimilated within this framework as follows. One starts at the highest organizational level, asking why the organization exists (or should exist), to begin with. The answer to this question, which requires a thorough analysis of the environment, will determine the overall mission of the organization, i.e. its function(s) within the larger system of which it is a part, and will be the basis for formulating the highest-level objectives of the organization. However, these have to be translated into lower-level objectives, which means that the next lower level must determine its function(s) within the context of the level above it, and so forth until all organizational levels and units are covered. What is crucial here is the design of coproducing subobjectives which ought to be accomplished jointly and interdependently for higher objectives to materialize. For instance, the objective "to increase sales" requires the proper balance between demand and price. Optimizing one in isolation from the other is bound to produce suboptimization on the higher level.

The third shadow hierarchy is that of actions, and can be formally derived from H.O. by eliminating the "to" at the beginning of every objective. For instance, the objective "to stimulate demand" becomes an action ("stimulate demand") relative to its higher objective, namely "to increase sales". Likewise, the objective "to stimulate demand" may give rise to the action "advertise more heavily", which itself then becomes an objective relative to its lower levels. This hierarchy assimilates the third broad category of S.A.s (namely S.A. as an approach to description and explanation) in that each action can be conceptualized as a process requiring inputs from lower levels of H.O., and producing outputs for higher ones. For instance, advertising as an organizational process requires money, personnel, know-how, etc. as inputs (the acquisition/utilization of these becoming lower-level objectives), and is expected to yield consumer awareness, interest, commitment, etc. as outputs (the generation of which becomes higher-level objectives).

Feedback manifests itself in the selection of appropriate inputs (lower objectives) based on past

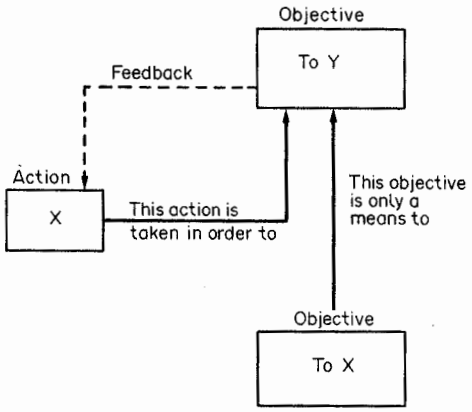

Fig. 3. The logical relationships between H.O. and its shadow hierarchy of actions.

experience with outputs (higher objectives). Feedback is traditionally defined as information about past performance in the light of which future performance may be improved [8, 9]. It has been argued [40] that feedback can not only improve performance, but it can also shed light on what constitutes "improved performance", to begin with. This amounts to the unraveling of the system's consensual values and objectives. As such, feedback may also manifest itself in the specification of outputs (higher objectives) based on a reinterpreted conceptualization of inputs (lower objectives). In a feedback loop, input "causes" output as much as output "causes" input. The concept of mutual causality thus highlights the cybernetic interdependence among the various levels of H.O. In the concept of HIPO [12] (hierarchy plus input–process–output) we find a useful operationalization of the shadow hierarchy of actions as it spans the entire H.O. Figure 3 depicts the logical relationships between H.O. and the shadow hierarchy of actions.

CONCLUSION

This paper aimed at identifying the various applied approaches to the S.A. Categorizing these within the three emerging categories of problem-solving/decision-making, planning/design, description/explanation, I argued for their integration within the framework of the H.O. and its three shadow hierarchies of problems, organizational levels, and actions. Figure 4 depicts the logical relationships among these hierarchies, while Fig. 5 represents the formal structure of the integration.

One contribution of this paper has been to

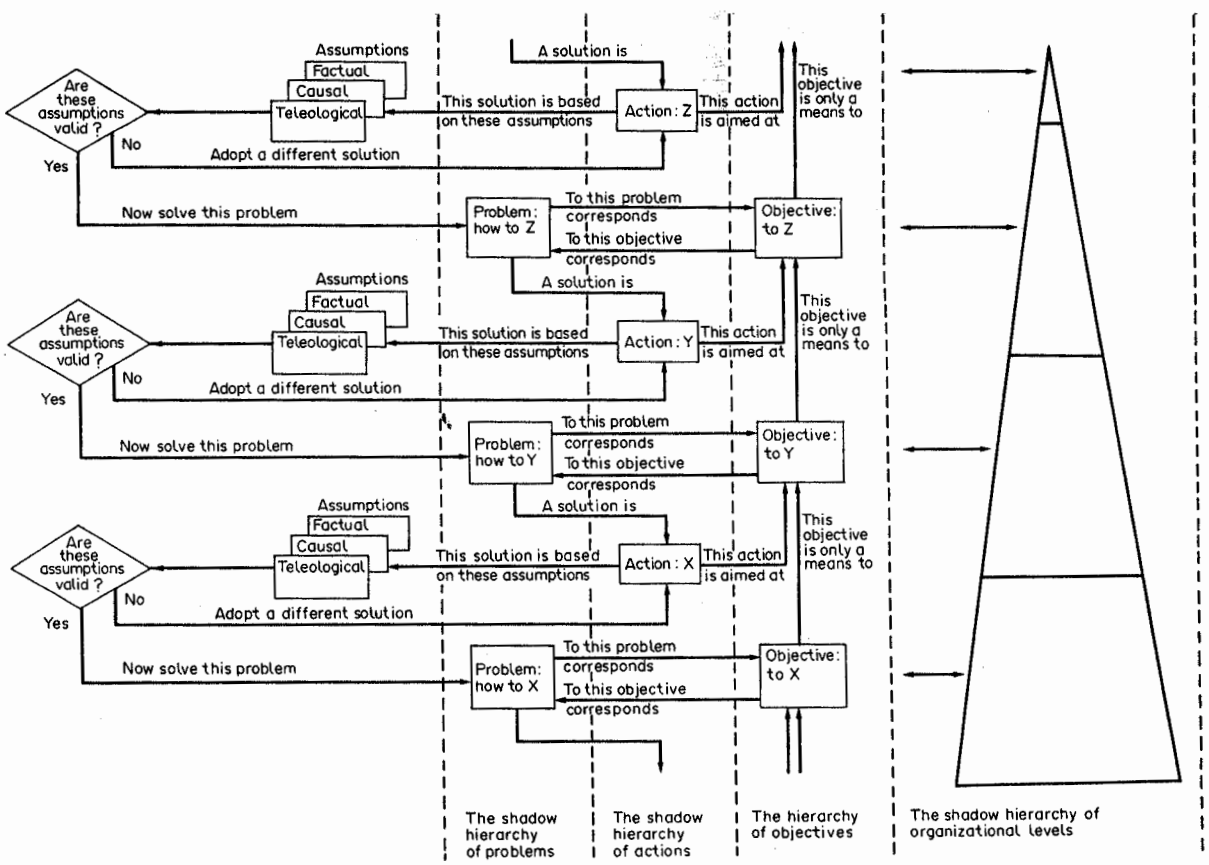

Fig. 4. The logical relationships among H.O. and its three shadow hierarchies.

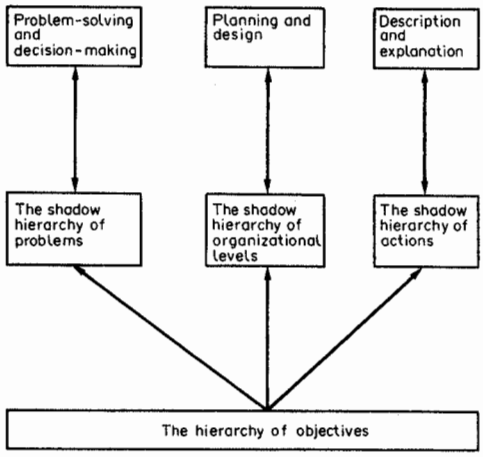

Fig. 5. The formal structure of the proposed integration.

describe various concepts of the systems approach within an applied setting. To have emphasized the multitudes of conceptual frameworks proposed by theoreticians would have served only to intensify the practitioner's suspicion of the irrelevance of S.A. to real-world issues and problems.

Moreover, the attempt to integrate the various approaches to S.A. is hoped to remove the air of self-contradiction that is seen to surround systems theory, namely unintegrated concepts of integration, unrelated concepts of relatedness, and fragmented concepts of holism! This can also have an educational benefit in terms of teaching systems methodology in its full variety, and yet in its rich unity.

The concept of hierarchy has recently become rather unpopular. This has been largely due to associating it—implicitly as well as explicitly—with authoritarianism, totalitarianism, and the dictatorial exercise of power. By contrast, "network" and "heterarchy" are becoming ideas in good currency, as they are associated with egalitarianism and democracy. There may be some wisdom to encouraging and promulgating these connotations in the arena of political theory. However, in this paper, the concept of hierarchy is proposed as a distinct modality of cognition. The human mind's way of organizing complex reality, understanding it, and manipulating it purposefully exhibits a fundamentally hierarchical structure [47]. This paper, therefore, employs "hierarchy" in a totally apolitical sense.

Finally, the hierarchical correlations suggested in this paper show that the processes usually associated with problem-solving are also associated with planning/design, and also with description/explanation. It is implied that one cannot construct one hierarchy effectively while ignoring the others. One is almost forced to take into account all the issues raised by other hierarchies.

The complete integration of these hierarchies is of course an enormous task going beyond a single paper. This paper is offered only as "the finger pointing the right way". In a forthcoming book [41], the themes expounded in this paper will be developed in greater depth.

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