UNDERLYING ASSUMPTIONS OF SEVERAL TRADITIONS IN SYSTEMS THEORY AND CYBERNETICS

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ABSTRACT

How is the field of systems science different from other scientific fields, and how can we distinguish the various traditions within systems science? We propose that there is a set of underlying assumptions which are generally shared within systems science but are less common in other scientific fields. Furthermore, the various traditions within systems science have adopted different combinations of these assumptions. We examine six traditions within systems science -- cybernetics, operations research, general systems theory, system dynamics, total quality management, and organizational learning. We then consider eight underlying assumptions -- observation, causality, reflexivity, self-organization, determinism, environment, relationships, and holism. We then assess where each tradition stands with respect to each of the underlying assumptions.

INTRODUCTION

There are, perhaps, two ways to understand the multi-faceted field of systems theory and cybernetics. One way is to recognize the various traditions or schools of thought as efforts to solve certain problems. Since different questions have been asked, different basic concepts have been defined and different approaches have been devised. From this first perspective, understanding the questions being asked is crucial to understanding the theories created. The second perspective is that there are fundamental issues or processes -- evolution, the emergence of complexity, communication, control, cognition -- which are thought to be parts of a general theory of systems, whether the systems are machines, human beings, or organizations. Each systems science tradition tends to focus on a somewhat different collection of these basic issues. This paper is an expression of the second point of view. For a description of the first point of view, see (Umpleby and Dent, 1997).

We examine six schools or traditions within systems science: cybernetics, operations research, general systems theory, system dynamics, total quality management, and organizational learning. We then consider six underlying assumptions on which each field takes a position and which we believe are important in defining differences among the various traditions. The six underlying assumptions are: observation, cause/effect, reflexivity, self-organization, determinism, and interdependence.

Our contention is that the six underlying assumptions are what distinguish systems theory and cybernetics from the more traditional sciences. Furthermore, we presume that the six traditions within systems theory are distinguished at least in part by which underlying assumptions they incorporate. At the conclusion of the article, we show which traditions within systems science incorporate the largest number of departures from classical science.

We begin by describing the underlying assumptions and then discuss how each tradition has dealt with the assumptions.

KEY UNDERLYING ASSUMPTIONS OF SYSTEMS TRADITIONS

Holism

People who claim to take a systems approach probably have most in common with respect to assumptions pertaining to the level of explanation, specifically taking a holistic view rather than a reductionist view. Many writers in the past twenty years have discussed how reductionism has been taken too far. Nonetheless, reductionism is deeply ingrained in Western culture. Excellent sources of discussions on holism and reductionism would include, Garfinkel (1991), Oppenheim and Putnam (1991), Clemson (1984, p. 24-27), Vaill (1991, p. 122), Ackoff (1981), Slife and Williams (1995).

In this paper, we will take holism to mean the assumption that an entity can be best understood by considering it in its entirety. The entity has "characteristics which belong to the system as a whole and don't belong to any of its parts" (Clemson, 1984, p. 24). Reductionism on the other hand is the assumption that an entity can be divided into its component parts and that a cumulative explanation of the parts and their relations fully explains the entity.

Relationships

Another underlying assumption shared by many systems traditions is that the unit of analysis should be relationships rather than entities. Entities only take on definition when they are in interaction with each other. It makes little sense to study a woman for example. The richness of her experience becomes much more apparent when she is studied in relationship to her husband, her sister, her subordinates, her friends, etc. A proponent of this assumption is Gregory Bateson who argued that "relationships should be used as a basis for all definitions, and that this should be taught to our children in elementary school" (Capra, 1982, p. 81). The alternative view is that the unit of analysis is an entity - the world is comprised of distinct entities which themselves are fruitful objects of study. It is especially useful to understand the basic building blocks of phenomena.

Environment

Another underlying assumptions of several systems traditions is that the environment plays a role in the manifestation of the phenomenon (environment-full). The environment is central to understanding and explanation. Ackoff (1981) suggests that in situations which he refers to as producer-product, any principle or explanation offered must stipulate the conditions under which the principle applies. If the principle were to apply in all conditions, then the environmental conditions are not co-producers of the effect.

The alternative view is that the environment does not matter (environment-free). The laboratory and its rules often explicitly omit the environment. The second law of thermodynamics, for example, stipulates that it is operational only when entities are left to themselves. In the Law of Freely Falling Bodies, "freely" means "in a vacuum," which is in the absence of any environmental influences.

Indeterminism

The assumption of indeterminism is that at times it is "inherently impossible to determine in advance which direction change will take" (Prigogine and Stengers, 1984, p. xv). The alternative view is that "conclusions can be precisely drawn from a set of known variables" (Dent, 1995, p. 13-5). Indeterminism is discussed in Burrell and Morgan (1979), Prigogine and Stengers (1984), Kellert (1993), Wilber (1995), and Slife and Williams (1996).

Causality

Assumptions about cause and effect, as well as those pertaining to observation and level of explanation (holism or reductionism) give the best indication of worldview (Dent, 1997). A concern with circular causality as opposed to linear causality was a key issue leading to the establishment of several systems science traditions. Most writers on the subject of cause and effect begin with David Hume who in 1748 suggested three requirements - association, direction of influence, and nonspuriousness - which he said are necessary (but not sufficient) to demonstrate causation (Singleton, Straits, and Straits, 1993). More recent writings about causation are found in Kitcher (1991), Schwartz and Ogilvy (1979, p. 14.), Clemson (1984, p. 233-235), Slife and Williams (1995) and Lincoln (1985, p. 35).

As noted by von Bertalanffy (1968), "[classical science is] essentially concerned with two-variable problems, linear causal trains, one cause and one effect, or with few variables at the most. The classical example is mechanics [in physics]" (p. 12). Postmodernists, also, have coined the term Fordism to connote the direct-causal mindset "characterized by the semi-automatic assembly line, organizing work into a straight forward linear flow of transformations applied to raw materials" (Clegg, 1990, p. 177).

Self-organization

By "self-organization" we refer to the idea that the elements of a system move toward their stable equilibrial states largely independently vs. the assumption that one or a small number of causes affect the elements of a system. Self-organization is discussed in von Foerster (1960?), Ashby (1960?), Clemson (1984), Goldstein (1994), and Capra (1993). Clemson (1984), for example, writes "Complex systems organize themselves; the characteristic structural and behavioral patterns in a complex system are primarily a result of the interactions among the system parts" (p. 26). Systems scientists claim that all systems are self-organizing, but some authors emphasize this phenomenon more than others.

Observation

A key belief underlying classical science was that observations are independent of the characteristics of the observer. Objectivity was possible if one assumed that very different people looking at the same phenomenon in the same way would create similar descriptions. In recent years, due in part to studies of the nervous system, more attention has been paid to subjectivity and to including the observer within the domain of descriptions. According to this point of view observers have immediate access only to their experience, and a "reality" is constructed by each observer. Hence, there are constructivists, who emphasize perception, conversation and reality construction and there are realists who assume that descriptions can be accurate respresentations of an external world.

Reflexivity

Is the system of interest composed of knowing subjects with characteristics such as the following: are they able to generate new states in themselves (think new thoughts, do new things) that they never manifested before. Are people (or machines) best thought of as continually trying to generate such new states? Do they have the property of being able to notice your attempts to theorize about them and model them, and do they modify themselves according to their reaction to this information? (Vaill, 1996, p. 117) Authors concerned with such questions are interested in reflexivity. The alternative view is that the objects of study are not influenced by the act of observation.

THE UNDERLYING ASSUMPTIONS OF SEVERAL SYSTEMS TRADITIONS

Cybernetics

We take as an example of recent work in the area of cybernetics The Tree of Knowledge: The Biological Roots of Human Understanding (1987) by Humberto R. Maturana and Francisco J. Varela. The authors claim to have written an "alternative view of the biological roots of understanding" (p. 9) which does not coincide with mainstream views on this subject. Their primary distinction is that they "propose a way of seeing cognition not as a representation of the world out there, but rather as an ongoing bringing forth of a world through the process of living itself" (p. 9). Their primary thesis is "that evolution occurs as a phenomenon of structural drift under ongoing phylogenetic selection. In that phenomenon there is no program or optimization of the use of the individual, but only conservation of adaptation and autopoiesis. It is a process in which organism and individual remain in a continuous structural coupling" (p. 115).

Observation

The topic of observation is an important one for Maturana and Varela. Their chapter one is entitled, "Knowing How We Know" and the largest part of chapter ten has the same heading. The distinction they draw about their assumptions concerning observation is what we have described above as a defining difference between their work and mainstream biological theories.
They are key contributors to the constructivist view of observation.

Causality

Maturana and Varela demonstrate their focus on feedback loops when they remind the reader that there is always a circularity between action and experience (p. 26). They also provide evidence of their belief in the indirectness of phenomena. For example, they maintain that the knowledge generation process "does not consist of a linear explanation that begins with a solid starting point and develops to completion as everything becomes explained" (p. 244).

Maturana and Varela make mutually causal assumptions throughout their book. For example, they suggest that "what is distinctive about [living beings], however, is that their organization is such that their only product is themselves, with no separation between producer and product. The being and doing of an autopoietic unity is inseparable (pps. 48-49).

Reflexivity

Reflexivity is also an important topic for Maturana and Varela. This assumption pervades their writing probably more so than any of the other authors examined in this paper. Perhaps their belief is best captured in their statement, "maybe one of the reasons why we avoid tapping the roots of our knowledge is that it gives us a slightly dizzy sensation due to the circularity entailed in using the instrument of analysis to analyze the instrument of analysis" (p. 24).

Self-organization

Perhaps because their subject matter is biological evolution, Maturana and Varela assume that systems are self-organizing. In fact, possibly in opposition to creationists, they frequently hint that an intelligent designer was not necessary for the evolution experienced in nature. An example of their assumption of self-organization is their description of an autopoietic system which "pulls itself up by its own bootstraps and becomes distinct from its environment through its own dynamics, in such a way that both things are inseparable" (pps. 46-47).

Indeterminism

Maturana and Varela assume indeterminism. They present an internal paradox many people feel. People very much want to be able to predict things. They want to know, for example, that when they take medicine, the outcome will be predictable. Yet, at the same time, "we resist the idea that we are determined, explainable , and predictable beings. We cherish our free will and want to be beyond determinism" (p. 122). The authors note that much of the analysis of the world and biological systems has been based on an assumption of determinism. Maturana and Varela conclude that we as observers, live in a world in which we cannot develop deterministic equations for what will happen.

Relationships

Maturana and Varela hold assumptions of holism. Holism is an implicit assumption in their definition of an autopoietic system. They suggest that, "since every autopoietic system is a unit of many interdependencies, when one division in the system is changed, the whole organism undergoes correlative changes in many dimensions at the same time" (p. 116). This quotation has in it the phrase that a "system is a unit of many interdependencies." From such a statement we would not be surprised to see that Maturana and Varela also assume that a relationship or interaction is a more fruitful unit of analysis than any single entity. Further support of their belief is found in the way they define language as "an ongoing process that only exists as languaging, not as isolated items of behavior" (p. 210).

Environment

Maturana and Varela assume the importance of the environment or context of any phenomenon. For example, they argue that "the evaluation of whether there is knowledge is made always in a relational context" (p. 174). Their book contains many other examples of differences in how certain species behave or develop depending on the environment.

Operations Research

The source we have selected as representative of recent work in the area of operations research is the Handbook of Systems Analysis (1985) edited by Hugh Miser, Jr. and Edward Quade. The editors suggest that the term operations research is synonymous with their work, which they prefer to call systems analysis. The typical problems addressed by systems analysis are those "relatively easy to structure and in which some important aspect is dominated by technology" (p. xii). Only recently has systems analysis been applied to systems with a significant human component.

Miser and Quade see their expertise as lying at the nexus of issues affecting society, enterprises, and the environment. Such issues involve a number of variables and the system effects are widely distributed in both space and time. Systems analyses typically are performed by multi-disciplinary teams. Systems analysts commonly follow a nine-step approach, although the steps may occur in a different order (p. 16).

Systems analysts use a well-defined method [footnote the steps], but do not see their work as a separate science. They relate it to engineering, which can be characterized as an applied science. Such an applied science employs the methods of science, but also involves many aspects of a craft. Systems analyses often include mathematical or computer model building, but the field is not limited to modeling.

Miser and Quade date their discipline to the 1940s. The term systems analysis was adopted in 1947 to differentiate this body of work from operations research. Both sets of techniques were being used to design future weapons systems for the U.S. Army, Navy and Air Force (p. 21). Systems analysts also distinguish themselves from general systems theorists, whom they describe as "classifying systems or ... discovering properties common to systems.

Observation

Miser, Quade, and their chapter authors occasionally employ an epistemology in which the observations of inquirers are dependent on the characteristics of the inquirers. Checkland, for example, notes that the systems analysis process is one which "continually enriches the perception of problems" (Checkland, 1985, p. 152). He warns systems analysts that they should not be beholden to a single point of view. Usually, however, systems analysts hold a number of assumptions consistent with realism. Miser and Quade include a quotation which suggests that facts are the primary coin of science. Science must begin with facts and end with facts (Quade and Miser, 1985, p. 19).

Causality

Systems analysis is imbued with an emphasis on identifying feedback loops. These analysts very much see their work as surfacing feedback loops which are present but are not apparent to the lay person. This description of causal relationships is one of the hallmarks of systems analysis. While the field has this emphasis, there is nothing written in Miser and Quade (1985) which explicitly suggests an appreciation for mutual causal phenomena. There are many examples of a direct, sequential emphasis in this book. The systems analysis method is described as nine sequential steps (Quade and Miser, 1985, p. 16). In the chapter, "The Methodology of Systems Analysis: An Introduction and Overview" by Wladyslaw Findeisen and Edward S. Quade, the authors provide a very linear framework for the discipline, including a flowchart which shows only direct,

linearly causal links (pps. 122-123). Also, these researchers state a preference for linear models which simplify the mathematics (Quade, 1985, p. 206). Although a caution is provided that the linear model may represent an oversimplification, there is no discussion of this caution, and no examples of alternative procedures are provided. We conclude that operations research/systems analysis is less embued with an interest in circular causal phenomena than other systems traditions.

Reflexivity

The topic of reflexivity does not appear in this book. The authors admit that only recently has systems analysis been applied to human systems and that it is too early to include experiences with human systems in a handbook on systems analysis (p. xii). There is no stated recognition that ideas or actions on a system are internalized by a "knowing subject."

Self-organization

As with reflexivity, the topic of self-organizing systems is not discussed in the Handbook of Systems Analysis.

Indeterminism

Systems analysts make probabilistic rather than deterministic assumptions. They state, "We are well aware that the future can at best be determined only in a probabilistic way" (Findeisen and Quade, 1985, p. 138). Examples provided throughout the book employ this probabilistic assumption. Systems analysts also assume that their role is to predict, rather than to explain or to understand. As stated above, the discipline is very practical. Systems analysis is applied to specific projects and problems. Systems analysts are serving as experts who are expected to provide answers, which often means, accurate predictions.

Environment

Systems analysts display a strong belief in the assumption that the problems they work on are heavily determined by the environment.

Relationships

Systems analysts also display a strong appreciation for the interdependence of phenomena. They point out that the traditional form of sensitivity testing (vary a single parameter at a time) is often inadequate. "It is almost always necessary to test the interactive variation by changing more than one factor at once." (Quade, 1985, p. 211).

The assumption of "relationship as unit of analysis" is built into the foundation of systems analysis. The discipline was essentially created to focus on problems "arising from interactions among elements in society, enterprises and the environment" (Quade and Miser, 1985, p. 2).

Holism

Finally, systems analysts advocate taking a holistic perspective. They maintain that analysis should be performed on a whole problem, rather than any part. They recognize that a systems analysis performed on a portion of the problem may result in a solution which is suboptimal for the larger whole

(Schwarz, et al., 1985, p. 223). Table 1 summarizes our reading of Miser and Quade, and the other authors as well.

Systems Dynamics

More than most traditions within systems science, system dynamics has focused on the use of a specific technique -- the building of computer models using the dynamo programming language and its successor software packages (e.g., Stella and iThink). The growth of this tradition has been in the number of problems analyzed using this method, the improvement of software packages, and the willingness of people to stop an analysis with causal influence diagrams, an early step in the creation of a computer model.

Observation

System dynamists operate on the assumption that a group of people can come to agreement about the nature of problems in the external world by building a computer model. They test the accuracy of the model against historical data. Although the process of creating a computer model could be seen viewed as a process of the joint construction of a reality, system dynamists usually describe their work as building an accurate model of the real world. Hence, most system dynamicists employ a realist perspective.

Causality

Feedback loops are the fundamental building blocks of system dynamics models. Belief in the importance of understanding circular causality lies at the heart of this tradition.

Reflexivity

System dynamists assume that the people in the systems they describe modify their actions as circumstances change. They also assume that people will change their ideas as they engage in a modelling exercise or as they listen to the results of a simulation study. Hence, they assume reflexivity but do not discuss it at length.

S**elf-organization**

Self-organization is raarely discussed by system dynamicists. Self-organization is usually modelled with a different set of techniques related to cellular automta. One could claim that system dynamics models describe self-organizing systems, however, system dynamics models use a very different programming approach than those used to model self-organiztion.

Indeterminism

Most system dynamics models are deterministic models. Probabilistic variables can easily be built into a computer models, but the structure of the model is deterministic.

Holism

System dynamicists take a holistic view. Once they have defined the system of interest, they attempt to model all the important relationships within that system.

Environment

The environment, meaning anything that affects the object of interest, is included within a system dynamics model.

Total Quality Management

The source that we have selected as representative of recent work in the area of total quality management (TQM) is Fourth Generation Management by Brian Joiner (1994). Joiner's book is a very practical, hands-on text written for practicing managers. The book references only other books that are also written for practitioners. He extends the field of TQM by maintaining that a new system of management is required, not just a focus on quality.

The cornerstone of fourth generation management is the Joiner Triangle (p. 11). Joiner sees the new system of management consisting of three primary components.

1. Quality - Quality is defined by the customer and is the shared responsibility of every employee.
2. Scientific Approach - "Learning to manage the organization as a system, developing process thinking, basing decisions on data, and understanding variation" (p. 11).
3. All One Team - Fostering dignity, trust, and respect throughout the organization and working toward win-win solutions with all stakeholders.

Joiner and his mentor, W. Edwards Deming, were trained as statisticians. Consequently, the largest part of the book is the section on "Managing in a Variable World." Joiner raises the important distinction between sources of variation which come from special causes and those that come from common causes. This idea is foundational in fourth generation management. The job of managers is to develop processes which identify errors, determine whether those errors are special causes or common causes, and take appropriate corrective actions. These actions must take place in a dignifying environment.

Observation

Joiner states that individuals create their own mental models of the world. He provides examples of how people "see" only what their mental model allows them to see. Since the book is practical in nature, there is little or no discussion of epistemological issues. Yet, it seems clear that Joiner is not a constructivist. An underlying theme of the book is that by understanding variation, managers can discover what is "really" happening in the world.

Causality

Joiner makes no reference to the possibility of circular causal phenomena. In fact, most of the tools he writes about (control charts, bar charts, etc.) are not able to portray circular causal phenomena. Joiner does not address what are commonly known as the "Seven Helpful Charts" (Walton, 1986, p. 98) used in TQM. However, he does ally himself with people who have written extensively about them, such as Deming and Ishikawa (Joiner, 1994, p. 5). The seven charts - cause-and-effect (or fishbone diagrams), flow charts, Pareto charts, run charts, histograms, control charts, and scatter diagrams - are all based upon direct, sequential assumptions. They cannot be used to surface circular causal chains. A cause-and-effect diagram, for example, cannot be drawn if there are

loops in the causal chain or if there are mutually causal phenomena. The 7-step improvement method that Joiner advocates is also sequential, with little or no recognition of any non-linearities in the improvement process.

The direct causal assumption of these tools seems surprising because Fourth Generation Management is otherwise very clear about the complexity of causality. Joiner writes, "The interdependencies within any system are often exceedingly complex and widely separated in time and space" (p. 30).

Reflexivity

Joiner includes in his book many prescriptions which are reflexive in nature. Perhaps the most prominent example is the inclusion of an entire chapter, "Improving our Ability to Improve." In this chapter, he suggests that improvement efforts in an organization should themselves be viewed as a system which should be improved using the same philosophy and techniques of fourth generation management. This chapter includes several examples of Joiner's belief that theories do have an effect on the systems they describe.

Joiner includes in the preface an anecdote which apparently had quite an impact on his beliefs. The story shows that he gives high regard to the assumption that the system is composed of thinking entities. Joiner relates his experience of being a recent college graduate assigned to do industrial engineering work in a pea harvest. The pea harvesters were well aware of any changes to the system he proposed, and often found ways to counteract his "improvements." Joiner also makes quite clear his belief that organizations must have a purpose: "Any organization must have a shared aim" (p. 31).

Self-Organization

Joiner does not discuss self-organizing systems.

Indeterminism

Fourth Generation Management contains little or no discussion about assumptions of indeterminism vs. determinism or understanding vs. prediction. The most important clue to this assumption is the strongly worded statement, "A fundamental tenet of 4th Generation Management is that nothing happens in a predictable, sustained way unless you build mechanisms that cause it to happen in a predictable, sustained way" (p. 79). As mentioned earlier, we will infer from the absence of discussion about an underlying assumption that the assumption held is the conventional one. In this case, it appears that Joiner assumes determinism, and seeks prediction as the outcome of his approach to systems.

Holism

Possibly the most frequently stated underlying assumption of fourth generation management is the belief in the value of a holistic perspective. In statements such as, "we need to work together to optimize the system as a whole, not seek to optimize separate pieces," (p. 27) Joiner makes clear his belief that the optimization of any subsystem will result in the suboptimization of the entire system. He also believes that it is critically important for employees to know the "big picture." For example,

Each employee gets the opportunity to experience nearly every job in the manufacturing process by following a product through the entire production

sequence. This helps them understand what happens through the whole chain, to see how their jobs fit into the system as a whole and how their jobs affect the final quality of the product. (p. 83)

Relationships

On the question of unit of analysis, Joiner writes, "to manage our organizations more effectively, we must begin to think more in terms of relationships than of independent components," (p. 25).

Environment

Joiner does not point out any particular significance to the environment, or to the context of his approach. All of the examples in his book are of problems of a rational nature. We deduce that Joiner is not making environment-full assumptions.

Organizational Learning

The source that we have selected as representative of recent work in the area of organizational learning is Organizational Learning II: Theory, Method, and Practice (1996) by Chris Argyris and Donald A. Sch”n. Argyris and Sch”n sketch the current state of work on the topic of organizational learning. They then reintroduce their concepts of single and double-loop learning(1974), and the espoused theory vs. the theory-in-use (1974), which are critical for their distinction between the organizational theories-in-use, model O-I and model O-II (The "O-" prefix is used to designate an organizational theory-in-use rather than an individual one). Model I has the following values: define goals and try to achieve them, maximize winning and minimize losing, minimize generating or expressing negative feelings, and be rational. These values are operationalized in the following action strategies: design and manage the environment unilaterally, own and control the task, unilaterally protect yourself, and unilaterally protect others from being hurt (pp. 92-94).

Argyris and Sch”n offer that all of the organizations they have worked with exhibit Model I behavior (at least initially). Model I behaviors are self-reinforcing and self-sealing because they place people in double binds and because a feature of Model I is making actions that are threatening or potentially embarrassing undiscussable. Argyris and Sch”n maintain that Model II is a more productive theory for organizations to use because it leads to double loop learning. Important values in Model II are: valid information; free and informed choice; and internal commitment to the choice and constant monitoring of its implementation. Model II action strategies include: "design situations where participants can be origins of action and experience high personal causation, [the] task is jointly controlled, protection of self is a joint enterprise and oriented toward growth, and bilateral protection of others" (p. 118).

Argyris and Sch”n see two major tasks for those assisting in organizational learning. The first step, described below, consists of surfacing the dysfunctional Model I behavior in the organization. The second step is to develop a strategy for short-circuiting the dysfunctional behaviors when they occur and establishing productive, Model II behaviors. Part of this second step is for any outside consultants to transfer the skills of this second step so that organizational members can perform them without assistance.

Observation

The topic of observation does not receive much attention in Argyris and Sch”n (1996). Nonetheless, there are a few statements which suggest that Argyris and Sch”n assume a constructivist epistemology. For example, they write, "Each member of an organization constructs his own representation of the theory-in-use of the whole, but his picture is always incomplete" (p. 15). They also place themselves at odds with positivists in the goals of their research and the nature of the causal relationships they deem important.

According to the normal-social-science model of causality, probabalistic covering laws may be inferred from data provided by either of two empirical methods: "contrived experiment" or "natural experiment." Researchers...avoid referring to their subjects' intentions, which they regard as subjective, idiosyncratic and qualitative -- unsuited to the generality, quantitativeness and context-independence that are essential to the normal-social-science model.... In everyday practice, on the contrary, organizational practitioners ... [connect] an actor's intention to the action he or she designs in order to realize that intention... to put the same idea in different terms, we describe the reasonings that led up to the action, not the reasoning by which the action might be justified after the fact. (p. 39)

Moreover, Argyris and Sch”n assume that "the act of inquiry influences the situation inquired into" (p. 49). They accept that the interview process -- by virtue of the questions, the interactions with the interviewer, the nonverbal communication -- has an effect on the way an interviewee will construct meaning, as well as whether the interviewee will choose to be honest and open in sharing his or her information.

Causality

Argyris and Sch”n place a strong emphasis on the identification of feedback loops which are often implicit. They provide some excellent examples of how typical actions taken by managers can result in an outcome which is the opposite what was intended. For example, if an organization implements a pay-for-performance reward system, managers will learn to soften the criticism in their performance appraisals to avoid grievance actions, which will increase because the performance appraisal now has additional, important meaning. Thus, performance appraisals will be inflated, raising the cost of labor. The rising cost of labor will alert upper-level managers to implement other ways of reducing the cost of labor. Consequently, "the system of pay-for-performance, originally intended to improve productivity, turns out to have the cumulative effect of rewarding mediocre performance and increasing the cynicism of the supervisors" (p. 40).

Organizational learning includes a belief in mutual causation. Argyris and Sch”n offer the example of how individual and organizational learning occur. They contend that the relationship between the two is mutually causal. As individuals learn, that learning may also be contributing to organizational learning. Likewise, the presence of organizational learning is often accompanied by individual learning. "The causal arrows [point] in both directions" (p. xxii).

Reflexivity

Argyris and Sch”n include 11 main features to their approach to organizations. Item eight in this list, "practitioners...capable of reflecting

on their own inquiry ("inquiring into inquiry," as Dewey put it.)" (p. xxiii) demonstrates their belief in the underlying assumption of systems being composed of thinking entities. They also ascribe to the assumption that theories have an effect on the systems they describe. As an example, they provide their finding that when people create an organization map, the "participants are too easily willing to confirm a map if they believe the end result is only research knowledge" (p. 155), but they will show greater concern for the accuracy of the map if they know they will be involved with using it in the future.

Holism

Argyris and Sch”n emphasize the importance of the interdependence assumption. Early in their book they describe an organization's learning system and note that it "is interdependent with the theories-in-use that individuals bring to its behavioral world. Individual theories-in-use help to create and maintain the organization's learning system; this system, in turn, contributes to the reinforcement or restructuring of individual theories-in-use" (p. 29). These authors also note that in a system the component parts are interdependent, since each part "gets sustenance from and gives aid to the others ... and each component facilitates or inhibits the values served by the pattern as a whole" (p. 157).

Argyris and Sch”n see one of their major roles in organizations as providing the organization's members with a "coherent, holistic, testable account of the [employees'] many multi- leveled, disconnected explanations" (p. 152). Part of accomplishing this task includes compiling the organization map, which the authors see as a visual representation of the organization as a whole.

Organizational learning theorists, such as Argyris and Sch”n, see organizational actions as their unit of analysis rather than employees of the organization, for example (p. 8). More specifically, they focus on the interactions between individuals, and the interactions between individual and organizational phenomena (p. 188). The environment of these interactions is also of importance. Argyris and Sch”n suggest that "the very process of inquiring, individual or collective, is conditioned by membership in a social system that establishes an inquiry's taken-for-granted assumptions" (p. 33). The assumptions vary depending on the context of the social system within which the inquiry takes place.

SUMMARY

One useful way of distinguishing between these assumptions is to view them collectively as comprising a worldview. The emerging worldview (EWV) consists of the major assumptions of constructivism, mutual causation, and holism. The traditional worldview (TWV) consists of the major assumptions of objectivism, linear causation, and reductionism (Dent, 1997).

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TABLE 1
Assumptions Made Explicit by Each Tradition

Assumptions

1. observation (constructivism vs. realism)
2. circular causality (vs. linear causality)
3. reflexivity (knowing subjects vs. non-knowing)
4. self-organization (vs. design or direction)
5. indeterminism (vs. predictability or determinism)
6. environment-full (vs. environment-free)
7. relationships (vs. entities)
8. holism (vs. reductionism)

TABLE 1 (cont.)
Systems Science Traditions

	Ops. Res. Miser & Quade	TQM Joiner	Lng. Org. Argyris & Schon	Cyber. Maturana & Varela	GST Boulding	Sys.Dyn. Forrester
1.	No	No	Yes	Yes	No	No
2.	Yes	Yes Implicit	Yes	Yes	Somewhat	Yes
3.	Mostly, No	Yes	Yes	Yes	Yes	Yes
4.	No	No	?	Yes	Yes	No
5.	Yes	No	?	Yes	Yes	No
6.	Yes	No	Yes	Yes	Yes	Yes
7.	Yes	Yes	Yes	Yes	Yes	Yes
8.	Yes	Yes	Yes	Yes	Yes	Yes
Total	5	4	6	8	6	5