DIALOGUE AND ECOLOGICAL ENGINEERING IN SOCIAL SYSTEMS DESIGN

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ABSTRACT

A number of systems theorists and practitioners have described ways in which human systems of thought and interaction might be consciously designed. Banathy (1996) specifically proposed approaches to the design of human social systems through conversation and dialogue. More recently, Allen, et al., (2003) have proposed distinctions between environmental engineering and ecological engineering, which offer valuable insights into some of the difficulties inherent in the design of human systems. This paper will explore ways in which engineering, as applied to ecological systems, may help us better understand design as applied to social systems.

Keywords: dialogue, organizations, social systems, eco-systems, ecological engineering

INTRODUCTION

The ways in which we envision or understand systems determine much about the ways in which we attempt to affect them. The industrial era created a concept of organizations which mirrored the machines on which it was built. An efficient organization was to run like "a well-oiled machine." A clear division of labor improved efficiency and productivity. Frederick Taylor's program of Scientific Management further optimized each task through isolation and measurement. In work with human organizations and institutions, it appeared that this debate might have been resolved with the shift from a mechanistic to an organismic metaphor view. In reality it only seems to have created additional confusion. Very few professionals would argue today that human organizations could be viewed simply as machines. In practice, though, many still rely on approaches based in this underlying assumption. In broader terms, it remains as the split between "hard" and "soft" approaches.

Early systems approaches relied on a mechanistic conception of organizations and institutions. Operations research, for instance, used highly successful solutions to mechanical and logistical problems in addressing institutional and organizational issues, first in the military during World War II, and later in industrial production.

Theorists and practitioners from many fields, of course, ranging from philosophers to organizational researchers challenged this mechanistic view of people and organizations. Schools of thought, from Marxism to humanism, challenged the ability of the natural sciences, based primarily on physics, to capture unique aspects of humanity.

Some systems-oriented approaches still argue for the need for quantitative research and modeling. According to the Web site for the Operations Research Center at the Massachusetts Institute of Technology, "Operations Research (O.R.) is the discipline of applying advanced analytical methods to help make better decisions" (http://www.mit.edu/~orc/). Current applications of OR include economics, marketing, manufacturing, transportation and medicine. A very similar approach can be found in more traditional approaches to System Dynamics, which relies on mathematical modeling and computer simulation of feedback loops to describe system functioning. First applied to business organizations, the principles were then expanded to urban planning and global environmental modeling.

Ackoff, Banathy, Checkland, Churchman, and others (Banathy, 1996) challenged the application of such engineering-oriented approaches to human systems, arguing that social systems could not be treated effectively as mechanical systems. Critical Systems theorists challenged issues of power disparity in human systems even further. Other approaches such as Interactive Management and the Cogniscope might be seen as a middle ground, including the involvement of stakeholders into design, but into a process captured through computer modeling. Later variations of earlier methods, including second-order cybernetics and Viable Systems Modeling, as well as "softer" approaches to System Dynamics, attempted to capture more human aspects of systems as well.

This debate within systems sciences only reflects the divisions in much larger realms. Some scientists and researchers still believe that measurement and mathematical modeling are the only ways to achieve any sense of accuracy – especially when attempting to predict future events or behavior. Others, more typically in the humanities or social sciences, argue that these approaches are simply not adequate to deal with the complexity of human systems.

While on the one hand espousing the value of people to organizations, and emphasizing the critical need for initiative, leadership, innovation and a host of other human characteristics, decision-makers at many levels continue to operate in mechanistic ways. Organizations value creativity and innovation until a downturn occurs, at which point only efficiency, productivity and return on investment seem to matter (significantly reducing the capacity for creativity and innovation.) These same business principles have been applied to the US Federal agencies, and to educational institutions through initiatives such as No Child Left Behind (for primary and secondary schools) and through requirements for outcomes-based measurements at university levels.

As systems scientists, we have argued for an understanding of principles such as emergence (that new properties come to light at new levels of organization.) We do not expect the properties of cells to express the full functioning of organs or organisms. And yet we continue to deal with human societies through sciences developed for physics, or possibly biology at best. By way of comparison, Allen, et al., (2003) have proposed distinctions within biological systems that may be of help in at least clarifying some of the problems that we have as we move towards a fuller understanding of human social systems.

ENVIRONMENTAL AND ECOLOGICAL ENGINEERING

Allen, et al., (2003) have drawn a distinction between environmental engineering and ecological engineering. Environmental engineering, as they describe it, is essentially the use of biological material as machines, or incorporated into machines. (Note the similarity with the concept of mechanistic human organizations.) This includes everything from horse-drawn farm equipment to the use of yeast in making cheese or beer, to much more complex genetic engineering.

> Environmental engineering is a branch of civil and sometimes industrial engineering. As such it remains within the purview of standard engineering protocol as it imposes an external design on material that is the passive recipient of engineered limits. Not so for

> ecological engineers, whose engineered material offers no such constancy (Allen, et al., 2003, p. 391).

Ecological engineering, on the other hand, does not deal with controlled environments and has to contend with the unpredictability of ongoing interactions and evolutions. As they explain the difference:

> The theory to which we refer introduces a clear distinction between: (i) a process of design and fabrication of machines driven by human purpose, i.e. environmental engineering as described above and (ii) the processes of autopoiesis (self-definition) and self-organization (emergence or order) typical of life and ecological systems (Maturana and Varela, 1980, 1998) i.e. ecological engineering (Allen, et al., 2003, p. 390).

In teaching entrepreneurs how to establish a new business, the most common process involves the production of a business plan. In most cases this only reaches the level of what is (hoped) to be done, with very little focus on how it is to be achieved. As we continue to track the distinctions made by Allen, et al. (2003), it becomes clear how our usual processes of planning mimic more mechanical approaches to engineering.

> An abstract description of engineering starts by recognizing the existence of a given set of goals at the outset. Often the goal can be a general statement coming from a client at some level. Engineers commonly require those goals to be explicit and settled before the actual engineering starts… The real engineering does not start until the planners have made their final decisions (p. 394).

In most cases we could substitute "strategic planner" or "business analyst" for "engineer" with the same accuracy, as in "An abstract description of strategic planning starts by…" Much the same could be said of urban planning, many styles of negotiation, and even family therapy – especially the more behaviorally oriented approaches.

Not only do explicit goals fix the intended outcome, they also effectively create a closed system in which the design and implementation are to take place. They assume a high degree of stability in the environment, without which no plan can be expected to create a predictable outcome.

> The closure of the information space arises through the imposition of two sets of constraints: (a) those reflecting the decisions made by the planners and the characteristics of the associative context (this is what drives the selection of a type); (b) those imposed by technical and economic aspects of the processes of realization (this is what presses the argument for a particular process of fabrication reflecting the selected type) (Allen, et al., 2003, p. 395).

Autopoietic Systems

What would it mean to approach human social systems design from the perspective of ecological engineering? We should first revisit an earlier distinction made by Allen, et al. (2003) between environmental and ecological engineering. While environmental engineering "imposes an external design on material that is the passive recipient of engineered limits," ecological engineering understands that the materials with which it works have no such constancy (p. 391). Allen, et al. also refer to ecological systems as autopoietic systems, in much the same way that Luhmann (1995) referred to social systems.

> The theory of self-producing, autopoietic systems can be transferred to the domain of action systems only if one begins with the fact that the elements composing the

> system have no duration, and thus must be constantly produced by the system these elements comprise… The system would simply cease to exist in any, even the most favorable, environment if it did not equip the momentary elements that compose it with the capacity for connection, that is, with meaning, and thus reproduce them (Luhmann, 1995, p. 11)

For comparison, Venter (2008) has described his work in digitally designing sequences of DNA which, when inserted into bacteria, changed the genetic code of the bacteria and therefore its fundamental characteristics. His goal is to create new micro-organisms with specifically desired characteristics (for instance, microbes which can synthesize fuels for use by humans.) This is clearly an example of what Allen, et al. (2003) have described in terms of using biology as machines. As both sets of researchers seem to agree, even organisms at the level of microbes are quite context-dependent (e.g. the outcome of inserting digitally-designed DNA into a molecule will differ depending on the environment in which it is placed.) But organisms have a more tangible structure than ecological systems. Or as Allen, et al. (2003) explain:

> An ecosystem is not a realized structure, in the same way as is an organism. A mature organism is a relatively fixed realization of a type (associated with a given context), translated through DNA into a concrete structure. In an organism there is a fixed being, but there is no such fixation to give a body that is an ecosystem… An ecosystem is a becoming, not a being (p. 397)

Every attempt at engineering environments begins with a set of assumptions about what is, or should be, possible. Beginning with pre-determined environments is largely what defines artificial or virtual systems. (It is also what defines purely theoretical systems.) Only certain possibilities exist. The environment is predictable, but ultimately sterile. Change will occur *within* the environment, but not *to* it. But if both ecological systems and social systems are autopoietic – that is, self-producing – to what degree can they be consciously engineered or designed?

HOLONS AND HIERARCHIES

Allen, et al. (2003) make reference to Koestler's notion of holons as entities which have identities, but which are comprised of smaller parts each of which have different identities, and also act as parts of larger entities with still different identities. (Water molecules are made up of hydrogen and oxygen atoms, and water molecules collectively form pools, ponds, lakes, rivers, oceans, etc.) They distinguish these levels as n (the level of current focus, which in this case would be water molecules); $n - 1$ (hydrogen and oxygen atoms); and $n + 1$ (e.g. a pond or river).

As biological organisms we have physical structures that could be seen at many levels of $n - 1$, $n - 2$, $n - 3$, and so on. Our functional systems (respiratory, circulatory, neurological, etc.) are comprised of organs, which are based on cells, which are formed from molecules, which are comprised of atoms, etc. We also inhabit worlds formed through ideas and symbols which have evolved through millennia. If we cease to operate at any underlying level, from neurological to molecular, it obviously affects our total functioning. And we know that by affecting underlying levels through interventions such as medical care we can restore our functioning as organisms. But changing physical structure at level n does not necessarily or predictably change the functioning at level $n + 1$.

Biological ecosystems are comprised of the organisms within them, but not in the same way that organisms are made up of cells. The ecosystem around a small pond, for instance, would seem to have greater degrees of openness as a system than the organisms which inhabited it. The fish and frogs in the pond, and the birds, insects, and mammals that visited it, could certainly change and adapt as individuals, and over time as species, but not to degree that the ecosystem as a whole might. If one of Venter's new micro-organisms were introduced to a pond, both would be affected, but the changes for all of the other species involved would magnify the effect on the ecosystem as a whole due to the increasing complexities involved.

Following this line of reasoning, human social systems would appear to be much more like ecological systems than like organisms. The difficulty with this comparison, though, is that as biological beings, we already inhabit biological ecosystems, just as other organisms do. We need to consider yet another leap in complexity in order even to begin addressing human social systems, as such.

HUMAN SOCIAL SYSTEMS

Animals of many kinds exhibit collective behavior. Insects form hives, birds flock, mammals form herds, pods, and so on. In some ways, human group behavior certainly looks like that of other animals, and probably has many instinctive, biological roots.

Looking at the $n + 1$ level for any given individual human, though, typically results in a very complex pattern of associations and relationships, many of which happen simultaneously and all of which are interlinked in various ways. (Characterized by roles, I am a son, father, husband, brother, business owner, professor, church member, citizen at many levels, just to begin the list.)

Language is often viewed as one of the key markers that distinguish humans from other animals. While other animals do communicate in many ways, and do coordinate behavior, the abilities to think and communicate symbolically seem to add a great deal to the variety and complexity of human worlds. This would seem to make language, or possibly its larger functions in symbolic communication or coordination of human interactions, a candidate for the material or fabric of social systems. But if that were so, how would we design or engineer a social system by using it?

People talk a great deal. Many people, in fact, appear to spend the greater part of their waking hours each day talking, or communicating through written text in some way. The advent of mobile communication devices which are accessible to general populations around the world has only exacerbated this.

Even without specific research, it would appear that most conversations are fairly repetitive. They deal with topics that have been addressed with those same people or with others in similar relationships, frequently. "How have you been?" "Did you hear this news?" "Have you seen or spoken to this person we both know", and so on. Sometimes new information is shared; sometimes conflicts are started or resolved. Mostly, though, connections are simply maintained and relations perpetuated.

Each setting (each different social system) creates a different context for different types of conversations. Identifying with, and being identified by others as belonging to, specific social systems means learning to engage in the interactions unique to it.

Dealing with language, as such, though, is highly complex and extremely difficult. We obviously need language, but it is often anything other than clear or exact, which is why relying on mathematics is much cleaner. But that requires creating a very different kind of environment.

Most human activity is also habitual and repetitive. In fact, we tend to value our routines and a sense of what is normal or regular a great deal (which is one reason that the concept of "home" probably carries such strong connotations.)

As already noted, by Allen, et al., (2003) engineering begins with a plan. A plan inherently involves language, at least in terms of interpretation, however graphic or quantitative the model or representation might be. So in beginning even to think about addressing human social systems as they are, we have a number of very complicated issues.

1. We are attempting to affect what are assumed to be autopietic systems.
2. We are working some number of layers of complexity above even biological eco-systems (by virtue of their basis in symbolic communication, in some way.)
3. The autopietic features of human social systems seem manifested, at least to some degree, by habitual and repetitive patterns of language and behavior.
4. We have, to some degree, to rely on the use of language as a means to affect systems based at least partly on language.

DIALOGUE

Banathy (1996) proposed dialogue as the basis for his approach to social systems design (SSD). (This would, of course, be consistent with the use of language as a means for planning for engineering, as described by Allen, et al. (2003.)) More accurately, Banathy proposed two related but distinct types of dialogue for SSD: generative and strategic. Of the two, strategic dialogue is much more familiar to most people. It is the type used for planning and decision-making of all kinds. It is what creates the "closure of the information space" to which Allen, et al. (2003) refer (p. 295).

Generative dialogue, on the other hand, functions in a much different way. It acts on the environments in which human communications and interactions might take place. Banathy (1996) initially relied on Bohm's (1996) concept of dialogue as his basis for generative dialogue. As Bohm explained:

> I'm going to propose that in a dialogue we are not going to have any agenda, we are not going to try to accomplish any useful thing. As soon as we try to accomplish a useful purpose or goal, we will have an assumption behind it as to what is useful, and that assumption is going to limit us (p. 17.)

Banathy (1996) proposed that generative dialogue should

> …lead to the creation of collective consciousness, collective inquiry that focuses on the thoughts, values, and worldviews of the group and creates a flow of shared meaning, shared perceptions, a shared worldview, and a social milieu of friendship and fellowship (p. 219.)

Before going further, a word of caution is warranted. It is relatively easy, and at the same time dangerous, to draw direct parallels between ecological and social systems. It may be that social systems function according to many of the same principles as ecological systems, only at a different level of complexity or based on different elements. If so, they could be mapped as analogous systems, in Rosen's (1985) terms. It could also be that the parallels are only metaphorical, and therefore useful for discussion but not for rigorous research. (Differences like this get confused often, as in talking about human brains as if they are electronic computers, or vice versa.) It is safest to assume that we are dealing with metaphors for now, until these systems can both be better understood.

Regardless of the true natures of either ecological or social systems, we oversimplify both when trying to affect them. This is the problem of taking a traditional engineering (or a traditional scientific) approach, in which we assume that we can effectively isolate and manipulate parts of an autopoietic system, with predictable, cause-and-effect, results. It is the difficulty that becomes obvious when we assume that we can operate human systems of any kind "strictly by the numbers," only to have to repeatedly fix the same or similar problems, in addition to having to address new problems which arise due to unintended consequences.

Strategic dialogue alone can, of course, produce results. These often happen quicker, at less short-term expense, and with less involvement by different stakeholders than through generative dialogue. Recapping from above, though, it assumes that:

1. There are fixed, agreed ends in mind;
2. The decisions of the planners involved have determined the appropriate limitations and closure on the information space to be used, and;
3. An external design can be imposed on material that is the passive recipient of engineered limits.

As described by Banathy (1996), generative dialogue is not meant to replace strategic dialogue, but to precede it (see Metcalf, 2008). By acting on the environment in which strategic dialogue is to take place, generative dialogue opens possibilities by creating a deeper sense of understanding between the people involved, which often leads to new connections between ideas or ways of thinking, and a sense of trust which makes the sharing of ideas feel less threatening that it might otherwise. When effective, generative dialogue fosters a sense of shared commitment amongst the individuals involved. As changes occur at a strategic level, they are less likely to be dismissed as "someone else's problem," and more likely to be attended to by those who feel a vested interest in them.

In a world that seems ever-more focused on short-term efficiency and optimization, generative dialogue may appear extravagant, wasteful, or even pointless. The proponents of this view, though, rarely go back to calculate the waste produced by ineffective short-term efforts that miss targets or goals entirely. Assuming that their approach is the only valid one, they simply continue to launch new efforts of the same type.

Because the world is both more dispersed, and at the same time connected, the need for generative dialogue (or some alternative that creates a similar result) is critical. There is very little left in our human world that remains in isolation. Economic markets are global, as are issues of health, climate, energy, food, etc. Specific problems still need to be understood, targeted, and resolved, but within a context of ongoing attention and shared responsibility. Competition remains useful, but in a context which understands that survival is ultimately a cooperative affair.

Despite our vast technical expertise, we struggle as a species with conflicts at both biological and symbolic levels. Like other species, we fight for territory and food. Unlike other species, we kill each other over religious differences. Trying to simplify these issues to the levels of our tools and models does not do them justice. (A horse and carriage and an automobile are both means of transportation involving horsepower, but dealing with both as though they were the same thing is only useful at a very general level.)

We may be a long way from fully understanding human social systems as such, but learning to make distinctions between mechanistic and ecological systems, even at the biological level, is a step in the right direction.

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