Creating a Science of Purposeful Systems

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1. Introduction

Creating a science of purposeful systems was an intention in the early years of cybernetics (Foerster, et al. 1968; Ackoff and Emery 1972). A key distinction was the difference between goal seeking and goal formulation. A goal seeking machine, such as a thermostat or a more complicated automatic machine, would have its goal set by the designer or user and the machine would then perform its function repeatedly. But how would one design a machine that would formulate its own goals? How are we to understand purposeful systems such as human beings and organizations? The question has been addressed in several ways in the field of cybernetics.

The Viable System Model

Stafford Beer's consulting work with corporations led him to develop the Viable System Model (Beer 1972, 1979, 1985), a model of organization based on the structure of the human nervous system and Ross Ashby's theory of adaptive behavior (Ashby 1952). Ashby noted that in order to be adaptive an organism, organization or machine needed to have two nested feedback loops. The first operated frequently, made small corrections and enabled learning. Behavior that yielded a successful outcome was repeated. Behavior that yielded an unsuccessful outcome was not repeated. The result was that the system acquired or "learned" a pattern of behavior that was usually successful.

The second feedback loop operated less frequently and enabled adaptation. When the behavior that the organism or machine had learned no longer kept the machine in equilibrium with its environment, that is, when some essential variables went outside their limits, the second feedback loop would erase what had been learned and the machine would learn a new pattern of behavior. For example, when a corporation that had been profitable became unprofitable, the Board of Directors would look for a new Chief Executive Officer. Hence, goal formulation could be defined as a process of maintaining an equilibrial relation between an organism and its environment. Adaptation was defined as changing behavior when necessary so that the organism was always

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acting in a manner appropriate to the environment.

Cyberneticians working with managers and organizations recognized that a complex system such as an organization has a hierarchy of levels and purposes. For example, part of a manufacturing firm has as its purpose the design and production of quality products; another part of the firm has as its purpose marketing the products to customers. Beer's Viable System Model described a recursive structure for the divisions of an organization. The model has three parts (systems 1, 2, and 3) that produce the current product, a fourth part that scans the environment and designs the next product and a fifth part that regulates the basic values of the organization and decides when to change to the new product.

Autopoiesis

Another approach to describing purposeful behavior was contained in the work of Maturana, Varela and Uribe on autopoiesis (Maturana & Varela 1980). Using the Greek words for other, self, and production they defined allopoiesis as other production and autopoiesis as self production. To illustrate, when the Ford motor company produces a car, it is producing something other than itself. However, the managers of the company not only have the responsibility to produce cars, they also must maintain the company as a viable entity. The processes of self-production include hiring and training capable workers and managers.

The term autopoiesis was originally invented to describe a living organism. An organism consists of a set of processes that create molecules that interact so that the molecules and their relations create additional molecules and relations. A living organism is autopoietic both biologically and psychology. That is, biological processes create and maintain the body as a functioning entity. But a human being must also survive within a social system. Hence, a human being must create an image of itself and others so that he or she can function effectively in a social system. As a purposeful system, a human being must create an image of itself, and a role for itself within society, so that it can sustain itself both biologically and psychologically.

Reflexivity Theory

Vladimir Lefebvre (1982) created a theory of two systems of ethical cognition. Some people grow up thinking that the end justifies the means. Others grow up thinking that the end does not justify the means, that only appropriate means should be used. Throughout one's life the first reaction will be to use the ethical system learned in childhood. However, it is possible for people to learn the other ethical system. Then, if the familiar ethical system is not working, an actor can decide to use the other ethical system. Lefebvre called this process reflexive control. In the 1990s the theory was widely used in Russia for strategic analysis and in education and psychological counseling.

George Soros created a different theory of reflexivity to describe the behavior of purposeful entities (individuals and organizations and some machines) within an economic system. A key concern has been the ability to predict future states, such as stock market values, in a social system. Soros noted that actors in social systems not only observe, they also participate. As they participate, they learn and change their behavior. The future states of such purposeful systems cannot be reliably predicted, hence knowledge of the behavior of purposeful systems within a society is fallible.(Soros, 2013).

Eric Beinhocker described the nature of a science of social systems when they are viewed as collections of economic agents (Beinhocker 2013). He noted that in Soros's theory there is internal model updating, meaning that purposeful systems can learn or change their minds. Also, social systems are complex in two ways. Social systems have interactive complexity due to multiple interactions among heterogeneous agents, and the system has dynamic complexity due to nonlinearity in feedbacks in the system.

Second Order Science

Another approach to the subject of purposeful systems is to ask how research on social systems should be done given that the elements of social systems (individuals and organizations) have their own purposes and from time to time change their goals and behavior. Since social systems and the elements within them are reflexive and purposeful, how can we create knowledge of social systems? This question has been discussed in several recent publications (Mueller 2016; Umpleby 2002, 2014, 2016, 2017).

In the literature on second order science a key question is whether the observer is outside the system or inside the system. Usually in science the observer is thought to be outside the system observed. But if the observer is inside the system, as is usually the case with social systems, additional complexities arise.

In the management literature mission, vision, goals and objectives are often discussed but less often purposes. Rarely discussed has been whether purposeful systems could be studied with the same methods developed for the physical sciences. Not discussing purpose and not challenging prevailing conceptions of science seemed to go together. But now that science is being reconsidered (Umpleby 2014, 2017), perhaps it is time to revive the idea of developing a science of purposeful systems.

Why study purposeful systems?

Both engineering and medicine had to struggle to accept a scientific rather than a craft approach to their field. Perhaps someday management and public administration will have a scientific foundation. The idea dates back at least to Donald T. Campbell (1988), who wrote, "Reforms as Experiments," and "The Experimenting Society." Quality or process improvement methods have made a major contribution to establishing an experimental approach to improving social processes. But a science of social systems seems to require a step farther.

One approach is to expand the conception of science to include purposeful systems. The idea that purposeful systems change their goals and their behavior is not a surprise to people in business and government. But it is inconvenient for scientists who assume that if a sample of people behave a particular way one week, a similarly drawn sample of people can be expected to behave similarly the next week. The idea of unchanging elements is carried over from physics, which studies inanimate objects. A different approach to social systems would be to include experimental subjects in the class of experimenters and vice versa. The result would be a conversation. Means exist to hold such conversations using group facilitation methods. See www.gwu.edu/~umpleby/ptp.html.

Conclusion

After more than fifty years of work in the field of cybernetics we now have several ways of thinking about purposeful systems. We know that purposeful behavior and adaptation occurs at many levels in organizations (Beer). We know that the primary task of viable systems is to create and maintain their essential components and processes (Maturana). We know that the psychological structure of awareness is different for different persons and that people can change their behavior (Lefebvre). We have learned that earlier models of social systems made unrealistic assumptions about human behavior (Soros). Beinhocker (2013) clarified several assumptions in Soros's theory of reflexivity. Since science is a human activity that rests upon our assumptions about human cognition and human interaction, we have now developed several ideas about how to change our conception of science and our methods for doing science in order to incorporate what we have learned about purposeful systems (Umpleby, 2014, 2017).

Key words: *Second order science; cybernetics; facilitation methods*

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