FROM CONTROL TO CHAOS: A SYSTEM DYNAMICS MODEL OF INTERPERSONAL COMMUNICATION

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The current interest in learning organizations makes clear the need for more open, more collaborative communication practices in the workplace. "To compete in today's fast moving business environment," says one corporate communication expert, "organizations must create a culture of shared understanding"(Locke, 1992, 245). However, a major obstacle to facilitating open communication and the generation of new ideas required in learning organizations is the inadequacy of traditional communication models. These models tend to use information for control in organizations; to see information as signals or bits separate from meaning; to see the brain as analogous to a computer; and to seek accurate transmission and replication of messages rather than creation of new information. The purpose of this paper is to show that the **confluence** model of negotiating differences in interpretation is better suited to understanding interpersonal communication than the traditional cybernetic and information theory models based on Wiener and Shannon and Weaver. Furthermore, it argues that information for control is an outdated model that binds us to old scripts, to replicating traditional patterns rather than creating new ones.

Modeling to control or to understand?

According to the editors of *Modeling for Learning Organizations* , the authors represented in the volume "share a 'modern' view of modeling...that uses "qualitative mapping...support team reasoning and learning [and] encourages system thinking and scenario planning"(Morecroft and Sterman 1990, xvii). The articles reflect a growing recognition of the value of the knowledge and expertise of workers in an organization. Recent developments in system dynamics have included techniques for eliciting knowledge and mental models (Hall, 1989; Vennix et.al., 1990; Hodgson, 1994). However, more attention needs to be given to interpersonal communication as a way of drawing out our often inchoate, implicit mental models. The turmoil of trying to come to a shared understanding with a colleague or a relative is often frustrating and time-consuming. But that recursive process pushes us to clarify our own thinking as we articulate our private mental models while it (ideally) generates new information and new meanings, and leads to shared understanding. The confluence model described in this paper offers a new way to understand the recursive process of interpersonal communication. This understanding suggests methods to facilitate the sharing and generation of knowledge which is vital to the organization's survival.

Cybernetics and information theory

Norbert Wiener's title *Cybernetics: Or Control and Communication in the*

Animal and the Machine (1948) contains an implicit promise for a general theory of information. At about the same time Shannon and Weaver working for the Bell Telephone Laboratories developed *The Mathematical Theory of Communication* (1949), which became" the basis of all contemporary Western theories of communication"(McLuhan and Powers, 1989, 75) . Management literature and practice continue to support Wiener's view that information increases system control (Steinbrunner, 1974;Senn, 1983; Beniger, 1986;Yates, 1989; Lord and Maher, 1990; Clark and Augustine, 1992). And governmental and private agencies continue to spend massive resources on collecting and collating data and management information systems. Enthusiasm for the work of Wiener and of Shannon and Weaver has been all but unbounded and continues to dominate the literature of business communication (Targowski and Bowman, 1988; Beamer, 1992) as well as management science.

But this enthusiasm is not universal. Clearly, the failure of cybernetics to provide a solid foundation for a theory of human communication results from the ways cyberneticists define information; from their view that minds operate like computing machines; and from their focus on communication as a linear process of transmitting a message through a channel to a receiver, rather than a recursive process with the capacity for continuous interaction between sender and receiver and the creation of new information.

Problematic definitions of information and communication

Originally designed to explain the transmission of electronic signals, the Shannon-Weaver (1949) model has been widely adopted by scholars in the field of interpersonal comunication "because of its seeming simplicity and its foundation in scientific principle"(Bowman and Targowski, 1987,p.23). Yet if we re-examine the language of *The Mathematical Theory of Communication* by Shannon and Weaver, we can quickly see why the application of their approach to interpersonal communication is, at best, problematic.

First, they define "communication" as "all of the procedures by which one may affect another"(p.3). Their explanation of source, transmitter, message, channel, and receiver (see diagram below) in terms of oral speech further encourages us to believe that this model can form the basis for a theory of human communication: "[T] he information source is the brain, the transmitter is the voice mechanism producing the varying sound pressure (the signal) which is transmitted through the air (the channel)." (p.7).

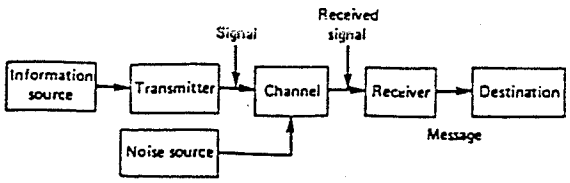


FIGURE 1 The Shannon-Weaver model. (From *The Mathematical Theory of Communic.* by Claude E. Shannon and Warren Weaver. University of Illinois Press. 1949.

Figure 1

But then Weaver presents us with a mathematical definition of information, which specifically precludes any consideration of meaning:

The word *information* , in this theory, is used in a special sense that must not be

> confused with its ordinary usage. In particular, *information* must not be confused with meaning" (p.8).

The discussion of information that follows is in terms of its measurement in terms of stochastic, Markoff, and ergodic processes; clearly, the theory presented here is mathematical, and specifically designed from an engineering perspective to explain the transmission of electronic signals, "and not at all directly concerned with the meaning of the individual messages"(p.14).

Wiener's discussion of information, like Shannon's and Weaver's, emphasized the isomorphism of the transmitted messages with the received message as a key measure of success (1948, pp. 66-67). The focus of interest is the accuracy of the transmission of symbols, that is, the technical problem . But the semantic problem of conveying the desired meaning and the effectiveness problem of modifying behavior in the desired way are given short shrift.

Initially, the confidence of Wiener and Shannon and Weaver in cybernetics as the basis for a theory of human communication and control was widely shared. Today, however, some management scientists are less sanguine than the researchers and theorists of the l940's. For example, a recent study that "empirically examined the signal hypothesis in the context of management control systems for 99 defense contracts" found no evidence to support the view

> that information is used for controlling project costs, schedule, or quality ....The quantity, detail, timeliness, and cost of information do not have a positive effect on project control. In fact these results were most noted for their insignificance. This lack of empiracal support for the signal hypothesis raises still further questions about the cybernetic vision and the principl of information for managerial control (Overman and Loraine, pp.193-195).

Wiener argued that "Control is nothing but the sending of messages which effectively change the behavior of the recipient"(1950, p.124) But the researchers evaluating the presumption that more information, and more timely information helps us to control expenditures in public management, as in project management of large contracts, found otherwise. Furthermore, interviews with project managers of government contracts showed that the managers suspected that "information was used more for audits and potential control than for immediate project control" and "was collected to maintain the *appearance* of accountability" and the *illusion* of control" rather than exercising the direct, real time control described by Wiener (Overman and Loraine, p.195; italics added). According to a recent book on management science

> The nub of the problem is that we've treated information as a "thing," as an inert entity to disseminate....This "thing" view of information arose from several decades on information theory that treated information as quantit, as "bits" to be transmitted....I believe it is information theory that has gotten us into trouble. We don't understand information at all" (Wheatley, l992, p.102).

We may conclude from the above (and from personal experience) that despite the

enormous effort and expense involved in collecting, compiling, and disseminating information in organizations, such efforts do not necessarily result in the control promised by cybernetics. To reiterate, this failure is in part due to the cybernetic/information theory view of information as signals or messages that are clearly objective and quantifiable "things."

Minds and machines

The second major limitation of the cybernetic approach to human communication is its failure to distinguish between animal and machine. Although Wiener conceded that the brain "is not the complete analogue of the computing machine but rather the analogue of a single run on such a machine" (Wiener,1949, p.121) he generally emphasized that the computers and the human brain are analogous, and that they are "logical machines" (p.124).

More recent research into the nature of mind and brain have produced lively debates between those like Marvin Minsky (1985) and Daniel Dennet (1991) who argue that the mind works very much like a computer, and others such as Jerome Bruner (1990), Gerald Edelman (1992) and Erich Harth (1993) who disagree with the view of the brain as a machine. For example, Bruner says that equating cognitive processes with computer programs is reductionist and simplistic. Harth and Edelman agree. They explore the relationship between psychology, biology, Darwinian evolution and the relationship of brain to mind. In short, they present a view of the evolution of brain and mind that is far more comprehensive than the cybernetic model.

Rich insights into the relationship of the mind to the brain can be found in Edelman's theory, which provides a bridge between psychology and physiology. He explains the connection between the evolution of the brain's neuroanatomy in Darwinian selectional terms and then shows how the experiences of an individual can modify the morphology of his/her brain(p.83). Edelman argues that:

> An analysis of the evolution, development, and structure of brains makes it highly unlikely that they are Turing machines .... [B]rains possess enormous individual structural variation at a variety of organizational levels. An examination of the means by which brains develop indicates that each brain is highly variable....Moreover, each organism's behavior is biologically individual and enormously diverse, whether or not that organism registers or reports subjective experiences as human beings can (pp.223-224).

Of course Edelman was not the first to dispute the mind/machine analogy. In his discussion of development in the cybernetics thread as applied to psychology and psychotherapy, Richardson tells us that the psychologist William Powers noted the mistake of social scientists who "think of control system models of behavioral organizations as a mere analogy of human behavior to the behavior of technological invention." Powers insists that these social scientists have reversed the true analogy: human beings have designed machines to imitate living systems, and machines are made to imitate the brain, not the other way around. According to Powers:

> The servomechanism has always been only an imitation of the real thing, a living organism, and the engineers who invented it, however unwittingly, psychologists. The analogy developed from man to machine--not the other way (1978, p.418, quoted by Richardson, p.259).

Powers says this "man/machine blunder" underlies the tendency of some behavioral psychologists to treat people like machines by trying to deal with behavior "strictly in terms of its objective appearance" thereby "miss[ing] the reason for its existence"(p. 419, quoted by Richardson, p.259). It also underlies the tendency of communication researchers to focus on the transmission of messages rather than the creation of shared meaning within a community.

Discrete events vs. dynamic patterns over time

The tendency to focus on discrete events rather than dynamic patterns over time is a third major problem with cybernetics and information theory as a basis for a theory of human communication. Human communication textbooks base their discussion of the process of communication on the Shannon-Weaver model, with various modi - fications. Invariably they analyze the process in terms of SENDER-MESSAGE-CHANNEL-RECEIVER, (SCMR) . (Berko, Wolvin & Wolvin, l995;Hoen, l991; DeVito, l986).

A survey of the most frequently cited models of commnication (including those by Shannon and Weaver; Westley and MacLean (1957); Berlo (1960); Thayer (1968); Schramm(l973); Campbell and Level (1985) shows that they focus on a single communication act or event, rather than a recursive process. Furthermore, they emphasize the act of transmitting a message rather than a process of creating meaning. (Kincaid, l980; Bowman and Targowski, l987; Hoen, 1991). Nonetheless, more recent models developed to redress the inadequacies of these previous models continue to focus on the Sender-Message-Channel-Receiver. For example, the Targowski-Bowman (1988) communication model shows two boxes to represent the sender and receiver, very much like the Shannon-Weaver model in figure 1 above.

Figure 2

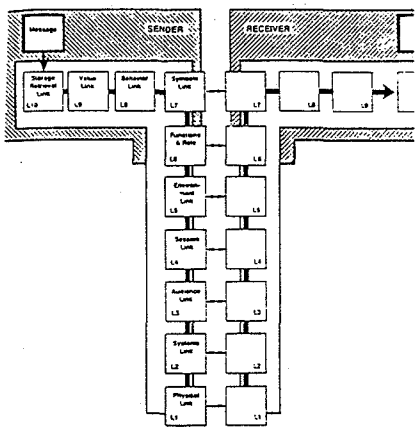


Figure 2
The Targowski / Bowman Communication Model:
Layer-based Links

While the authors offer the disclaimer that this is "only the first step" (p.24) of an in-

depth analysis of dyadic communication, one can see serious flaws in their layer-based link model. First, like the Shannon-Weaver model, it is based on the notion of information as "bits" of data, as a material entity. Secondly, it is based on the view of the mind as a machine with a "storage-retrieval system."

System dynamics and interpersonal communication

It is fair to say that human communication as an academic discipline --distinct from philosophy and linguistics-- is based, in large part, on the work of Wiener and Shannon and Weaver in the l940's. As we have seen from the brief discussion of the limitations of their definitions of *information* and *communication* ; their (mis)use of the analogy of minds and machines; and their focus on single events rather than on patterns of behavior over time, the contribution of cybernetics and information theory to our understanding of interpersonal communication and our understanding of communication for control of social systems is at best problematic, and all too often is simplistic, reductionist and distorted.

Like cyberneticists, system dynamicists identify the disparity between observed and desired conditions in a system, and generate "correction action to bring apparent conditions toward desired conditions" (Forrester, l994, p.51). But unlike cybernetics and General System Theory, which have produced no coherent set of practical techniques, system dynamics has generated clearly articulated philosophies and methodologies for model building. (Forrester, l961, l968, l994;Richardson and Pugh, l981; Roberts et al., l983; Richmond et al. l987; Wolstenholme, l990). (Richmond, 1994).

Within that body of literature are techniques that facilitate the analysis of interpersonal communication -- the sharing and creating of information within a social context. System dynamics is more suitable than cybernetics for constructing a model of interpersonal communication because

- 0 system dynamics defines information broadly, to include intuition and experience as part of one's mental models
- 0 the focus is on patterns of behavior over time, not events
- 0 the focus is on understanding a system, and not on controlling it

A major weakness of most communication models is that they are abstracted from a social environment, as though human minds were little more than electronic boxes sending and receiving signals. But the individual mind is not an isolated entity, and is not separate from the body, or other minds, or the culture or society in which it exists (Bateson, l972; Senge and Kim, l994, pp.290-281). Fortunately, system dynamicists embrace a more comprehensive definition of information than the researchers discussed earlier and recognize the importance of an individual's personal experience and culture in forming his or her mental models.

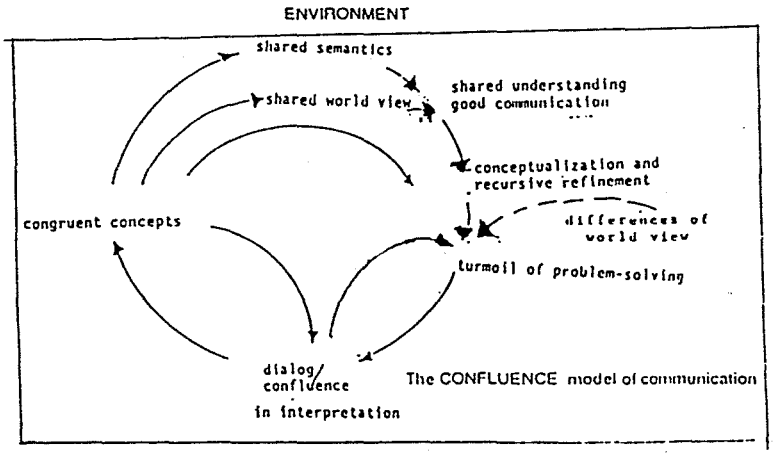
The confluence model of negotiating differences in interpretation

Psychologist Jerome Bruner argues that meaning, which is included in mental models, is constructed within human culture and cannot be discussed apart from

culture. He says that it is

> only by virtue of participating in a culture [that] meaning is rendered *public* and *shared.* Our culturally adapted way of life depends upon shared meaning and shared concepts and depends as well upon shared models of discourse for negotiating differences in meaning and interpretation"(Bruner, l991, p.13).

A model illustrating the recursive process of negotiating differences in interpretation and working towards the goal of shared understanding within the context of a culture or a social environment is shown below in figure 3.



The system is viewed from an appropriate perspective to help solve the problem of how interpersonal communication works. It does not attempt to explain the contents of the "black boxes" or minds of the participants, nor does it look at a single communication event. Instead it views communication recursive process in which the participants send and receive multiple messages in any one conversation. Furthermore, it is a process which involves the whole personality, including reason and emotion, body and mind. (Barnlund, l962). In addition to the values of the individuals engaged in conversation it involves the values and mores of the culture within which the communication occurs.

The confluence model is based on the premise that the parties, each approaching a particular issue from a different point of view, commit themselves to work through the turmoil of problem solving until (ideally) they reach their goal of shared understanding. The basic idea of the confluence model of communication is based on C.S. Peirce's analysis of the nature of signs and meanings. Peirce concluded that "no concept, not even those of mathematics, is absolutely precise [because]... no man's interpretation of words, is based on exactly the same experiences as any other man's" (quoted by Kincaid, p.44). No two people see anything exactly the same way because our perceptions are filtered through our unique personal experiences. Edelman argues that even the morphology of one's brain is modified by one's personal experience. Furthermore, he says, what we know cannot be clearly separated from how we know.

The term **confluence** is meant to suggest the flowing together of "streams of consciousness" in the same direction. For a period of time, when the participants have achieved shared understanding on a particular point or issue, they are, to use another metaphor, on the same wavelength. But like James Joyce's fictional characters

Leopold and Molly Bloom and Stephen Daedalus, each individual has his/her own frame of reference for interpreting personal experience and for creating meaning; thus we will not always be confluent with our colleagues, friends, and relatives.

Implications for managers of learning organizations

Enlightened managers recognize that all wisdom is not necessarily at the top of the organization and that information sharing and the generation of new ideas are essential in order to compete and to survive. A recent book on leadership in organizations states :

> If there is nothing new, or if the information that exists merely confirms what is, then the result will be death....We need....the development of new approaches to information...not control but genesis (Wheatley, l992, l09).

It is interesting to note that some recent publications in management science diminish the need for control, and value chaos as a source of new information and new order. Wheatley argues that "Information is always springing out of uncertain, even chaotic circumstances"(l09). Overman and Loraine put it this way:

> Managers who rely.... on direct experience and on direct, sometimes intuitive, information soon recognized that the very chaos they see is the source of new order....Chaos theory suggests that researchers and managers should seek to understand the apparently chaotic conditions of their organization rather than simply requiring more information and means of controlling them.... Accountability is not found in...the outdated principle that information is for control (Overman and Loraine,l96).

Unlike traditional communication models based on matching the transmitted and received messages, the confluence model privileges the generation of new ideas rather than the accurate replication of old ones. Because the survival of organizations depends on their ability to build a culture of shared understanding and to encourage the generation of new ideas, enlightened managers will work toward creating a climate of trust and openness to facilitate face-to-face and electronic communication between individuals, departments, and divisions. System dynamicists have for some time recognized the value of group discussion to capture team knowledge and have used various techniques to capture information, including the visual mapping of ideas with hexagons. But our mental models are often inchoate until we try to explain them:

> By acknowledging the chaos in our minds as a resource and not a failing, we can set out to catch...odd thoughts, the significance of which we have yet to realize....The generation of new thinking...requires that we tap into this reservoir of insight and information and form new patterns of understanding it (Hodgson, l994, 368-9).

Increasingly, managers and CEO's are recognizing the need for dialogue and teamwork. According to an executive from a major corporation, learning organizations need leaders who are also good teachers and effective facilitators in order to

encourage "dialogue, the heart of the discipline of team learning"(quoted by Senge, l990, p.191). A director of corporate communications at another organization argues that knowledge is generated and shared as people tell work related stories:

> Genuine knowledge has two irreducible aspects: it is seldom structured in the form of fixed fields or dependable rules, and it's social (i.e., it is distributed as shared understanding among human groups that often have little respect for artificial organizational boundaries)....This living knowledge emerges as people share their perspectives and defuse their collective prejudices, blind spots, and unfounded assumptions. (Locke, 1990, p.246).

Locke argues that to facilitate collaboration, the traditional hierarchical structures and departmental divisions need to be revised.

Not only do we need to facilitate dialogue between members of each department, but also across departments, across functions, and across geographic locations. In their book on the impact of information technology on organizations, Grenier and Metes (l991) discuss some of the impressive results achieved in organizations, particularly in the high-technology sectors, as a result of cross-functional team composed of workers from different divisions within a company, and even from different companies collaborating on a major project. For example, a team including members of Northrop and McDonnel Douglas were able to reduce "by 50% the normal time from engineering design to the release of tooling information"(Grenier and Metes, p.3). The team also significantly improved production time and reduced costs.

Summary and conclusion

Clearly, information for control is an outdated ideal. To survive in a world of continual change organizations must be able to generate information and create new patterns of understanding. And this information is generated from the chaos in our own minds, as we negotiate our differences with others in a human community. In the turmoil of the recursive process of interpersonal communication, we articulate our ideas publicly, modify them, and create shared understanding and new meaning. More work is needed, however, to develop and evaluate techniques to facilitate productive dialogue in the workplace. How shall these groups and teams be constituted in terms of function and size? How and where shall they meet? And how can we best capture the new insights and the wisdom of experience of workers as they collaborate in teams? Finally, how can we overcome management's reluctance to modify hierarchical structures and to allocate resources to building shared understanding?

This paper has shown that traditional communication models based on the cybernetic model of Wiener and the information theory model of Shannon and Weaver are inadequate for today's learning organizations. "Models are not true or false," according to Barlas and Carpenter, "but lie on a continuum of usefulness"(l990, p.157). The confluence model of interpersonal communication helps answer many questions about the communication process and communication in the workplace in particular. Some advantages of this model are that it is grounded in an interactional view of the process "in which both (or all) persons [simultaneously] act and react, 'receive,' and 'send,'"(Watzlawick and Beavin, l977, p.57). It also holds that "meaning" is determined jointly by the participants in the conversation. The confluence model, which privileges the generation of new ideas over the replication of old ones, is more

useful than the traditional linear, transmission models. Finally, the confluence model recognizes the value creating a climate of trust and openness to allow individuals to tell their stories and to negotiate their differences of interpretation and work towards shared understanding.

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