Beyond Intelligent Systems: Listening to the Ghosts In the Machines

Steven K. Wyman, School of Information Studies, Syracuse University  
<skwyman@mailbox.syr.edu>

Ping Zhang, School of Information Studies, Syracuse University  
<pzhang@mailbox.syr.edu>

If we look back 50 years in computing history, we can compare Vannevar Bush's vision of what information technology might one day be able to accomplish to what it has since become. Bush foresaw the use of the computer as an effective memory system, with which humans could store and retrieve information, as well as sort data, and trace a kind of hyperlink trail of reasoning. Not only that, but in Bush's memex machine, one would even be able to print off or magnetically store an information set for delivery to others. Everything Bush described has come to pass, and in nearly every case exceeds what he imagined. Bush was prescient indeed, but he also occupied a good vantage point: he directed certain military research in the war effort. He was familiar with rapid developments in prototype feedback experiments such as fire control and communications theory, among other things. In early fire control a system's state advanced through iterative looping of feedback through the system. Output was re-entered as input. Refinements in such processes led to the birth of cybernetics. In this phase of the information revolution cybernetic systems combined machines doing environmental scanning with human intervention providing the intentionality, or wisdom, to the system. Machines appeared fully capable of combining data structures into information constructs. Information domains were defined by task.

Feedback and Distributed Systems

As computers matured, the concept of feedback emerged as a central feature of human computer interactions. Expert systems employ feedback from one or multiple users to determine relevancy and retrieve appropriate data, or to forecast plausible scenarios. In systems design, we can take data directly from the system's users via keystrokes or other input. We can have intermediaries such as professional online searchers reformulate input into more refined categories. We can even unleash genetic algorithms to "learn" about and mine data for potential knowledge. Artificial intelligence research inspired some to expect that machines might be constructed with autonomous intelligence. In this view, machine intelligence might be devised to solve problems without [at least direct] participation of users. This approach, strongly reflected in the information technologies influencing organizational restructuring, dissociates the human from the machine, in effect constructing an artificial and abstract environment in which processes are efficiently automated. Human feedback is removed as much as possible. Many information systems began to take on a self-contained aspect. Mechanical systems are becoming highly knowledgeable in artificial environments. The result is an extremely rational model of work, processes, and intelligence. Problem solving, or task, still defines the boundaries of the system's behavior and utility. In other words, humans still determine the intentionality directing the information system. The system may be effective and efficient as well as organizationally and socially transforming, perhaps even knowledgeable, but it is not intrinsically wise. This context must be provided by the system's architects and users.

The Internet was created to resolve a problem. Like so much of Bush's insight, it originated from concerns with communications and warfare. However, over the past decade we have all witnessed the emergence of computer networks as highly distributed, highly social, and very open systems. Feedback is pouring into the networks in unprecedented volumes. In many cases this feedback targets tasks and problem solving. But in as many other instances, what is occurring is exploration, socialization, or even plain mischief. There is randomness loose in the networks. At the same time, and perhaps not so coincidentally, there is creativity, self organization, and adaptive behavior. Networks are not simply computers communicating; they are
people communicating. The Internet has evolved from a controlled, task-oriented structure to an unregulated social system with communication as its essence. At this task, the Internet is wildly successful.

Colonization and Control

Metaphors ascribing spatial qualities to the Internet abound. It is developing into an environment in and of itself, or so it seems. Perhaps Information Superhighway and similar transportation analogies are misleading. What the global network more closely resembles is a frontier. The Asiatic tribes which first populated the Americas established cultures that closely interacted with their physical environments, but did not ordinarily place heavy demands upon it. When Europeans arrived, with more technology and urbanized social structures, they promoted a different concept of the environment. The indigent populations were likely to adapt to their environment: the Europeans rapidly adapted the environment to themselves. They sought to subdue and control nature. In the process, they created a new, rationalized environment. They began closing the system to certain categories of input. Self-organizing frontier communities eventually came under the jurisdiction of territorial and then a national government, which absorbed the communities as components of the economic and social infrastructure of the new nation.

This same process of colonization and control is unfolding across computer networks. As the online population grows, increasingly it comes to be perceived by various interests as communities in need of external regulation. Similarly, networks are emerging as mechanisms for the delivery of goods and services. In an economic sense, the transportation motif invoked by "Information Superhighway" is appropriate. Recent telecommunications regulations seek to constrain the communications aspect to the Internet. The same regulations grant to commercial interests an implicit organizational mandate. We believe that there are presently energies and agendas to shift the primary focus of the Internet from a communications medium to an economic instrument. The wilderness is being reshaped by developers. The randomness and chaos so inherent in the rise of the Internet is colliding with institutionalization. Users are being transformed into consumers.

It can hardly be a bad thing that the global network presents enormous economic opportunities, given that they are equitably distributed, and not destructive. This same opportunity drives much of the technical infrastructure that makes the system possible in the first place. There are many benefits to societies around the planet to have ready access to vast reservoirs of information. We live at a singular point in history. A discontinuity is occurring before our eyes in our abilities to materialize our insight and imagination and share it with millions, and perhaps within a few decades, billions. The global network is presently an open system. It is complex, adaptive, and evolving rapidly. It is highly intelligent insofar as it is an increasingly creative medium for human minds to freely associate. It bears little resemblance, on the other hand, to a coherent, rational organization. It is cybernetic because it is responsive to its users, who are in many respects its creators. This dynamic is in the balance at the moment. If the networks diminish the active creative input of the individual user, then in effect, the networks are losing adaptability. This is highly consequential.

Complex Adaptive Networks

We inhabit a moment in history at which it is wise to consider how the networks are penetrating our daily lives. Computer networks are effectively bound up with national economies, with the communications infrastructures, and with environmental monitoring and assessment activities. The scale of our information technologies requires us to expand the levels at which we assess its impact on our lives, our societies, and our common future. The technology that is embedded deeply within our lives has become a social environment. We should wonder if we are not, in turn, becoming embedded deeply within it? Technology can greatly enhance our security and well-being, as well as enrich our experience. It is imperative to reflect on how the systems we develop add layers to our interactions with the world. Are these systems open or closed in nature? Do they allow human input, or do they limit human choices? Are they designed to enable or to control? It is urgent to address these and similar questions now -- the pace of change is too quick to safely ignore. The danger is that we will create an artificial environment which is unresponsive to
environmental indicators. If this happens, and it may be a secular process already well underway, then we risk drifting into marginal adaptive fitness. The single best way to guard against this situation is to preserve as many channels of direct user input/feedback into the system as possible.

If we look ahead past this brief, but fateful moment in our evolution, what can we imagine the networks becoming? By asking this question, framed by our past experiences, we come face-to-face with the need for a systems design philosophy based on principles and vision. We cannot merely trust that the technological environment with which we are surrounding ourselves will be benign simply because we intended it to be so. For that matter, perhaps not everyone's intentions are so benevolent.

If we peer into the wilderness of possibilities that suggest the future and take current technological conditions into account, we can make several predictions of the network environment. Global computer networks will be deeply interwoven into the fabric of society. Rich, immersive online multimedia environments will be commonplace. Modern survival skills will include electronic competencies. The networks will be intelligent complex adaptive systems provided intentionality by the human users. Distributed cybernetic systems will be interactive networks. Randomness will be used strategically in systems design to foster adaptability. The mechanistic model of human computer interaction will be applied mostly to closed system problems. Open systems with human "components" will employ emotional intelligence over empirical analysis to resolve complex problems involving distributed behaviors. Online memories will be ephemeral, tokenized representations constructed quickly to establish relevance and organizational contexts for rapid problem solving. The philosophy reflecting the needs of this world should comprehend its qualities.

Organizational Memory Systems (OMS):
Templates for Learning Organizations

At the organizational level work is in progress to design OMS for various tasks. The development of online collaborative environments establishes an ideal forum for abstracting communications tokens as feedback to grow intelligent networks. It's been said that there is no learning without memory, and in this paper we associate learning with adaptation. Organizations strive to maintain equilibrium through constant aligning of environment and organizational mission. Multiplying this relationship by the internal dynamics of the organization, which include the interactions of its descriptive, prescriptive, procedural and programmatic elements, we witness the emergence of complex systems. At the heart of Complexity Theory is the concept which Christopher Langton coined "the edge of chaos." The edge of chaos is the limn where patterns emerge from randomness. For the construction of OMS, the edge of chaos appears at the intersection of the organizational culture's normative orientation and the substantive content of its routines, procedures, manuals, and mission. This is the prescriptive + programmatic region where external environmental stimuli meets organizational belief and tradition; where development meets conservation. Emerging OMS provide a laboratory for proof-of-concept. Language in G-7 Global Information Infrastructure documents calls for the creation of international "collaboratories" for scientific work. We propose that this concept be further developed in regards to general distributed systems design.

Patterns in the social world, including economics, geopolitics, computers and telecommunications, to name a few, have been changing ever more rapidly in recent years. The vernaculars of organizational and management sciences reveal the responses of their respective communities: reinvention, reorganization, restructuring, transformational leadership, change agency, paradigm shifts, downsizing, rightsizing, and so on. Each of these terms derives from coping with change. Add to this the fact that information technology has greatly enhanced the ability of a corporation to decentralize its authority and thereby distribute its operations nationally, and globally. Reorganization at the organizational level in some ways mirrors similar global social processes of realignment now so prevalent.

The fluidity of the global marketplace is reminiscent of the edge of chaos conditions. Niches disappear and new opportunities open constantly. The entire global system of social and economic networks is refining, and redefining. Traditional values are in conflict with unfamiliar adaptations at the levels of nations,
societies, organizations, families, and perhaps somehow in our individual psyches. Our focus here is at the organizational level, but all levels interconnect and affect the others. They make up a significant portion of the environment in which the organization must survive. At each level as the values and norms collide, there is instability in cultures, mythologies, and superstitions.

Learning Organization Memory Systems

Conceivably, OMS can be designed to detect mood or emotional color in discourse that act as early warning of threat, discovery of opportunity, or serve as a channel for aggregating employee insight. Hirsch described how during corporate takeovers the emotionality of the language surrounding the contest could be intensely emotive. Such episodes are conducted in an atmosphere of high anxiety and uncertainty. Mitroff suggests that the parties in opposition drop customary diplomatic language and resort to a stripped-down archetypal discourse. This provides a tableau for rallying the organizations' members around a shared conception of the situation, coordinating them as stakeholders in the outcome. The heightened level of uncertainty promotes a drive to stabilize the organization around its core values that are being challenged by an alien culture. McKelvey wrote that when an organization is faced with high degrees of uncertainty, it goes into a state which he termed the "turbulent field." The question is: Is an accentuation (or an assertion) of core values and retracting to tradition through a command and control structure the most effective way to overcome the uncertainty?

The world has proved to be a fuzzy place for systems designers. New attention to systems' users (stakeholders) draws a different picture of the future of systems design than mechanical philosophies can comfortably accommodate. Regardless of the obstacles, to justify their sizable costs organizational memory systems must increase the fitness of the organization within dynamic environments. Those environments include cultural formations and other messy realities.

Learning organizations could benefit from complex, dynamic OMS beyond training and enculturation uses. They might increase organizational fitness by constantly helping to align mission and culture with dynamic operating environments. A delicate, and interactive blend of organizational memory systems with learning organizations might serve to increase the viability of the organization by providing adaptability in both competitive and cooperative environments. At a global level, they hold the potential to add intelligence to distributed systems in collaborative situations.

Conclusion

Bush was able to anticipate many of our world's information developments. As we populate our world with artificial systems and environments, we need to maintain awareness of designs that will continually recalibrate or rejuvenate within larger social and natural environments. To drift too far from basic human needs, or to build closed network information systems which lack distributed human feedback, is perilous at cumulative levels. The consequence will be to reduce adaptive capacity, and to constrain human development. The alternative is to design open systems which resonate with an open destiny, as we may learn.

References available from Steven Wyman upon request.