INFORMATION ECOLOGY AND KNOWLEDGE MANAGEMENT

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Summary

The traditional view of organizational systems and supporting information and knowledge systems is based on the model of a well-oiled machine expected to deliver optimum performance derived from pre-defined parameters and specifications. Such systems consider performance as a derivative of external controls defined by the designers of the systems and have given marginal importance to the self-adaptive and emergent nature of human and organizational systems. These characteristics of human and organizational systems are particularly relevant to their adaptation and survival within dynamically changing business environments. Recently, some management thinkers have attempted to address the human bases of information systems within the framework of information ecology. This characterization, although interesting, needs to

be further developed to account for the human sense-making processes and self-regulatory nature of the natural ecosystems relevant to new organizational environments. We extend the information ecology framework to a framework of knowledge ecology. The knowledge ecology of organizational systems goes beyond the emphasis on information, to account for action, performance and adaptation of self-regulatory systems.

1. Introduction

The author's quest for the knowledge ecology of organizational systems was motivated by his dissatisfaction with the prevailing paradigm of information systems. The problem doesn't seem only with the prevailing technology-based paradigm of information systems but also with related control systems and performance systems. The paradigm of information systems developed around optimization-driven focus on efficiencies was adequate for the industrial era. However, the new business environments have exposed serious limitations in the traditional logic underlying development, design and performance of information systems. Such limitations are often reified in the increasing failure of sophisticated information systems to deliver up to expectations, and the large-scale implementation failures of information systems that cannot keep up with the radical and discontinuous pace of change in the organizational environment.

The information ecology is an organization's information environment, and consists of the numerous interacting and interdependent social, cultural, and political subsystems that shape the creation, flow and use of information in the organization. Thus an organization's information ecology influences what information is produced and stored, what information is made available and to whom, and what information is required and valued in task performance. The framework of information ecology attempts to emphasize people rather than technology within networked information and communication systems. The key proponents of information ecology have made an interesting case for focusing on information rather than on the hardware, software and telecommunication networks.

However, for relating information to action, performance and adaptation, we need to extend the information ecology framework to relate the "information-centric" networks to "action-centric" networks of knowledge ecology. In addition, the proposed framework of knowledge ecology suggests that some of the prescriptions of information ecology framework need to be refined for application in hyperturbulent organizational environments characterized by radical and discontinuous change. These environments are characteristic of the new forms of organizations that represent a departure from the traditional models of organizations based on agency theory models of humans motivated primarily by punishments and rewards. Based on the model of self-control in contrast to the traditional emphasis on external control mechanisms, the proposed framework is better aligned with what Chris Argyris has termed "the current revolution in management theory." The knowledge ecology framework proposed in this article seems more relevant to performance embedded in dynamically evolving informal and formal relationships that defy clear demarcations in terms of traditional concepts of organizations and industries. Examples of such entities include free agents, business ecosystems, and virtual communities of practice.

2. From Information Ecology to Knowledge Ecology

2.1. Information Ecology Revisited

The key premise of *information ecology*, defined as "the complete information environment," is that organizations need to focus beyond the "machine-engineering" focus on the technologies of information. The complete information environment addresses "all of a firm's values and beliefs about information (culture); how people actually use information and what they do with it (behavior and work processes); the pitfalls that can interfere with information sharing (politics); and what information systems are already in place (yes, finally, technology)." The proponents of information ecology have criticized the information-processing model of organizational information systems for its following simplistic assumptions:

- information is easily stored on computers – as "data";
- modeling computer database is the only way to master information complexity;
- information must be common throughout an organization;
- technology change will improve the information environment.

Instead of a narrow focus on technology, information ecology puts how people create, distribute, understand and use information at its center by supporting the following beliefs:

- information is not easily stored on computers – is not "data";
- the more complex an information model, the less useful it will be;
- information can take on many meanings in an organization;
- technology is only one component of the information environment and often not the right way to create change.

Information ecology recognizes that humans endow information with relevance and purpose and acknowledges that human involvement increases as we move along the continuum of data-information-knowledge. However, information ecology doesn't explicitly account for the dynamically changing organizational environment that is often characterized as a "world of re-everything". The new organizational environment requires richer understanding of human sense-making processes that relate knowledge to action and performance. Furthermore, with its emphasis on traditional logic of external controls, such as performance incentives and bonuses, information ecology needs to be extended to grasp the concept of emergent behavior that is often a characteristic of self-adaptive systems. Self-regulation is the hallmark of intrinsic motivators and self-control that are essential for realizing true human involvement in endowing information with relevance and purpose, and most importantly in converting knowledge into action and performance. Hence, despite recognizing the distinction between data and information, information ecology falls short of accounting for the link between information and performance, particularly in the case of new organizational environments. The following discussion elaborates upon each of these issues and provides the bases for the contributions made by the proposed framework of knowledge ecology.

2.2. New Organizational Environments and Information Ecology

Information ecology assumes a relatively stable and predictable environment as the basis for mapping all the attributes of that environment. However, a review of literature on environmental change presents a more interesting picture. Three decades earlier, system theorists such as Emery and Tryst had noted that the environmental contexts in which organizations exist are themselves changing under the impact of technological change -- at an ever-increasing rate, and toward ever-increasing complexity. Developing on their work, other system theorists, such as Shirley Terreberry, had concluded that an increasing number of organizations find themselves in environments in which accelerating rate and complexity of interactive effects exceed their capacities for prediction. She suggested that organizational change was increasingly externally induced and organizational adaptability was increasingly a function of the ability to learn and to perform according to changing environmental contingencies. Organizational change is generally described as a response to the increasing environmental complexity and environmental turbulence. Existing literature on organizational change management distinguishes between two kinds of environmental change in terms of *incremental change* versus *discontinuous change* and *continuous change* versus *discontinuous change*. While *environmental complexity* is a function of the numerosity, diversity and interdependence of other entities in the organization's environment, *environmental turbulence* is a consequence of the decreasing cycle-time of the individual events [such as new product introduction, customer response, etc.]. It has been suggested that the levels of both environmental complexity and turbulence, as well as their absolute rates of growth, will be significantly greater in the future than in the past. Hence, future environmental change is expected to be more rapid and more *discontinuous* in nature. Moreover, this change is anticipated to be of an ongoing and continual nature. The desired organizational response to such environmental changes will be increasingly of an *anticipatory* nature and less of a *reactive* nature. Members of such organizations would need to be "effective anticipators" who can carry out the mandate of a faster cycle of knowledge-creation and action based on new knowledge.

In contrast, information ecology assumes a relatively predictable environment in its pre-specification of the utility of information and the consequent actions and performance. Such assumptions are embedded in the proponents' assertions such as: "the cost of having the *wrong* information – or not using the *right* information – is difficult to measure" and "decisions made based on *useless* information have cost companies billions of dollars" [italics added for emphasis]. The dynamic and discontinuous change characterizing the new organizational environments makes pre-specification of any information in terms of "right information," "wrong information" or "useless information" dubious. When *core competencies* of yesterday may become *core rigidities* of tomorrow, the best practices embedded in the "right information" may act as blinders for organizations and restrain questioning of prevailing assumptions related to status quo.

Knowledge ecology contributes beyond the extant understanding of information ecology in two important aspects – first, by realizing the dynamically changing nature of organizational environments that constrain optimization-oriented, efficiency-seeking, logic of mainstream information systems; and, second, by proposing how better

understanding of self-control in human sense-making processes can better relate the human meaning-making activity with actions and performance outcomes.

2.3. Knowledge Ecology for the Era of Discontinuous Change

Some of the key premises underlying the notion of knowledge ecology may be extrapolated based upon observations of the natural ecosystems. How these characteristics relate to the changing organizational environments is explained in the subsequent discussion.

- Knowledge ecology primarily focuses on social networks of individuals in contrast to the *overly* technological emphasis of traditional knowledge management systems on computers and information technology networks.
- Within knowledge ecology, focus on people does not *only* imply understanding of knowledge exchanges and relationships based on such exchanges. It also implies understanding of how such knowledge influences action or potential for action based on such exchanges.
- Just as natural ecologies thrive based on species diversity, knowledge ecology thrives on diversity of knowledge. Such diversity rests on cooperative competition: the various knowledge nodes collaborate *as well as* compete based on their differentiating characteristics.
- In a knowledge ecology environment impacted by sudden and pervasive change, mode of survival is adaptation [or more accurately, "anticipation of surprise"] instead of optimization.
- Knowledge ecology is made up of knowledge nodes and knowledge exchanges and knowledge flows. In knowledge ecology, the basis for cooperation and survival is differentiation *and* similarity between the knowledge nodes. Highly differentiated knowledge nodes can collaborate to accomplish specific actions and may dissolve thereafter. However, collaboration between such nodes would require that they be able to "relate" to one another under an overarching mission or theme.

Knowledge ecology treats knowledge creation as a dynamic evolutionary process in which knowledge gets created and recreated in various contexts and at various points of time. More detailed distinction between knowledge ecology and information ecology is presented in the following section. The supporting rationale suggests that knowledge ecology framework provides a more robust basis for designing knowledge management systems conducive to the new organizational environments.

2.4. Beyond Information Ecology to Knowledge Ecology

The notion of knowledge ecology shares its emphasis on information management with information ecology. However, it goes beyond this concept to underscore the more important issues of knowledge creation and knowledge renewal, and resulting action and performance. The emphasis of knowledge ecology, as apparent, is on creation of new knowledge and renewal of existing knowledge. In addition, this perspective lays primary emphasis on action and performance based on knowledge, as without action and performance, the issue of information is quite *meaningless*. In addition, knowledge ecology, as explained in this article, advances general understanding of human self-

controls as they relate to information processing and human sense-making and performance. Finally, it highlights the model of *loose-tight systems* that encourage simultaneous learning and unlearning for coupling the optimization and efficiency-seeking processes with human sense-making processes that can facilitate deconstruction of assumptions that may be left unchallenged otherwise.

The framework of knowledge ecology shares its emphasis on changing information ecologies and need for designing flexible systems. However, it differs from information ecology that prescribes: "if we can't anticipate the future, we shouldn't plan it in detail," by treating diversity of perspectives as necessary for generating multiple views of the unpredictable future. Such appreciation of diversity of perspectives, similar to what was deployed by the Royal Dutch Shell strategic planning chief Arie de Gaus, is essential for creating the interpretive flexibility necessary for learning, unlearning and adaptation required by the radical pace of discontinuous change. Another key assertion of the information ecology framework is that: "it makes much more sense to focus on describing [the available information and information processes relevant to] *today*" rather than defining information and information processes for tomorrow. In comparison, knowledge ecology explicitly takes into consideration a future characterized by discontinuous shifts and innovative breakthroughs that may turn today's assumptions on their head. In contrast to the information ecology framework that has its focus on today's status quo, the proposed knowledge ecology framework thus takes a more proactive approach by visioning the opportunities and threats inherent in today and mapping multiple courses of the future. The flexibility of vision of tomorrow inherent in the knowledge ecology framework makes it a more dynamic and adaptive model for thriving on discontinuous and radical pace of change. In contrast to the information ecology framework, it considers "multiplicity of information sources" not as a liability but as an asset for defining multiple views of a future that doesn't compute.

3. Philosophical Bases of Organizational Knowledge Ecology

3.1. Philosophical Bases of Knowledge Ecology

The model of information ecology is suitable for predictable environment characterized by incremental change. However, such conceptualizations, based upon heuristics -- embedded in procedure manuals, mathematical models or programmed logic -- capture the preferred solutions to the given repertoire of organization's problems. Mason and Mitroff noted that such systems have: "implicitly assumed...a well-structured problem, a data or model basis, an operational control-hierarchical authority organizational context and an impersonalistic [sic] computer printout mode of presentation."

Following Churchman, they observed that such systems are best suited for:
(a) "well-structured problem situations for which there exists a strong *consensual* position on the nature of the problem situation," and,
(b) "well-structured problems for which there exists an analytic formulation with a solution."

Type (a) systems are known as Lockean systems and type (b) systems are known as

Leibnitzian systems. Current conceptualization of organizational knowledge repositories is motivated by projected efficiencies that would follow from [almost] impassive acceptance of institutionalized and archived “best practices.” Based primarily upon the above consensus-building models, such knowledge repositories tend to institutionalize the *status quo*.

Organizational routines that were originally embedded in the standard operating procedures and policies, practices, rules and norms become embedded in the “shared” knowledge databases in the form of “best practices.”

For instance as observed by Hedberg and associates: "Formalized information systems tend to be mechanistic and inflexible, and they incorporate assumptions that their designers have already identified the organizational and environmental properties deserving attention."

As evident, the information ecology perspective is based primarily upon a Lockean and Leibnitzian logic of consensus building, representing an extension of the decades-old predisposition of information systems designers for Leibnitzian and Lockean inquiry systems.

However, such *consensus building* systems are generally capable of providing "only one view of the problem," and hence are not very suitable for discontinuously changing environments. Dynamic environments not only require multiple perspectives of solutions to a given problem, but also diverse interpretations of the problem based upon multiple views of the future.

Following Churchman, there are two other kinds of inquiry systems that are more conducive to ill-structured environments. Kantian systems attempt to give multiple *explicit* views of "complementary" nature and are best suited for "moderate" ill-structured problems. In contrast, Hegelian systems provide multiple "*completely antithetical*" representations that are characterized by "intense conflict" because of the contrary underlying assumptions and are best suited for "wickedly" ill-structured problem domains.

The proposed model of knowledge management is based upon Kantian and Hegelian systems to facilitate multiple interpretations of archived “best practices.” This divergence-oriented process would ensure that the best practices and their underpinning assumptions are subjected to continual re-examination and modification.

3.2. Myths Underlying Current Knowledge Management Systems

The preceding discussion, about the changing organizational environment and the increasing relevance of divergent meanings of information, underscores some myths that underlie current design of organizational knowledge management systems. Technology gurus, as well as hardware and software vendors, have been offering “out-of-box solutions” that are expected to enable knowledge management. Such off-the-shelf solutions are expected to offer means for storing best practices devised by human experts in information databases.

These databases, in turn, may be later used for crunching out *pre-determined* solutions based on *pre-defined* parameters. The convergent and consensus building emphasis of such systems may be adequate for stable and predictable organizational environments. However, such systems -- based primarily on rules and procedures embedded in technology -- seem misaligned with the dynamically changing business environment.

Knowledge ecology framework addresses some such myths about the design and efficacy of organizational knowledge management systems.

Myth 1: Knowledge management technologies can deliver the right information to the right person at the right time. This idea applies to an outdated organizational model. Information systems in the old industrial model mirror the notion that businesses will change incrementally in an inherently stable market, and executives can foresee change by examining the past. The new organizational environment, however, is marked by radical, not incremental, change. Organizations can't plan long-term; instead, they must shift to a more flexible "anticipation-of-surprise" model. Thus, it's impossible to build a system that predicts who the right person at the right time even is, let alone what constitutes the right information.

Myth 2: Knowledge management technologies can store human intelligence and experience. Technologies such as databases and groupware applications store bits and pixels of data, but they can't store the rich schemas that people possess for making sense of data bits. Moreover, information is context-sensitive. The same assemblage of data can evoke different responses from different people. Even the same assemblage of data when reviewed by the same person at a different time or in a different context could evoke differing response in terms of decision-making and action. Hence, storing a static and explicit representation of a person's tacit knowledge -- assuming one has the willingness and the ability to part with it – is not tantamount to storing human intelligence and experience.

Myth 3: Knowledge management technologies can distribute human intelligence. Again, this assumes that organizations can predict the right information to distribute and the right people to distribute it to. However, bypassing the distribution issue by compiling a central repository of data for people to access doesn't solve the problem. The fact that information is archived in a database doesn't ensure that people will necessarily see or use the information. Most of our knowledge management technology concentrates on efficiency and creating a consensus-oriented view. The data archived in technological "knowledge repositories" is rational, static and without context and such systems do not account for *renewal of existing knowledge* and *creation of new knowledge*.

A key contribution of the proposed model of knowledge ecology is developing a richer and more complete understanding of *sense-making* bases that are only cursorily accounted for by the *information ecology* framework.

The sense-making bases help us understand the linkage of information processing to action and performance and also the appreciation of the diversity of meaning and action that may result from the same information.

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Biographical Sketch

Dr. Yogesh Malhotra has contributed to knowledge management and strategic innovation policies and strategies of Intel, British Telecom (UK), Ziff Davis, Hewlett Packard, Arthur Andersen, South Korean technology companies, Government of Netherlands, U.S. Federal Government, and, Government of Mexico in advisory and visionary roles. He has taught on the faculty of Executive MBA programmes at the Kellogg School of Management at Northwestern University and the Graduate School of Industrial Administration at the Carnegie Mellon University and currently holds a professorial appointment at the Syracuse University. He is the author and editor of two critically acclaimed books and several influential research journals and articles on knowledge management, e-business, and strategic innovation. He has served on advisory, editorial and review boards of the National Science Foundation, the Conference Board, Knowledge Management Consortium International, the Academy of Management, IBM Research, Association of Computing Machinery, American Management Association, Association for Information Systems, Harvard Business School Publishing, Institute of Electrical and Electronics Engineers, and Ziff Davis Standard for Internet Commerce. His interviews and analyses and reviews of his award-winning e-learning and knowledge management ventures have appeared in Business Week, Wall Street Journal, Fortune, Fast Company, Business 2.0, CIO Magazine, Computerworld, Information Week, KM World and hundreds of other TV, print and media channels around the world. As a global thought leader on Knowledge Management and E-Business, he has delivered recent invited keynotes to CIOs in Government of Mexico, hi-tech entrepreneurs and professionals network based in Silicon Valley, Baldrige Quality Award winning U.S. corporations, and global corporate executives at most prestigious industry conferences. He is the founding Chairman and Chief Knowledge Architect of the BRINT Institute, the New York based research, advisory, and e-learning company internationally recognized as a pioneer of leading edge research, practice, and thought leadership on Knowledge Management and Strategic Innovation. He is profiled in the Marquis' *Who's Who in the World* (Millennium Edition), Marquis' *Who's Who in Finance and Industry*, Knowledge Inc. *Top Knowledge Management Experts and Luminaries*, *Who's Who in the Internet Commerce Stand*ard, *Leaders and Legends of Business Intelligence and Data Warehousing*, and, *CRM Leaders and Legends of Intellibusiness*.