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Jane Fedorowicz
*Bentley College*

Janis L. Gogan
*Bentley College*

Amy W. Ray
*Bentley University*

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**Jane Fedorowicz**
**Janis L. Gogan**
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**Bentley College**

## ABSTRACT

*Increasingly, companies use interorganizational information systems to support business process partnerships, such as automatic replenishment systems and other supply chain initiatives, invoicing and payments, and insurance claims processing. Inter-firm networking in turn can increase the visibility of information generated and used by business partners. These business partners may experience intended and unintended impacts from the changes in the partnering relationship, in effect altering the ecology of the organization. Yet IT researchers rarely study an organization's ecology, focusing instead on impacts upon internal processes. Our goal in this paper is to propose a definition of interorganizational information ecology, to provide IT researchers with a lens through which interorganizational information sharing should be studied. We begin by reviewing principles of ecology from the natural and social sciences and then discuss the emergence of principles of organizational ecology and information ecology within the management literature. We then argue that advances in information technology have been a primary enabler for companies' focus on interorganizational business processes and that field research on IT-enabled business partnerships must include the impacts upon each partner and the information shared among them. An example from health care demonstrates the usefulness of the concept, and we conclude with suggestions for field-based research on the ecology of interorganizational information sharing.*

## INTRODUCTION

Firms of all sizes face increasing pressure from suppliers, customers, and others to connect information networks in order to improve the efficiency or effectiveness of specific business processes. For example, retailers invest in automatic stock replenishment systems with their suppliers, and product design teams collaborate with suppliers to speed up the design life cycle, increase customer satisfaction, and promote cost reductions. Such investments result in increased information sharing, which is expected to help managers in partner organizations make better decisions, engage in more effective planning, and build stronger interorganizational relationships. Many such initiatives have been led by the information technology (IT) organization, with a heavy focus on crafting a coherent IT architecture and perfecting the enabling technologies. To these ends, IT managers have allocated substantial resources to identifying effective means for connecting enterprise application systems with other organizational systems (such as linking ERP and CRM), identifying appropriate points of integration with their partners' systems, and defining data-sharing standards. Forrester Research predicts that corporate spending on interorganizational information integration will outpace spending on new stand-alone software applications over the next five years (Surmacz, 2003). Because the enabling technologies and standards continue to change, managers run the risk of focusing on these rapidly-changing complex technical challenges at the expense of other factors that affect implementation success.

It is our view that interorganizational systems (and the resulting information sharing between business partners) should be studied from a holistic perspective. A holistic view of interorganizational information sharing should incorporate the viewpoints of and impacts upon many other companies (e.g., suppliers, customers, competitors) that comprise the organization's "ecology". This paper suggests that researchers build on previous studies of organizational and information ecology that examine interorganizational information sharing. An interorganizational information ecology affects and is affected by processes of adaptation in a dynamic interplay of actors, technologies, information and processes. It is important that IT professionals and scholars develop a deeper understanding of the dynamic processes that ultimately determine the effectiveness of interorganizational information sharing initiatives.

In what follows, we briefly review the literature of ecology leading to a definition of *interorganizational information ecology* and the identification of four research propositions. An example from health care illustrates the usefulness of the concept, and we conclude with suggestions for research on the ecology of interorganizational information sharing.

## THE EVOLUTION OF ECOLOGY

### From Natural Science to Social Science

With roots in the natural sciences, ecology theory has been applied in numerous domains to explain specific relationships among humans and other life forms and their environments. The Institute for Ecosystems Studies describes ecology as the "…scientific study of the processes influencing the distribution and abundance of organisms and the transformation and flux of energy and matter." There are several branches of ecology theory. One branch, Population Ecology, examines the rise and decline of species, with an emphasis on "vital" outcomes (birth of and extinction of species). Another branch, Evolutionary Theory, examines the selective pressures imposed by the environment and responses to these pressures over time, with an emphasis on processes of incremental change. Darwin (1859) proposed a unifying theory which explained both the transmutation of species (i.e., the vitals) and the adaptation of organisms to their environment (the processes) in his well-known theory of natural selection.

Although rooted in natural science, ecology theory has been extended to social sciences such as sociology, anthropology, and archeology. Ecology theories in the social sciences and management have borrowed from all three approaches (population ecology, evolution, and natural selection). Human Ecology is a branch of sociology dealing with the interaction of people with economic, social and political structures. A related branch, Cultural Ecology (Steward, 1955) is "the study of the processes by which a society adapts to its environment." Anthropologists, archaeologists and geographers have often borrowed from human and cultural ecology theories and methodologies. For example, anthropologists Nardi and O'Day (1999) examined technology use in schools, libraries, hospitals, and other work and recreation settings. They define an *information ecology* as "a system of people, practices, values, and technologies in a particular local environment, characterized as follows:

- a *system* of interrelated people and tools;
- contains a *diversity* of roles for the people and functions for the tools;
- there is *coevolution* over time as new technologies arrive and are assimilated, and as people's roles develop and change;
- there is a *keystone species*—a particular role, such as a person who can translate across disciplines—that is essential to the success of the ecology; and
- has a defined *locality*." (Nardi and O'Day, 1999, p. 53)

In their case studies, Nardi and O'Day provided evidence of the diversity of roles, coevolution processes, and the influence of the keystone species. Their work offers a glimpse at the benefits that can be gained when theories developed in one discipline are applied to another. This example shows how ecology theory can be borrowed from the natural sciences and applied to the social sciences, with useful findings.

Nardi and O'Day's information ecology theory drew on the cultural perspective of anthropology. To provide a glimpse at an extension of their theory from the realm of anthropology to strategic IT management, we could ask: how might Nardi and O'Day's definitional criteria (listed above) apply to interorganizational information sharing? Clearly, the first two criteria fit well: an interorganizational system is comprised of people playing a variety of roles in multiple organizations and using various tools, including hardware or software technologies and methodologies. The next two criteria offer intriguing possibilities: research might fruitfully examine processes of co-evolution among people, organizations, and tools over time. And, research can examine whether a so-called "keystone species" is essential and if so, who or what plays that role and why. The final criterion, "locality," could be a problematic construct for describing interorganizational information sharing arrangements, unless a *virtual* "locality" can be defined and observed (similar to Rayport and Sviokla's mapping of "marketplace" to "marketspace" in 1994).

Before we further consider the application of ecology theory to interorganizational information sharing, it is

helpful first to examine work that has already been done to apply ecology theory to economic and management disciplines, including the sub-disciplines of industrial organization, competitive strategy and organizational behavior. We do so in the next section.

## From Social Science to Management Studies

Many researchers in management have built on both the natural-science and the social-science theories of ecology. A useful review is provided by Lewin and Volberda (1999), which we briefly summarize here (see also Amburgey and Rao, 1996 and Lewin, et al., 1999).

According to Lewin and Volberda (op cit.), sociologists Michael Hannan and John Freeman (1976) pioneered the application of population ecology theory to organization studies, triggering several decades of research in this stream. Researchers have drawn on population ecology theory to explain why some organizations adapt to changes in the environment and survive, while others fail to adapt and (sometimes) fail entirely. Rao (2001) extended the population-based concepts of organizational ecology to an interorganizational ecology to predict how different patterns of competition, governance structures, and institutional and technical discontinuities influence the rise or decline of interorganizational communities. The population ecology perspective takes place primarily at a macro-level that examines structural ties between organizations, and chronicles the rise and demise of interorganizational structures. Studies based on population ecology theory do not examine micro-level information-sharing over time.

While Rao took the population ecology perspective, other strategy and organizational studies borrowed from the evolutionary branch of ecology theory, which focuses on micro-level processes, including coevolution. In this paper, we also focus primarily on this stream of management-related ecology literature, since this perspective is better suited to shed light on interorganizational information sharing processes. Polos, et al. (2002) used evolutionary ecology theory to examine adaptation processes and new organizational forms, which is highly relevant to the issue of interorganizational systems and authority structures. Polos et al. (along with many organization theorists) noted that organizational structures (for defining authority and accountability within the organization, and boundaries with the external environment) can impact how organizations adapt to internal and external challenges. And, they proposed, in turn, the processes of adaptation can change organizational culture which ultimately leads to changes in organizational structure. In an influential paper that built on this and other work (such as the seminal work on dynamic organizational processes of exploration and exploitation by March, 1991), Lewin et al. (op cit.) proposed a general theory of organization-environment *coevolution*, which "attempts to integrate the interplay between the adaptation of individual organizations, their competitive dynamics, and the dynamics of the institutional systems within which firms and industries are embedded." Lewin et al. explain: "The theory assumes that organizations, industries (populations) and environments (institutional and extra-institutional) coevolve, that their rate, pace and patterns of change are distinct and interdependent, and that the directions of these changes is not unidirectional." They present an ambitious research agenda that includes the following aspects (Lewin et al. op cit., p. 536):

- "Studying organizations over time
- Multidirectional causalities between micro-and macro-coevolution
- Mutual, simultaneous, lagged, and nested effects
- Restricting and enabling constraints of organization path dependence
- Contingent effects such as nation-state institutional arrangements
- Extra-institutional influences … as well as social movements that affect the deep structure enveloping the enterprise and market competition."

Lewin's broad and ambitious research agenda offers potential for the study of interorganizational information sharing as it frames the intricate interlinked impacts of business processes.

Lewin is not alone in calling for further attention to interorganizational issues. Van de Bosch et al. (1999) examined coevolutionary processes in a longitudinal comparison of two firms in the Dutch publishing industry. Having found that a firm's ability to assimilate new knowledge (absorptive capacity) was a key element in its organizational adaptation, Van de Bosch et al. called for further research that would focus on interorganizational co-evolution processes.

This view of organizational coevolution reflects one organization theorist's adaptation of ecology theory. Just as biologists have debated aspects of evolutionary theory, so have management theorists. Haveman (2001) explains the current debate surrounding different perspectives within the evolutionary branch: "Adaptation theories predict that change occurs as fluid organizations adjust to meet shifting environmental demands, while selection theories predict that change occurs through the differential selection and replacement of inert organizations as environmental demands vary over time." Haveman further proposed that management theory can be strengthened by borrowing from recent advances in biology, such as Stephen J. Gould's theory of punctuated equilibrium (Gould, 1989). According to Gould, evolutionary change more often occurs as a result of rapid adaptation to sudden abrupt events, not as a long, slow steady progression over time. Like Gould, Haveman proposed that industries sometimes change dramatically in response to sudden and abrupt events, including radical technologies (such as the integrated circuit), economic events (such as the Great Depression) and new laws or regulations (such as the Glass-Steagall Act, which dramatically affected financial services, and its subsequent repeal, which caused a new round of changes in the financial services industry). Haveman argues that exogenous system "shocks" stimulate organizations to overcome inertia and make dramatic changes in strategy, structure and other elements under managerial control.

Recently, Iansiti and Levien (2004) proposed that organizations be considered as members of an ecosystem, in which a company's role in its interorganizational relationships determines the business strategy with which it might best succeed. Rather than investigating the parallels between ecosystems and business networks from a research perspective, these authors use the analogy to put forward pragmatic recommendations regarding strategy formulation based on interorganizational business networks. They borrow the concept of the keystone from biology, and contrast it with firm positioning as a niche player or physical dominator in an ecosystem. A company may take on one of these roles n a particular ecosystem, and another with respect to an alternative ecology. In these authors' view, information sharing is one of the benefit-creating aspects that can contribute to good management within an ecosystem. Collectively, these benefits are seen to accrue cost savings, increased productivity and responsiveness for the company who takes on the keystone role.

In this brief review of the adaptation of ecology theories from the social sciences to management studies, we have shown that ecology theory can fruitfully be used to examine organizations and their broader environment, particularly when (per Lewin et al.), longitudinal studies are conducted to assess the complex interplay of these relationships. Research is still needed to shed further light on how to best model processes of interorganizational coevolution and adaptation, and especially the impact of punctuating events/exogenous shocks. Much of this prior work can help to inform the study of interorganizational information sharing. We next turn to the final piece of our evolutionary puzzle: the application of ecology theories from the natural science, social science and management disciplines to the field of management information systems (MIS).

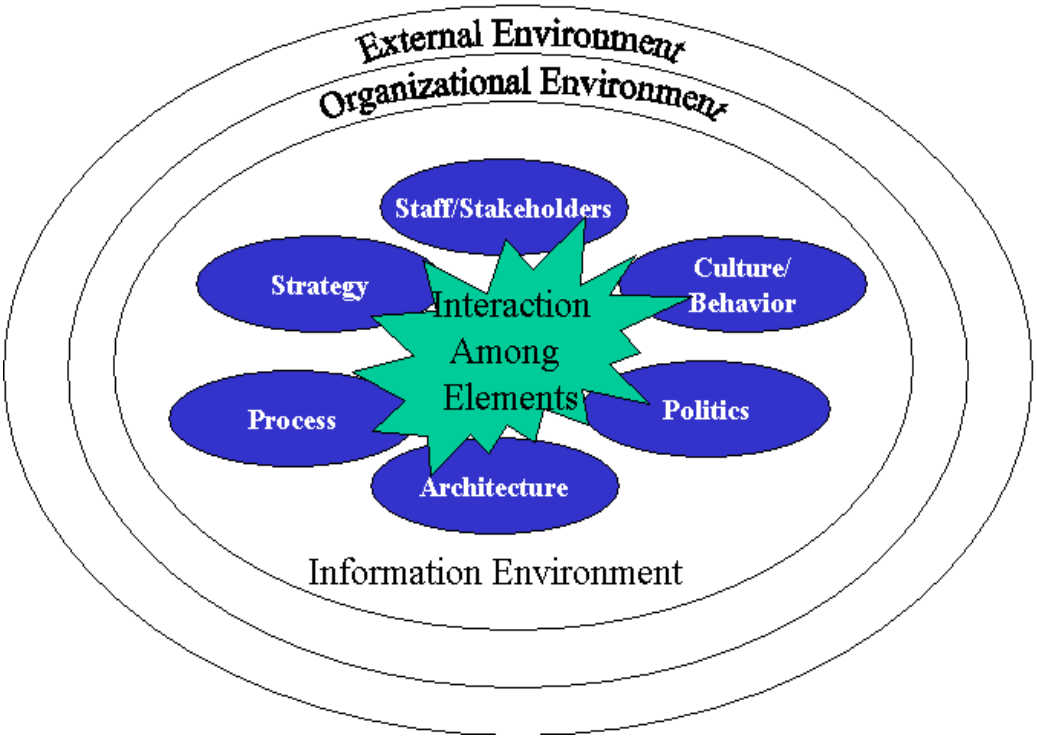
## From Multiple Reference Disciplines to MIS

MIS consultants and researchers have also begun to apply ecology concepts to information dissemination within organizations. Davenport and Prusak (1997) define Information Ecology as "holistic management of information." Consistent with evolutionary theories from both management and anthropology, they argue that for a given organization, a separate information environment/ecology exists and includes a balance of organizational staff, culture/behavior, politics, architecture, process and strategy. The information environment is embedded within the organizational environment, which is in turn embedded in a larger external environment (See Figure 1).

Davenport and Prusak observed that effective management of an information ecology entails four key elements:

1. integration of diverse types of information
2. recognition of evolutionary change
3. emphasis on observation and description
4. focus on people and information behavior

Figure 1: Adaptation of Davenport et al. Information Ecology




How might these principles extend to the study of interorganizational information sharing? Clearly the first element (information integration) is a primary goal of interorganizational collaboration. Davenport and Prusak's three additional elements suggest an avenue for research that would address such questions as: Do the ecology principles proposed by Davenport and Prusak for organizational information systems apply to interorganizational information sharing? That is, must these systems be designed with an emphasis on flexibility and adaptability so that they may be changed in response to events in the broader environment? Is there just as great a need for observation and description of the processes and tasks that are supported by interorganizational systems as is true for those processes that take place solely within organizational boundaries? Are new techniques required to describe and analyze interorganizational processes? And, will the same techniques that are recommended for helping to ensure acceptance and effective use of within-organization systems prove useful for ensuring effective use of systems that cross organizational boundaries? While Davenport and Prusak help us to understand the ecology within an organization, extending their concepts to the outermost circle in Figure 1 will require significant research attention.

Davenport and Prusak cautioned their readers to avoid taking a mechanistic "engineering" view of information systems. Porra (1999) took this advice a step further, by arguing that the traditional dichotomy in organizational theory (first proposed by Burns and Stalker, 1961), which pits "mechanistic" versus "organic" policies and structures on opposite sides, fails to capture the full range of choices available to managers. Porra (op cit., p. 39) explains that, like the mechanistic model: "The organic model also includes an implicit assumption of progressive evolution, which is incorrect." Drawing on Gould's theory of punctuated equilibrium, Porra proposes a "colonial system" explanation. A "colony is defined by Porra (op cit., p. 56) as "a collection of individuals who share a history and an environment and who cooperate directly or indirectly for the maintenance of the colony." Porra asserts: "The colonial viewpoint attempts to explain how history, local refinement, and radical change are all required to operate in periods of both calm and turbulence." In applying this theory to information systems, Porra proposed that successful systems use a process of "punctuated prototyping," in which each system is designed with built-in adaptability in mind, by incorporating alternative, just-in-case designs. In this way, Porra contends (p. 66) that "successful (i.e., persistent) systems operate like a colony, whereas unsuccessful (i.e., rigid) systems fail

because they are predicated on machine or cellular processes." Similar to Haveman's (op cit.) findings about organizational processes of adaptation to exogenous shocks, the colonial systems theory claims that inter-organizational systems need to be designed with built-in flexibility so as to withstand the shocks of occasional punctuations (exogenous shocks).

Thus, in an interorganizational ecology, change can occur as a result of shifts in an organization's internal environment or its surroundings, and sometimes change can be a rapid and dramatic response to a punctuating event. These developments might occur within any of the elements depicted in figure 1. In turn, change in each element can contribute to further changes in other elements, resulting in a complex organizational evolution, as well as interorganizational coevolution.

In this review, we have established that previous ecology research in organization studies and information systems provides a useful foundation for our proposal to extend these findings to interorganizational information sharing relationships. Table 1 summarizes the contributions of ecology theories from the natural and social sciences and management disciplines to an emerging theory of information ecology in MIS.

**Table 1. How Management and MIS Drew from Natural and Social Sciences Ecology Theories**

| Natural and Social Sciences | Management | MIS |
|---|---|---|
| *Population Ecology* (vitals) rise/decline of species | Studies use population ecology theory to explain why organizations thrive or fail (e.g., Hannon and Freeman, 1976; Rao, 2001) | Davenport and Prusak, 1997: systems investments are less likely to fail when a firm's information ecology is considered. |
| *Evolution* (adaptation processes) responses to pressures over time. Many studies in cultural or human ecology, anthropology, archeology, geography. | Adaptation processes and organizational forms (e.g., Polos, et al., 2002; Brown and Eisenhardt, 1997) | Davenport and Prusak, 1997: effective managers closely observe and direct change in the information environment, and use their information systems to respond to change in the organizational and external environments. |
| *Natural Selection* (Darwin) Transmutation of species (vitals) plus adaptation (processes) coevolution. Nardi and O'Day examined coevolution of people and technology in organizational settings. | Coevolution of organizational forms. (e.g., Lewin, et al., 1999; Lewin and Volberda, 1999; Van de Bosch, et al., , 1999) | Porra, 1999: "Colonies" (collections of individuals) cooperate directly or indirectly to keep an information ecology in balance. |
| *Punctuated Equilibrium* (Gould) Impact of exogenous events | Adaptation in response to exogenous events (e.g., Haveman, et al., 2001) | Porra, 1999: systems need to be designed with built-in adaptability in order to withstand occasional exogenous shocks. |

Building on this previous work, we propose that interorganizational information ecology be defined as *a system of people, processes, technologies, and information sharing behaviors, in a local environment, and characterized by colonial processes of adaptation.* To study an interorganizational information ecology, it is important to conduct longitudinal studies to observe information usage and sharing behaviors of participants, capturing observations during times of both environmental stability and turbulence. In the following sections, we illustrate how this concept can be applied to defining, measuring and observing change in interorganizational settings.

## Examining the Ecology of Interorganizational Information Sharing

Davenport and Prusak (op cit.) suggested that systems investments are more likely to succeed when the ecology of the firm is considered, and Porra (op cit.) proposed colonial-systems theory to explain why adaptability needs to be built into systems. Because the boundaries of interorganizational systems are often unclear, and because relationships in interorganizational information sharing are dynamic and complex, these two perspectives would appear to complement each other within an ecological study of information sharing. Each organization's computing environment is unique and complex, so integration efforts bring technical challenges. Each participating organization has a different motivation for investing in information-sharing technologies, and as they change their business processes to capitalize on these investments (or to respond to external challenges), their motivations and concerns will also evolve. Furthermore, punctuating events (such as a disruptive technology or a new governmental regulation) can occasionally stimulate abrupt changes in participants and processes.

We propose a theory of interorganizational information ecology based on close examination of the interplay of technical, strategic and operational choices of participants (separately and collectively as a virtual organization) and information sharing behavior (including choices regarding when and how to disclose different types of information), under both stable and turbulent conditions. We offer four research propositions:

- Over time, participants in interorganizational information sharing systems make adaptations in their organizational processes and structures.
- Over time, participants in interorganizational information sharing systems engage in processes of coevolution with each other and with system elements, including tools and information.
- Successful cross-boundary sharing systems utilize flexible process and technology design features to enable effective responses to environmental changes, including punctuating events.
- Adaptation and coevelution lead to changes in organizational and interorganizational forms and relationships.

The theory can accommodate both ongoing interactions and responses to occasional punctuating events, including the impact of newly-visible information on people, business processes, and institutions. Building on the work of Davenport and Prusak; Haveman; Nardi and O'Day; Lewin et al.; and Porra, the theory proposes that successful interorganizational information sharing systems successfully engage in processes of co-evolution among participants and system elements (including abrupt responses to punctuating events and maintain an equilibrium among people, processes and behaviors).

A brief review of an old and familiar interorganizational system story – that of American Airlines' and United Airlines' travel-agency reservation system -- will illustrate some key features of an interorganizational information sharing ecology. Back in the 1960's and 1970's, the airline industry was regulated, and shifts in competitive power occurred slowly. The key participants were airlines, airports, travel agencies and customers. Some airlines – including American and United, but others as well – invested during this period in computers and proprietary software that improved their internal operational efficiency. A grass-roots initiative at American Airlines in 1967 involved a marketing manager who equipped several large travel agencies with computer terminals and a direct connection to American's reservation system. This was found to improve efficiency, but the airline-travel agency connection was not aggressively exploited in the seventies, since during that period travel agencies were not an important intermediary for the sale of air tickets (most customers booked directly with the airline; they used their travel agent for other purposes). Although changes in competitive position, technology use, relationships between airlines and travel agencies and other elements occurred over time, this ecology remained in a state of equilibrium during the sixties and seventies.

In 1978 a punctuating event occurred: deregulation of the airline industry (Copeland, et al., 1995). Suddenly, airlines had great latitude in terms of pricing seats, setting schedules, and changing routes, resulting in large changes in their internal operations. Very quickly, individual travelers found that the process of booking a reasonably-priced ticket had become quite complicated – unless a travel agency was used. The travel agents

suddenly found themselves playing a pivotal role in the sale of air tickets, especially through computerized reservation systems. Both American Airlines (with its SABRE system) and United Airlines (with its Apollo system) introduced new reservation systems to the travel agencies. By 1981 (just three years after deregulation), 68% of airline tickets were sold through travel agencies using the automated systems provided by American or United.

This example offers a glimpse at the dynamic co-evolutionary processes that quickly unfolded in response to a punctuating event (deregulation). American and United would undoubtedly have evolved into an even more-dominant "species" had they not been stopped by the Department of Justice's anti-trust actions. Note also that in 1994, two other important punctuating events occurred: the National Science Foundation's decision to open the Internet to commercial activity, and the introduction of the first web browser (Mosaic), which together enabled a new communication medium for electronic commerce. These events led to another period of significant instability for the airline industry. Viewing the evolution of the travel reservation process in this light gives an expanded understanding of the intended and unintended impacts of punctuating events.

There are many examples to draw from that illustrate the power of the ecological lens for viewing information sharing consequences. The next section discusses an example of interorganizational information ecology within the health care industry. What is particularly interesting about this example is that it depicts an ecological environment that is currently reacting to a known punctuating event. In this light, the ecology perspective can be used to identify or predict key impacts of the event on interorganizational and intraorganizational processes and relationships.

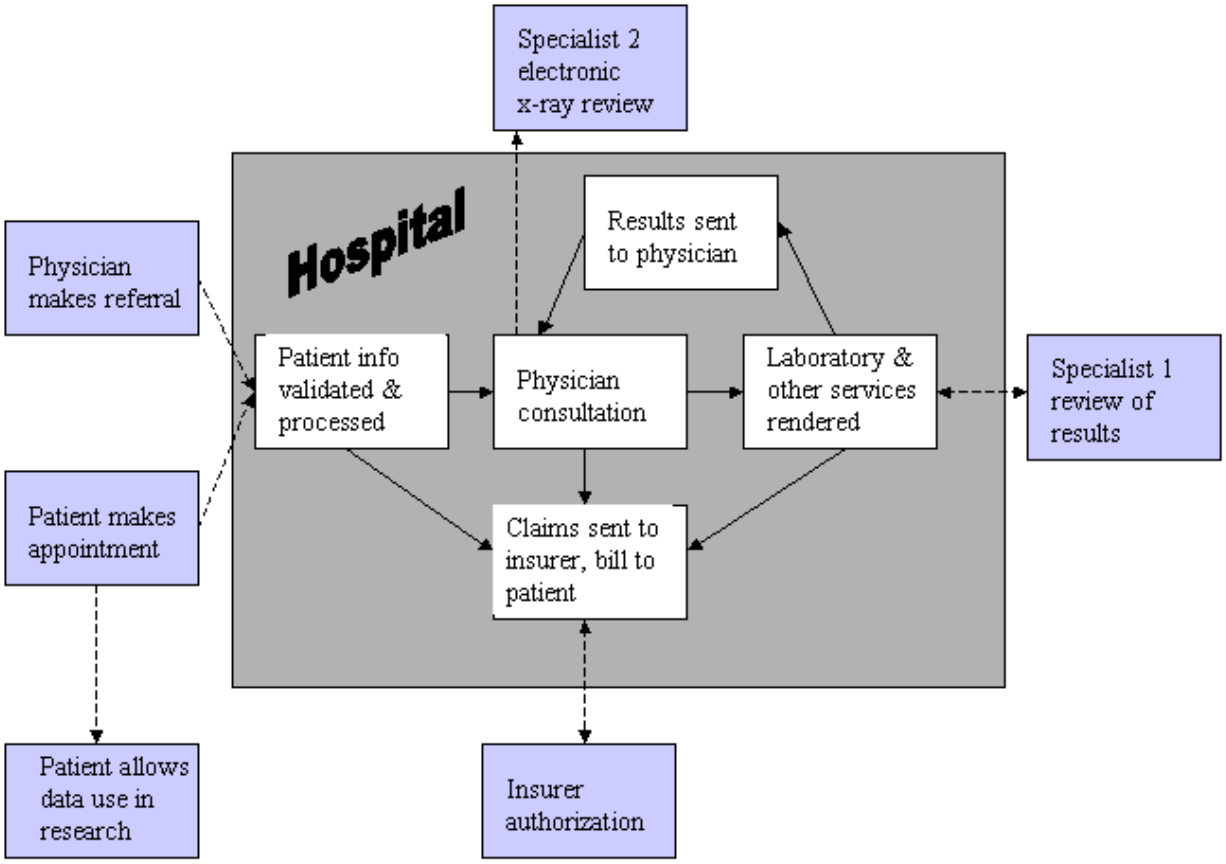
## An Interorganizational Information Ecology for Health Care Providers

The health care industry encompasses pharmaceuticals and drugs, medical devices and equipment, and health services. Health care is the largest service industry in the world, accounting for 14% of the Gross National Product in the United States (Salazar, 2001). Maintaining individual information privacy and security while improving the efficiency and effectiveness of information sharing practices among health care providers is a constant balancing act worldwide (Tan, 1999). Growing use of the Internet for transfer of sensitive health information creates additional complexity (Hsieh, 1998). It is a highly regulated industry. In the United States, all health care organizations must soon comply with a legislative act entitled the Health Insurance Portability and Accountability Act (HIPAA) (Hulme, 2003; Brewin, 2003). The original intent of HIPAA was to simplify administrative tasks such as filing health claims, while simultaneously ensuring security and privacy of shared patient information. A secondary purpose of HIPAA was to encourage more electronic filing of health claims. When HIPAA was first legislated, the number of claims filed was increasing dramatically but the percentage of claims that were filed electronically remained very low. Logically, increasing electronic claims filing should improve transaction efficiency and effectiveness, ultimately leading to faster payment to physicians, faster turnaround of patient information and reduced errors in health care records.

HIPAA takes effect in stages, with substantial parts of the standards for administrative simplification required by October 15, 2002, compliance with standards for privacy of patient data required by April 14, 2003 (April 14, 2004 for small health plans) and compliance with security standards required by April 21, 2005 for large organizations and April 21, 2006 for small health plans. Organizations that must comply with HIPAA include doctor's offices, insurance companies and HMOs, hospitals, health care clinics, pharmaceutical and medical equipment suppliers, pharmacy benefits managers and health care research organizations. All of these organizations share information with each other and altogether form a complex interorganizational information ecology.

Figures 2 and 3 illustrate the complexity of the health care information ecology and the interplay among a hypothetical hospital and its business partners. We adopt the viewpoint of a non-teaching, general service hospital in this illustration of interorganizational ecology theory. The hospital activities included in this illustration are: accepting patients for care, administering medical services, discharging patients after services have been rendered, and follow-on services and care. Bills are sent to patients and/or insurers reflecting the services provided. These processes are depicted in Figure 2.

Figure 2: Simple Patient Care Process, Hospital View




Even in the elementary health care case illustrated in Figure 2 there are a number of interorganizational information sharing points, shown by dashed lines. HIPAA dictates the data format for the type of information exchanges shown in Figure 2 and also legislates minimum requirements for protecting patient privacy and health information security as information flows internally and externally.

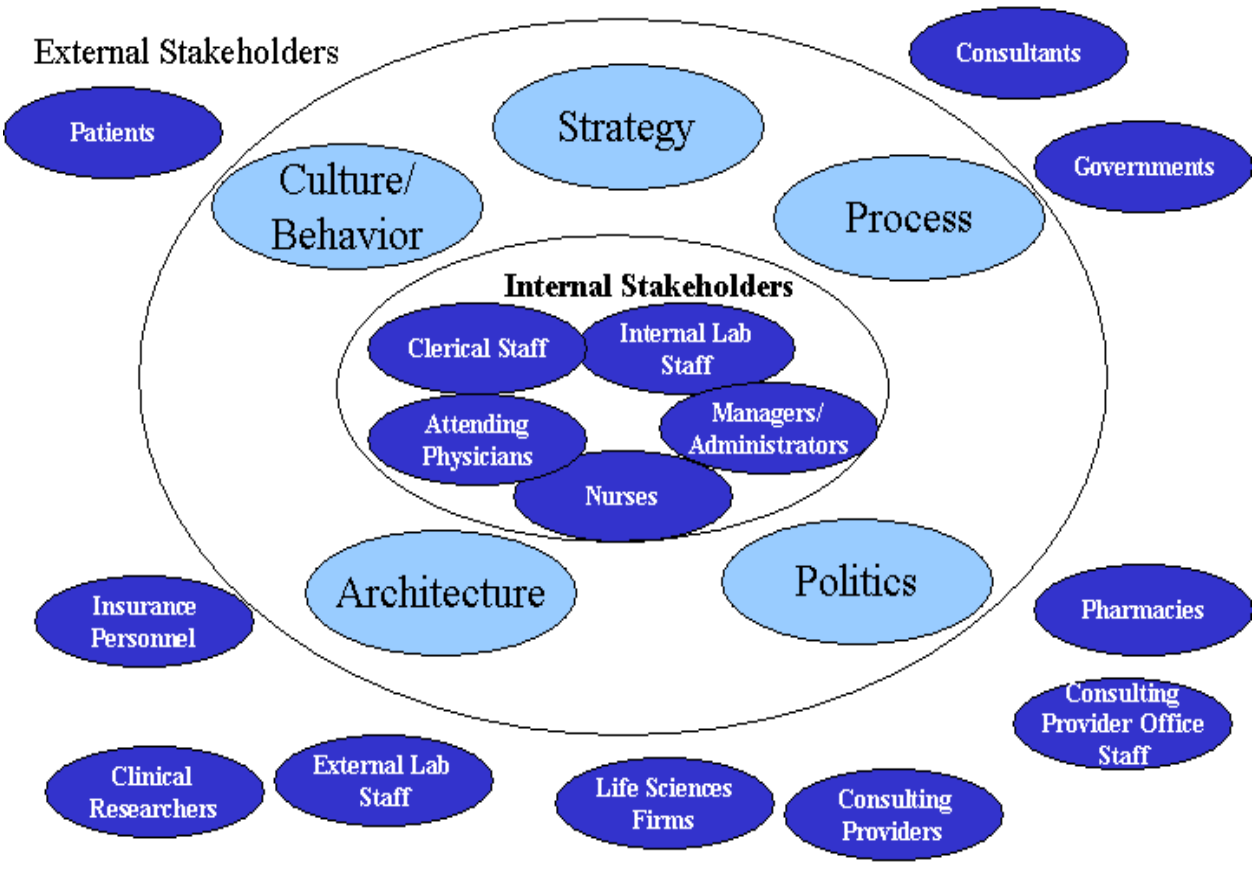
Virtually all organizations that access health care information must rethink and reengineer their information systems and security practices in order to comply with HIPAA, making HIPAA an example of a punctuating event. A punctuating event occurs over a relatively short period of time and has a dramatic impact on an ecosystem. Note that deregulation of the airline industry in 1978 dramatically reduced the behavioral constraints that had been placed on airline industry participants. HIPAA compliance dramatically increases behavioral constraints by imposing strict data security and privacy requirements. Both are punctuating events, because each occurred over a short period of time and had a dramatic impact on the target industry.

While actual financial costs are not yet known, estimates of total costs to comply with HIPAA range from $5.8 billion from the Department of Health and Human Services to $43 billion from the Blue Cross-Blue Shield Association (Bogen, 2002). As health care organizations implement changes to their systems and processes, consideration of their interorganizational ecologies should facilitate generation of alternative means for leveraging HIPAA investments.

To examine the impact of HIPAA on an interorganizational information sharing ecology in health care, it is necessary to identify the elements that are within the boundaries of a local information ecology, and the elements

that constitute its relevant external environment, similar to the approach taken by Davenport and Prusak (op cit.). Essentially, the first step in delineating the boundaries is similar to the first step in a stakeholder analysis: identification of the relevant participants. To examine a local health care information ecology for a hospital, we start by identifying the different roles of staff members within the hospital (that is, we drill down into the "Staff/Stakeholders" bubble in Davenport and Prusak's information ecology diagram) Next, we identify relevant external participants, such as insurance company personnel, referring or consulting physicians from other hospitals, and health care research organization personnel, as shown in Figure 3 (which depicts an ecology from the perspective of the hospital). A depiction of the local ecology for a different participant, such as an insurance company, would include many of the same participants, but not all, and the internal/external relationships will be very different. Ultimately, each organization's view of an interorganizational ecology will dictate who is considered an internal or external participant. Similar diagrams can be constructed to illustrate how each of the other internal information ecology elements (strategy, process, politics, IT architecture, and culture/behavior) relates to corresponding elements at each of the external participants' organizations. Since ecology theory addresses processes of adaptation and coevolution over time, it is necessary to capture observations about characteristics of each of the relevant elements, as well as the levels and forms of information sharing among the participants at multiple points in time.

**Figure 3: Interorganizational Stakeholder Example For Hospital**




Health care organizations may leverage HIPAA-related investments for strategic advantage through careful examination of their interorganizational relationships. A hospital, for example, may find new ways to securely share patient lab results with consulting physicians and patients more rapidly, thus potentially improving the efficiency and effectiveness of patient care as well as patient satisfaction. Such interorganizational systems would be a natural extension of the basic HIPAA requirements and may involve minimal additional cost if considered during HIPAA reengineering efforts. A schematic diagram of interorganizational relationships among stakeholders, processes and

strategies is a useful first step in identifying the scope of possible alternatives and may also be useful for determining metrics for ongoing assessment of the consequences of interorganizational information sharing.

### A Cautionary Note: Limitations of the Theory

In this paper, we have briefly reviewed ecology theory as it has evolved in the natural sciences, shown how it has been applied to organizational theory and information systems research, and proposed an extension to the study of interorganizational information sharing. We believe that this theory offers a promising avenue for shedding light on the complex interplay of technical, social, and informational tools and processes. However, a cautionary note is also in order, since the application of theories from the natural sciences to the social sciences requires an important adjustment. There are at least two key reasons for caution in applying ecology theory to social systems. One is the role of time, and a second reason is the nature of human choice and intervention.

Time is certainly relevant, and this is evident in the differences in focus between the study of ecology in the natural sciences and applied management studies. When natural scientists study adaptive processes and evolution, the focus is on changes which take place over very long periods of time. Even Gould's punctuations are seen to have impacts that unfold over many years. In contrast, a study of adaptive processes and evolution in interorganizational systems has a far shorter time horizon. While a paleontologist speaks in terms of changes occurring over millennia, and an anthropologist speaks in terms of changes occurring over decades or centuries, an IS researcher might look for changes that take place over the course of one decade or one year. To address this key difference, it is imperative that IS researchers specify clearly the time span over which observations have been made, and clearly reveal their methodology and sources of evidence so that others can form opinions as to the nature of the observed changes and the likely causal chains.

Another, somewhat less important difference between our use of the term "ecology" and that of some natural scientists is the role of human choice and intervention. The scientific research that we described early in the paper focused on evolution and adaptation in non-human natural systems. Yet, in organizations, managers make deliberate decisions that can accelerate the pace of changes that might already be underway, or alter the direction and scope of changes. Thus, it can be argued that while "natural" evolution is heavily susceptible to random events, organizational evolution is frequently affected by deliberate choice. Still, as Nardi and O'Day (op cit.) point out, any ecology is influenced by a keystone species. In an interorganizational ecology, that role is likely to be played by human agents (although there is also evidence to suggest that information systems themselves impact how and when information is shared, the nature of the shared information, and how business processes are carried out -- i.e., the information-sharing platform itself becomes a keystone species).

We recognize that a biosystem in the wild differs markedly from a human ecology, and that organizational and interorganizational ecologies have unique characteristics that prevent a simplistic carry-over from theories derived from studies in the natural sciences. Some might argue that sociotechnical systems theory provides the necessary framework for understanding interorganizational information sharing. Yet, by focusing on diverse roles, responses to punctuating events and other processes of adaptation and coevolution, we contend that a theory of interorganizational information ecology should yield new and practical insights that move our understanding forward beyond what sociotechnical systems theory can provide.

## CONCLUSION AND FUTURE RESEARCH

The holistic view enabled by an interorganizational information ecology gives a more complete picture of the issues, benefits, costs and consequences surrounding the introduction of new technologies for creating or enhancing information sharing relationships. Since an interorganizational ecology is a dynamic system, it is not sufficient to take a snapshot of its evolving relationships. To be useful, processes of adaptation and coevolution must be considered over time to truly understand the interplay of its elements. We call on the IS community to consider the larger information environment and the relevant punctuating and adaptive processes that incorporate internal and external relationships when pursuing research on interorganizational information sharing. This will entail examining punctuating events, processes of co-evolution, and other dynamics that are not often captured in intraorganizational research studies.

The identification of parties affected by information sharing is a good first step, followed by close examination of the interplay among these parties, the affected business processes, changes in social norms and relationships, and other aspects of the ecology. Case studies can examine the subtleties of interorganizational information sharing processes and perceptions of actors in different roles. Development of a set of metrics that measure information-sharing behaviors and impacts through the lens of each of the affected parties can also be a useful next step that will facilitate ongoing research on the dynamics of a particular interorganizational ecology.

Although the figures in this paper depict a fictitious hospital, the example does represent an ongoing research effort to identify the ecological elements within the healthcare area that are impacted by HIPAA. Our multi-year project to study the players, roles, information requirements, IT, processes and policies that will be affected by HIPAA will yield insights into the adaptive processes in the interorganizational ecology of healthcare as the key stakeholders respond to (and further shape) the range of the legislation's impacts. In addition, similar studies of the information ecology within other interorganizational settings will enable us to generalize the types of consequences experienced by organizations faced with choices brought about by punctuating events.

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