Reconceptualizing Information Systems as a Field of the Transdiscipline Informing Science: From Ugly Duckling to Swan

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Hans Christian Andersen wrote a tale in which all the young ducks made fun of another. They made the duckling feel inadequate because he was different. One day a swan, the most beautiful of the fowl, declared that the youngster was in fact a young swan and a fine one at that.

The field of Information Systems (IS) has been attacked for its lack of tradition and focus. This paper suggests that the criticisms are based on the misunderstandings of the nature of Information Systems, both inside and outside the field. The paper begins by extending the fragmentation problem seen by Information Systems to the hierarchical model for knowledge expounded by the universities. It then examines the limitations of existing frameworks for defining IS, and introduces an evolutionary approach. This paper reconceptualizes Information Systems and demonstrates that it has evolved to be part of an emerging discipline of fields, Informing Science.

Keywords: evolution, informing science, history, information systems, framework, philosophy The Problem with Information Systems

1. The Problem with Information Systems

The maturing field of Information Systems (IS) is experiencing growing pains. It is not well recognized. Its research is fragmented, and its educational organization is not only fragmented, but competes with topics taught by other fields.

IS is not well differentiated from Applied Computer Science

As recently as January of 1998, the national publication Netscape Enterprise Developer published an article that demonstrated how misunderstood IS was, even among computing literati. The article "Ready to get your degree in IS?" decried the lack of business background among the graduates of computer science programs, apparently unaware of the 250 or so IS programs in the US alone. ("Ready to get your degree in IS?" 1998)

IS seems fragmented

A strong argument has been made that both the research and the teaching of IS is anything but unified. In their review of research, Swanson and Ramiller (1993) write that they found fragmentation and pockets of inquiry in their review of IS research.

Similarly, IS '97, the undergraduate curriculum model for IS majors endorsed by three major professional organizations, includes a number of alternative paths that can be used to create majors that have little in common. (Davis et al., 1997)

Is IS so broad, that no common research or learning agenda applies, or, as the critics of IS charge, is this a sign of lack of focus? Or, is this fragmentation a sign, as this paper suggests, that IS has been misconceptualized?

IS topics are taught throughout the campus

Nunnamaker (1996) and Cohen (1997) found that those topics, that IS thinks of as its own (and that are found in its model curricula), are currently being taught in a large variety of fields, such as computer science, engineering, library science, social work, technology, education, communications, journalism, and design.

Also, the emphasis of what is taught as IS varies from campus to campus, and from country to country. Likewise, the IS program is variously housed as part of a school of business, liberal arts, engineering, or informatics.

2. Methods to Define IS

To understand how IS has reached its current state of disarray, we need to examine how, in the past, IS determined what areas of knowledge it includes. Primarily, two methods have been used: one based on the other fields IS references and one based on definition. This paper introduces a third method, evolution.

2.1. Reference Disciplines

The first method determines which knowledge is and is not IS by the fields it references. Kroenke (1984), Ahituv and Neumann (1990), and Laudon and Laudon (1996), among many others, have used this approach to define the field and use frameworks that are quite similar to one another. For example, Sprague (1980) argues that IS is derived from computer science, management sciences, organizational behavior, behavioral science, management accounting, economics, and library science. They all agree that the field of IS exists at the intersection of three sets of fields: business (management, inexact science), computing (technology), and systems (organization, exact science).

King argues that the appearance of the term "reference disciplines" in IS discourse reflects that the area of IS still lacks a "solid intellectual center" and the best way to address this issue is to "take the bull by the horn." But reference disciplines are critical for an evolving field for three reasons, as King explains. First, reference disciplines are a well-established source of intellectual capital; second, they provide the IS community with an "appeal to authority"; and finally, reference disciplines are an excellent way for identifying pockets of research that are uncharted. "Discipline is important for us, and obtaining it by reference is a perfectly sensible way for us to proceed, despite the inherently marginalizing consequence of our dependence on 'outside' versus 'inside' disciplinary traditions." (King, 1993)

Swanson and Ramiller (1993) wrote in their review of research of fragmentation and pockets of inquiry in three disparate fields: technical, humanistic, and business and economic. If this is the case, IS incorporates the union of three separate fields and is not at their intersection. Which of these fields is the true IS?

Even worse, Evaristo and Karahanna (1997) note that IS research, as conducted in North America, is qualitatively different from IS research conducted in Europe, both in focus and in epistemology. Where is the true IS research conducted?

Therefore, as King points out, information systems, as currently conceptualized, is probably not even a field, "but rather an intellectual convocation that arose from the confluence of interests among individuals from many fields who continue to pledge allegiance to those fields through useful ties of various kinds." (King, 1993)

2.2. Definition-based Approach

A definition-based approach to determining what is IS uses words to describe its boundaries. Two definition-based methods have been used to define IS. One defines current IS by classifying the methods and topics that have been studied in the past. The second approach is teleological, defining IS by the functions it provides to its clientele.

Classification definition. Barki, Rivard, Talbot (1988, 1993) took the approach that IS is what IS does and set out to define the field by classifying its research. Other researchers also have taken this approach. Defining a discipline through a keyword classification scheme of research is like driving while looking through the rear-view mirror. It has a number of limitations:

- It is descriptive, not proscriptive,
- It is static, unresponsive to changes in the field and environment,
- The classification itself has cultural bias built-in, and
- The classification scheme is at best arbitrary.

Functional definition. In contrast to the classification definition, the functional definition is more dynamic and open to change. One of the earliest and most influential attempts to do this was by Mason and Mitroff (1973). They used an expanded sentence definition to provide boundaries of what is and what is not IS research. More specifically, they delineated IS as that field which assists "a **person** ... with a certain **psychological type** with a **problem** within ... an **organizational context** ... by providing **evidence** ... using a selected **mode of presentation**." The full model expands on the meanings of the various emphasized words of this word definition of the field. Note that the technical fields often associated with IS are not explicitly stated in this model.

Cohen (1983) expanded the work of Mason and Mitroff and others by conceptualizing IS through a meta-model derived from information theory. This simple three-component model provides a great deal of explanatory power. He applied a metasystem framework that defined IS on three levels: an Information-Using Environment, a Development Environment, and a Management Environment. This framework and the one above will be used later in this paper.

2.3. Evolution

This paper suggests evolution as a third approach to defining what areas of knowledge are IS. The evolutionary approach to IS examines the origins of the field. This approach is quite useful in understanding the current lack of consensus. It also points out connections to reference fields, both past and current.

Clearly, fifty years ago there were no individuals who professed IS, either as academics or as professionals. The profession of IS came into being through the evolution of other, precursor, occupations. The question is, what were the precursor occupations that evolved into the IS profession?

One such occupation is the efficiency expert. The profession of efficiency expert came into existence to meet the needs of managers wishing to optimize the assembly line. It drew from fields as diverse as psychology and operations management. The occupation of systems analysis grew out of this line of thinking and working.

Office systems and most recently end-user computing, both of which IS considers as part of its realm, developed from the profession of secretary. (Regan, 1994)

Another precursor occupation is the accounting machine operator. The oldest organizations that include IS professionals, such as ACM and IACIS, drew membership from these workers. They operated the machines and provided much of the earliest programming. Both computer operation and programming are rooted in this profession.

Clearly, the profession of IS did not evolve from any one occupation. This explains why a variety of fields, such as accountancy and computer science, view IS as a part of their manifest destiny. The separate and disparate parent occupations of IS led to the misunderstanding of what IS is, both inside and outside the field.

3. New Conceptualization of IS

This paper proposes a new conceptualization of IS along the lines of Mason and Mitroff (1973) and Cohen (1983). At its heart is a functional definition of those areas of knowledge which are IS.

> *Information Systems is the field of inquiry that attempts to **provide the business client** with **information** in a **form, format, and schedule** that maximizes its effectiveness.*

To understand what is information for a client, one must understand the client's task. To maximize the form, format, and schedule, one must understand, not only the task, but also the client's psychology. This definition implicitly links IS to all its reference disciplines in an organized, consistent way. This definition includes almost, if not all, of the research that is currently published in IS journals.

Beyond Information Systems
Let us expand the definition above by removing the restriction that the client must be business related. This provides a definition for a number of disparate fields that share some common goals. We will call these fields collectively the discipline of Informing Science.

> *The fields that comprise the discipline of Informing Science **provide their clientele** with **information** in a **form, format, and schedule** that maximizes its effectiveness.*

Informing Discipline	Client to be Informed
Information System	Workers in a Firm,Managers
Information Science	Library patron
Journalism	Reader/Viewer/Listener
Education	Learner
Public Relations	Public
Secretarial/Office Systems	Office Workers

Table 1. Examples of Informing Science Disciplines and their Clients

The term Informing Science applies to disparate fields that share the common goal of **providing** a **client** with **information** in a form, format, and schedule that maximizes its effectiveness. The definition points to three interrelated components: the client (who has a task to perform that requires information for its completion), the delivery system (for providing information), and the informing environment that creates information to aid the clients complete their tasks. Table 1 lists some of the disciplines that comprise Informing Science. These are the very same fields that teach core IS topics, as noted in Nunnamaker (1996) and Cohen (1997).

Merely changing one term shows linkages between IS and a host of other fields. This paper refers to these fields collectively as the discipline of Informing Science. The definition also provides explanatory power over why non-IS disciplines teach courses on topics that IS claims for its own. While IS focuses on providing managers and other business clients with information, other fields define their clientele differently. For example, the clientele for education includes students. The information needs of students and of managers are not the same, but the task of providing information so as to make it useful for these two constituencies has a great deal of overlap.

4. The Informing Science Framework

Let us now expand the word definition to form a framework shown in Fig. 1. Readers will note that this framework contains elements derived from others' models. Combined, these elements form a powerful yet simple framework for the study of Information Systems and all of her sister disciplines; it provides a perspective on the field of IS.

The first of the works from which the Informing Science framework is derived is Shannon and Weaver's model of the communication process (Shannon, 1949). At its core, the model proposes understanding communications through its impact on five fundamental elements: the sender, the receiver, the medium, encoder, and decoder. Shannon and Weaver define information as a reduction in uncertainty. In this model, information can be said to be transmitted (and

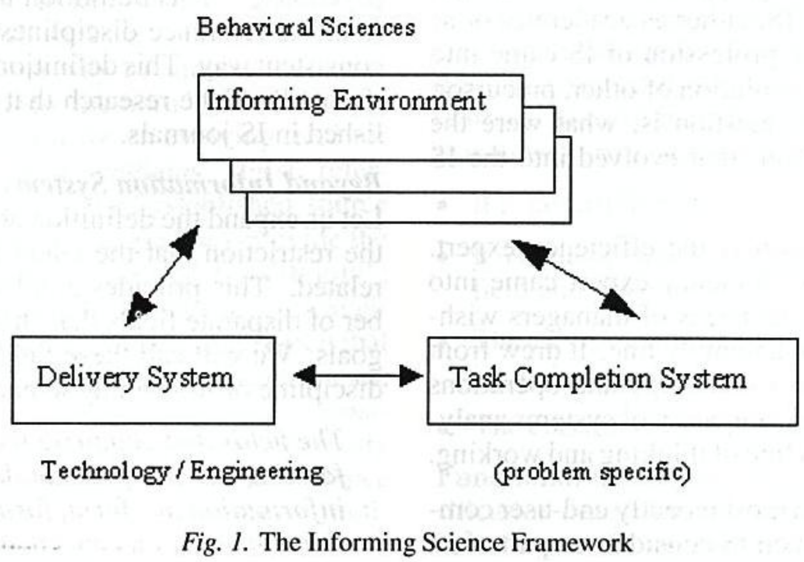

Fig. 1. The Informing Science Framework

received), only if the receiver has reduced entropy. That is, information is defined in terms of the receiver's level of uncertainty. In the field of Information Systems, we would say, information is defined as that, which reduces risk for the decision-maker.

A second conceptual development from which the Informing Science framework is derived is that of the "meta-approach" to modeling. The meta-systems approach applies set-theory-like thinking to the analysis of systems. The obscurity of this useful approach has limited its use by researchers. To make the approach more accessible here, let us consider the simple example of applying meta-system analysis to building houses. At the most concrete level (no pun intended), we think about the individual house. The next higher level of abstraction considers all houses that follow one set of blue prints. A third, more abstract level considers the realm of the maker of blueprints, the architect. The architect creates plans, the builder constructs from architect-provided plans, and the house is an instance of the application of such plans. For Informing Science, we use three similar levels of abstraction: the implemented system, plans for implementation, and the creation of plans. (The "houses" we are building are systems to inform our clients. We are creating environments that promote informing.) A third and final framework from which the Informing Science framework is derived is Leavitt's (1965) Change-Equilibrium Model. Leavitt writes that to understand organizational change, we must consider four distinct elements as inter-related: the task, technology, structure, and people. The key points here are that the components are interrelated, so a change in one affects all the others, and that the task, the technology, and other key components comprise the model.

Putting it together: The Informing Science framework

The framework has three components: the informing environment, the delivery system, and the task-completion system.

Informing Environment. The informing environment is analogous to the sender and encoder in the communication model. Unlike the communication model, the Informing Science Framework considers the informing environment at three levels of abstraction. These three levels are (1) the instance (using a system that is in place), (2) the creation of new instances of informing (to the organization or any of its components), and, at the highest level, (3) the creation of new designs for informing.

An academic example of these three levels is as follows: (1) teaching a course someone else has designed, (2) designing a course that will be taught by others, and (3) creating a new curriculum. A business example is (1) using an existing transaction processing system (TPS), (2) creating a TPS following general design rules, and (3) creating a new type of TPS. The purpose of the informing environment is to provide information to the client in a form, level of detail, and sequence to optimize the client's ability to benefit from that information. This component draws heavily upon applied behavioral sciences.

Delivery System. The delivery system refers to the use of information technologies (computing, communications, and so on) that support the implementation of informing environments. This corresponds to the transmission or media component of the communications model. Information technologies are not limited to computing. Data communication includes video and voice, and even personal contact when it is augmented through planned communication.

Task-Completion System. The driving force behind the creation of informing environments and delivery systems is that a task needs to be accomplished. The task defines what information is needed. This task completion component typically involves a person who has a job at hand. It corresponds to the decoder - receiver components in the communications model. The task completion system is the sole component that defines the difference among various academic disciplines comprising Informing Science. In business, the decision-maker commonly is a person (worker or manager) needing help completing a business process. In library science, the task commonly is helping a patron or creating a system to help future patrons. While the task may be different for students, readers or viewers of journalism, or business decision-makers, all share the need to be informed so as to be able to complete their task at hand.

Informing Sciences as a new discipline

Turchin (1977) developed the evolutionary construct of Meta-system Transition (MST). An MST occurs when a new control level emerges that integrates a set of subsystems at the level below. Developments in IS and other fields that now teach its courses can be viewed in terms of MST as undergoing an evolutionary progress. From this process, a new discipline is emerging, one that subsumes IS and other fields that endeavor to inform their clientele. This emerging discipline is what this paper calls "Informing Science."

Using the term "informing" in this way is not new. Boland (1987) wrote, "...information is the inward-forming of a person that results from an engagement with data." What may be new is the acknowledgement that IS is one of many fields in an emerging discipline that share a common goal.

Beyond Informing Science

The elegance of this simple definition is apparent. Less apparent is that other keywords in the definition can be replaced to uncover other linkages. For example, replacing the word "information" with "services" shows the relationship among, say, hospitals, consultants, and exterminators. The hierarchical structure is not well suited to benefiting from or adapting to the multidimensional nature of knowledge.

5. Implications: University Organization no Longer Suitable

This paper suggests that the many problems of fragmentation first made apparent by IS are due to the very structure of the university and its method of segmenting knowledge creation and dissemination. The problem is most endemic to new fields, which do not fit cleanly in the outdated paradigm on which universities are administered.

Universities use a hierarchical approach to knowledge creation and dissemination. Universities divide knowledge hierarchically into colleges (or faculties) and then departments. The theory behind this categorization of knowledge made sense when the university began. This structuring of knowledge no longer meets the needs of a more complex environment. Indeed, borrowing a phrase from Alstyne and Brynjolfsson (1996), universities tend to Balkanize knowledge into competing clusters of research on the same campus. There are alternate structures, including the matrix structure and the virtual organization.

Under the matrix structure, researchers and teachers, who are assigned to a specific administrative unit, are assembled into teams based on the needs of the team. A teaching or research project may require, for example, a computing expert and a linguistics expert to collaborate. For research, this approach is used informally at times when colleagues from different fields collaborate on research. However, cross-field collaboration is less than common, and crosscollege collaboration is rare. For teaching, any collaboration is rare. The reward structure is particularly ill-equipped to deal with cross-disciplinary work.

The third approach, the virtual organization, has the fluidity of the matrix approach without requiring separate administrative structures. The current university as a virtual organization would easily accommodate the cross-disciplinary realities of today's world. One method to accomplish this is for faculty to join ad hoc independent teaching or research centers that take on complimentary missions. The centers can establish their own reward structures.

The problem in defining one field has led to uncovering the obvious: knowledge is not hierarchical in nature.

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