DESPERATELY SEEKING SYSTEMS THINKING IN THE INFORMATION SYSTEMS DISCIPLINE

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Abstract

Although called systems, information systems in organizations are often viewed as tools that "users" use. IS success is often gauged as though it were about acceptance and usage of a tool. System development is often conceived as building computerized tools that satisfy information requirements of idealized business processes. Frequent IS disappointments and occasional failures are often attributed to inadequate user involvement, and even users involved in the projects often admit difficulty contributing fully to these technical discussions.

This paper argues that the current balance between tool thinking and systems thinking in IS practice and research is slanted toward tool thinking, and that the IS discipline has done far too little to exploit the system nature of systems in organizations. Progress in that direction would fully recognize the sociotechnical nature of systems in organizations, thereby encouraging richer systems thinking than is possible in practice or in research when largely social entities and largely technical entities are treated separately.

A long-term effort toward richer systems thinking in the IS field is the attempt to develop the work system method, a systems analysis method for business professionals. To date, this effort has generated innovations that may have valuable implications for systems analysis, IS pedagogy, and the development of a body of knowledge for the IS field. Many research issues for the future have also emerged.

Keywords: Systems thinking, systems analysis, work system, body of knowledge for information systems, work system principles, Sysperanto

Introduction

The information systems discipline is ostensibly about systems, but many of our fundamental ideas and viewpoints are about tools, not systems. For example, our basic vocabulary implies that information technology vendors and IT groups provide tools and that an IT group's users use them. Similarly, typical concepts about IS success imply that a tool's success is measured by whether it fits specifications, how well it is used, and what is its impact. Likewise, system development often refers to developing software tools that meet requirements and satisfy perceived needs of users, rather than developing or modifying a system in an organization.

This paper's title is a play on the title of Orlikowski and Iacono's (2001) influential paper "Desperately Seeking the 'IT' in IT Research," which noted the unfortunate lack of attention in IS research to what they describe as the core of the field, the IT artifact. The many *CAIS* and *JAIS* articles responding to Benbasat and Zmud (2003) demonstrated the IS community's interest in this area. The current paper addresses related issues, but focuses on systems thinking rather than IT artifacts. Research in this direction is eminently relevant to practice because it addresses part of the abysmal rate of disappointment and failure (e.g., Standish Group 2004) that continues to frustrate business and IT executives. Inadequate, techno-centric analysis is one of many reasons for the poor results. Failure to engage the system nature of the work system that is being improved or created decreases the probability of appreciating how intended tool improvements may affect work practices, people, and business results. The success rate might improve if business and IT professionals had a deeper shared understanding of the scope, nature, and impact

of IT applications. Greater attention to systems thinking is one direction for extending this understanding for both practitioners and researchers.

After distinguishing between systems thinking and tool thinking, this paper discusses a long-term research effort directed at developing systems analysis methods for business professionals. The thrust of this effort follows Hirschheim and Klein's (2003) recommendation that the IS field should "change research priorities" and "work from paradigms toward broader, more general theories" (p. 271). They note that

> the current academic culture of rigor tends to inhibit [generalization, which]…rarely advances to the building of broad theories that span multiple systems of hypotheses or conjectures as building blocks.…We are stuck too much in one corner of the literature and lose sight of the greater, overarching issues. In fact, there is currently little broad-based debate on identifying overarching issues let alone on exploring them. (Hirschheim and Klein 2003, pp. 272-273)

Systems thinking is one of those overarching issues, and the work system approach is one of many possible foci for extending the surprisingly limited systems thinking in the IS discipline.

Systems Thinking versus Tool Thinking

Everyone in the IS field does a lot of thinking about systems, but one might wonder whether thinking about systems necessarily involves systems thinking. For example, it is remarkable that in a field called information systems, a 2003 inquiry to the ISWORLD listserv says "there does not appear to be any fundamental notion of the systemic (as in Systems Thinking or Systems Approach) inherent in IS. I wondered how central to the field members of the List consider 'Systems'— whatever their understanding of the term—to be." The subsequent summary of the responses said, "Most felt [systems thinking or a systems approach] is important, but difficult or neglected, and concentrated on the softer approaches (several references to Churchman, Ackoff, Checkland) or System Dynamics" (Stewart 2003). Part of the issue is that systems thinking is ephemeral and difficult to define.

Table 1 shows that systems thinking focuses on interactions of things, not just correlations between variables. It is more concerned with feedback loops than with linear relationships between static variables. It is more about trajectories than about events, and those trajectories are discussed in terms of multiple entities affecting each other. Also, a "fundamental limitation of any modeling of a system [is] that the system is always embedded in a larger system" (Churchman 1979, p. 76).

Table 1. Definitions or Comments about Systems Thinking by Four Authors

Author	Definition or Comment
Senge (1990, p. 68)	"Systems thinking is a discipline for seeing wholes…a framework for seeing interrelationships rather than things, for seeing patterns of change rather than snapshots."
Sterman (2000, p. 4)	Systems thinking is "the ability to see the world as a complex system, in which we understand that 'you can't just do one thing,' and that 'everything is connected to everything else.'"
Checkland (1999, p. 121)	Systems thinking starts "with an observer/describer of the world outside ourselves who…wishes to describe it 'holistically'…in terms of whole entities linked in hierarchies with other wholes." At minimum, the observer's description will include "his purpose, the system(s) selected, and various system properties such as boundaries, inputs and outputs, components, structure, the means by which the system retains its integrity, and the coherency principle which makes it defensible to describe a system as a system."
Wolstenholme (2003, p. 20)	"Successful systems thinking is about being able to see the whole or context of a situation and its interconnections to its environment. Such a perspective enables unintended consequences of well-intended actions to be pre-empted and minimized."

Table 2. Comparing a Tool View with a System View of Information Systems

	Tool View	System View
Headline	The tool that is used	The system of doing something.
Role of people	Users of the tool	Participants in the system.
Information	Whatever information is stored or processed by the tool	Whatever codified or non-codified information is produced or used by the system.
Technology	The tool is the technology or is a part of the technology	The system may use a variety of technologies that may or may not involve IT.
Customers	Users of the tool or whatever the tool produces	People who receive and use whatever the system produces.
Performance variables related to operation	Measure how well the tool operates and how well it is used. Metrics include user satisfaction, uptime, energy usage, ease of use, and degree of use	Measure how well the system operates internally and how good are the products and services it produces.
Life cycle model	A project-oriented model related to defining, creating or acquiring, and installing the tool	Model in which the system is created and then evolves through a series of iterations of system in operation, initiation of changes, development efforts, and implementation of changes in the organization.
Ownership	A tool may be owned by the organization that uses it or by an organization that controls tools or provides shared infrastructure.	A system is owned by the organization a part of whose work it performs.
Performance variables related to change	In a new setting, measure the tool's diffusion and acceptance. In a setting where the tool is already used, measure the tool's usefulness, success, and cost/ effectiveness.	For a new system that is being created, measure the implementation effort and extent to which the system is institutionalized in its originally desired form. For an existing system, measure the effort involved in defining, implementing, and stabilizing a change.
Main issues in analysis and design	Produce a tool that meets requirements in a cost effective manner, is installed successfully, and is used as intended.	Create or improve a sociotechnical system, assuming that technical and social issues may be intertwined.

Systems are an expression of an observer's viewpoint and do not have independent, verifiable existence (Checkland 1999). Thus, a systems perspective treats a system as a way of viewing interrelated things in the world rather than as a concrete, fully defined, independent entity. The system is defined based on the purposes of the analysis. This viewpoint is inconsistent with Dell or SAP saying that they sell systems, and far afield from "the ontological position of positivist research," which assumes "an objective physical and social world that exists independent of humans, and whose nature can be relatively unproblematically apprehended, characterized, and measured" (Orlikowski and Baroudi 1991, p. 9, as cited by Paré 2004).

Table 2 clarifies the nature of systems thinking by comparing a tool view to a system view. With a tool view, the headline is the tool that is being used. In contrast, a system view focuses on a system of doing something. With a tool view, the people are users of the tool, whereas a system view of a system in an organization treats people as participants in the system.

There is nothing wrong with tool thinking as long as it doesn't overwhelm the research in a field that is purportedly about systems. Although few research topics or projects are totally in one camp, many IS topics or research efforts are more aligned with one viewpoint. For example the technology acceptance model (TAM), "the most widely applied theoretical model in the IS field" (Lee et al. 2003), is a tool model that says an individual's acceptance of a technology is determined by perceived usefulness and perceived ease of use. Similarly, most (but definitely not all) of the discussions of important IS types such as DSS, EIS, and GSS treat IS of these types as tools whose use is based on its features and capabilities, rather than as systems in which human participants perform work such as analyzing decisions, making sense of the environment, and solving problems. In the realm of

systems analysis and design, the centrality of "use cases" in UML (unified modeling language) illustrates the underlying assumption that the immediate goal is to create computerized tools whose features and capabilities satisfy usage requirements. Finally, although implementation in the organization often absorbs over half of the total effort, typical system life cycle models pay disproportionately little attention to what happens after the software (the tool, not the system) is debugged.

On the other hand, a number of methods and concepts in the IS literature represent systems thinking, at least to some extent.

- Soft system methodology (SSM) is clearly a systems approach because it focuses on identifying and summarizing a system that exhibits a problem within an organization.
- Actor network theory (ANT) is a systems approach because it models a situation as a system in which various human and non-human actors interact.
- Kling and Scacchi's (1982) web of computing has a system nature because it encompasses a broad range of past and current interrelationships.
- The sociotechnical approach is a systems approach because it describes situations as a social system and a technical system that should be optimized jointly.

Many specific research studies address system issues, at least to some extent. For example,

- Brynjolffson (2003) explains results related to the productivity paradox by noting that nine dollars of complementary assets including human capital and organizational capital are required for every dollar of IT expenditure. In other words, the effectiveness of IT expenditures depends on systems that encompass much more than IT *per se*.
- Briggs et al. (2003) explain the discontinuation of previously successful GSS applications by noting that their success depends on skilled facilitators who often move on to other jobs. Thus, the system involves much more than the computerized tools.
- Brown and Vessey's (2001) case study of an ERP implementation illustrates that implementation can be viewed as a system in which interacting activities over many months produce the result of changing the way an organization operates.

Figure 1 distinguishes between tool thinking and systems thinking in the IS discipline and shows how both types of thinking can look at situations with different degrees of breadth. Tool thinking in the IS discipline focuses on topics such as a tool's creation and maintenance, capabilities and nature, usability, fit to the user's purpose, and acceptance and usage by the user. Systems thinking in the IS discipline often focuses on either the technical system or the social system and its context, but rarely focuses on both in combination. Interpreted in terms of Figure 1, Orlikowski and Iacono (2001) say that too little of IS research takes a system view that explicitly recognizes the overlap between the social and technical aspects of a system (represented in the upper right hand corner of Figure 1). Both research and practice might benefit from more systems thinking that spans the technical and the social.

Developing a Systems Thinking Approach for Business Professionals

This section discusses a long-term research project whose initial goal was to solve a practical problem related to systems thinking, but which eventually generated a set of ideas that may help in extending systems thinking in the IS field. The project began in the early 1990s, motivated by perceived difficulties in attaining genuine communication between a software firm and its customers about the use and impact of its software. The goal was to develop systems analysis methods that business professionals can use at whatever level of depth and detail is appropriate for their purposes.

The research unfolded iteratively using successive sets of group papers written by employed MBA and EMBA students about real world systems. Based on initial results, it became apparent that employed MBA and EMBA students attempting to address business issues were more successful if they focused first on the work and business objectives that were being supported, and second on the information system. In particular, starting with the features and capabilities of software framed the question inappropriately because the main point from a business perspective is doing work more efficiently and effectively, not using software more efficiently and effectively. Work system seemed a good term to focus a systems thinking viewpoint that they could pursue. A work system is a system in which human participants and/or machines perform work using information, technology, and other resources to produce products and/or services for internal or external customers. Typical business organizations contain work systems that procure materials from suppliers, produce products, deliver products to customers, find customers, create financial reports, hire employees, coordinate work across departments, and perform many other functions.

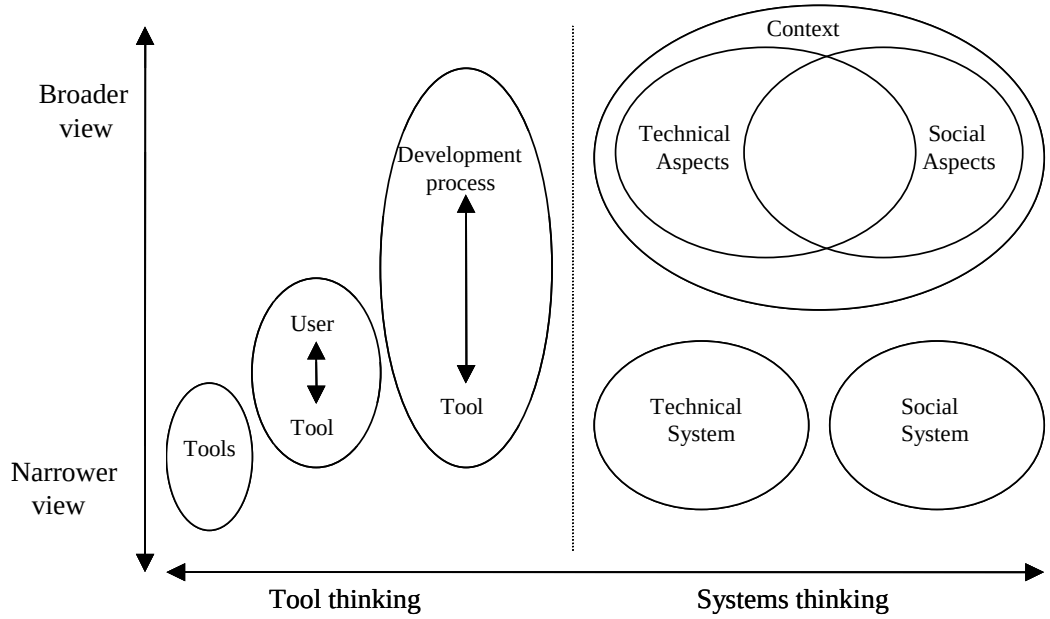

Figure 1. Tool Thinking Versus Systems Thinking in the IS Discipline

Initial Internet searches on the term *work system* that occurred before search engines started to include PDFs found few references, and most of these were to things like "back-to-work systems" or "high performance work systems," highly democratic work arrangements touted by consulting firms. Subsequent reading of the sociotechnical literature discovered that a number of researchers had used the term *work system*, but often had not defined it clearly and had not made it a central analytical concept (see Table 3). With that realization, the research took a new turn. The central concern shifted to understanding the work system, with the underlying assumption that the information system often overlaps with the work system.

Table 3. Examples of Previous Uses of the Term *Work System*

Authors	Representative Statement
Bostrom and Heinen (1977, pp. 17, 18)	The socio-technical systems approach "is used for redesigning existing **work systems** as well as for new site designs.…When one intervenes in a **work system**, two potential improvements are possible. The first is an improvement in task accomplishment …The second is an improvement in the quality of working life."
Mumford and Weir (1979, p. 3)	"The ETHICS method consists of a set of steps which must be taken in the design and implementation of a new **work system**."
Davis and Taylor (1979, p. xv)	"Job design…had its origins in attempts at comprehensive **work systems** design, including the social systems within which the work systems are embedded."
Trist (1981, p. 11)	"Primary **work systems**…are the systems which carry out the set of activities involved in an identifiable and bounded subsystem of a whole organization—such as a line department or service unit."
Sumner and Ryan (1994)	"While social aspects are important in the design of **work systems**, these aspects are not supported by CASE tools.…Current CASE tools do not fully support the process of generating multiple design alternatives for the new **work system**."
Mitchell and Zmud (1999, pp. 425, 434)	"When the viability of [a] new **work system** depends on IT, the process innovation is IT-enabled.…Usually substantial gaps between the organization's IT infrastructure and the IT requirements of the adopted **work system** would be recognized and dealt with before planners develop and implement the new **work system**."

Innovations to Date in Developing the Work System Approach

To date the research has progressed using an industrial research model (create, test, adjust, iterate) rather than a sequence of carefully defined experiments. Each step involved group papers written by MBA and EMBA students as a required part of introductory IS courses. Since 1997, student teams have submitted over 200 group papers using various iterations of the ideas. Details of individual iterations were of little general interest, but valuable cumulative results have been produced. Based on personal communications at conferences and with current and former students, it is clear that the basic ideas have been applied in teaching undergraduates, MBAs, and EMBAs, in professional pursuits of some former students, and in some research.

Table 4 lists five innovations that this research has produced to date, each of which is related to organizing or supporting systems thinking in the IS discipline. Each innovation will be discussed in turn. Underlying these specific innovations is the belief that practitioners and researchers might benefit from reframing the discussion of specific information systems and information systems in general by shifting the level of analysis in recognition of four points:

- The central issue concerns the creation, operation, and maintenance of IT-reliant systems in organizations, not the creation, operation, and maintenance of tools (IT artifacts)
- Information systems (and IS projects) are special cases of work systems.
- Specific information systems are often integral parts of the work systems they support.
- The analysis of IT-reliant systems should focus first on the work system that is using IT, and second on the information system that supports the work system.

Initial Versions of a Systems Analysis Method for Business Professionals

As mentioned at the outset, even after decades of computer usage, information systems encounter an unacceptable rate of disappointment and failure, regardless of whether the software is custom programmed or purchased from an outside vendor. Any significant success in generating greater understanding and better communication through better analysis by business professionals could increase the probability of success for the computerized systems that have become omnipresent in today's business and governmental organizations.

Table 4. Innovations to Date in Developing the Work System Approach

Innovation	Significance of the Innovation
Initial versions of a systems analysis method for business professionals	An effective systems analysis method for business professionals could help them analyze systems for themselves and could help them communicate with peers and IT professionals.
The work system concept as an analytical tool	Undergraduates and inexperienced MBAs can understand this concept, which can be used in depth by focusing an analysis and organizing additional layers of concepts.
A different type of life cycle model	This iterative work system life cycle model focuses on how systems in organizations evolve over time; in contrast, project oriented life cycle models organize the work of IT professionals on specific projects.
Initial draft of Sysperanto, an ontology for understanding systems in organization	Many business and IT professionals need an organized, business-oriented vocabulary for discussing systems. Also, identifying and organizing the main vocabulary for understanding systems is an essential step in identifying the body of knowledge for the IS field.
Identification and use of work system principles	Current work systems analysis and design books are primarily about analysis and documentation of processes, data, programs, and computer configurations. Work system principles provide a basis for evaluating a current system and proposed improvements.

Examination of over 200 group papers based on various trial versions of the work system method indicates that a systems analysis method for typical American business professionals (represented by employed MBA and EMBA students) must be much more prescriptive than soft system methodology. While not a straitjacket, it must be at least somewhat procedural and must provide specific, teachable vocabulary and analysis concepts while at the same time encouraging the user to perform the analysis at whatever level of detail is appropriate for the task at hand. The latest version of the work system method is organized around a general problem-solving outline. It incorporates a number of innovations:

- explicit use of work system principles
- explicit use of characteristics and metrics for the work system and its elements
- inclusion of work system participants as part of the system (not just users of the software)
- inclusion of codified and non-codified information
- inclusion of IT and non-IT technologies
- requirement that recommendations specify which work system improvements rely on IS changes, which recommended work system changes don't rely on IS changes, and which recommended IS changes won't affect the work system's operational form

The Work System Concept as an Analytical Tool

The work system concept is like a common denominator for operational information systems, projects, supply chains, e-commerce Web sites, and other types of systems that are studied within the IS discipline. The work system approach includes both a static view of a current (or proposed) system in operation and a dynamic view of how a system evolves over time through planned change and unplanned adaptations. The static view is based on the work system framework (Figure 2), which identifies the basic elements for understanding and evaluating a work system. The work system itself consists of the four elements inside the trapezoid. The other five elements must be included in even a rudimentary understanding of a work system's operation, context, and significance. This framework is prescriptive enough to be useful in describing the system being studied, identifying problems and opportunities, describing possible changes, and tracing the likely impacts as those changes propagate to other parts of the system.

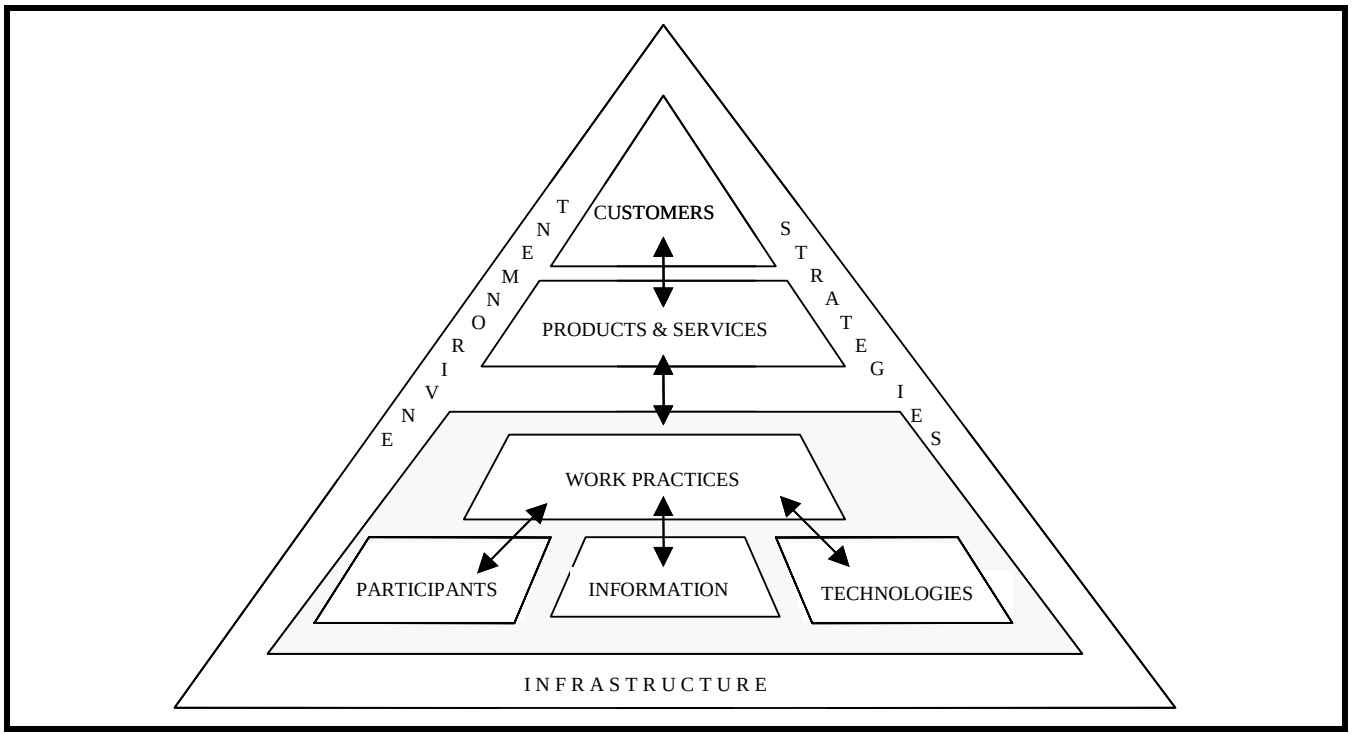

Figure 2. The Work System Framework (Alter 2002, 2003)

This framework has been used in a number of ways outside of the original classroom setting. Many current and former students have mentioned its usefulness in their jobs, but testimonials from these students lack the external validity of observed experience in other settings. In an extensive application of work system ideas outside of the original setting, the MIS program at the University of Alabama's Business School uses the core concepts in the work system framework to help keep student projects focused on business benefits for the industry clients who fund the projects. Relatively non-technical second year MBA students with an MIS concentration manage these projects, supervising teams of undergraduates who are technically proficient but have little or no business experience. Part of the background training includes modeling each step of a five-step value chain as a separate work system. At the beginning of the projects, the students use work system concepts to clarify the real world intentions motivating the technical work they will do as their projects unfold. During the projects, students use the work system ideas as a point of reference for conceiving and evaluating design alternatives.

In a different educational setting, Ramiller (2002) reports on using a version of the work system framework within a method for *animating* the idea of business process within an undergraduate class. In a research setting, Petrie (2004) used the work system framework as a basic analytical tool in a Ph.D. thesis examining 13 e-commerce Web sites. One of his findings was that "the work system framework was accurate in retrospectively identifying the technology impacts on organizational competencies. By examining the changes to work system components and interfaces required to fully deploy the technology, we are able to identify impacted business and technical competencies" (p. 186). However, "work system models do not contain some needed information about components and interfaces, and do not show the complexities of integrating business partners' processes. Another avenue of further research is to expand the work system framework to address these weaknesses" (p. 192).

A Different Type of Life Cycle Model

The dynamic view of a work system starts with the work system life cycle model (Figure 3), which shows how a work system may evolve through multiple iterations of four phases. This life cycle model encompasses both planned and unplanned change, and differs substantially from project models that are often called life cycle models when applied to software projects. Most of what are called life cycle models in the IS discipline actually describe projects that attempt to produce software or produce changes in a work system. These life cycles end when the software goes into maintenance mode or when the changes have been accepted. Hence, the term *system life cycle* may be yet another example of misleading terminology because it often refers to the life cycle of a project, not a system.

Initial Draft of Sysperanto, an Ontology for Understanding Systems in Organizations

Sysperanto is being developed as an ontology codifying concepts and knowledge useful in describing and analyzing systems in organizations. Sysperanto's architecture is organized around the nine elements of the work system framework and the observation that information systems, projects, supply chains, e-commerce, and other important types of systems can be modeled as special cases of work systems. These supertype-subtype relationships provide an opportunity to organize relevant concepts economically based on the conjecture that most, but not all, elements, properties, and propositions for a specific work system type are inherited by more specialized work system types (Alter 2004a).

Many iterations led to the architecture and an initial draft of the first layer, the properties of work systems in general. The various types of properties include components and phenomena (nouns), actions and functions (verbs), characteristics (adjectives), performance variables (adverbs), and generalizations, among others. For any particular type of work system, the properties are organized within "slices" for each of the nine elements of the work system framework. The slices are specific groups of properties that are associated with a particular perspective on a work system element or the entire work system. For example, slices for understanding work practices include business process, communication, and decision making, among others. Each slice provides an umbrella for a set of terms that constitute the vocabulary for viewing part of a work system from a particular perspective. In different situations, the observer might find different perspectives more valuable. Because the goal is to help people analyze systems, there is no reason to impose one or several perspectives (as might be implied by systems analysis tools that steer the analyst to rely on process modeling and data modeling).

Initial attempts to identify the properties within the various slices may explain why the IS field can be described as a fragmented adhocracy (Banville and Landry 1989). The current draft of Sysperanto's top layer, work systems in general, consists of hundreds of properties organized within various slices for each element. It appears that nearly all of the properties for information systems in general will be inherited from work systems in general. In other words, it is difficult to identify *any* useful properties of infor-

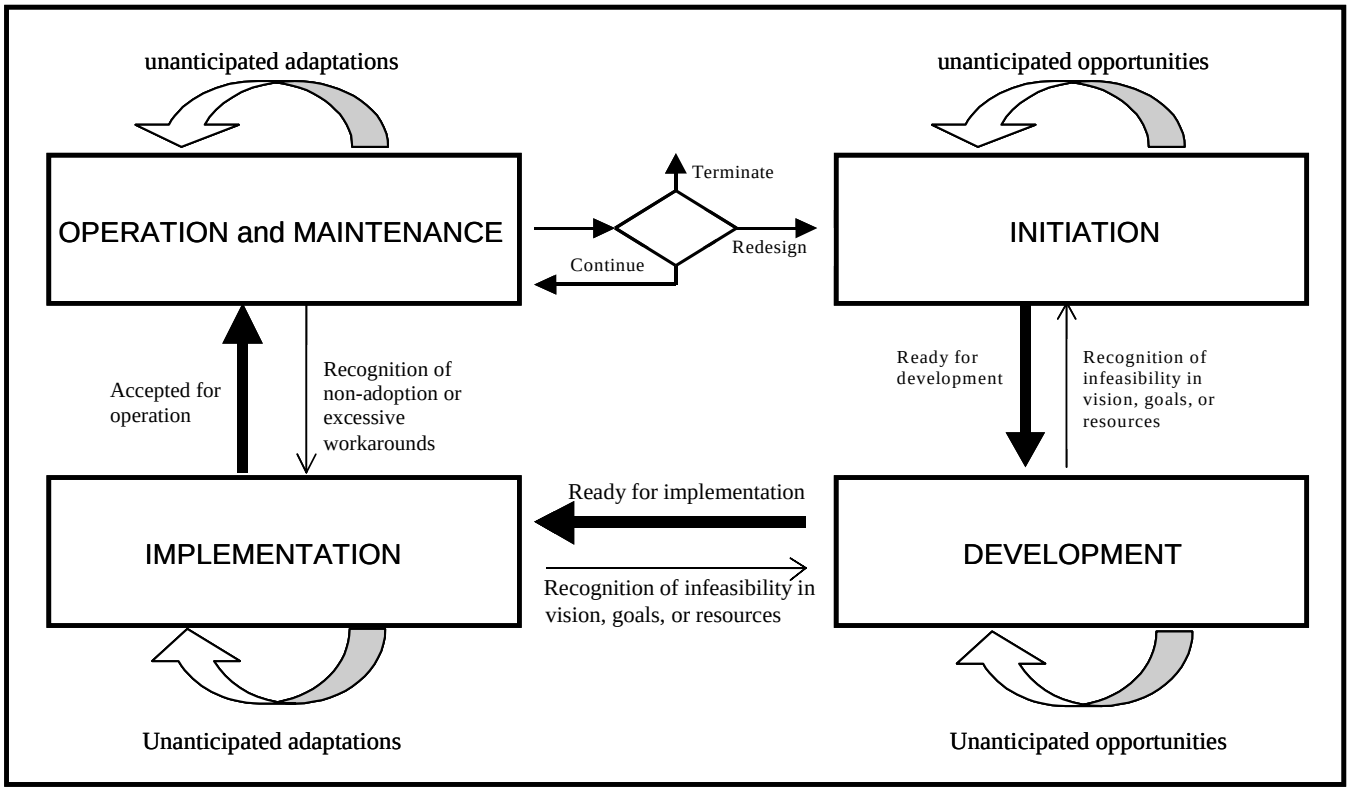

Figure 3. The Work System Life Cycle Model (Alter 2002, 2003)

mation systems that are not properties of work systems in general. On the other hand, subsequent layers for specific types of information systems may provide additional properties related to the special cases. Thus, the main ideas are about work systems in general, little of interest can be added for information systems in general, and the other interesting properties may be added for special cases of information systems. Hence, the main ideas about information systems are actually work system ideas, and the fragments of the fragmented adhocracy might be viewed as special cases of information systems where most of the additional ideas reside.

Identification and Use of Work System Principles

Examination of many group papers revealed that few MBA or EMBA students have instinctive fluency with system-related knowledge needed to evaluate whether a particular system change would be likely to improve performance or undermine it by causing problems elsewhere in the system. A practical, easily understood set of work systems principles seemed an important step toward helping the students identify issues within a system and evaluate likely impacts of proposed changes. Such principles are not obvious. For example, as Majchrzak and Borys (2001, p. 3) noted in their report on developing testable sociotechnical systems theory, "The grounding principles are often quite abstract.…The first [of three concerns] is that the principles are misunderstood or even ignored in practice." The 21 principles in the current version of the work system method combine sociotechnical principles (e.g., Cherns 1976) with additional ideas from TQM, reengineering, computer science, ethics, and other sources. Use of the current version of the principles by MBA and EMBA students has confirmed their plausibility and potential usefulness in identifying possible alternatives and in sanity-checking a recommended set of changes (Alter 2004b). To date, however, the principles have not been validated formally (as was done for sociotechnical principles by Majchrzak and Borys in a complex project) and the practical balance between using too few and too many in a systems analysis and design effort has not been examined.

Conclusion: Toward Greater Use of Systems Thinking in the IS Discipline

This paper has argued that systems thinking is currently under-emphasized in a field that is ostensibly about systems. A deeper level of systems thinking in both practice and research seems worthwhile based on high rates of disappointment and failure for information systems in operation and IS projects. Five innovations related to the work system approach have been presented to exemplify progress toward greater use of systems thinking in the IS field. Research to date involving employed MBA and EMBA students has demonstrated that each individual innovation is at least potentially useful for understanding, evaluating, and designing systems in organizations. In combination, the five innovations illustrate a direction that could lead to a stream of valuable research about the work system approach and could demonstrate the value of more extensive systems thinking in other areas of practice and research. Areas for future research include studying systems thinking, developing tools and methods that support systems thinking, and developing a body of knowledge that can support systems thinking.

Study Systems Thinking

General systems theory is too abstract and its vocabulary is too sparse for most people to use it for anything beyond a simplistic picture of the components, boundaries, inputs, outputs, and environment of a system. To go deeper most people need more ideas and need them in the form of lenses such as the work system framework, work system life cycle model, and work system principles. Although those innovations apply to the work system approach, progress in that area is only an indication of the potential value of embracing systems thinking more fully in IS practice and IS research. Table 5 identifies research issues that might generate insights about systems thinking in the IS field and might contribute to the development of tools and methods.

Develop Tools and Methods That Support Systems Thinking

The work system method will go through additional iterations in an attempt to support systems thinking by business professionals. A possible next step is the development of decision support tools that could help business professionals understand and explore work systems in their organizations. Such tools might be designed to complement existing tools for IT professionals. An attempt to develop tools would fit into the long tradition of developing and evaluating tools in areas such as DSS, expert systems, and GSS. It might generate a tool like TOP Modeler (Majchrzak and Borys 2001; Markus et al. 2003) or might produce a suite of simpler tools. Table 6 identifies research issues for specific topics or issues related to method and tool development.

Table 5. Areas for Research Concerning Systems Thinking in the IS Field

Topic or Issue	Research Issue for the Future
More systems thinking is needed.	To what extent does systems thinking occur in practice?
Greater attention to systems thinking might reduce the level of disappointment and failure related to information systems and IS projects.	Much has been written about IS-related disappointment and failure. Is there evidence that inadequate systems thinking contributes substantially to the problem?
The IS discipline over-emphasizes tool thinking and under-emphasizes systems thinking.	To what extent is this assertion supported by the choice of research topics and approaches in leading journals?
The work system approach provides a series of lenses that lead toward more effective systems thinking in the IS field.	In what ways do the lenses in the work system approach support systems thinking? What additional ideas might support systems thinking to a greater extent?
In each iteration of the research to date, critical thinking capabilities and propensities seemed an important factor limiting the effective use of the ideas and tools provided.	Is there any way to minimize the impact of inadequate critical thinking skills by incorporating critical thinking approaches into a systems analysis method?

Table 6. Develop Methods and Tools That Support Systems Thinking

Topic or Issue	Research Issue for the Future
Experience to date shows that typical American business professionals (represented by MBA and EMBA students) need a systems analysis approach that is more prescriptive than soft systems methodology and that includes specific, teachable vocabulary and concepts.	What are the criteria for deciding how well someone performs the preliminary analysis of a system? How (and how well) do MBAs, EMBAs, and business professionals analyze systems without any prescribed method or when using soft systems methodology?
The work system approach reframes the analysis to focus on the work system rather than the information system.	In practice, what are the advantages and disadvantages of shifting the unit of analysis in this way? Does this support communication between business and it professionals, and if so, how?
There is a tradeoff between superficial methods that are relatively easy but don't go far versus more elaborate methods that may become overwhelming.	How can we measure superficiality versus overwhelm? (E.g., see Majchrzak and Borys 2001, p. 16.)
It is important to include human and social issues within the analysis and therefore to include human participants within the system.	To what extent do most systems analysts do this today? To what extent do student and professional analysts tend to ignore human and social issues when analyzing systems? (See Majchrzak and Borys 2001, p. 11.)

Develop a Body of Knowledge for the IS Discipline

As a first part of a proposed body of knowledge for the IS field, Hirschheim and Klein (2003) suggest four categories within information system development: organizational alignment of IT, user requirements construction, organizational implementation, and evaluation/assessment of IT artifacts (p. 267). Reframing analysis and design to focus on the work system rather than on an IT artifact it uses may or may not qualify as a new paradigm, but the combination of the work system concept, work system framework, work system life cycle model, work system principles, and Sysperanto could provide a new way of thinking about a body knowledge for the field. Sysperanto assumes that knowledge about work systems in general is the starting point for knowledge about information systems, projects, and other special cases. It says that a body of knowledge includes concepts, frameworks that combine related concepts, and generalizations such as principles, success factors, risk factors, and procedures and methods that prescribe action. It emphasizes the multidisciplinary nature of the IS field and rejects the importance of focusing the IS body of knowledge on the unique contribution of the IS field. Table 7 identifies research issues for specific topics or issues related to the IS body of knowledge.

Incorporating Systems Thinking into IS Research

The systems approach has not yet achieved its original promise in either practice or research, partly because the full complexity of systems thinking doesn't fit well into typical genres of IS research. Systems thinking is difficult to capture as linear relationships that fit easily into typical positivist research. Typical interpretivist approaches may be unsuited to analysis that emphasizes the system nature of a situation. Atheoretical surveys have difficulty producing meaningful results about the system nature of business situations. Therefore, research exhibiting a high degree of systems thinking tends to encounter the challenges to rigor, relevance, and research mentioned by Hirschheim and Klein.

Despite these caveats, progress has occurred in applying various forms of systems thinking. Greater attention to the surprising scarcity of systems thinking in the IS field might motivate efforts to create new systems concepts, methods, and tools that are practical, teachable, observable, and testable. The work system approach is a step in that direction. The research issues in Tables 5, 6, and 7 involve topics that can be studied using a variety of positivist and interpretivist research approaches. The potential payoff from better ideas, methods, and tools is surely large enough to sustain research on these basic issues that are at the core of the IS discipline.

Table 7. Develop a Body of Knowledge for the IS Discipline

Topic or Issue	Research Issue for the Future
Sysperanto, an ontology based on the work system framework, might be a good starting point for a body of knowledge for the IS discipline.	Fill in the details of Sysperanto and try to link it to systems analysis and design tools in order to demonstrate its practical usefulness.
Hirschheim and Klein (2003) suggest development of a body of knowledge should start with IS development, a "mature IS sub-specialization." Sysperanto starts with work systems and treats projects as a special case.	Produce a body of knowledge for IS development and determine the extent of overlap with Sysperanto. In particular, examine the commonality of concepts, frameworks, and principles and other generalizations.
Hirschheim and Klein (2003) identify the categories of knowledge that should be included in the first part of an IS body of knowledge, but they don't identify the types of knowledge that should be included.	Should the body of knowledge explicitly include the types of knowledge in Sysperanto, such as components and phenomena, actions and functions, characteristics, performance variables, and generalizations?
The current version of the work system method uses 21 principles that apply to any operational system or project. The principles were adapted from the literature and from experience in using prior versions of the principles.	What is a principle in relation to human systems? How do principles differ from success factors or cultural assumptions? Should principles be based on personal experience or empirical research? Can principles be mutually contradictory in a particular situation?

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