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THE WORK SYSTEM METHOD FOR UNDERSTANDING INFORMATION SYSTEMS AND INFORMATION SYSTEM RESEARCH

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Abstract

The work system method is a broadly applicable set of ideas that use the concept of "work system" as the focal point for understanding, analyzing, and improving systems in organizations, whether or not IT is involved. The work system method 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," which identifies the basic elements for understanding and evaluating a work system. 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. The dynamic view is based on the "work system life cycle model," which shows how a work system may evolve through multiple iterations of four phases. The static and dynamic views are used together in a principle-based systems analysis method that treats the information system as part of the work system until a final step when it distinguishes between work system changes that do and do not involve the information system.

Keywords: Work system, information system design, information system development, implementation, system life cycle

Introduction

The work system method is an approach for understanding and analyzing systems in organizations whether or not IT plays an essential role. This method is more broadly applicable than techniques designed to specify detailed software requirements and is designed to be more prescriptive and more powerful than domain-independent systems analysis methods. As explained elsewhere (Alter and Dennis, 2002), its development over the last decade stemmed from personal experience in the manufacturing software firm Consilium, some of whose customers and staff might have benefitted from an organized method for seeing the relationship between software features and work practices.

The work system method combines a static view of a current or proposed system in operation and a dynamic view of how a system evolves over time. The work system framework in Figure 1 represents its static view. The work system life cycle model in Figure 2 represents its dynamic view of how systems change over time through planned change and unplanned adaptations. The underlying ideas have been discussed in an information systems textbook and a set of articles listed in the references. This tutorial puts these ideas together and explains some of their implications for IS practice and IS research.

The premises underlying the work system method may be controversial because they imply that traditional jargon and concerns of IS practitioners and researchers address only part of the issues that should be covered and may discourage focusing on other issues related to successful projects and systems. These premises include:

1. **Relationship between work systems and the IS field**: The concept of "work system" is a general case that encompasses information systems, projects, value chains, supply chains, and other special cases. Accordingly, the IS field should place substantial emphasis on work systems.

2. **Inheritance of work system components and properties**: As a special cases of work systems, information systems and projects may inherit system elements, subelements, properties and propositions about work systems in general. The inherited concepts and propositions may constitute basic concepts and propositions about information systems and projects.

3. **Understanding information system goals and success**: As information systems are increasingly integrated into work systems they support, it is increasingly difficult to separate information system success from work system success.

4. **Applying general principles about work systems**: A set of general principles related to work systems are the basis of a systems analysis method that business and IT professionals can use at whatever depth makes sense for them. With this type of method, business professionals may become more willing and able to analyze systems for themselves.

5. **Work system life cycle model**: A work system life cycle model that incorporates both planned change and unanticipated adaptations is useful in understanding the goals and desired results of information system projects. Typical project or information system life cycle models may focus too much attention on computerized capabilities and too little attention on business and human realities, perhaps discouraging the typical adaptations that occur in healthy work systems.

The Work System Framework

A work system is a system in which human participants and/or machines perform a business process using information, technology, and other resources to produce products and/or services for internal or external customers. (Alter, 1999a) Typical business organizations have work systems for obtaining materials from suppliers, producing and delivering end products, finding customers, creating financial reports, hiring employees, coordinating work across departments, and many other functions. The term *work system* is used occasionally in the writings of socio- technical researchers but it is not clear from the publications I have found whether most of these researchers defined the term carefully or used it consistently.

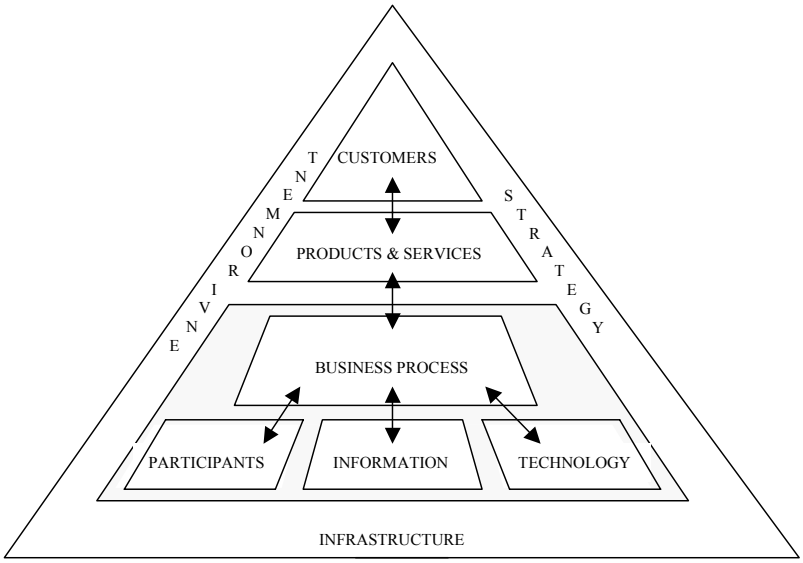

Figure 1. The Work System Framework

Figure 1 is a graphical representation of a framework that can be used to summarize any work system and to serve as a focal point for analyzing a work system. (Alter, 2002a, as updated in Alter, 2002b) Each element in the framework should be included in even a superficial understanding of a specific system. The arrows between various elements reflect the importance of maintaining mutual alignment between these elements.

The trapezoid surrounding the business process, participants, information, and technology in Figure 1 indicates that those four elements constitute the system performing the work. The work system's outputs are the products and services received and used by its customers. Consideration of products, services, and customers even though they are not part of the system reflects the notion that a work system exists to produce things customers want. Environment and infrastructure are usually key determinants of whether a work system can operate as intended and can accomplish its goals. A work system's strategy may not be explicit, but it sometimes helps in explaining why the work system operates as it does.

Business process. The work steps or activities performed within the work system. These steps may be defined or may be relatively unstructured. In some situations, different participants may perform the same steps differently based on differences in skills, training, and incentives. Activities within each step might include any combination of information processing, communication, decision making, thinking, and physical actions.

Participants. People who perform at least some of the work in the business process. Some participants may use computers and IT extensively, whereas others may use little or no technology. Whether or not particular participants happen to be technology users, the role of participant is more important when analyzing a work system than the role of technology user.

Information. Codified and noncodified information used and created as participants perform their work. Either type of information may or may not be captured on a computer. The distinction between data and information is secondary at this level because data not related to the work system would not be discussed.

Technology. Hardware, software, and other tools and equipment used by the participants while doing their work. Technology includes IT (whether computerized or not) and technology related to moving or modifying physical things. Technology within a work system is dedicated to that system, whereas technical infrastructure is technology shared with other systems.

Customers. People who receive direct benefits from products and services the work system produces. External customers receive the organization's products and/or services; internal customers are inside the organization. Consistent with TQM, the customers are best able to evaluate products and services. Customer satisfaction is often linked to the entire customer experience, starting from determining requirements and acquiring the products or services.

Products & services. The combination of physical things, information, and services that the work system produces.

Environment. Organizational, cultural, competitive, technical, and regulatory environment within which the work system operates. These factors affect system performance even though the system does not rely on them directly in order to operate.

Infrastructure. Human, informational, and technical resources that the work system relies on even though these resources exist and are managed outside of it and are shared with other work systems. This includes support and training staff; shared databases, and networks and programming technology.

Strategy. The rationale under which the work system operates, such as an assembly line approach versus a case-manager approach, or a mass customization approach versus a manually customized approach.

Work System Life Cycle Model

Work systems exist in a particular form during a particular time interval. Changes in the work system's state may occur during that interval without significantly changing the work system's form. The work system life cycle (WSLC) model in Figure 2 summarizes how a work system's form evolves through iterations combining planned and unplanned change. In planned change, human, monetary, and technical resources are allocated to a visible project (with initiation, development, and implementation stages) whose goal is to change the system's form. In unplanned change, minor adaptations lead to further adaptations usually accomplished without major projects or major allocation of resources.

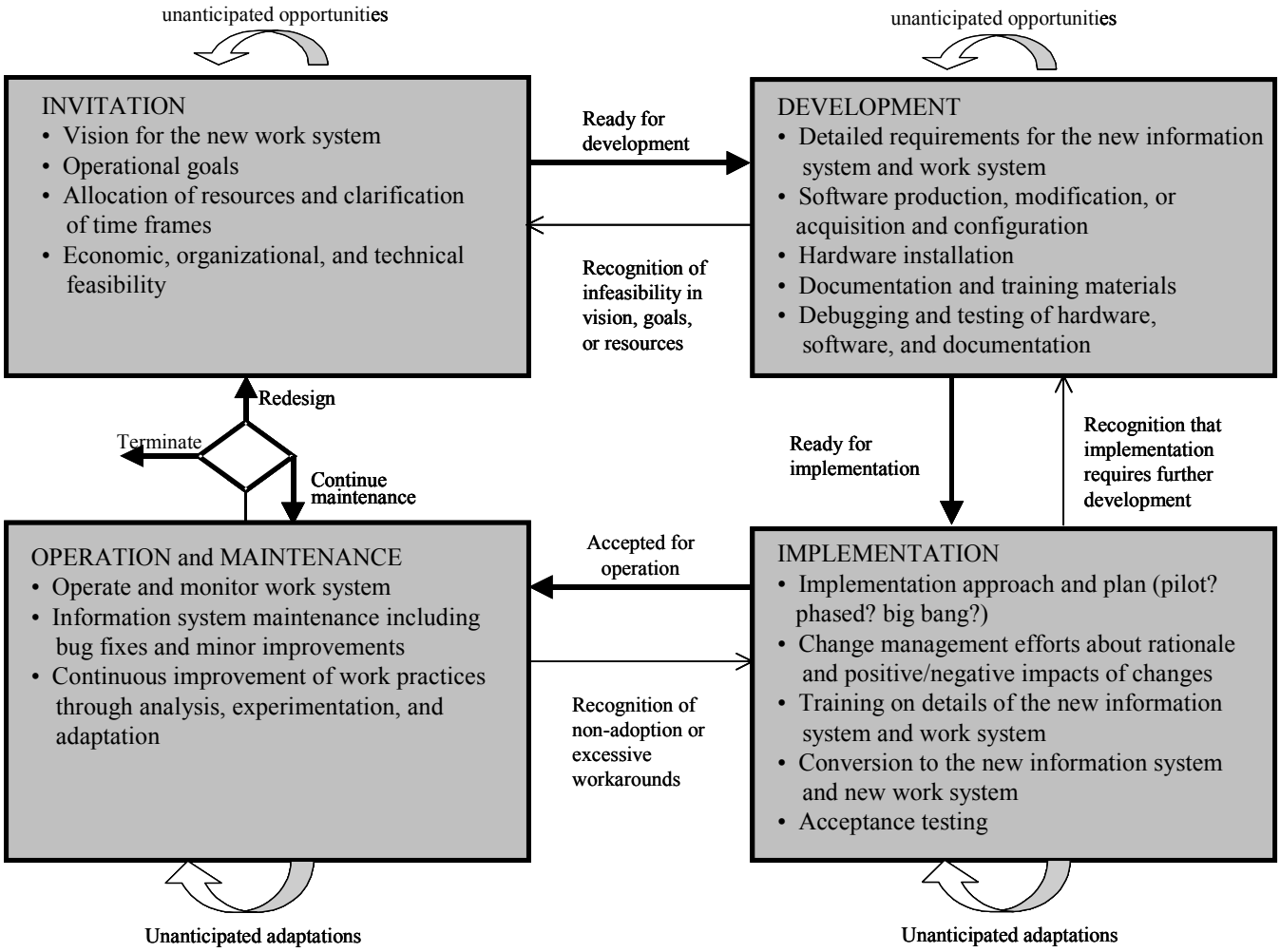

Figure 2. The Work System Life Cycle Model

The first version of the WSLC model appeared in the first edition of my textbook and was designed as a common denominator for custom development, use of application packages, prototyping, end user computing, and other ways to build information systems. The names of the four phases were chosen to apply to non-computerized systems as well. Alter (2001b) presented an extended version that included iterations, and demonstrated its generality by showing how it encompassed over a dozen models in the IS literature. The revised version in Figure 2 adds explicit recognition of unanticipated opportunities and unanticipated adaptations, thereby recognizing the importance of diffusion of innovation, experimentation, adaptation, emergent change, path dependence, windows of opportunity, and assimilation gaps. (e.g., Rogers, 1983; Tyre and Orlikowski, 1994;Orlikowski and Hofman,1997; Gallivan, 2001, Fichman and Kemerer, 1999) Inclusion of these factors is at least partly inconsistent with project-oriented viewpoints, which often seem to treat unanticipated opportunities and adaptations as problems rather than opportunities and categorize them under pejorative headings such as "requirements creep" and nonconformance.

Information Systems and Work Systems

Information systems constitute a special case of work systems in which the business processes performed and products and services produced are devoted to information. The activities in their business processes are limited to six types of computerized or manual activities: capturing, transmitting, storing, retrieving, manipulating, and displaying information. Examples of

information systems include tracking systems used by package delivery companies, medical reimbursement systems used by insurance companies and governments, and architectural design systems used by architecture firms. Participants in these information systems perform or trigger information processing activities while also participating larger work systems (delivering packages, providing reimbursements, designing buildings). In addition to information processing, activities in those work systems include communication, decision making, thinking, and physical actions.

Projects, value chains, and supply chains are also work systems. A project is a time-limited work system designed to produce something and then go out of existence. A supply chain is a work system devoted to procuring materials and other resources a firm needs in order to produce products and services for its external customers. A value chain is a work system consisting of a set of smaller work systems that combine to produce whatever value the external customer receives.

Overlap Between Information Systems and Work Systems

Information systems typically exist to produce products and services used by other work systems that may or may not be information systems. The distinction between an information system and the work systems it serves is important because there are many possible relationships and forms of overlap between the information system (IS) and the work system (WS). These include (Alter, Ein-Dor, Markus, Scott, and Vessey, 2001):

- Comparatively small IS provides information for a WS but is not part of it. Example: An IS that collects production data and creates a file of production data later used by the accounting department.
- Comparatively small IS is a dedicated component of a WS. Example: A real time dispatching system that helps manufacturing workers decide which lot to process next in a factory.
- WS is primarily devoted to processing information and the IS and WS are almost identical. Examples: billing system, payroll system, loan approval system.
- One IS overlaps with several separate WSs. Example: An IS for sales call tracking might be used by the sales force for tracking sales progress and by the finance department for financial projections.
- A large IS supports various WSs and might be larger than any of them. Example: An airline reservation system used for deciding what flights to take, booking reservations, making yield management decisions about overbooking flights, and analyzing frequent flyer promotions.

The process of designing an IS or WS it supports should depend on the degree of overlap between the two systems. For example, if a WS is largely an IS, the design of the WS would largely be an IS design effort. On the other hand, separate design might be more effective for a WS and a related IS whose business processes overlap minimally or not at all.

As information systems become more integrated with work systems, the entire topic of evaluating the information system and its impact becomes more problematic because important aspects of the work system cannot operate without the information system. On the other hand, the work system may include decision-making, communication, negotiations, physical activities, and many other activities that are outside of the information system even if they may be influenced by it. Under these increasingly common circumstances, studying the success of the information system without evaluating the success of the work system is increasingly like studying only one of a pair of Siamese twins. (Alter, 1999b)

Inheritance of Work System Characteristics and Success Factors

The fact that information systems, projects, supply chains, and value chains can all be characterized as work systems implies that vocabulary and concepts that apply to work systems in general also apply to these special cases. Although the special cases also have their own unique vocabulary, it is possible that a large majority of the core concepts related to information systems and projects are actually concepts related to work systems and are best understood at that level. (Alter, 2001a)

Figure 3 goes a step further by illustrating the hypothesis that generalizations and success factors related to work systems in general are inherited by special cases such as information systems and projects. (Alter, 2002a, p. 59) Inheriting success factors

from the general case in no way precludes the existence of additional success factors based on issues relevant to each special case but not to work systems in general. Similarly, specific types of information systems and projects should inherit success factors for information systems and projects, respectively, but might have additional success factors related to their defining attributes. For example, the success factors for an expert system or for an ERP project should include:

- some success factors for work systems in general, such as management support, commitment, participant incentives aligned with system goals, adequate training, and adequate resources
- additional success factors related to information systems and projects, respectively, such as prior experience with related information systems or careful project management
- additional success factors related to the particular types of information system and project, such as cooperation between the knowledge provider and knowledge engineer or extensive involvement of experienced ERP consultants.

The inheritance relationships expressed in Figure 3 may explain why studies about different types of information systems and projects frequently produce overlapping success factors and generalizations. The most common success factors and generalizations typically concern work systems in general rather than the special cases.

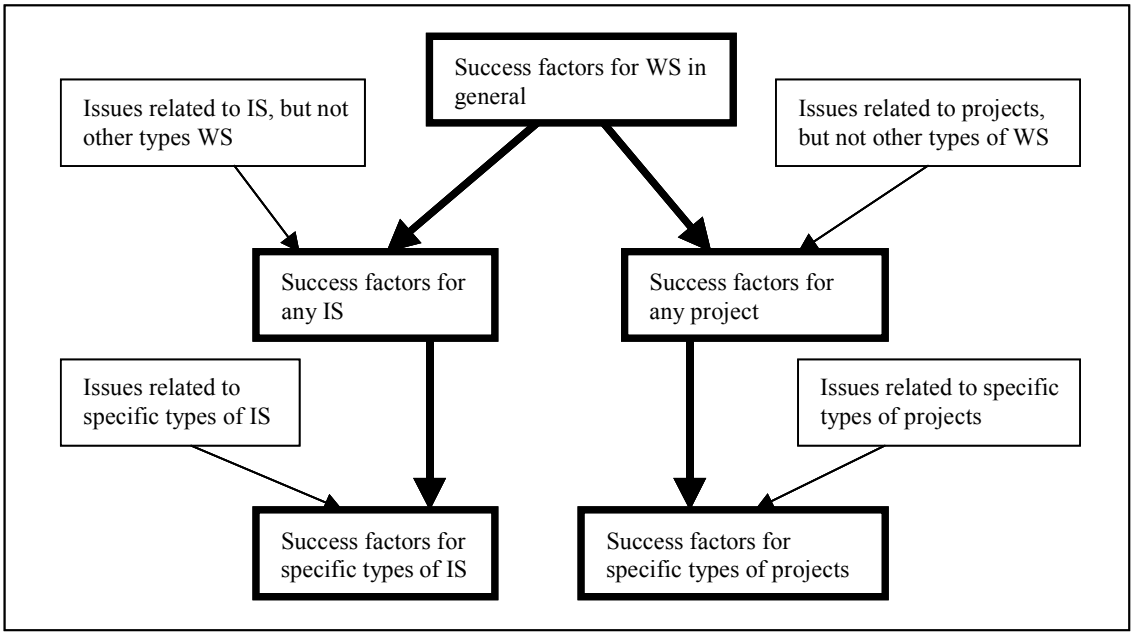

Figure 3. Hypothesized Inheritance of Work System Generalizations and Success Factors

Analyzing a Work System from a Business Viewpoint

Assume that business or IT professionals want to analyze a system to solve a problem or exploit an opportunity. Unless the problem is only about technical aspects of IS hardware or software, work system concepts are useful in organizing the analysis. First, define the work system and the problem or opportunity. Then explore the work system elements in turn to identify possible improvements and to reveal additional problems not considered initially. After identifying the possibilities, decide how to address the problem or opportunity without creating even worse problems. Use the fundamental concepts of work systems, information systems, and projects as the basic vocabulary for the analysis. (Alter, 2002a)

These steps sound logical and straightforward, but even an overview of the steps and related pitfalls helps in identifying confusions and communication lapses that affect system-related results in many organizations.

Define the problem and work system. The first step in analyzing a work system is to define the problem or opportunity and the smallest work system whose operation reflects that problem or opportunity. For example, if the problem involves disappointing sales revenue, the work system may be viewed as all sales activities or just a part of the sales work that is being done poorly. MBA and EMBA students analyzing real world systems in their organizations consistently report significant difficulty in deciding exactly what system they are studying. Common pitfalls in this initial phase include:

- The system is never defined clearly. A common result is meetings in which some people think a system under discussion, such as a manufacturing system, is the way the company performs a particular type of work, whereas others think the system being discussed is the software or information system that supports the work.

- The system to be improved is assumed to be software or the technology. This limits the likely improvements to aspects of the software or technology rather than other aspects of the work system that might be changed more easily than software or that might be so resistant to change that software improvements would have little impact.

- The system definition is too broad or too narrow. If it is too broad, the analysis will cover too much territory and will be unnecessarily complicated. If it is too narrow, the analysis might be easier but might produce an inconsequential result.

- The problem definition is vague. At minimum, a clear problem definition simplifies the analysis by focusing on the smallest system that exhibits the problem. In addition, a vague problem definition makes it difficult to assess the quality of the recommendation.

A useful tool for clarifying the scope of the work system is a "work system snapshot." (Alter, 2002a, 2002b) This is a single page or less that identifies the customers, products and services, and participants, lists the business process as no more than ten steps, and gives a brief indication of the most important information and technology in the work system. Even when there is initial agreement about the work system snapshot, looking at the situation in more depth as the analysis unfolds often results in revising the initial assumptions about the work system's scope. The definition of the problem and system should also include constraints, priorities, and system strengths that should not be undermined.

Explore the situation and search for possible improvements. After defining the system and the problem or opportunity, the next step is to design and evaluate alternative ways to produce improvements. It is possible to use general principles to help in identifying current shortcomings or new problems that might emerge if a particular change is pursued. One version of these principles and the related work system elements is as follows:

#1: Please the customers.	*[customers, products & services]*
#2: Perform the work efficiently.	*[business process]*
#3: Serve the participants.	*[participants]*
#4: Create value from information.	*[information]*
#5: Minimize effort consumed by technology	*[technology]*
#6: Take full advantage of infrastructure.	*[infrastructure]*
#7: Minimize unintended conflicts and risks.	*[environment]*
#8: Support the firm's strategy	*[strategy]*
#9 Maintain balance between work system elements	*[all elements in combination]*

Very few work systems actually satisfy all of these principles, partly because the principles are often contradictory. For example, the principle of pleasing the customers often contradicts the principle of doing the work efficiently (because customers are most concerned about the products and services produced and may not care how efficiently the work is done). This principle may also contradict other principles such as serving the participants (because customers may not care about the conditions under which the participants work) and minimizing effort consumed by technology (because customers may not care about work system efficiency). The internal contradictions between the principles demonstrate why it is difficult to design work system changes that are improvements from every viewpoint.

Common pitfalls in the exploratory phase of the analysis include:

- Too often the "analysis" leaps from the problem to a solution without considering possible improvements and additional problems that even a superficial exploration would reveal. Whenever I compare this method to "Ready, Fire, Aim" in

an EMBA class, someone pipes up with "We do that. We just did a major project without ever figuring out how the software changes would change the business process or affect system participants."

- Especially when IT professionals are involved, the analysis may tend to emphasize computerized tasks and may assume that recommendations should emphasize that area. In many cases other issues such as inappropriate incentives, inappropriate business process characteristics, and organizational issues are just as important.

Produce recommendations. Ideally the recommendation should address the problem in a manner that generates improvements without generating too many new problems. A typical recommendation should include at least:

- Recommended changes in each element of the work system
- Clarification of which changes involve just the work system, just the information system, or both the information system and the work system
- Explanation of how the proposed improvements will address the main problem and the other problems discovered in the analysis
- Identification of meaningful alternatives that were not chosen and why these were deemed less beneficial than the alternatives that are recommended
- Identification of important stakeholder interests, whether and how these will benefit from the proposed change, and implications for successful implementation
- Tentative project plan including timing and deliverables

This is just the beginning of the analysis required to build or significantly improve a computerized system. In terms of the WSLC, this is the analysis that should occur in the initiation phase, and its results should be verified and extended in the detailed analysis in the development phase.

Implications for Research and Practice

The work system method is based on the possibly counterintuitive assertion that the best way to understand information systems in organizations is to avoid focusing on the information system until the work system is understood. This assertion applies to both IS practice and IS research.

IS Practice: Poor communication and difficulty establishing clear expectations frequently contribute to the appalling rate of disappointment and failure of IS projects. The work system method addresses these problems by providing a business-oriented vocabulary and an organized method that business professionals can use at whatever level of depth makes sense to them. The combination of the work system framework and work system life cycle model provides a basis for communicating about systems and system-related projects. These ideas encourage business and IT professionals to adopt a business- and organization-oriented view that cannot ignore concerns of business professionals whose participation and commitment is often essential for system and project success.

IS research: Most important work systems in today's organizations rely on computerized information systems. These work systems combine activities that may or may not involve processing information and may or may not be supported by IT. Under these circumstances, it simply doesn't make sense to create an artificial boundary between IS research and WS research. For maximum value and long-term impact, the IS field must recognize explicitly that it should or already does encompass aspects of work systems that may or may not involve IT directly (as anyone involved in an implementation or reengineering project surely realizes).

Implications of the work system approach for understanding the meaning of IS research are more problematic. Assume that someone has done research about expert systems, MIS or another special case. Were the findings really about expert systems or MIS, or were they really about information systems or work systems in general? Of course they were about whatever the sample actually represents, but where do the findings belong in the accumulated knowledge of the IS field? For example, if a study of

expert systems finds that management support is important, it seems at best uneconomical to place that finding in expert system folder when it already exists in the MIS folder, the IS folder, the WS folder, and many other folders. The inheritance conjecture mentioned earlier provides an effective way to reduce the redundancy by associating the generalization about management support with the most general type of work system to which it applies. Doing that would facilitate the progress of the IS field by clarifying what we think we know and placing it at the most useful level. At minimum the attempt to codify IS-related knowledge in this way would help reveal what we think we know.

Next steps. The work system method is the result to date of an effort to develop a systems analysis method that business professionals could use in whatever level of detail makes sense for them. The testbed has been MBA and EMBA classes at the University of San Francisco. The next step is to test whether this approach facilitates understanding by business professionals and better communication between business and IT professionals. In addition, it would be interesting to compare the relative effectiveness of the work system method and other methods in the literature, such as soft system methodology (Checkland, 1993, Checkland and Scholes, 1990), the "thinking process" proposed by Goldratt as an extension of the theory of constraints (Dettmer, 2000), and the systems analysis methods discussed in current textbooks for IS majors.

Another important direction is to verify the inheritance conjecture by developing an ontology of the IS field that covers the elements of a work system and related subelements and properties. Ideally, this ontology should be tested by determining whether the propositions and findings in the IS literature can be stated using the terms in the ontology. The guiding metaphor for this effort is "Sysperanto," not really a language, but rather, an organized set of core concepts that business professionals, IT professionals, and IS researchers might use for describing, understanding, and analyzing systems in organizations. If successful, Sysperanto might help in codifying and organizing the disparate and inconsistent propositions, methods, and findings that constitute the current state of knowledge in the IS field. (Alter, 2002c)

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