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An "Interpretary" for the IS Discipline, a Compendium of Interpretations of Basic IS Concepts and Methods from Different Theoretical Perspectives

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Abstract:

This article proposes the development of an "interpretary," a compendium of interpretations of IS concepts and methods from different theoretical perspectives. Such an interpretary would recognize the importance of different theoretical perspectives while also moving toward an organized body of knowledge for the IS discipline. An idealized interpretary can be viewed as a two-dimensional concept interpretation matrix whose cells contain interpretations of specific concepts from specific theoretical perspectives. The first column is a list of important IS concepts. The other columns represent specific theoretical perspectives. Each cell contains an interpretation of a particular concept from a particular perspective Thus, the row for "user" would contain interpretations of that term from different perspectives. After explaining the idea of an interpretary, this article presents an illustrative example that compares interpretations of seventy-five selected IS concepts from two theoretical perspectives: (1) systems are technical artifacts that are used by users and (2) systems are IT-reliant work systems whose components include human participants. The first perspective is consistent with most systems analysis and design textbooks. The second is based on work system theory, the basis of the work system method. A more complete interpretary would include many other perspectives. The conclusion summarizes some of the challenges related to creating a more complete interpretary for the IS discipline.

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I. EXPLORING OVERLAPS AND COMPATIBILITY BETWEEN THEORIES AND VIEWPOINTS IN THE IS DISCIPLINE

Researchers in the IS discipline have used many different theoretical viewpoints and perspectives that address different concerns based on different assumptions about what is important. While it is worthwhile for a young discipline to let all flowers bloom through what might be called a marketplace of ideas [Lyytinen and King, 2004], inattention to the comparability of different theories and perspectives creates obstacles to communication, collaboration, and the creation of a coherent body of knowledge for IS/IT. That inattention to comparability is an important but frequently overlooked factor in the IS discipline's perennial discussions of rigor vs. relevance. Regardless of how relevant certain research might be, unnoticed inconsistency in usage and connotations of basic terms and inattention to basic assumptions reduces rigor by muddling the meaning of research hypotheses and conclusions and by making it difficult or impossible to combine findings from different streams of research.

From both teaching and research perspectives, inattention to comparability of theories and viewpoints also makes it more difficult to visualize the extent to which existing theoretical formulations have similar or different implications in relation to the same IS/IT topics. For example, many researchers have used actor network theory. Others have developed conceptual modeling methods. Yet others have focused on IT-related innovation or on the technology acceptance model or on enterprise systems. How are ideas and implications from any one research stream or viewpoint reconciled with ideas from other approaches? Surely we are not genuinely satisfied to assume that different parts of the IS discipline should be treated like unrelated sport leagues, with the football league happy to co-exist with the basketball and golf leagues, but unconcerned about creating anything more integrated and comprehensive than a set of unconnected intellectual silos.

Another characteristic of theoretical perspectives in the IS discipline is that its theories have vastly different ranges of applicability. Some theories focus on a specific type of situation, such as a theory concerning user participation or a theory concerning mobile commerce. Other theories or theoretical perspectives focus on a much broader range of phenomena. Examples include actor network theory [Callon,1986], structuration theory [Giddens, 1984], activity theory [Kaptelinin and Nardi, 2006; Luukkonen, Korpela and Mykkanen, 2010], work system theory [Alter, 2006, 2008, 2013c,], practice theory [Feldman and Orlikowski, 2011], and sociomateriality [Orlikowski and Scott, 2008]. One might wonder about the potential synergy of broader theories in relation to narrower theories, and about whether narrower theories might provide interesting challenges to the applicability of purportedly broader theories.

Addressing comparability directly. This article proposes the idea of an "interpretary," a compendium of interpretations of basic concepts and methods from different theoretical perspectives. The descriptive name “interpretary” combines a focus on interpretations and a dictionary-like purpose related to presenting textual information about the essence of specific topics.

An interpretary would make it easier to compare interpretations of specific concepts or methods from different theoretical perspectives. The initial form of an interpretary would resemble an extensive text-oriented table whose cells contained interpretations of specific concepts or methods from specific theoretical perspectives. A computerized version of that type of interpretary would be able to answer inquiries requesting different interpretations of terms such as “user” or “implementation” from different viewpoints. A much more sophisticated version of an interpretary might use characteristics of theoretical perspectives (e.g., primarily technical or primarily social; or individual, group, or enterprise level) or even textual analysis of interpretations in order to respond to queries requesting groupings of interpretations from different viewpoints.

An initial version of an interpretary could be produced by groups of researchers who are proponents or experts in specific theoretical perspectives. For example, assume that a panel of IS researchers produced a list of 100 to 200 concepts that are broadly applicable in the IS discipline. Proponents or experts in specific theoretical perspectives could offer brief interpretations of each of those concepts based on their particular theoretical viewpoint. It is unlikely that any particular theoretical viewpoint would have an interpretation of most of the concepts in the list of concepts. For example, structuration theory might say something about business processes and the technology acceptance model, but probably would not say much about a theory of cloud computing technology or conceptual modeling. An initial version of an interpretary that encompassed five or ten broad perspectives in the IS discipline would probably be sufficient for testing the overall approach and visualizing how to extend it further.

This article's main goal is to introduce the idea of interpretary as a breakthrough idea that could lead in many directions. Producing and using an interpretary is at least somewhat "out-of-the-box" in relation to mainstream thinking in the IS discipline, where there have been calls for development of a body of knowledge (e.g., Hirschheim and Klein [1994]), but only preliminary progress in that direction has occurred (e.g., Alter [2012b]; Hassan and Mathiassen [2009]; Iivari, Hirscheim and Klein [2004]). Given the novelty of the general idea of interpretary, almost any totally abstract description of it probably would be unclear to most readers. Furthermore, almost any completely abstract description probably would miss important issues and potential directions that would be shown or implied by simply producing an example. Accordingly, this article focuses on providing an illustrative example.

An illustrative example comparing interpretations based on two perspectives. This article illustrates the idea of an interpretary through an extended example, what might be called an "instantiation" in design science research [Hevner, March, Park and Ram, 2004]. The illustrative example includes two theoretical perspectives on systems. The first will be called the "technical artifact" (TA) perspective, whereby the system is a technical artifact, a hardware/software configuration that is used by users, either directly as in application software, or indirectly as in operating system software that is largely hidden from users. Most systems analysis and design textbooks are based on a TA perspective. For example, a textbook by Dennis, Wixom, and Tegarden [2009, pp. 4–5] says, "The analysis phase answers the questions of who will use the system, what the system will do, and where and when it will be used." ... "The design phase decides how the system will operate, in terms of hardware, software, and network infrastructure; the user interface, forms and reports; and the specific programs, databases, and files that will be needed." Similar views of "the system" appear in the first chapters of Hoffer, George, and Valacich [2008], Kendall and Kendall [2011], and Valacich, George, and Hoffer [2012]. Similarly, formal methods such as the Unified Process [Rational Software, 2011] emphasize defining a technical system rather than a sociotechnical system with human participants. Accordingly, the diagrams in UML clarify processes, information requirements, and some details of processing logic but ignore other important issues related to skills, incentives, and organizational culture.

In the second theoretical perspective, called a work system (WS) perspective, the system of interest is a work system in which human participants and/or machines perform processes and activities using information, technology, and other resources to produce products/services for internal or external customers. Appendix A presents a summary of work system theory focusing on the work system framework and the work system life cycle model, which are the basis of various versions of the work system method [Alter, 2006, 2008, 2013c]. "A WS perspective assumes by default that systems include human participants, although totally automated work systems are an important special case, especially since totally automated subsystems are identified and described during the analysis of almost any work system that has human participants. Human participants within a work system may or may not be direct users of technology.

Organization. Since the author is not aware of anything in the IS discipline that is directly comparable to an interpretary, this article explains a bit more about the idea of an interpretary and then proceeds directly to an example that encompasses interpretations of seventy-five concepts from TA and WS perspectives. An example of that size is sufficient for illustrating what an interpretary is without being overwhelming. Although an interpretary can be visualized as an extensive table, for purposes of this article it is easier to present the example as an alphabetically organized list of selected IS-related concepts, each with a comparison of interpretations of the concept from TA and WS perspectives. A discussion and conclusion section explains how a more complete interpretary might be built. Implications for IS/IT theory in general and for developing a body of knowledge for the IS discipline are discussed. Since work system theory surely is unfamiliar to some readers, Appendix A summarizes the main ideas in that perspective for thinking about systems in organizations.

II. EXAMPLE: INTERPRETATIONS OF SEVENTY-FIVE CONCEPTS BASED ON TWO THEORETICAL PERSPECTIVES

An interpretary can be viewed in the abstract as a "concept interpretation matrix," a two-dimensional table whose columns represent particular theoretical perspectives and whose rows represent significant concepts in the IS discipline. Table 1 illustrates the idealized form of a concept interpretation matrix. For example, the cell for the concept "user" in the column for the theoretical perspective "actor network theory" would contain the interpretation of that concept from that theoretical perspective. That particular interpretation might or might not differ from the interpretation for the cell for "user" in the column for "agency theory" or "structuration theory." Even a first cut version of an interpretary would show how different theoretical viewpoints have different interpretations of specific concepts and how different concepts are or are not viewed as relevant in relation to specific theoretical viewpoints.

Table 1: Idealized Form of a Concept Interpretation Matrix						
Concept	Perspective A	Perspective B	Perspective C	Perspective D	Perspective E	Etc. ...
Concept 1	Interpretation (1,A)	Interpretation (1,B)	Interpretation (1,C)	Interpretation (1,D)	Interpretation (1,E)	Etc. ...
Concept 2	Interpretation (2,A)	Interpretation (2,B)	Interpretation (2,C)	Interpretation (2,D)	Interpretation (2,E)	Etc. ...
Concept 3	Interpretation (3,A)	Interpretation (3,B)	Interpretation (3,C)	Interpretation (3,D)	Interpretation (3,E)	Etc. ...
Concept 4	Interpretation (4,A)	Interpretation (4,B)	Interpretation (4,C)	Interpretation (4,D)	Interpretation (4,E)	Etc. ...
Etc.	Etc.	Etc.	Etc.	Etc.	Etc.	Etc. ...

The example used to illustrate the idea of the interpretary is as follows:

- Concepts: Relevant concepts were selected from the list of keywords provided by Manuscript Central for submissions to ICIS 2012. Other concepts were added that seemed to illustrate interesting differences between the TA and WS perspectives, bringing the total number of concepts to seventy-five. Many other concepts might have been included. Most readers will surely identify some concepts that should have been included, in their opinion, and others that seem tangential and not worth including in a list of that length. The issue of how many concepts and which concepts to include in a more complete interpretary will be discussed later.
- Perspective A: With a TA perspective, systems are technical artifacts with human users and system development is a project that produces and debugs technical artifacts.
- Perspective B: With a WS perspective, systems are work systems with human participants, at least by default, since a totally automated system is a special case of work system. With this perspective, system development is a phase in an iterative work system life cycle model (see Appendix A) involving creation, modification, or acquisition and configuration of resources such as hardware, software, process specifications, documentation, training materials, and other resources needed in order to implement a new version of a work system in an organization.

To fit better in the layout of a journal article, interpretations of each of the selected concepts are presented in the form of normal text paragraphs, rather than in a table. Tabular presentation of the data would result in a great deal of empty space on the page wherever one perspective had a lot to say about a concept while the other perspective had little to say.

Using a concept interpretation matrix. Assuming that a full concept interpretation matrix were stored as a computerized table of textual data, that table could support a number of possible queries or operations, such as:

- Find the interpretation of concept *n* using theory *X.*
- Compare interpretations of concept *n* based on theories *X, Y*, and *Z.*
- Find similarities between theories *X, Y*, and *Z* by examining their interpretations of concepts *m* and *n*.
- Identify concepts that are most theorized and least theorized.
- Identify omissions (i.e., identify concepts for which specific perspectives have nothing to say).
- Identify theoretical perspectives that have the broadest range of interpretations.
- Use clustering methods to create similarity maps that compare and position theoretical perspectives in relation to each other.

A more complete interpretary would start with a summary of basic concepts and assumptions for each theoretical perspective that it includes. That type of information is already available for most well-articulated theoretical perspectives, although with some disagreements related to different researchers' views of the same theoretical perspective and some gaps or inconsistencies related to the way that specific theoretical viewpoints evolved over time. Part of the value of creating an interpretary would involve the reconciliation of different researchers' views of interpretations of specific concepts for specific perspectives.

The following illustrative interpretations are solely those of the author, and were produced in full recognition that other researchers might select other concepts to include and might articulate conflicting interpretations of the concepts that are included. The interpretations emphasize differences between the two perspectives, and in many cases do not try to provide complete definitions of common terms. An interpretary in the format of the concept interpretation matrix in Table 1 would contain separate entries for each concept and perspective. In order to minimize redundancy in the illustrative example, wherever the TA and WS interpretations are similar, comments about a concept start with a statement such as, "The TA and WS interpretations are similar. Both focus on ...."

Agile development. Both TA and WS interpretations view this as a software development method involving rapid iterations with users. A WS interpretation could treat a specific agile development project as a work system on its own right.

Architecture. Both TA and WS interpretations view architecture as a system's structure summarized in terms of its major components. With a TA interpretation, architecture is the structure of the hardware and software. Although the term “architecture” might not be used in relation to a work system, with a WS interpretation a work system's architecture would include the following:

- Structure of the processes/activities (e.g., flow charts or activity diagrams)
- Structure related to participants (e.g., organization chart, assignment of participants to roles)
- Structure-related information (e.g., database schema or entity-relationship diagram)
- Structure related to technology (e. g., structure of hardware and of software modules)
- Structure related to products/services (e.g., physical and/or informational structure of whatever is produced for the work system's customers)

Automation. From a TA perspective, automation is basically the use of technical artifacts. From a WS perspective, automation is the performance of processes and activities by technical artifacts that were set up and/or launched by people and/or other technical artifacts.

Business intelligence. With a TA interpretation, business intelligence is a type of software. With a WS interpretation, business intelligence is a type of work system whose participants compile and analyze information related to an organization's internal operations and/or information related to the competitive environment, including current operations and capabilities of competitors and potential developments by current and future competitors.

Business process. With a TA interpretation, a business process is a set of steps within which the system (a technical artifact) is used. With a WS interpretation, a business process consists of activities performed by human participants and/or machines within the work system. The work system framework (see Appendix A) refers to processes and activities rather than business processes because some work systems have clearly specified business processes with well-articulated start and end points and clearly defined intermediate steps, whereas other work systems contain recognizable activities that are not organized in clearly defined business processes.

Business value of IS/IT. Neither a TA perspective nor a WS perspective provides a direct interpretation of the business value of IS/IT. In both cases, business value cannot be evaluated directly, but needs to be evaluated in relation to a larger context. The distance from the core of the perspective to the business value of IS/IT is greater for the TA perspective than for the WS perspective because any business value that can be traced to specific technical artifacts must involve their use in specific work systems. Although it is a bit closer to business value, a WS perspective often is not very close to the ultimate business value of IS/IT because most uses of IS/IT are for work systems that produce products/services for internal customers.

Change management. TA and WS perspectives have quite different interpretations of change management. With a TA perspective, change management is about changing from one hardware/software configuration to another. Software change control methods would be a central topic. With a WS perspective, change management is fundamentally about changing the way people perform their work. Change management is directly related to the implementation of new or improved work systems because people perform most work as participants in work systems. The TA and WS perspectives overlap in practice because changes related to visible technical artifacts within work systems almost always involve many factors other than changes in technology.

Communication. From a TA perspective, communication is basically about human-computer interaction and about transfer of messages between machines, modules, or UML classes. From a WS perspective, communication is an essential component of any work system. In sociotechnical work systems, communication includes various types of communication between people plus human-computer interaction and the transfer of messages to and from hardware/software modules. It is noteworthy that some communication occurs within formally defined aspects of business process steps, whereas other communication occurs in articulation work [Schmidt and Simone, 1996] that facilitates the formally defined steps by making it possible to perform those steps efficiently.

Complexity. From both perspectives, complexity involves a combination of the number of components of different types, the number and nature of the interactions between the components, and the number of options or alternative paths. From a TA perspective, the components are technical artifacts or subsystems of technical artifacts. From a WS perspective components include human participants and/or technical artifacts or subsystems of technical artifacts.

Coordination. From both perspectives, coordination is a type of interaction between systems or subsystems whose purpose is to facilitate work within systems, to use resources efficiently, or to enact appropriate trade-offs between short-term goals and activities of systems or subsystems that interact directly or indirectly.

Cost-benefit analysis. From both perspectives, cost-benefit analysis is about providing input for decision-making based on identifying and quantifying both the costs associated with performing a project and the benefits that will accrue as a result of whatever the project produces. From a TA perspective, cost-benefit analysis related to any technology that is used directly by end-users necessarily needs to consider improvements in work systems, such as operating the work system more efficiently or serving the work system's customers more effectively. Thus, whether or not the TA perspective uses the terminology of work systems, a thorough cost-benefit analysis from a TA perspective still needs to consider most of the same factors that a thorough cost-benefit analysis from a WS perspective would consider.

Customer. The idea of customer is quite natural from a WS perspective because all work systems produce products/services for customers according to the work system framework (see Appendix A). The term “customer” is not generally associated with a TA perspective although users of technical artifacts and automated modules that receive outputs of other technical artifacts can be viewed as playing direct or indirect customer roles in those situations.

Database management system. From both perspectives, a database management system is a technical artifact that is used to store, retrieve, and manipulate information whose content and format are specified prior to data collection and storage.

Defect. From a TA perspective, a defect is a feature of a technical artifact that impedes its performance, causes it to fail, or causes other problems in the context in which it is used, such as difficulties for users or for other related systems. Defect has the same meaning from a WS perspective, except at the level of a work system rather than a technical artifact. Thus, work system defects could involve not only defects in technologies used within the work system, but also defects related to inadequate processes and activities, inadequately skilled or unmotivated participants, inadequate information, inadequate design of the products/services produced for customers, and even inadequate fit with the surrounding environment.

Design. From both perspectives, design as a noun is an abstract description of what a system should be, how a system should operate, and what a system should produce. As a verb, design is a process of creating a system's design. In both senses, design within a WS perspective is a broader concept because it involves not only technical artifacts and their use, but also the work systems within which they are used.

Domain knowledge. From a TA perspective, domain knowledge may or may not be built into technical artifacts, but is almost always important for using technical artifacts efficiently, effectively, and reliably. From a WS perspective, domain knowledge is important in the same ways, although domain knowledge may also be built into processes and activities (e.g., in the form of business rules), may exist as tacit knowledge in the minds of work system participants, may be recorded in the information used and produced by the work system, may be embedded in the products/services that are produced, and may be an important determinant of whether a work system's customers can use its products/services effectively.

Effectiveness. From both perspectives, effectiveness is the extent to which whatever the system produces helps the system's customers achieve their goals.

Efficiency. From both perspectives, efficiency is the extent to which resources consumed by the system's operation (including physical resources, money, time, and effort) are converted into intended outputs. With higher efficiency, a higher proportion of the resources that are consumed are converted into desired outputs.

Electronic commerce. Neither perspective speaks directly of electronic commerce, which is commerce performed through computerized means, especially the Internet. In relation to electronic commerce, a TA perspective tends to focus on the technical artifacts that are used, such as the website, the database, and the Internet. From a WS perspective, electronic commerce can be viewed as a combination of several work systems, including a self-service work system in which the customer uses the e-commerce vendor's website to select and purchase goods and services and the vendor's back-office work systems related to deciding what to sell, maintaining inventories, packaging orders, and shipping them to customers.

Emergent change. From a TA perspective, emergent change does not happen because (almost all) technical artifacts cannot change themselves through unplanned adaptations and learning. From a WS perspective, emergent change is part of the life cycle (see Appendix A) through which work systems evolve over time through a combination of planned change and emergent change. Planned change is executed through projects. Emergent change occurs as work system participants perform and learn from adaptations and workarounds that respond to obstacles that make it difficult to attain work system goals and personal goals while also performing work efficiently.

Emergent properties. Both technical systems and sociotechnical systems have emergent properties that are not properties of the individual components of those systems. From both TA and WS perspectives, emergent properties include system capabilities and other features that are not capabilities and features of subsystems or components.

Enterprise resource planning (ERP). From a TA perspective, an ERP system is a technical artifact consisting of software and related documentation and training material that is typically purchased from an ERP vendor. From a WS perspective, an ERP system is part of the technical infrastructure that is shared by multiple work systems in an organization. Specific modules within an ERP suite are used as part of the technology within specific work systems. Since ERP configuration parameters that are optimal for some work systems may have negative consequences for other work systems, a key challenge in implementing and using ERP successfully is configuring the ERP software to attain the right trade-offs between enhanced capabilities for some work systems and diminished capabilities for other work systems.

Environment. From a TA perspective, environment is the technical environment (e.g., operating systems, networks, and technical standards) and physical environment (e.g., temperature, humidity, and vibration) within which a technical artifact operates. From a WS perspective, the environment is the relevant organizational, cultural, competitive, technical, regulatory, and demographic environment within which the work system operates, and that affects the work system’s effectiveness and efficiency.

Flexibility. From both perspectives, an artifact or system's flexibility is the extent to which it can adapt or can be adapted based on future contingencies. A TA perspective on flexibility focuses on the extent to which a technical artifact can adjust or can be modified or configured in response to contingencies. A WS perspective on flexibility includes flexibility of the technology and flexibility of other elements of the work system, including processes and activities, participants, information, and the products/services produced. In other words, a WS perspective on flexibility includes many more degrees of freedom than a TA perspective on flexibility.

General system theory. Neither perspective provides an interpretation of general system theory (GST) [Skyttner, 1999, 2005]. In the reverse direction, GST might be applied in describing either a technical artifact or a work system as a system that produces outputs based on inputs, internal structure, and capabilities of components. In both cases, GST terminology is not specific enough to provide non-obvious guidance in creating, describing, or evaluating either technical artifacts or work systems. Work system theory (see Appendix A) was developed as a subset of general system theory devoted specifically to systems in organizations.

Human-computer interaction. From both perspectives, human-computer interaction is the communication between people and computerized devices that occurs when people use computerized devices directly.

Implementation. From a TA perspective, implementation is the process of converting the abstract design of a technical artifact into an operational technical artifact (e.g., using a programming language to implement an algorithm as a computer program). From a WS perspective, implementation is the process of converting from a previous version of a work system to a new version of the work system (or creating a new work system from scratch) after necessary resources have been created or acquired and configured, such as the required hardware, software, procedures, documentation, and training material.

Incentives. From a TA perspective, incentives either are irrelevant because technical artifacts do not need incentives, or are possibly relevant if potential users need incentives to encourage them to use technical artifacts. From a WS perspective, incentives are always important when work systems have human participants because incentives have an important impact on the quality and quantity of participants' effort. Other factors that affect the quality and quantity of effort include skills, intrinsic motivation, and the quality of the general work environment.

Information. From a TA perspective, information is whatever analog or digital information is captured, stored, retrieved, transmitted, deleted, manipulated, or displayed by a particular technical artifact. From a WS perspective, information is defined similarly except in relation to all of the elements of a work system. The relevant information may be processed by the technology inside of the work system, may exist in the minds of work system participants, may be the subject of communication and coordination that is never captured by technical artifacts, may be built into processes and activities, may be part of products/services produced by the work system, may be in the minds of the customers, and may exist in the environment, in the infrastructure, or in the relevant strategies.

Information system. From a TA perspective, an information system is a technical artifact that is used by users and that performs information processing operations such as capturing, transmitting, storing, retrieving, deleting, manipulating, or displaying information. From a WS perspective, an information system is a work system whose processes and activities are devoted to any combination of the same types of information processing operations. With a WS, information produced by an information system may be used by users even though it is not correct to say that the information system itself is used by users because the human participants are included (by default) in the WS definition of information system.

Information technology. From both perspectives, information technology is technology that performs information processing activities such as capturing, transmitting, storing, retrieving, deleting, manipulating, or displaying information.

Input/output. From a TA perspective, any information received or captured by a technical artifact is an input and any information transferred outward across the technical artifact's boundaries is an output. From a WS perspective, anything that comes into a work system and that is worth mentioning in an analysis is an input, and anything that the work system produces for its customers and is worth mentioning is an output. In relation to the work system framework, inputs are not mentioned explicitly because a clearly written summary of the processes and activities would have to mention or at least imply any important inputs that are used. In relation to the same framework, a work system's outputs are the products/services that are produced for the work system's customers. The caveat about inputs and outputs that are worth mentioning is related to use of a WS perspective in analyzing and designing systems. Except in very unusual situations, any real world analysis and design effort would purposefully ignore inputs and outputs that are taken for granted in everyday life, such as the air that work system participants breathe and the light that they use when doing their work.

Interface. From a TA perspective, an interface is a boundary or point of interaction between a user and a technical artifact or between two technical artifacts. The term “interface” has the same general meaning from a WS perspective, where it would also apply to points of interaction between work systems. A number of additional terms that might be associated with interfaces in a WS sense include communication media, conversations, and boundary objects.

IT artifact. From a TA perspective, the technical artifact of interest is an IT artifact unless it is a different type of technical artifact, such as an entire airplane or automobile, either of which might be of interest in the IS discipline due to their high degree of computerization. The term “IT artifact” is generally avoided in conversations related to work systems because it has accumulated many inconsistent definitions [Alter, 2008].

Job satisfaction. From a TA perspective, job satisfaction either is not of interest because it is not a property of technical artifacts, or is of tangential interest because it may affect a potential user's likelihood of using a technical artifact and the quality of such usage. From a WS perspective, job satisfaction is quite important because it and other factors affect the quality and quantity of effort that work system participants exert when performing their work.

Knowledge management. From a TA perspective, knowledge management is not directly relevant except in relation to how knowledge might be built into technical artifacts and whether users of technical artifacts have the knowledge needed to use technical artifacts correctly both in standard situations and in nonstandard situations that might call for adaptations or workarounds. A WS perspective on knowledge in general is somewhat similar to a WS perspective on information. Knowledge may be codified in processes and activities, may exist in the minds of work system participants, may be the subject of communication and coordination that is never captured by a technical artifact, may be codified in the form of a knowledge base that is somewhat like a database, may be embedded in technical artifacts, may be embedded in products/services, and may be in the minds of customers. From a WS perspective, a knowledge management system may be a work system (in which participants perform processes and activities) for capturing and storing knowledge and making it available when needed. Alternatively, it may be software that is used in a knowledge management work system.

Legacy system. From a TA perspective, legacy systems are configurations of hardware and software that the organization has used for many years. The term "legacy system" is usually associated with systems that are out of date technically and that may not fit to current business needs. From a WA perspective, legacy systems have the same associations, although with a broader connotation of the entire work system being out of date, rather than just its technical artifacts being out of date.

Loose coupling. From both perspectives, loose coupling is a characteristic whereby subsystems can operate without detailed information about the internal state and history of other subsystems. From a TA perspective, loose coupling between modules (e.g., UML classes) and high cohesion within modules is desirable because it increases the internal focus within modules and makes it easier to create and modify systems consisting of modules. From a WS perspective, loose coupling [Orton and Weick, 1990] has the advantage of allowing greater focus within work systems or their subsystems; however, it may have the related disadvantage of allowing work system participants to do their work without considering status and history information about related work systems that should be considered if the overall goal is to produce the best outcomes for the organization.

Metric. From both perspectives, a metric is a measure of performance. From a TA perspective, measures of performance focus on the operation and direct usage of technical artifacts. From a WS perspective, managing a work system requires attention to metrics for each of the elements of the work system and metrics for the work system as a whole.

Network. From a TA perspective, a network is a technical artifact that can be described in terms of nodes and arcs. From a WS perspective, some work systems might be described as social networks, and many work systems use technical artifacts that can be described as networks.

Organizational change. From a TA perspective, organizational change is at a different level of concern because technical artifacts do not exhibit organizational change and because organizational change that is facilitated by the creation or existence of technical artifacts always involves other factors that are distinct from technical artifacts. From a WS perspective, changes in work systems are almost always an essential part of organizational change. Thus, any attempt at significant organizational change needs to consider not only organization charts, but also changes in the work systems through which the organization operates.

Organizational culture. The relationship between technical artifacts and organizational culture is usually too distant to be considered within a TA perspective, although there are some cases where organizational culture has an impact on topics such as how much freedom people have to use whichever types of laptops or smartphones they prefer. Organizational culture is quite important from a WS perspective because the operation of work systems is often influenced by how well work systems conform with the surrounding organizational culture.

Outsourcing. From a TA perspective, the cost and effort required for outsourcing of data centers, networks, and maintenance of laptop computers depends partially on the specific technical artifacts that are involved. From a WS perspective, outsourcing projects can be viewed as work systems and the outsourced work can also be described and evaluated as one or more work systems.

Participant. From a WS perspective, systems have participants who perform some of the work in at least one process or activity within the system. From a TA perspective, technical artifacts have users, but not participants.

Platform. From both perspectives, a platform is a specific combination of hardware and software capabilities that forms the basis of a family of technical artifacts.

Product/service. From a TA perspective, the term "output" is more typical than the term "product/service." From a WS perspective, the term "product/service" is used because the things that are produced by many work systems combine characteristics that are often associated with products and characteristics that are often associated with services. Since the distinction between products and services has been problematic and unresolved in marketing and service operations (e.g., Alter [2010b]; Sampson and Froehle [2006]; Vargo and Lusch [2004]) there is little reason to try to be more specific about it in relation to work systems.

Project. From a TA perspective, the term "project" is relevant only in that specific projects may use specific technical artifacts whose capabilities and features affect the project's performance. From a WS perspective, a project can be viewed as a special type of work system—one that is designed to produce specific products/services and then go out of existence.

Quality. From both perspectives, quality can take on a number of different meanings. From a TA perspective, quality often refers to a combination of cost, fitness for use, conformance to specifications and standards, and technical and aesthetic finesse built into a technical artifact. From a WS perspective, quality in relation to whatever products/services a work system produces refers most directly to a customer's perception of a combination of total cost to the customer, fitness for use, conformance to specifications and standards, and technical and aesthetic finesse.

Reliability. From both perspectives, reliability is the likelihood that the system or whatever a system produces will conform to its own specifications, will operate according to the specifications (if it has operational functions), and will not become unusable or inoperable prematurely.

Requirements analysis. From a TA perspective, requirements analysis is performed to determine the functional capabilities and nonfunctional characteristics and features that are required for a technical artifact that is being designed. From a WS perspective, requirements analysis is performed to determine the capabilities and characteristics of a work system that is being designed. Those capabilities and characteristics include a summary view of the processes and activities, human participants, information that will be created or used, technologies that will be used, and products/services that will be produced for specific groups of customers of the work system.

Resource. From a TA perspective, resources are any physical or informational entities that are used and possibly consumed in order for a particular technical artifact to operate as expected. From a WS perspective, resources are the specific human, informational, and technical entities (and any other entities) required in order for processes and activities to be performed as expected. The work system framework does not mention resources explicitly, although a work system metamodel [Alter, 2010a] that clarifies details not mentioned in the work system framework calls for identifying resources used and produced by each activity within a work system.

Scalability. From both perspectives, scalability is the extent to which it is possible to increase (or decrease) a system's size and capabilities in order to increase (or decrease) its rate of production over a long time span. From a TA perspective, scalability is directly related to the technical features of an artifact, such as its architecture, complexity, and the durability of its components. From a WS perspective, possible degrees of freedom related to scalability include changing its processes and activities, adding, subtracting, or changing human participants, changing the information that is used or produced, changing the technology, and changing the nature of the products/services that are produced. In some cases, there may be multiplier effects between the various sources of scalability. In other cases, clashes between the various sources of scalability may make it difficult to expand or contract a work system's size and capabilities.

Security. From both perspectives, security is the likelihood that a particular system is safe from attack, interruption, and accidents within the system and from the surrounding environment. From both perspectives, security is related to the ability to identify and repel attacks and the ability to identify and respond to potentially harmful events and conditions. From a TA perspective, security is largely about building secure features into technical artifacts and ensuring that technical artifacts are used properly, including prevention of use by unauthorized users. From a WS perspective, aspects of security are related to the interplay of vulnerabilities and defensive capabilities in every component of the work system, in interactions between those components, and in interactions with other work systems.

Self-service. From a TA perspective, self-service is not a meaningful concept since every technology that is used directly and consciously helps a user perform a task for his/her own benefit or for the benefit of the larger organization. From a WS perspective, self-service work systems are work systems in which customers use resources provided by work system owners, which may be external vendors in the case of e-commerce, in order to produce something of value for themselves (the customers). For example, an e-commerce customer may perform self-service activities that use the vendor's website in order to identify something to buy and to complete a purchase transaction.

Service. Service has quite different meanings within TA and WS perspectives. For example, in service computing, a representative case for a TA perspective, a server entity produces an unambiguous response to an unambiguous request from a client entity. The client and server are software or machines that interact through definable IT-based interfaces. Neither the client nor the server has the capability of discerning unstated needs, interests, or concerns, methods used by the other entity, or anything else that is not included in explicitly coded messages governed by the specifications of the interface (e.g., Brown, Delbaere, Eeles, Johnston and Weaver [2005]; Cherbakov, Galambos, Harishankar, Kalyana and Rackham [2005]). With a WS perspective, services are basically actions performed for the benefit of others. That definition is simpler and less restrictive than many of the definitions in the service marketing and service operations literature, but fits more situations. A more general definition that covers both person-to-person services and totally automated services is "services are acts performed for other entities including the provision of resources that other entities will use." (See [Alter, 2010b] and [Alter, 2012a] for related discussions.)

Skills. From a TA perspective, skills are important in relation to a user's ability to use a technical artifact. That ability includes an understanding of how to interact with the technical artifact and an understanding of how to use it productively to accomplish the user's goals. From a WS perspective, skills are characteristics of work system participants. In combination with knowledge, ambition, incentives, and other factors related to work system participants, skills have a direct effect on how well people perform tasks within work systems.

Sociotechnical systems. From a TA perspective, systems are technical artifacts that might be used in sociotechnical systems or might be used by individuals outside of the scope of sociotechnical systems. From a WS perspective, work systems are sociotechnical systems by default because human participants are assumed to be essential components of systems in organizations. On the other hand, because the definition of work system says that the work is performed by people and/or machines, work systems may be totally automated systems. That observation is especially important when work systems are decomposed into subsystems during systems analysis and design. The previously mentioned work system metamodel [Alter, 2010a] reinterprets the elements of the work system framework in a way that makes it easier to model both sociotechnical and totally automated systems using the same core of ideas.

Stakeholder. From both perspectives, stakeholders are people or organizations that are affected or will be affected by a system. From a TA perspective, the impacts on stakeholders or stakeholder interests are directly related to specific technical artifacts. From a WS perspective, those impacts are related to specific work systems and the products/services produced by those work systems.

Standards. From a TA perspective, standards are industry expectations related to data formats, technology features and capabilities, and other compatibility-related guidelines that are adopted to increase the likelihood of efficient usage of information and interoperability of technology. From a WS perspective, standards are also relevant to other topics such as widely accepted processes and activities that are sometimes called best practices; qualifications of work system participants in certain situations (e.g., degrees and certifications); features, functions, and physical and informational characteristics of products/services; and laws and regulations that are imposed from the external environment.

Strategic information system. Neither perspective says anything direct about whether a particular information system is a strategic information system. From a WA perspective, an information system is more likely to be a strategic information system if its operational costs and the products/services that it produces help in creating competitive advantage for the firm in relation to other firms in the same market.

System usage. From a TA perspective, a system is a technical artifact. Therefore, system usage is the usage of a technical artifact. From a WS perspective, the system of interest is a work system. Work systems perform processes and activities to produce products/services, but are not used in the same sense that technologies are used. Therefore, system usage is not a meaningful concept from a WS perspective.

System quality. From a TA perspective, system quality is the quality of a technical artifact. From a WS perspective, system quality is the quality of a work system, which can be evaluated in relation to whether the work system meets its various operational goals related to operational cost, product quality, reliability, responsiveness, and conformance to standards and regulations. The quality of a work system can also be evaluated based on whether it conforms to general work system principles [Alter and Wright, 2010].

System life cycle. From a TA perspective, a system life cycle is basically a project that starts with creating requirements for a technical artifact and then produces and tests that artifact. From a WS perspective, a system life cycle is better described using the work system life cycle model, which involves multiple iterations of four phases: operation and maintenance, initiation (of a project), development of required resources, and implementation in the organization. The work system life cycle model combines planned change through projects with emergent change that grows out of short-term adaptations and workarounds.

Technology. Both perspectives view technology as artifacts that are used by users or by other technical artifacts. Other perspectives may view technology differently. For example, an article on sociomateriality by Orlikowski and Scott [2008] refers to "the inherent inseparability of the social and the technical" (p. 456) and says that within the lens of sociomateriality, "humans/organizations and technology are assumed to exist only through their temporally emergent constitutive entanglement" (p. 457).

Testing. With a TA perspective, testing focuses on whether modules operate in conformance with their specifications and whether an entire technical artifact operates consistent with its requirements. With a WS perspective, testing includes testing of the technology during the development phase and also includes testing of the new or improved work system during the implementation phase.

Training. With a TA perspective, training focuses on ensuring that users of technical artifacts understand how to interact with the artifacts and how to use them to perform work tasks. A WS perspective includes the same training on technical artifacts but also includes training related to processes and activities, information, and products/services. With a WS perspective, training ideally should ensure that work system participants understand the rationale of the work system well enough to respond appropriately when contingencies occur that are inconsistent with the expected operation of the work system. Ideally, work system participants should understand the work system's rationale well enough to design and use appropriate adaptations or workarounds or to take other action that will avoid problems for the work system or for its customers.

Uncertainty. With a TA perspective, uncertainty is primarily about uncertainty in the operational performance of technical artifacts, uncertainty related to their interactions, or uncertainty related to skills in using technical artifacts. A WS perspective brings a broader set of uncertainties, such as whether human participants will perform their roles appropriately, whether resources will be available, and whether contingencies and mishaps outside of the work system will degrade work system's performance.

Unified Modeling Language (UML). From both perspectives, UML may or may not be used to specify the structure and behavior of technical artifacts that are being described or built. From a WS perspective on systems in organizations, an important challenge is to be able to translate from system descriptions stated in work system terms into UML specifications of software within those work systems. Alter and Bolloju [2012] describe preliminary progress in that direction.

Use case. OMG's latest specification of UML expresses a TA perspective on use cases: “A use case is the specification of a set of actions performed by a system, which yields an observable result that is, typically, of value for one or more actors or other stakeholders of the system” [OMG, 2011, p. 606]. In effect, use cases answer the question, "Which activities will use the technical artifact that is being built?" From a WS perspective, that is not the best question to ask business professionals whose main concern is improving the efficiency and effectiveness of work systems containing human participants, not just users of technology. More important questions concern how the current work system operates, how well it operates, and how work system changes could yield better performance. Those changes could involve new or existing technical artifacts and/or changes in business processes, information, skills, knowledge and incentives of participants, expectations of work system customers, and interactions with the surrounding environment.

User. From both perspectives, a user is a user of technical artifacts. Within a WS perspective, the work system framework does not include the term “user”; instead, it uses the term “participant” because some important participants in a work system may not be users of technology. The work system metamodel that was developed to model work systems in more detail [Alter, 2010a] supports identifying which technological entities are used by which work system participants.

User involvement/user participation. From a TA perspective, users of existing technical artifacts and/or potential users of new artifacts should be represented in projects that develop or improve those artifacts. From a WS perspective, direct participation by representatives of the people who use technical artifacts may be less important than direct participation by representatives of people who perform the processes and activities within the work system. (See Alter [2009], which extends the coverage of user participation in Markus and Mao [2004].)

Value creation. A TA perspective is concerned with the creation and use of technical artifacts, but is not particularly concerned with value creation. In contrast, a WS perspective is concerned with value creation because work systems exist to produce products/services for customers. Value creation is a topic of debate in the marketing literature, where there is disagreement about whether providers can create value for customers, whether providers and customers always co-create value, whether customers need to produce value for themselves with the help of whatever providers give them, and whether co-creation of value is optional. (For example, see Grönroos [2011]; Sampson and Froehle [2006]; Vargo and Lusch [2004]; Alter [[2013b].)

Virtual team. From a TA perspective, virtual teams are relevant only when they use technologies of interest. From a WS perspective, a virtual team can be viewed as a geographically distributed work system whose goal is to perform processes and activities in order to produce products/services for its customers.

Workaround. From a TA perspective, a workaround is a temporary or long-term adaptation that bypasses transient malfunctions or structural limitations of technical artifacts including the technical infrastructure that allows a work system to operate. From a WS perspective, a workaround is "an adaptation, improvisation, or other change to one or more aspects of a work system in an attempt to overcome, bypass, or minimize the impact of obstacles, anomalies, or structural constraints that prevent a work system or work system participant from achieving a desired level of efficiency, effectiveness, or other organizational or personal goals" [Alter, 2013a].

*XML (Extensible Markup Language***)**. From both perspectives, XML can be viewed as a syntax for encoding data within certain types of software artifacts. In general, a TA-inspired discussion of a technical artifact that uses XML would be more likely to mention XML than a WS-inspired discussion of a work system containing one or more technologies that use XML.

III. DISCUSSION AND CONCLUSIONS

This article introduced the idea of an interpretary for the IS discipline, a compendium of interpretations of IS concepts and methods from different theoretical perspectives. An interpretary can be described as a two-dimensional concept interpretation matrix whose cells contain interpretations of specific concepts from specific theoretical perspectives. To illustrate the type of information that an interpretary would contain, this article compared the author's brief interpretations of 75 selected concepts from the IS discipline based on two different theoretical perspectives: (1) a "technical artifact" (TA) perspective, whereby the system of interest is a technical artifact; and (2) a work system (WS) perspective, whereby the system of interest is a work system, a system in which human participants and/or machines perform processes and activities using information, technology, and other resources to produce products/services for internal or external customers.

Development of a more complete interpretary would start by identifying the theoretical perspectives that are worthwhile to compare and identifying a substantial number of terms, perhaps 100 to 200 or more, that might be interpreted in terms of each of those perspectives. Some of those terms would be within the core of at least some of those perspectives. Other terms would be outside of the core, but would be interpretable in terms of at least some of the perspectives. For example, if actor network theory (ANT) were included as a theoretical perspective, the interpretary contents for ANT would define and possibly elaborate on concepts that are inside its core, such as actor, network, problematization, interessement, enrollment, and mobilization [Callon,1986]. The contents for ANT would also apply the vocabulary and assumptions of ANT to interpret IS terms that are outside of its core, such as "user," "system," and "software development." The interpretations of terms inside and outside of its core would probably have interesting similarities and differences in relation to interpretations of the same terms from other theoretical viewpoints, such as activity theory, agency theory, soft system methodology, and structuration theory. The similarities and differences could have important implications for many ongoing discussions and controversies related to the nature of information systems, the nature of technology, the need to develop theories that are unique to IS, rigor vs. relevance in the IS discipline, and the possibility of developing an IS body of knowledge.

Challenges in Developing a More Complete Interpretary

This article's central example, in essence a partial instantiation of an interpretary, illustrates a number of points that would have to be addressed in developing a more complete interpretary:

Which concepts should be included? It is not obvious which concepts should be included in an interpretary. The starting point for the 75 concepts in the example was a subset of the list of keywords that Manuscript Central uses to characterize paper submissions for ICIS. A different starting point might have led to a different initial list of concepts. The author added additional concepts that seemed of interest in relation to comparing TA and WS interpretations. Other researchers surely would have selected many concepts that the author did not select.

Which theoretical perspectives should be included? Similarly, the author selected the TA and WS theoretical perspectives based on his own research interests. Other researchers surely would have preferred other theoretical perspectives.

How should the interpretations be produced? Interpretations in the example are the author's briefly stated interpretations. Other researchers trying to use the same theoretical perspectives surely would have produced different interpretations.

How precise and detailed should the interpretations be? A comparison of the comments for each of the concepts in the example illustrates that interpretations can take on many different forms and different levels of detail. Some of the comments said little more than that TA and WS interpretations of a particular concept are similar. Other comments said that TA and WS interpretations diverge in significant ways. Those differences imply that a more complete interpretary might clarify the nature of some of the disagreements in the IS community in relation to fundamental topics and their meaning.

Also, differences in the length of the comments for different concepts illustrate an important challenge for any attempt to develop an interpretary. The shortest comments were two to three lines long and said that TA and WS interpretations of a concept are similar or that a concept is basically unrelated to TA and WS concerns. Careful inspection of the longer comments, typically from seven to ten lines long, shows that much more could be said. The related challenge for developing a more complete interpretary is to make sure that the interpretations have sufficient depth without excessive length.

*Who should decide what to include***?** A final question about an interpretary concerns the identity of the people who will decide what to include. While there are many ways to propose ideal characteristics of such individuals or teams, in practice the identity of those people will be based on self-selection. Interpretaries will be created by whomever decides to do the work of creating them. Those individuals will likely use their own interests and resources when determining their own answers to the above questions about the content of the interpretary that they create.

Possible Contributions to the IS Discipline

The proposed interpretary might contribute to the IS discipline in a number of areas, such as the following:

Exploring relationships between different theoretical perspectives. Merely creating a good first draft of an interpretary containing five to ten perspectives would expand knowledge in the IS discipline. It would provide relatively parallel overviews of major theoretical viewpoints and their implications in interpreting important IS concepts that are inside or outside of the core of the particular theory or perspective. Overviews of that type would provide insights about the compatibility or incompatibility of different theories and perspectives that are used by different researchers. Ideally, a usable and readily accessible interpretary would help in interpreting research that is based on a theoretical viewpoint by clarifying the underlying assumptions and the related interpretation of many basic terms. Also, it might help in translating research findings from one theoretical viewpoint to another. Overall, the compendium of interpretations in a carefully produced interpretary would provide far deeper knowledge than is available in the "Theories Used in IS Research Wiki**"** [Schneberger and Wade, 2013] that is accessible through www.aisnet.org, the website of the Association for Information Systems.

Providing insight about the nature of IS theories. While this article does not try to contribute significantly to ongoing controversies about the nature of theory in the IS discipline and social science in general (e.g., Gregor [2006]; Markus and Robey [1988]; Sutton and Staw [1995]; Weber [2012]; and Weick [1995]), it is possible that the interpretary might actually provide an interesting input into that discourse. Many of the discussions of theory focus on theory in general and say relatively little about specific theories. In contrast, an interpretary's extensive compilation of interpretations of important concepts might add to that discussion by showing how the generalizations about theories apply to the application of specific theories.

Providing insight about the possibility of creating a body of knowledge for IS. Hirschheim and Klein [1994] suggests creating a body of knowledge for the IS discipline. Others have suggested ways of filling in some of the knowledge. (e.g., Alter [2012b]; Hassan and Mathiassen [2009]; Iivari et al. [2004]). The interpretary adds a new wrinkle by saying explicitly that different theoretical perspectives will have different interpretations of specific concepts. Instead of thinking about a body of knowledge that is unified and totally consistent, it might be more practical to start with a set of interpretations of important ideas based on different theoretical perspectives. This might lead to the conclusion that the IS body of knowledge is actually a set of different perspectives on concepts, and that anyone using that knowledge needs to know something about the perspectives in order to use the concepts effectively.

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Editor's Note: The following reference list contains hyperlinks to World Wide Web pages. Readers who have the ability to access the Web directly from their word processor or are reading the article on the Web can gain direct access to these linked references. Readers are warned, however, that:

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APPENDIX A: SUMMARY OF WORK SYSTEM THEORY

This summary of work system theory is based on Alter [2013c].

Work system theory (WST) is a theory for analysis [Gregor, 2006] that provides a way to view a situation as a work system, just as actor network theory, activity theory, coordination theory, and structuration theory provide ways to analyze situations using other concepts. Since many of the ideas in WST have been published previously, this summary is limited to basic premises and two central frameworks.

Domain of relevance. WST is relevant for describing, analyzing, designing, or evaluating systems within organizations, whether or not IT is involved. It also covers systems that cross organizations.

Unit of analysis. The unit of analysis is a work system, a system in which people and/or machines perform processes and activities using information, technology, and other resources in order to produce products and/or services for internal or external customers. Enterprises that grow beyond a largely improvised start-up phase can be viewed as consisting of multiple work systems. Almost all significant work systems in business and governmental organizations rely on IT in order to operate efficiently and effectively.

Information systems. WST applies to work systems in general and, by inheritance, to special cases of work systems such as information systems, where all processes and activities involve processing information [Alter, 2008]. Sociotechnical IS include accounting systems in which accountants produce financial statements and planning systems in which managers produce plans. Automated IS include search engines that produce search results and automated stock trading systems that produce and/or execute buy orders or sell orders.

Static View of a Work System

Work system framework. The nine elements of the work system framework (Figure A–1) are the basis for describing and analyzing an IT-reliant work system in an organization. The framework outlines a static view of a work system’s form and function at a point in time and emphasizes business rather than IT concerns. Figure A–1 identifies four internal elements of a work system (processes and activities, participants, information, and technologies) plus five other elements (customers, products/services produced, environment, infrastructure, and strategies) that are part of even a rudimentary understanding of a work system. Customers of a work system often are participants, as when doctors examine patients. The elements of the work system framework are summarized in Table A–1. The framework covers situations that might or might not have a tightly defined business process and might or might not be IT-intensive. Figure A–1 says that work systems exist to produce products/services for customers. The arrows say that the elements of a work system should be in alignment.

System identity and integrity in the presence of change. A work system maintains enough integrity to be described, measured, and managed as a system even though specific features or components may change incrementally or may not operate in accordance with designer intentions. Recognition of incremental change mirrors Feldman and Pentland's [2003] distinction between ostensive vs. performative aspects of routines, which "creates an on-going opportunity for variation, selection, and retention of new practices and patterns of action within routines."

Dynamic View of a Work System

Work System Life Cycle Model (WSLC). Figure A–2 says that work systems change over time through iterations involving planned and emergent change [Alter, 2006, 2008, 2013c]. Planned change occurs through defined projects in which resources are allocated to create a work system or change aspects of an existing work system. Emergent or unplanned change occurs through incremental adaptations and workarounds as work system participants try to minimize or bypass obstacles that interfere with expeditious achievement of work goals.

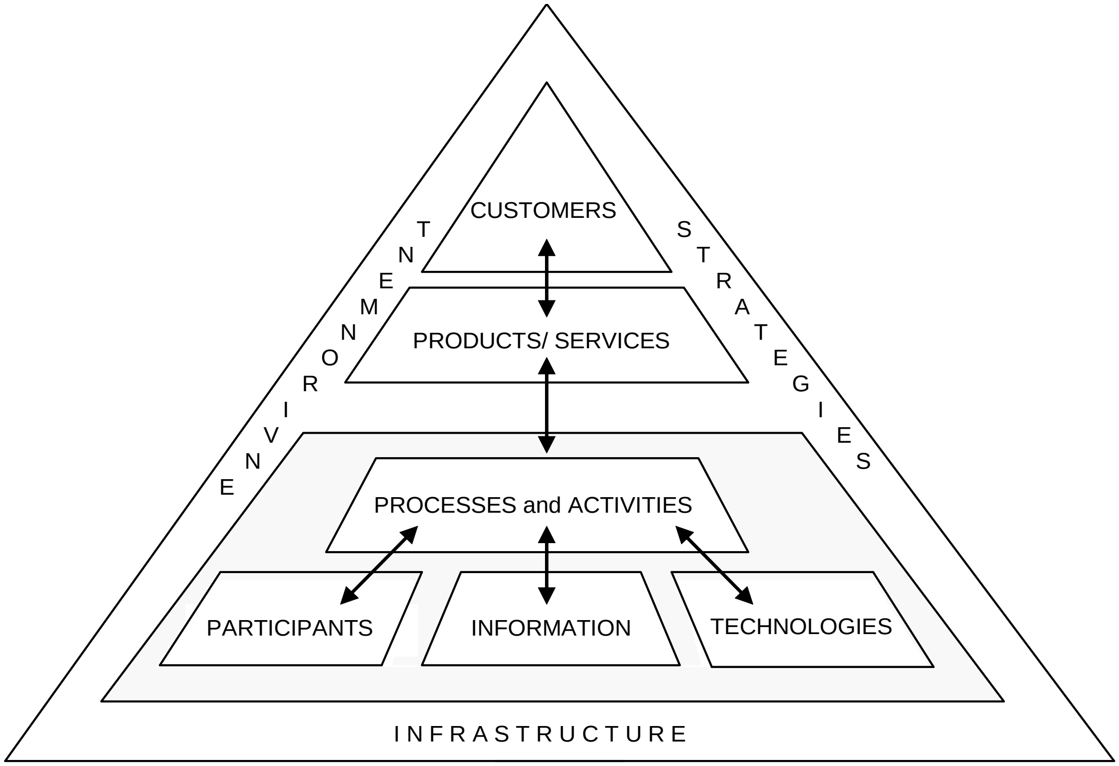

Figure A–1. The Work System Framework [Alter, 2006, 2013c]

Table A–1: Reasons for Including Each Element of the Work System Framework

Element	Reason for inclusion in the work system framework
Processes and Activities	Processes and activities occur within a work system to produce products/services for its customers. A work system must contain at least one activity; otherwise, it does not do anything. Use of the term "processes and activities" recognizes that the work being performed may not be a set of clearly specified steps whose beginning, sequential flow, and end are defined well enough to call it a process by some definitions. Many important work systems perform organized activities that rely heavily on human judgment and improvisation (e.g., Hall and Johnson [2009]; Hill, Yates, Jones and Kogan [2006]), are semi-structured, and are better described as a set of interrelated activities.
Participants	Participants are people who perform work within the work system, including both users and non-users of IT. Failure to include participants in an analysis automatically would omit important sources of variation in the results. Inclusion of the term "participant" instead of the term "user" avoids ignoring important participants who do not use computers and minimizes confusion due to referring to stakeholders as users, whether or not they actually use the technology in a work system that is being analyzed. Customers are often participants in work systems, especially in service systems.
Information	All work systems use or create information, which in the context of work system analysis is expressed as informational entities that are used, created, captured, transmitted, stored, retrieved, manipulated, updated, displayed, and/or deleted by processes and activities. Typical informational entities include orders, invoices, warranties, schedules, income statements, reservations, medical histories, resumes, job descriptions, and job offers. Informational entities may contain other informational entities. For example, an order may contain a line item and a document may contain a chapter. The distinction between data and information is not important for understanding a work system since the only data/information that is mentioned is information that is used or processed by the work system.
Technologies	Almost all significant work systems rely on technology in order to operate. Technologies include tools that are used by both work system participants and automated agents (hardware/software configurations that perform totally automated activities). That distinction is crucial as work systems are decomposed into successively smaller subsystems, some of which are totally automated.

Table A–1: Reasons for Including Each Element of the Work System Framework – Continued	
Products/ Services	Work systems exist in order to produce things for their customers. Ignoring what a work system produces is tantamount to ignoring its effectiveness. Products/services consist of information, physical things, and/or actions produced by a work system for the benefit and use of its customers. The term "products/services" is used because the controversial distinction between products and services in marketing and service science is not important for WST or WSM even though product-like vs. service-like is the basis of a series of valuable design dimensions for designing the things that a work system produces [Alter, 2010b, pp. 206–207].
Customers	Customers are recipients of a work system's products and services for purposes other than performing work activities within the work system. Since work systems exist to produce products and services for their customers, an analysis of a work system should consider who the customers are, what they want, and how they use whatever the work system produces. External customers are work system customers who are the enterprise's customers, whereas internal customers are work system customers who are employed by the enterprise, such as customers of a payroll work system. Customers of a work system often are participants in the work system (e.g., patients in a medical exam, students in an educational setting, and clients in a consulting engagement).
Environment	Environment includes the relevant organizational, cultural, competitive, technical, regulatory, and demographic environment within which the work system operates; it also affects the work system's effectiveness and efficiency. Organizational aspects of the environment include stakeholders, policies and procedures, and organizational history and politics, all of which are relevant to the operational efficiency and effectiveness of many work systems. Factors in a work system's environment may have direct or indirect impacts on its performance results, aspiration levels, goals, and requirements for change. Analysis, design, evaluation, and/or research efforts that ignore important factors in the environment may overlook issues that degrade work system performance or even cause system failure.
Infrastructure	Infrastructure includes relevant human, information, and technical resources that are used by the work system but are managed outside of it and are shared with other work systems. From an organizational viewpoint such as that expressed in Star and Bowker [2002] rather than a purely technical viewpoint, infrastructure can be subdivided into human infrastructure, informational infrastructure, and technical infrastructure; all of these can be essential to a work system's operation and therefore should be considered in any analysis of a work system.
Strategies	Strategies that are relevant to a work system include enterprise strategy, organization strategy, and work system strategy. In general, strategies at the three levels should be in alignment, and work system strategies should support organization and enterprise strategies. Unfortunately, strategies at any of the three levels may not be articulated or may be inconsistent with reality or with beliefs and understandings of important stakeholders.

The WSLC represents planned change as projects that include initiation, development, and implementation phases. Development involves creation or acquisition of resources (e.g., software development, acquisition, or configuration and creation of procedures, documentation and training materials needed for implementation of the new version of the work system). Implementation means implementation in the organization, not implementation of algorithms on computers.

Figure A–2 uses inward-facing arrows to represent emergent change such as ongoing adaptations, workarounds, and experimentation, none of which involve separate allocation of significant project resources. The inward-facing arrow for the operation and maintenance phase also represents emergent changes in practices or goals that occur over longer periods without explicit planning. The inward-facing arrows for development and implementation phases of formal projects represent emergent changes in intentions, designs, and plans based on insights after the initiation phase.

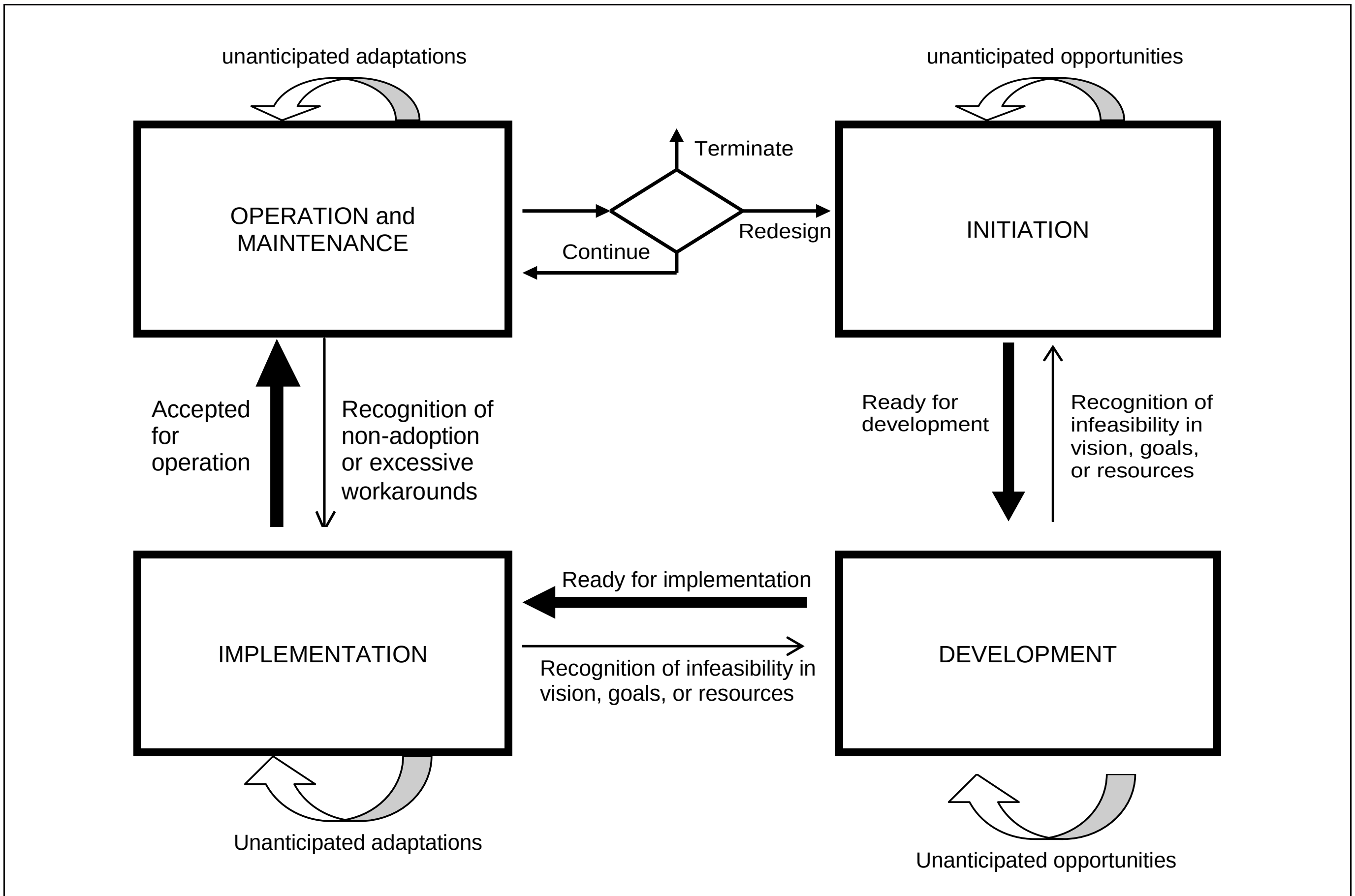

Figure A–2. The Work System Framework [Alter, 2006, 2013c]

ABOUT THE AUTHOR

Steven Alter is Professor of Information Systems at the University of San Francisco. He earned a PhD from MIT and extended his thesis into one of the first books on decision support systems. He served for eight years as Vice President of Consilium, a manufacturing software firm that went public and later was acquired by Applied Materials. Since returning to academia, his research has focused on developing systems analysis concepts and methods that can be used by typical business professionals and can support communication with IT professionals. His book, *The Work System Method: Connecting People, Processes, and IT for Business Results*, is a distillation and extension of ideas in a series of information system textbooks (1992, 1996, 1999, 2002) that raised awareness of the essential role of IT in work systems in organizations. His 2013 article on work system theory summarizes much of his research and positions it in relation to other IS research. His articles have been published in many leading journals and conference proceedings.

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