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HOW DOES THE LENS OF PRAGMATISM HELP IN UNDERSTANDING, USING, OR IMPROVING WORK SYSTEM THEORY?

Completed Research Paper

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Abstract

This paper explores linkages between work system theory (WST) and central concerns of the SIGPrag community related to theorizing the IT artifact and its organizational and societal context. The first part of the paper provides background about the development, basic ideas, and underlying premises of WST. In addition to summarizing older facets of WST, it summarizes three new extensions of WST, a service value chain framework for looking at service systems in terms of service concepts, a metamodel (Alter, 2010a) for looking at work systems in more depth than is supported easily by the work system framework, and a concept classification matrix (Alter, 2010e) that can support analysis and design activities and that might provide a way to organize a body of knowledge for the IS field. The second part of the paper returns to the questions about the fit and synergy between WST and the interests of the SIGPrag community. While it is clear that WST fits with central themes in pragmatist IS interests and research, such as usefulness, action, change, and knowledge, the potential synergy between WST and existing research topics in the SIGPrag community is not obvious.

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Exploring whether Work System Theory Is "Pragmatic" in the SIGPrag Sense of that Term

I have worked for many years trying to develop a systems analysis method for business professionals called the work system method (WSM). Going back as far as the 2001 organizational semiotics conference in Montreal (whose book and t-shirt I still own), I have had occasional discussions with members of the SIGPrag community to understand how their research could provide insights for WSM. Although I have always thought of WSM as being extremely pragmatic in form, content, and intention, I am still not sure whether WSM is pragmatic in a way that would interest the SIGPrag community. Conversely, I continue to wonder about whether research under the umbrella of "pragmatist research in IS" would provide concepts, insights, or case studies that would help in developing WSM further.

Instead of focusing on WSM per se, this paper addresses the broader topic of work system theory (WST), an evolving, integrated body of theory (Gregor 2006) consisting of assumptions, concepts, frameworks, and principles for analyzing and designing systems in organizations. Focusing on the WST body of theory provides a better fit with the Call for Papers for the 2010 SIGPrag Workshop, which referred to "a growing recognition of the importance of theorizing the IT artifact and its organizational and societal context from a pragmatic and action-oriented perspective."

This paper is divided into two parts. The first part provides background about the development, basic ideas, and underlying premises of WST (Alter, 2003a, 2006b, 2008a, 2010e). In addition to summarizing older facets of WST, it discusses three new extensions of WST, a service value chain framework for looking at service systems in terms of service concepts, a metamodel (Alter, 2010a) for looking at work systems in more depth than is supported easily by the work system framework, and a concept classification matrix (Alter, 2010e) that can support analysis and design activities and that might provide a way to organize a body of knowledge for the IS field. The second part returns to questions about the fit and synergy between WST and the interests of the SIGPrag community. Placing the content and intention of WST in relation to the SIGPrag 2010 Call for Papers and several recent articles about pragmatic IS research leads to the obvious conclusion that WST fits with central themes in pragmatist IS interests and research, such as usefulness, action, change, and knowledge. The more interesting question concerns the potential synergy between WST and existing research topics in the SIGPrag community.

Part 1: Overview of Work System Theory

Work system theory (WST) as a body of theory primarily for analyzing and designing systems in organizations, but also containing concepts, frameworks, and principles that can be used for explanation and prediction. Unlike narrower theories that express relationships between several primary constructs, WST is potentially "interesting" (Davis, 1971) as a body of theory in the IS field because it links a well-defined big picture view of IT-reliant systems in organizations with more detailed concepts and theories for analysis, explanation, prediction, and design and action. A number of articles have been published about work systems and topics related to the work system method (e.g., Alter 2003a, 2006b, 2008a, 2008b, 2010a, 2010d; Truex et al., 2010).

WST is conceived as an integrated body of theory that encompasses static and dynamic big picture views of systems in organizations (represented by the work system framework and work system life cycle model) and that provides a scaffolding for additional layers of concepts that support analysis and design efforts and that are useful in research about IT-reliant systems in organizations. WST is a body of theory concerning systems in organizations rather than a body of theory only about information systems per se. This is consistent with suggestions that IT-reliant work systems are the core subject matter of the IS field (Alter, 2003a) and that the IS field should lay claim to systems in organizations (most of which are IT-reliant) as its unique niche in academia (Alter, 2003b). The development of WST has always had the explicit goal of incorporating concepts that are "rigorous enough," i.e., neither grandiose nor abstruse, but rather, straightforward and readily usable by business professionals, not just Ph.D. researchers. WST was developed with the conscious goal of incorporating ideas and methods associated with a broad range of disciplines and approaches including general systems theory, systems analysis and design, organization theory, information theory, total quality management, operations management, marketing theory, and computer science.

The glossary in Table 1 defines many terms related to work systems and work system theory that are used in this article. More thorough discussions of most of these terms (other than WST per se) appear in Alter (2006b) and/or in subsequent articles.

Table 1. Glossary of Central Terms in Work System Theory

These terms are listed with the most central terms first and additional or peripheral terms later.
Work system theory (WST). A body of theory for analysis, explanation, prediction, and design and action related to systems in organizations.
Work. The application of resources such as people, equipment, time, effort, and money to generate products and services for internal or external customers
Work system. A system in which human participants and/or machines perform work using information, technology, and other resources to produce products and/or services for internal or external customers.
Information systems as a special case of work systems. Information systems are work systems whose processes and activities are totally devoted to processing information. (Alter, 2006b, 2008a). The default assumption is that information systems have human participants who may or may not be users of information technology. The default assumption does not apply to information systems that are totally automatic or that are basically tools that have human users but no human participants.

Work system method (WSM). A flexible systems analysis and design method for business professionals; based on viewing systems in organizations as work systems. (Alter, 2006b, 2008a); Truex et al. 2010)

Work system framework. Visual representation of a static view of a work system's form and function during a particular time period; minor adaptations may occur within that configuration. Consists of nine elements that should be included within a basic understanding of the work system: customers, products and services, processes and activities, participants, information, technologies, environment, infrastructure, strategies. (Alter, 2006b, 2008a, 2008b, 2010a)

Work system snapshot. A one-page summary of a specific work system in terms of six elements: customers, products and services, processes and activities, participants, information, technologies. (Alter, 2006b, 2008a, 2008b, 2010d)

Work system life cycle model (WSLC). A dynamic view of how work systems change over time through iterations that may combine planned and unplanned change. Phases include operation and maintenance, initiation, development, and implementation. (Alter, 2006b, 2008a, 2008b, 2010d)

Work system principles. A set of principles that should apply to the elements of any work system and to the work system as a whole; currently includes 24 principles. (Alter, 2004; Alter and Wright, 2010)

Service value chain framework. Core of an extension of WST related specifically to performing services; represents value co-creation in relation to responsibilities of service providers and service consumers along a series of typical categories of service activities; can be used in conjunction with the work system framework. (Alter, 2008b, 2010d)

Design spaces for work systems. Organized summaries of different types of work system changes and implied directions for change that might be considered during the analysis and design of work systems. One design space identifies types of changes in components and form for each element; another identifies characteristics that might change; others involve metrics, risks and obstacles, work system principles, and different locations in which knowledge can be located (Alter, 2006b, 2010b).

Metamodel for integrated analysis and design of sociotechnical and technical systems. A more highly elaborated version of the work system framework, designed to support detailed analysis and design of technical and sociotechnical systems more effectively than the work system framework, whose goal is to support basic understanding and summary-level communication about specific systems in organizations. (Alter, 2010a)

Concept classification matrix. Three dimensional matrix for classifying concepts and principles related to work systems in general and special cases of work systems, such as information systems and supply chains. (Alter, 2010e)

System interaction theory. Theory for analysis that identifies different types of work system interactions; also includes several testable propositions related to congruence and alignment of interacting work systems. (Alter, 2010c)

Model of information system risk. Posed in relation to a specific work system, this model includes goals and expectations, risk factors and other sources of uncertainty, the contingency management effort, the range of outcomes and their probabilities, impacts on other work systems, and resulting financial gains or losses. (Alter and Sherer, 2004)

Background about Work System Theory

WST's evolution to date stems from a project extending over two decades in which Alter tried to develop a systems analysis method that can be used by business professionals for their own understanding and can support communication between business and IT professionals. That research effort anticipated many of the goals of design science research (Hevner et al., 2004; Winter, 2008), such as relevance, testing, and iterative improvement. For example, Alter believed that the problem was relevant based on his experience in a manufacturing software firm in the 1980s and based on subsequent reports by his Executive MBA students that, unlike well-trained IT professionals, most business professionals in their firms were not aware of well articulated analysis methods that they could use for thinking about systems and system improvement. Work system concepts and methods were developed through numerous iterations. The initial ideas were an attempt to distill, combine, and simplify industry

experience plus ideas from many sources including the sociotechnical literature (e.g. Cherns, 1976; Bostrom and Heinen 1977a, 1977b; Mumford and Weir, 1979; Trist, 1981; Pasmore, 1985; Majchrzak and Gasser, 2000; Majchrzak and Borys, 2001, Thomas et al., 2008), systems theory (e.g., Ackoff, 1981; Checkland, 1999; Churchman, 1979), systems analysis textbooks, total quality management, and Six Sigma. Over many years, MBA and Executive MBA students used successive versions of a work system analysis outline to write group papers analyzing IT-reliant work systems in their own organizations. The papers from each semester revealed confusions, knowledge gaps, and other problems that led to revisions in the work system analysis outlines for subsequent semesters. For example, Alter (2006a) identifies pitfalls observed in 202 group papers between 1997 and 2002 and summarizes approaches that were attempted for minimizing those pitfalls.

WST assumes that the unit of analysis is a work system, a sociotechnical system in which human participants and/or machines perform work (processes and activities) using information, technology, and other resources to produce specific products and/or services for specific internal or external customers. Almost all value chain systems (e.g., systems for inbound logistics, operations, sales and marketing) and support systems (e.g. systems for procurement and human resources) are IT-reliant work systems that rely on IT but are not IT systems. Information systems, supply chains, and ecommerce systems are special cases of work systems. Table 2 lists a subset of 75 IT-reliant work systems that were analyzed by advanced MBA students at a major East Coast US university who looked at work systems in their own organizations for class projects in spring 2009. As reported in Truex et al. (2010), the deliverable was a five part management report (executive summary, background, system and problem, analysis, recommendation and justification) written based on a work system analysis template that included tables for summarizing the "as is" work system, assessing how well it operates and where problems exist, summarizing a proposed "to be" work system, and clarifying why proposed changes probably would improve performance.

Table 2. Examples of work systems analyzed by employed MBA students

• Renewing insurance policies • Receiving materials at a large warehouse • Controlling marketing expenses • Performing pre-employment background checks • Performing financial planning for wealthy individuals • Approving real estate loan applications •	• Planning and dispatching trucking services • Scheduling and tracking health service appointments • Operating an engineering call center • Administering grant budgets • Collection and reporting of sales data for a wholesaler • Invoicing for construction work • Determining performance-based pay • Timekeeping for field technicians for a public utility	• Finding and serving clients of a marketing consulting firm • Determining government incentives for providing employee training • Planning for outages in key real time information systems • Acknowledging gifts at a high profile charitable organization • Acquiring clients at a professional service firm • Purchasing advertising services through an advertising agency

The work system framework and other aspects of WST have been used in North America, Europe, Asia, and Australia as a component of university courses for undergraduate business majors, undergraduate IS majors, generalist MBA students, and MBAs majoring in IS. The courses have included introduction to IS, systems analysis and design, business process improvement, IS development, and ERP systems. In some cases the usage involved one or several lectures to provide context for the course or for important topics. Some courses asked students to apply the work system framework to create "work system snapshots," which summarize a work system using the six central elements of Figure 1. The work system framework, work system principles, or sets of questions related to work system elements have been used to establish the rationale for programming projects by computer science students. The ideas have also served as the conceptual core of projects in generalist undergraduate and MBA classes (e.g., the projects mentioned in Table 2). Beyond its use in teaching, a number of researchers other than Alter have applied or cited the work system framework and other aspects of the work system approach in a broad range of contexts. Other related research is in progress.

Summary of Work System Theory

Definition of work system. A work system is a system in which human participants and/or machines perform work using information, technology, and other resources to produce products and/or services for internal or external customers. Typical business organizations contain work systems that procure materials from suppliers, produce products, deliver products to customers, find customers, create financial reports, hire employees, coordinate work across departments, and perform many other functions. Almost all significant work systems in business and governmental organizations rely on IT in order to operate efficiently and effectively.

Work system as a general case for systems in organizations. *Work system* is a general case for thinking about systems within or across organizations. There are many special cases that should inherit the body of knowledge from the general case. For example, information systems are work systems whose processes and activities are totally devoted to processing information. (Alter, 2008a). Consistent with comments in Ågerfalk's (2010), some information systems are basically representations of aspects of the real world, whereas other information systems provide value in other ways, such as performing services that are not related to representing other things. Supply chains are inter-organizational work systems whose goal is to provide supplies required for the operation of organizations that use whatever the supply chain produces. The use of an ecommerce web site can be viewed as a self-service work system. On the other hand, software such as an ERP suite is not a work system; rather, the entire suite is infrastructure shared by multiple work systems; the programs that are used in a specific work system are part of the technology within that work system. In turn, as represented in the metamodel discussed later, each of those specific programs might be viewed as a totally automated work system.

Work system method. This is a flexible systems analysis method that starts by identifying the work system that is to be created or improved. Various versions of the work system method use tools such as a "work system snapshot" to summarize the "as is" work system and the "to be" work system that will exist after any proposed changes are implemented. The MBA students who analyzed the work systems listed in Table 2 used a version of the work system method based on a work system analysis template that guided a simplified analysis process and then provided an outline of a management report. Future versions of the work system method may be supported by interactive tools based on a combination of the work system framework and the metamodel that is discussed later.

Work system framework. WST contains two central frameworks. The first is the work system framework (Figure 1), whose nine elements) are the basis for describing and analyzing an IT-reliant work system in an organization. This framework outlines a static view of a work system's form and function at a point in time and is designed to emphasize business rather than IT concerns. It covers situations that might or might not have a tightly defined business process and might or might not be IT-intensive. Figure 1 says that work systems exist to produce products and services for customers. The arrows say that the elements of a work system should be in alignment.

Work system life cycle model. The other central framework in the work system approach is the work system life cycle model (Figure 2), which expresses a dynamic view of how work systems change over time through iterations involving planned and unplanned change. (Alter 2006b, 2008a, 2008b, 2010d). Planned change in the WSLC is represented by projects that include initiation, development, and implementation phases. Development involves creation or acquisition of resources required for implementation of desired changes in the organization. Unplanned changes, represented by inward-facing arrows, are ongoing adaptations and experimentation that change aspects of the current work system or of ongoing work system projects without separate allocation of significant project resources. For example, the inward facing arrow attached to the operation and maintenance phase is typically about small work system changes that do not require formal projects or allocation of significant resources. In some cases the inward-facing arrow for the operation and maintenance phase could also represent emergent changes in practices or goals that occur over longer periods without conscious planning. The inward-facing arrows for development and implementation phases of formal projects represent emergent changes in intentions, designs, and plans based on insights and knowledge that were not considered in the initiation phase.

The WSLC differs fundamentally from the "system development life cycle" (SDLC). First, the SDLC is basically a project model rather than a system life cycle. Some current versions of the SDLC contain iterations, but even those are basically iterations within a project. Second, the system in the SDLC is a basically a technical artifact that is being programmed. In contrast, the system in the WSLC is a work system that evolves over time through multiple iterations. This evolution occurs through a combination of defined projects and incremental changes resulting from small adaptations and experimentation. In contrast with control-oriented versions of the SDLC, the WSLC treats unplanned changes as part of a work system's natural evolution.

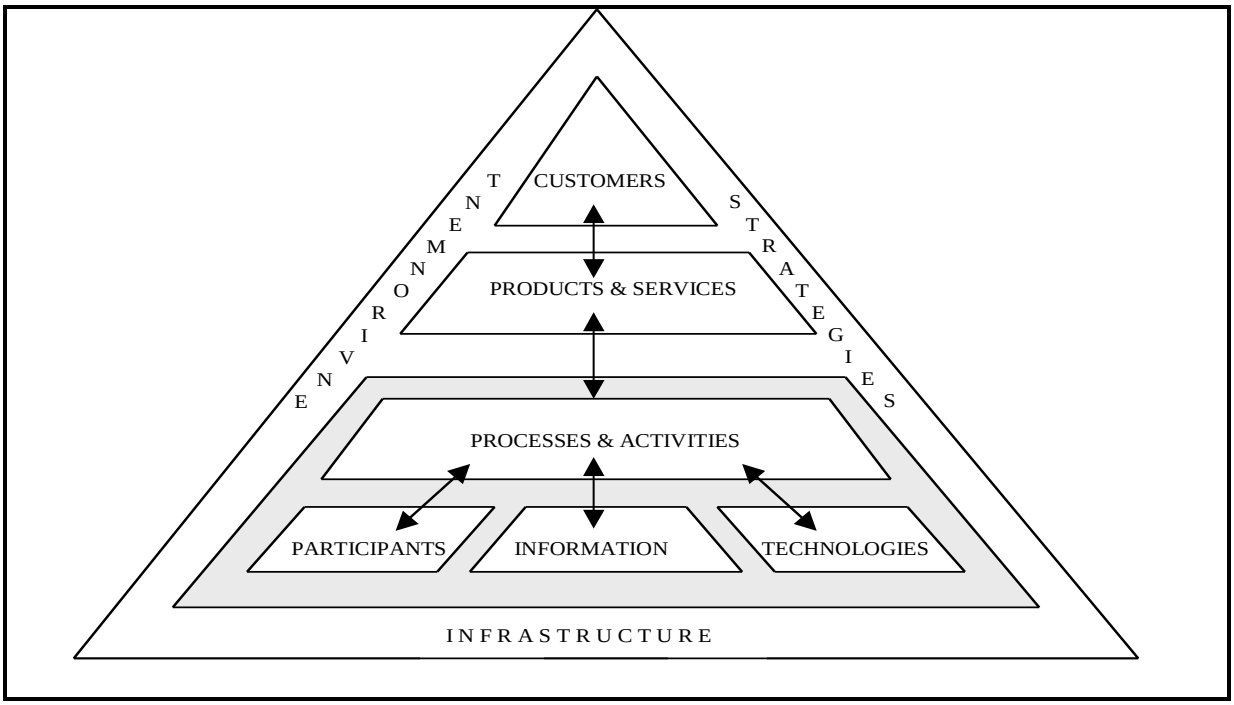


Figure 1. The Work System Framework. Alter (2008a, 2008b)

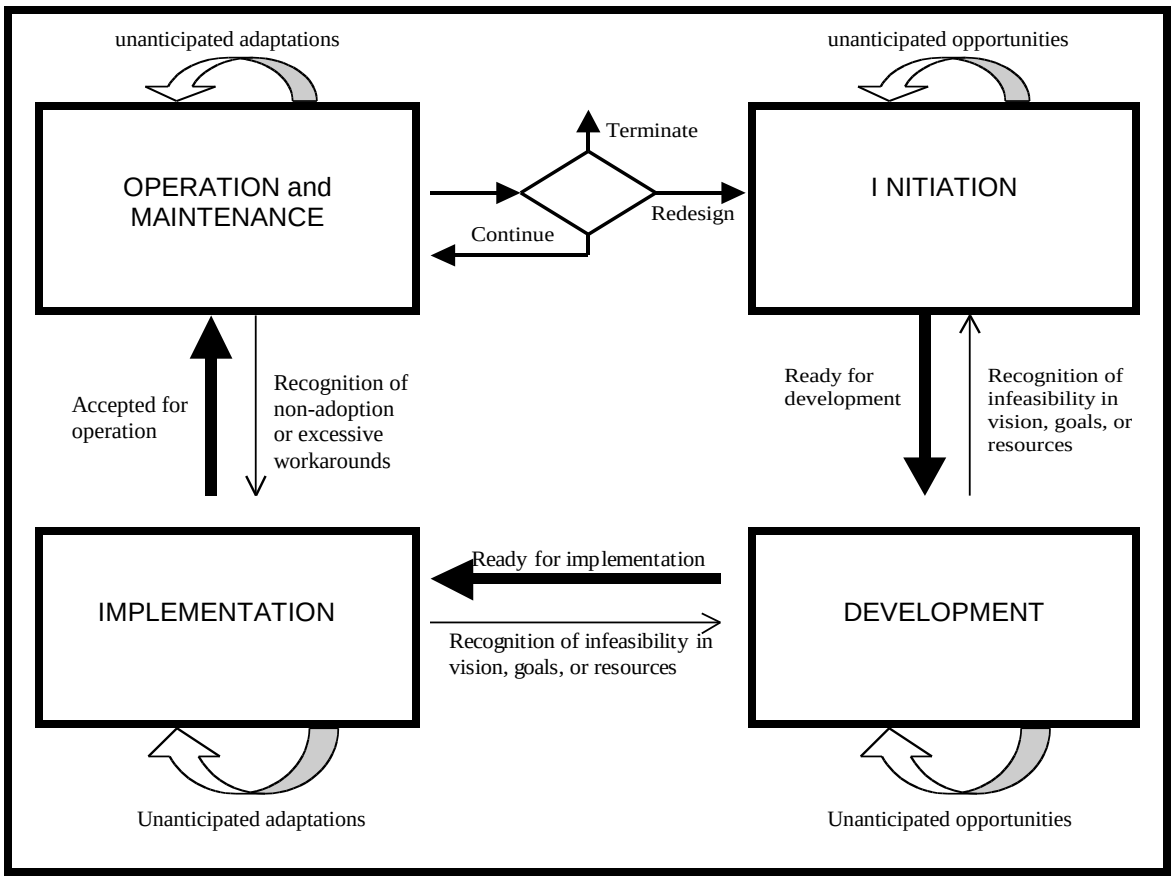


Figure 2. The Work System Life Cycle Model (Alter 2006b)

Work system principles. The idea of defining work system principles and incorporating them within WSM was motivated by difficulties encountered by MBA and Executive MBA teams in accomplishing more than describing a work system and identifying several readily apparent weaknesses. The elements of the work system framework provided a good outline for describing a work system, but many teams had difficulty searching for improvements other than relatively obvious changes such as recording data that wasn't being recorded or sharing data that wasn't being shared. They seemed to need guidelines for thinking about the various types of improvements that might be considered. Introducing a general set of system principles seemed a plausible way to make sure that the teams would think about each element and would have a basis for comparing the current status and possible modifications to a set of ideals.

A set of work system principles were developed iteratively between 2002 and 2004 (Alter, 2004) and validated subsequently based on views of Executive MBA students at the University of San Francisco between 2005 and 2009. (Alter and Wright 2010). A first version of work system principles contained one general principle per work system element. (Alter 2002) Sociotechnical principles from Cherns (1976) were added after adapting them to make them more understandable to typical business professionals. Additional principles were added based on comments and feedback from academic colleagues and Executive MBA students. A set of 24 work system principles listed in Table 3 seemed to strike a reasonable compromise between completeness and complexity.

Table 3. 24 work system principles

<table>
<tr><td colspan="2">Customers</td><td colspan="2">Products & Services</td></tr>
<tr><td colspan="4">• #1: Please the customers.
• #2: Balance priorities of different customers.</td></tr>
<tr><td colspan="4">Processes and Activities</td></tr>
<tr><td colspan="4">• #3: Match process flexibility with product variability
• #4: Perform the work efficiently.
• #5: Encourage appropriate use of judgment.
• #6: Control problems at their source.
• #7: Monitor the quality and timing of both inputs and outputs.
• #8: Boundaries between steps should facilitate control.
• #9: Match the work practices with the participants.</td></tr>
<tr><td colspan="2">Participants</td><td>Information</td><td>Technologies</td></tr>
<tr><td colspan="2">• #10: Serve the participants.
• #11: Align participant incentives with system goals.
• #12: Operate with clear roles and responsibilities.</td><td>• #13: Provide information where it will affect action.
• #14: Protect information from inappropriate use.
•</td><td>• #15. Use cost/effective technology.
• #16: Minimize effort consumed by technology.</td></tr>
<tr><td>Infrastructure</td><td colspan="3">• #17: Take full advantage of infrastructure.</td></tr>
<tr><td>Environment</td><td colspan="3">• #18: Minimize unnecessary conflict with the external environment</td></tr>
<tr><td>Strategies</td><td colspan="3">• #19: Support the firm's strategy</td></tr>
<tr><td>Work System as a Whole</td><td colspan="3">• #20: Maintain compatibility and coordination with other work systems.
• #21: Incorporate goals, measurement, evaluation, and feedback.
• #22: Minimize unnecessary risks.
• #23: Maintain balance between work system elements.
• #24: Maintain the ability to adapt, change, and grow.</td></tr>
</table>

Concepts related to work systems. A large number of concepts that are not shown in the work system framework are related to either a work system as a whole and or specific elements of a work system. Some of those concepts are included in the two design spaces and the metamodel that are mentioned next. A subsequent section describing a concept classification matrix (Alter 2010) will provide a more extensive discussion of the concepts in WST.

Service value chain framework. Starting with Porter (1985), value chain models have become common in the business literature. Such models focus on a firm or organization's activities that add value for customers or that support value added steps. Most of these models emphasize a producer viewpoint. Porter's model focuses largely on the internal operations of manufacturers.

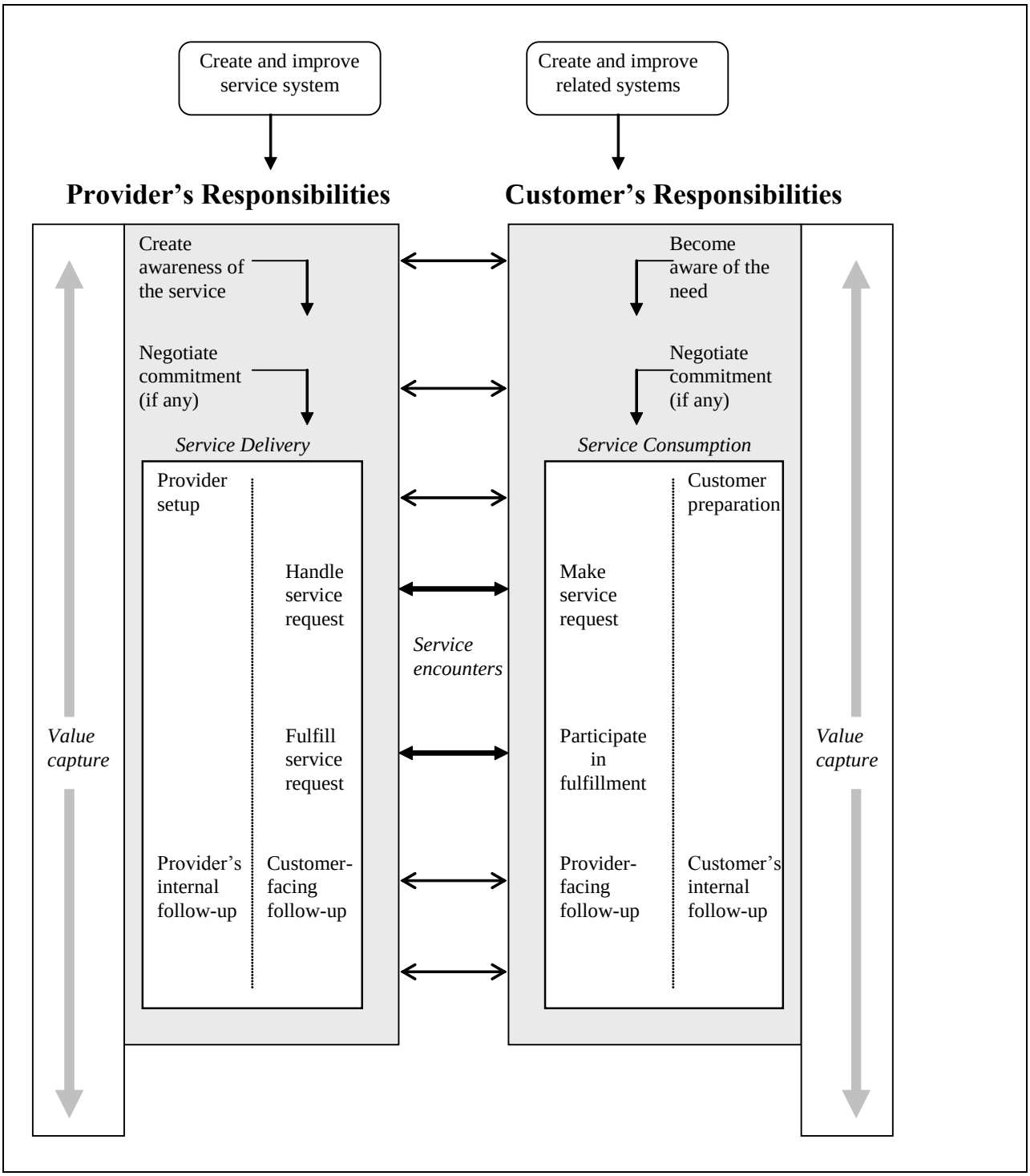


Figure 3. Service Value Chain Framework (Updated Version of Figure 2 in Alter [2008b]

Figure 3 shows a service value chain framework (Alter, 2008b, 2010d) that incorporates typical categories of service activities and responsibilities. This framework augments the work system framework by introducing activities and

responsibilities associated with services. Each element of this framework is important for many, but not all service systems. The entire service value chain for a service can be viewed and analyzed as a single work system. Alternatively, different subsystems in Figure 3 (such as provider preparation or negotiation of commitments) might be analyzed as separate work systems. The bilateral form of the service value chain framework is based on the widely accepted observation that value from services is co-produced by service providers and service consumers. The service value chain framework's form and content highlight the importance of activities and responsibilities, the co-production of value, internal and external customers, the customer experience, service interactions, the importance of front stage and back stage activities, and specific steps such negotiating commitments that will govern future service instances that include preparation, request handling, service fulfillment, and follow-up.

Design spaces for work system components, characteristics, and interactions. Systems analysis and design typically focuses on identifying and improving specific components, subsystems, or interactions of systems, both at aggregated and detailed levels. Alter (2006b, 2010e) use the general format of Table 3 to list many types of changes that an analysis and design effort might consider. Some are in the spirit of engineering, such as adding, combining, or eliminating steps in a business process, or upgrading hardware and software. Others are more in the spirit of design, such as changing the nature of customer relationships or the customer experience. This type of table or some other way of expressing typical possibilities for changes in work system elements or the work system as a whole could support analysis and design efforts through general knowledge, checklists, or even design tools. Alter (2006b, 2010e).

Another design space uses the same format to organize design characteristics that are relevant to many work systems. Each characteristic could be viewed as a design variable that might be assessed on a numerical scale (e.g., 1 to 5). These characteristics represent big picture choices that should be considered before determining a work system's details. Design characteristics that are relevant to a specific work system might be used in systems analysis and design by searching for gaps between a work system's current and desired status in relation to important characteristics (e.g., Are decisions too structured or too unstructured? Are the activities too complex or too simple? Is the work too manual or too automated?) Important gaps would provide directions for changes that could be accomplished through many combinations of tactics. Typical systems analysis and design texts for IS students say relatively little about these design characteristics, and move quickly to technical documentation of processes and information.

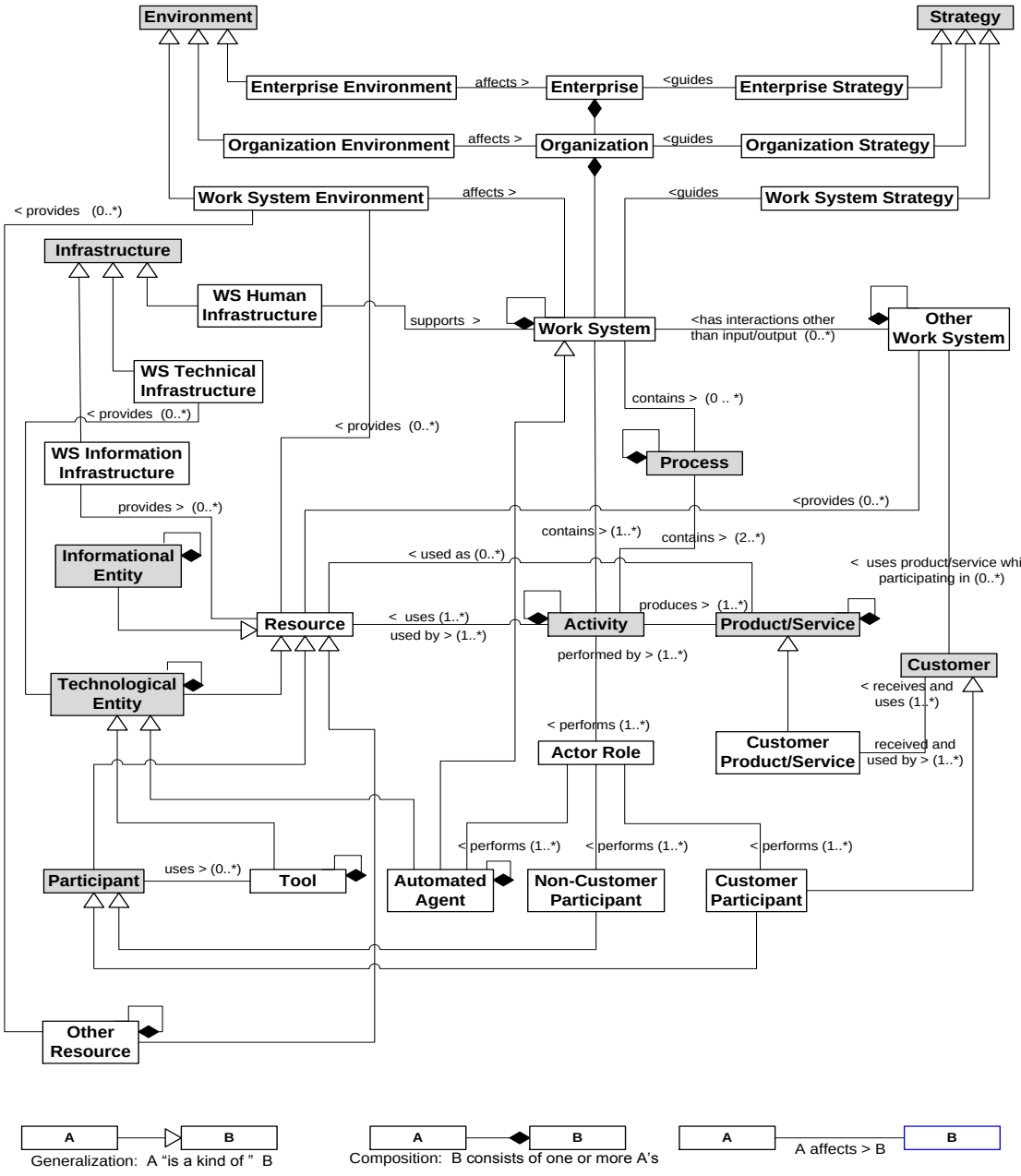
Metamodel for integrated analysis and design of sociotechnical and technical systems. Figure 4 is a representation of an integrated metamodel for the analysis and design of sociotechnical and technical systems. (Alter, 2010a). Sociotechnical concepts in the metamodel include customer and non-customer participants, actor roles, activities, environment, and human infrastructure. Technical concepts include technical and informational entities and technical and informational infrastructure. Attributes of those concepts also represent both sociotechnical and technical concerns. For example, goals, incentives, and job satisfaction are attributes that would typically appear in analysis from a sociotechnical viewpoint.

The impetus for creating the metamodel came from reading hundreds of reports by MBA and Executive MBA students about IT-reliant work systems in their own organizations. A general conclusion was that the work system framework (Figure 1) is effective for developing a summary that reflects basic understanding of a work system and for performing a preliminary analysis, but that deeper analysis would benefit from a more detailed view of most or all of the elements, something like the level of detail in the metamodel.

Figure 4 uses shading to highlight the distinction between elements in the work system framework and other concepts that are not in the work system framework. Some terms that appear in the work system framework are defined differently in the more detailed metamodel. In general, representation decisions attempt to maximize understandability while highlighting potential omissions from an analysis or design process. To the extent possible, the representation in Figure 4 tries to place resources on the left, operational structure in the middle, and intentions on the right. Goals, characteristics, metrics, principles, and other concepts that pertain to multiple elements and to the work system as a whole are attributes that are not shown. The use of the metamodel in analysis situations would apply those concepts as the analyst defines the problem or opportunity, evaluates the "as is" work system, and justifies proposed improvements that would appear in the "to be" work system.

Whereas the work system framework in Figure 1 is simple enough to present to typical business professionals, the metamodel in Figure 4 contains so many elements and relationships that it is best used in the background as part of a template or decision support tool that helps in selecting specific topics that need to be considered, discussed, or

documented in some way. The metamodel may also be more effective than the work system framework as a means of organizing the body of knowledge in the IS field, as will be discussed later.



Note: Many elements in the conceptual model have goals, attributes, performance indicators, and related principles, patterns, and generalizations that do not fit into a one page representation, and that must be included in more detailed explanations.

Figure 4: Metamodel for integrated analysis and design of sociotechnical and technical systems (not showing multiple goals, attributes, principles, and other important concepts related to specific elements)

Premises and Assumptions Underlying Work System Theory

This section discusses a number of underlying premises and assumptions that became evident during the evolution of WST to date. While it might be disappointing that WST was not deduced from basic premises and assumptions through logic and the accumulated wisdom in the literature, these premises and assumptions were not at all obvious in the early parts of WST's development. That probably would not be surprising to Lee and Nickerson (2010), who recognize the valid reason for desiring theories to be justified based on provenance, but who also introduce the Peirce's concept of abduction as a way to generate theories, and who see a corresponding limitation of "the opinions of many academics who believe that theories need to be derived from previous theories (the "literature") in order to be considered worthy of testing."

Consistent with arguments by DiMaggio (1995) and others that theories should encourage insights and ideally should lead to surprises rather than just summarizing associations that seem obvious, the following summary of WST's underlying premises and assumptions emphasizes areas of divergence from typical terminology, frameworks, and beliefs in the IS field.

Scope of applicability. WST provides a body of theory for IS, but is stated in terms of work systems in general, perhaps conflicting with the frequently stated goal of identifying core theories that are unique to the IS discipline (e.g., Weber, 2003). It is less general than general systems theory (which also applies to biological and physical systems that are beyond the scope of WST). It is more general than a theory of how to build a website or why people decide to use technology. It is most applicable to operational business systems (see Table 1), almost all of which can be viewed as IT-reliant work systems. WST is less applicable in situations where designed patterns of purposeful activity cannot be articulated, or where technology has been distributed in experiments as a first step in a desired innovation and diffusion process. It is less applicable to situations that are better described as ecologies, rather than work systems in which various elements of the work system framework can be identified. It can be used to model entire enterprises or organizations, but it is less useful at that level because entire enterprises and organizations involve too many people doing to many different types of work using to many different types of information technology.

Inheritance of concepts. The hierarchy of system types, with information systems as a special case of work systems, may explain some of the difficulty of developing IS theories and a body of knowledge about information systems. It is possible that most of the body of knowledge relevant to information systems and most of the valuable theories are either about work systems in general or about special cases of information systems, and that almost nothing of genuine interest can be said about information systems in general that is not also true of work systems in general. (Alter, 2005, 2008a) Organization of a body of knowledge around a hierarchy of special types of work systems organization is quite different from the organization of a body of knowledge for IS proposed by Iivari et al. (2004).

Service orientation. WST has a built-in service orientation, starting with the way in which the work system framework (Figure 1) places customers at the top, thereby emphasizing that the purpose of work system is to produce products and services for customers. The service value chain framework (Figure 3) provides a more elaborated view of service systems. Consistent with Figure 3 and with parts of the service literature that emphasize co-production of value by customers (e.g., Sampson and Froehle, 2006; Vargo and Lusch, 2004), the metamodel (Figure 3) extends the service orientation in Figure 1 by distinguishing between two types of human actor roles within a work system, non-customer participant and customer participant. The IS field traditionally paid little attention to co-production of value. Emphasizing service orientation leads to the possibility of new systems analysis and design tools and to the possibility of seeing all systems in organizations as services.

Sociotechnical by default. The default assumption in WST is that the terms system and work system usually refer to sociotechnical systems with human participants rather than hardware/software configurations that may have human users or may be hidden within computerized entities that are invisible to people who use computers and computerized information. Human participants are usually essential elements of a work system, not just users of hardware and software. In contrast, the default assumption in much of the IS field is that the term system refers to a configuration of hardware and software. With that assumption, systems are technical artifacts that users use, rather than systems in which people participate. Typical systems analysis textbooks implicitly support improving work systems, but treat "the system" as a technical artifact (a configuration of hardware and software) that is "used" by users. For example, in a summary of the design phase of the SDLC, Hoffer et al. (2008, p. 13) says "analysts must design all aspects of the system, from input and output screens to reports, databases, and computer processes."

Similar statements appear in Kendall and Kendall (2008, p. 13), Dennis et al. (2002, p. 7), and Mathiassen et al. (2000, p. 7).

Indeterminacy of systems with human participants. The value of producing perfect specifications of systems and software is often undermined by the variability and indeterminacy introduced by human participants. The development of WST was driven by the assumption that significant progress in systems analysis and design and related communication between business and IT professionals was possible without producing increasingly precise documentation of specifications and requirements, a typical emphasis of research concerning business process management (BPM), UML, BPMN, conceptual modeling, and ontologies. Recognition of the indeterminacy of systems that include human participants implies an expectation that human participants may not follow whatever specifications or requirements may have been agreed upon, may work with different degrees of accuracy and commitment at different times, and may produce justifiable and/or opportunistic workarounds and shadow systems for bypassing whatever rigorous specifications are built into software and into business processes that are supposed to use software in a particular way.

Design as guidelines for action rather than a strict determinant of action. The indeterminacy of systems with human participants implies that the design of most work systems cannot specify exactly what will happen inside of each non-automated step even though it can outline triggering conditions, completion conditions, and post-conditions of activities and processes. This is one of the areas where the WST body of theory might be developed further by incorporating ideas from research involving gray spaces and emergent phenomena. Examples of possible starting points include Suchman (1987), Schmidt and Bannon (1992), and Star and Strauss (1999) emphasize the importance of articulation work, coordination, and improvisation. Those topics are downplayed in typical process models, which focus mostly on work flows, triggering conditions, resource requirements, business rules, and post-conditions of specific activities.

Multiplicity of goals. On various occasions the academic IS field as been preoccupied with the question of what is the dependent variable for information systems or information system success. The multiplicity of goals inherent in most work systems suggests that attempts to identify a single dependent variable or definition of IS success will be futile. While it is possible to calculate a single number by constructing a mathematical combination of various metrics, the fundamental issue is that work systems have multiple goals that may not be consistent and that need to be considered separately. Managing a work system requires attention to tradeoffs between multiple goals related to different elements and their interactions.

Decomposition and traceability. The analysis and design of sociotechnical systems should aspire to at least some of the same types of traceability that are assumed important in analysis and design of technical systems. Ideally, it should be possible to decompose sociotechnical systems into successively smaller subsystems during the course of an analysis and design effort. Conversely, it should be possible to trace the subsystems back to their supersystems, and to trace the effects of design choices in either direction.

Layers of description. Successive decomposition of a work system into subsystems will often reveal components and phenomena that are not visible at higher levels of aggregation. Systems analysis and design methods should recognize the need to allow resources to become visible as subsystems are isolated during the process of decomposition.

Construction, emergence, and evolution. Contrary to the form of various SDLC models in the IS literature, the work system life cycle model assumes that both planned and unplanned change occur frequently, and that deviations from an existing plan or specification are natural occurrences in many situations rather than problems that must be avoided. Concepts related to emergence and incremental change play a relatively superficial role in the current model, which might be expanded to incorporate those ideas more fully.

Integration with methods and concepts from other disciplines. Some IS researchers believe that maintaining the status and legitimacy in the IS field in academic requires the development of theories that are unique to IS. Whether or not that political argument is correct, the goals of WST are best served by incorporating any genuinely useful ideas from any academic or practitioner source.

Concepts in Work System Theory

WST is an integrated, evolving body of theory consisting of assumptions, concepts, frameworks, and principles. The previous sections emphasized WST's main components and its underlying assumptions and premises. This section says more about the concepts in WST.

Desirability of a consistent, integrated set of concepts. Ideally, the concepts in any theory or body of knowledge should be clear, internally consistent, comprehensive, and easy to use in the theory's intended domain of application. An article called "Same Words, Different Meanings: Are Basic IS/IT Concepts our Self-Imposed Tower of Babel?" (Alter, 2000) raised these issues at the time when the work system method was initially taking shape. It showed how ten articles published in *CAIS* in 1999 used basic IS/IT terms with different meanings and connotations related to the different perspectives of their authors. The terms were system, user, stakeholder, IS project, implementation, reengineering, requirements, and solution. The article's conclusion noted that the IS field seems "terribly concerned with issues of rigor vs. relevance, as demonstrated by a 1999 issue of *MIS Quarterly* (Applegate, 1999; Benbasat and Zmud, 1999) and perennial panels on this topic at ICIS and other conferences. It is very hard to be rigorous with slippery concepts that legitimately mean different things to different people ... Does the IS discipline really have a knowledge base? Assume that this knowledge base existed in ANY form ranging from some kind of oral tradition through a highly codified database of assertions along with supporting documents. It seems reasonable to argue that a knowledge base could not exist unless the basic concepts were fairly well defined. ..."

The Tower of Babel article helped crystallize a general challenge for the development of the work system method. Regardless of whether it was impossible to get IS/IT practitioners and researchers to use basic terminology in a consistent manner, ideally it should be possible to produce at least one instance of an integrated set of basic IS/IT concepts that were internally consistent, broadly applicable across the entire IS field, and genuinely useful for understanding, analyzing, designing, and evaluating systems in organizations.

Concept Classification Matrix. A comprehensive body of theory about systems in organizations cannot rely solely on definitions of nine basic elements in the work system framework. Each element has a large number of properties that are important for analysis, explanation, prediction, and design and action.

Table 4 presents the first two dimensions of a three dimensional matrix for classifying concepts related to work systems. (The third dimension, an extension that covers special cases of work systems such as information systems, will be discussed later.) The vertical dimension of the matrix consists of the work system as a whole and each of its nine elements. The horizontal dimension consists of 10 categories of properties for elements. The result is 10 by 10, i.e., 100 cells into which concepts (and principles and empirical findings) relevant to work systems can be classified. For example, the note at the bottom of Table 4 says that cell (4,2) is the location for concepts related to aspects of performance, metrics and goals related to the customer, and that cell (6,6) contains concepts concerning standards and rules related to using personal data.

The ten categories in the horizontal dimension clarify and extend parts of the architecture of "Sysperanto," a proposed model-based ontology of the IS field. (Alter, 2005). The first four categories in the concept classification matrix correspond to different parts of speech: nouns (components and phenomena), verbs (actions and methods), adjectives (characteristics), and adverbs (aspects of performance, metrics, goals). The next four represent additional types of concepts (but not necessarily different parts of speech) that are often important when analyzing and designing systems (risks and obstacles; standards and rules; exceptions, workarounds, and special cases; and relationships. The last two columns, 9) principles and generalizations and 10) empirical findings, involve applications of concepts rather than just concepts per se. They are included in the concept classification matrix mainly for the convenience of organizing topics related to concepts and making a comprehensive concept map available to analysts, designers, and researchers. Most of the properties in the first eight columns are words or phrases. The principles and generalizations in the ninth column are sentences, paragraphs, statistical and diagrammatic summaries. The empirical research findings in the tenth column are textual summaries of whatever empirical findings are deemed worthy of inclusion (an interesting decision by an individual or committee).

The potential value of the concept classification matrix is illustrated by its relationship with the work system principles in Table 3 and the design spaces for work system components, characteristics, and interactions. The work system principles are distributed across the 10 cells in the ninth column. The design space identifying possibilities for changing components, subsystems, and interactions consists of selected concepts from the 10 cells in the second column, actions and methods. Likewise, the design space identifying characteristics for elements of a work system and for the work system as a whole consists of selected concepts from the 10 cells in the third column,

characteristics. In other words, the effort of populating the concept classification matrix could pay off by clarifying and facilitating use of various sets of concepts that are important in drilling down and expanding upon initial thoughts in an analysis and design effort.

Table 4: Concept Classification Matrix for Work System Theory

	1) Components and phenomena	2) Actions and methods	3) Characteristics	4) Aspects of performance, metrics, goals	5) Risks and obstacles	6) Standards and rules	7) Exceptions, workarounds, and special cases	8) Relationships and interactions	9) Principles and generalizations	10) Empirical findings
1) Work system as a whole										
2) Customer				Cell (4,2)						
3) Products and services										
4) Processes and activities										
5) Participants										
6) Information						Cell (6,6)				
7) Technologies										
8) Environment										
9) Infrastructure										
10) Strategies										
	Sample cells: .... Cell (4,2) Aspects of performance, metrics and goals related to the customer .... Cell (6,6): Standards and rules related to using personal data Note: The column for empirical findings is included to indicate where empirical findings would belong if this matrix were used to organize a body of knowledge									

The potential value of the concept classification matrix is illustrated by its relationship with the work system principles in Table 3 and the design spaces for work system components, characteristics, and interactions. The work system principles are distributed across the 10 cells in the ninth column. The design space identifying possibilities for changing components, subsystems, and interactions consists of selected concepts from the 10 cells in the second column, actions and methods. Likewise, the design space identifying characteristics for elements of a work system and for the work system as a whole consists of selected concepts from the 10 cells in the third column, characteristics. In other words, the effort of populating the concept classification matrix could pay off by clarifying and facilitating use of various sets of concepts that are important in drilling down and expanding upon initial thoughts in an analysis and design effort.

Inheritance through a hierarchy of work system types. A key component of the Sysperanto architecture proposed in 2005 is that work system is a general case, and that special cases such as information systems in general, projects in general, or supply chains in general should inherit both the nine elements for summarizing a work system and most of the concepts related to those elements. (The participant slot would be blank for totally automated work systems.) The implication is that the entries in the concept classification matrices for work systems in general would differ somewhat from those for special cases of work systems, and further that most of the concepts for work systems in general should be inherited by the special cases, thereby providing an efficient method for organizing concepts related to different types of systems. In other words, the concept classification matrix is actually a three dimensional matrix whose first two dimensions are represented in Table 4, and whose third dimension consists of different layers for different special cases of work systems,

1) the horizontal dimension: 10 different categories of properties,
2) the vertical dimension: the work system as a whole plus the nine elements of a work system,
3) the depth dimension: different layers for work systems in general and different special cases of work systems, such as totally automated work systems, information systems, projects, and supply chains.

Based on inheritance, most of the concepts in a subordinate layer would be inherited from its superordinate layer. Thus, information systems and projects would inherit most of their concepts from work systems in general; accounting information systems would inherit most of their concepts from information systems in general and SDLC projects would inherit most of their concepts from projects in general.

The formulation of the concept classification matrix for work systems is quite recent, and even a first draft of a fully populated version of the layer for work systems in general does not yet exist. It would be interesting to observe the similarities and dissimilarities in the results when qualified individuals or groups of qualified individuals separately attempted to populate the matrix for work systems in general. It would also be interesting to see how they would modify that matrix when producing a matrix for information systems in general. That exercise would test a "level-skipping conjecture\" in Alter (2005), by which "most of the properties of information systems in general are inherited from work systems in general; very few additional concepts are related to information systems in general but not work systems in general; most of the additional properties of information systems are related to unique features of specific types of information systems." That conjecture might help explain why it is so difficult to generalize about information systems and why the IS field seems to lack a conceptual core.

Applications in research and practice. The cells in the top layer of the concept classification matrix can be used to organize hundreds or thousands of concepts. If each of the cells in the matrix for work systems in general were populated with typical concepts that that are more closely associated with that cell than with any other cell, the result would be a two dimensional outline of the typical concepts, principles, generalizations, and empirical findings that are relevant for analyzing, designing, implementing, and evaluating systems in organizations. Even a partially populated version of the concept classification matrix could be valuable in a number of ways. Six possible applications of the concept classification matrix will be mentioned briefly. In each case, a fully developed discussion could be quite lengthy.

- **Guiding systems analysis and design**. Use the dimensions of the matrix as a checklist to make sure that analysis and design processes have considered whichever categories need to be considered, have done so at the appropriate level of depth, and have not overlooked topics in important cells accidentally or purposefully. For example, a reminder to consider concepts in cell (4,4) such as speed, consistency, and activity rate might make it more likely that those aspects of performance would not be overlooked
- **Observing systems analysis and design projects.** Researchers observing systems analysis and design projects could use the dimensions and the cells categories as a checklist for characterizing the content discussed in those projects and for assessing the completeness of an analysis or evaluation. Inattention to

concepts within any cell may imply that important topics and concerns are being overlooked accidentally or purposefully.

- **Developing tools for systems analysis and design**. Most current tools for systems analysis and design related to IS focus on documenting processes, information, and technology in current and proposed information systems. It should be possible to develop new or improved tools that incorporate concepts that are downplayed or ignored by established methods.
- **Exploring complementarity with frameworks that might be alternatives to the work system framework**. The matrix could be used to flesh out a comparison of the work system framework with potential alternative frameworks that the work system framework might augment (or vice versa). The concepts in the cells in a populated matrix could help in visualizing some of the practical overlaps and areas where important ideas for analysis and design are or are not implied by the alternative frameworks..
- **Explaining limitations of UML and the need for other types of systems analysis tools**. It is possible to explore which cells in the concept classification matrix are and are not addressed by UML. For example, activity diagrams are more directly related to cell (2,4), *actions and methods* related to *processes and activities*, although they also identify which participants or groups of participants perform particular activities. Most other UML diagrams belong in the same column. It is possible that other tools and methods that emphasize other concepts in the concept classification matrix might be very helpful in addressing issues and topics not addressed by UML.
- **Developing a body of knowledge for the IS field**. Populating at least the layer of the concept classification matrix for work systems in general would address the challenge mentioned earlier of providing a single set of basic IS/IT concepts that is genuinely consistent, broadly applicable across the entire IS field, and useful for understanding, analyzing, designing, and evaluating systems in organizations. It would also be a major step toward addressing calls for developing a body of knowledge for the IS discipline. (e.g., Hirschheim and Klein, 2003; Iivari et al., 2004; Hassan and Mathiassen, 2009). It would be interesting to observe and evaluate the differences in results from different teams trying to fill in the body of knowledge using that type of method.

Is the granularity of the vertical column sufficient? The reasons for creating the metamodel (Figure 3) provide an admonition about the 10 by 10 form of the concept classification matrix. It may turn out that the work system framework is not granular enough to support effective development of a body of knowledge. The concept classification matrix might be more effective if its vertical dimension used at least a major subset of the entities and relationships in the metamodel instead of the elements of the work system framework. For example, research findings concerning the technology acceptance model (TAM) do not link directly with any particular element of the work system framework, but do link directly with the relationship between *participant* and *tool* in the lower left-hand corner of Figure 3. Similarly, results to date of an attempt to develop system interaction theory (Alter, 2010c) would be attached to the link between *work system* and *other work system* on the right side of Figure 3.

Part 2: How Strong Is the Fit and Synergy between Work System Theory and SIGPrag Interests?

This paper started with a question about whether WST genuinely fits into the interests of the SIGPrag community and whether discussions with members of that community might lead to mutual benefits related to further development of WST and value for some members of the community. Although not stated explicitly at the outset, it was clear that interests of a research community should not be defined by someone who lacks much of the historical context. Accordingly, this paper's approach was to introduce the issue of possible commonality of interest at the outset, to devote Part 1 to explaining the current state of WST, and to devote Part 2 to exploring whether WST and its continuing development fits into the SIGPrag agenda, and if so, how mutual benefits might result. To support that purpose, Part 1 covered both older WST ideas and recent WST extensions that might resonate with various overlapping interests in the SIGPrag community. The older ideas related to theorizing IT in the context of work practices and social action included the definition of work system, the work system framework, work system life cycle, and work system principles. The newer extensions, including the service value chain framework (Figure 3), the metamodel (Figure 4), and the concept classification matrix (Table 4), were extensions that may provide an additional bridge toward SIGPrag interests related to communication, collaboration, business processes, service delivery, language, and knowledge.

The remainder of this paper will look two issues:

- Is there is good fit between WST and SIGPrag interests in terms of content and general intentions?
- Is there genuine synergy between the interests of the SIGPrag community and the future development of work system theory?

The answer to the first question is an obvious yes. The answer to the second is not totally obvious.

Is there is good fit between WST and SIGPrag interests in terms of content and general intentions?

There is no question that the content and intentions of WST fit with the main themes in the Call for Papers for the SIGPrag Workshop (SIGPrag 2010) and the main themes in several recent articles related to IS and pragmatism (Ågerfalk 2010, Lee and Nickerson 2010; Goldkuhl 2008) which represent at least a meaningful subset current interests of the SIGPrag community. It is easy to demonstrate the overlap by looking briefly at the following themes: theorizing the IT artifact, usefulness linked to values, action, design, change and responses to change, language, knowledge, and making a difference.

Theorizing the IT artifact. The SIGPrag 2010 Call for Papers referred to "a growing recognition of the importance of theorizing the IT artifact and its organizational and societal context from a pragmatic and action-oriented perspective."

- WST is a body of theory primarily for analysis and design and action, but with facets that can be used for explanation and prediction (categories from Gregor (2006)). WST starts with the definition of work system and uses that definition as the basis of an elaborate assemblage of assumptions, concepts, frameworks, principles, and work system analysis and design templates. Some of the underlying assumptions and viewpoints in WST differ in interesting ways from common assumptions and viewpoints in the IS field. (Alter, 2010e).

Usefulness linked to values. "As pointed out by Goles and Hirschheim (2000) pragmatists are more interested in utility and usefulness than in an abstract notion of truth. That is, the true value of knowledge is seen to lie in its practical usefulness and its ability to bring about informed change. .... Note, however, that the pragmatist view of usefulness should not be mistaken for utilitarianism. Pragmatists acknowledge that usefulness must always be related to the particular value system of the social practice in which the knowledge is brought into play (Lee and Nickerson, 2010)." (Ågerfalk 2010)

- The initial goal in developing WSM (and hence WST) was to help typical business professionals understand and analyze systems in organizations for their own purposes. Greater effectiveness in describing and analyzing systems from a business viewpoint should help them communicate and collaborate with IT professionals. The related values include the belief that business professionals (and anyone else) should be empowered to think about systems for themselves, without handholding by consultants and with less probability of being drawn into world view of IT professionals that might not reflect important business and social concerns.

Action. "To engage with the action character of the empirical field is at the core of pragmatism. This follows from Blumer's (1969, p. 71) insight that 'the essence of society lies in an ongoing process of action – not in a posited structure of relations. Without action, any structure of relations between people is meaningless." (Ågerfalk 2010)

- Work systems exist to perform work that produces products and services for customers.. It is impossible to say much of value about work systems in general or about specific work systems without talking about action.

Design. "The action research methodology (Baskerville and Myers, 2004) as well as the design science research paradigm (Baskerville, 2008; Winter, 2008), two common IS research approaches, particularly in the European context, are both expressions of pragmatic ideas (Hevner et al., 2004; Lee and Nickerson, 2010)." (Ågerfalk 2010)

- WSM provides an organized approach for describing and analyzing an existing work system and designing a proposed improvement at whatever level of detail is appropriate for the situation. WSM was developed

through iterations that anticipated the slightly more formalized approach that is currently associated with design science research.

Change and responses to change. "Essentially, a pragmatist outlook implies an interest in change and how people bring about and respond to change. ..... The pragmatist researcher's interest in change and action brings with it a number of pragmatic concepts and concerns that may be of immense value to IS research. At the core of these is the belief that the true value of information technology and IS lies in their potential to support human communication and collaboration, which is central to human activity and life." (Ågerfalk 2010)

- WSM is a flexible method for performing analysis and design activities that plot a path toward desired changes. The analysis includes attempt to anticipate responses to those changes. The work system life cycle model provides a general outline of how those changes occur. On the other hand, WSM and WST contain no assumption that "the true value of information technology and IS lies in their potential to support human communication and collaboration." To the contrary, while communication and collaboration are obviously very important, the value of IS plays out in many other very important areas as well, including support of individual work, support of individual and group decision making through data analysis and mathematical models, delivery of information products, capturing of information (e.g., bar codes, MRIs, retina scans), answering questions (e.g., search engines, database software, apps for mobile phones), and operation and control of automated production processes. Those other areas of value are certainly pragmatic in a general sense of that term, even though they may not fall within the purview of SIGPrag interests. (We return to that question at the end.)

Language. "Over the years pragmatic thinking has inspired quite a lot of IS research. The most well known is perhaps that which has been explored within the so-called language/action perspective. This research came to focus a lot on the intentional aspects of language use and how IS codify language patterns that facilitate and impose restrictions on activities (e.g. Goldkuhl and Lyytinen, 1982; Winograd and Flores, 1986; Dietz, 2001; Weigand, 2006)." (Ågerfalk 2010)

- A fundamental theme underlying the work system framework, the metamodel, and the concept classification matrix is that clarifying the language for thinking and communicating about systems will generate better analysis, better design, better implementation, and fewer disappointments and failures. In contrast to LAP's emphasis on utterances and conversational commitments, the language emphasis in WST concerns organizing a deep array of concepts that can be used in understanding and communicating about systems in organizations.

Knowledge. "As pointed out by Goldkuhl (2008), this [belief in the true value of IT and IS] leads to an interest in the development of (1) knowledge that is aimed *for* action, change and improvement; (2) knowledge *about* actions, activities and practices; and (3) knowledge *through* action, experimentation and exploration." (Ågerfalk 2010)

- WST is "knowledge *for* action, change, and improvement." WST contains "knowledge *about* actions, activities and practices." The evolution of WST created "knowledge *through* action, experimentation and exploration." Note also that the work system framework at the core of WST identifies many possible locations for knowledge in relation to a work system. Knowledge that is relevant for understanding, operating, and maintaining a work system might be tacit knowledge in the heads of work system participants; might provided through documents and knowledge bases. might be built into formal or informal business rules; might be codified in expert systems; or might be built into hardware or software technologies designed to support and/or de-skill and/or replace workers

Making a difference. "SIGPrag 2010 will address pragmatic issues across the full spectrum of information systems research, including areas such as systems development, social software, social media, social responsibility, business in society, business modeling, sustainable development, digital innovation, and IT in the supply chain. Diverse aspects of pragmatic theory, pragmatic research, and pragmatic methods are of special interest and especially their relation to other research streams such as design science research and action research. How can pragmatic IS research make a difference in practice and theory?" (SIGPrag 2010)

- A primary goal throughout the entire development of WST was to make a difference in the world by helping business and IT professionals think and communicate more effectively about systems in organizations.

Is there mutual synergy between the interests of the SIGPrag community and the future development of work system theory?

The previous section showed that the content and general intentions of WST overlap substantially with the content and general intentions of SIGPrag interests. That overlap increases the likelihood of future synergy, but doesn't guarantee it. The practical issues related to potential synergies are two-sided: First, are specific aspects of WST sufficiently aligned with interests in the SIGPrag community that it will be worthwhile for SIGPrag members to extend WST as they pursue their own interests? Second, could WST contribute significantly to the existing research interests of SIGPrag community members?

To address the potential for synergy with relative brevity, we will move beyond general content and intentions, and will look in turn at a series of research topics mentioned in several places including Ågerfalk's (2010) *EJIS* editorial "Getting pragmatic," articles from several ALOIS (Action in Language, Organizations, and Information Systems) conferences, the 2005-2007 articles in *Systems, Signs, and Actions* that are available on its web site, and other articles that are related to SIGPrag interests. For each topic we look at areas of overlap between WST and SIGPrag interests and prospects for future synergy. The topics mentioned and articles cited are a subset of a larger group of topics and articles could have been selected. Caveat: Many of the comments in this section are highly subjective, are not based on deep involvement in the SIGPrag community, and may be based on misunderstandings of both concepts and research. Part of the value of this section might be in identifying common misunderstandings of SIGPrag interests that could be overcome in a clearer SIGPrag identity that might attract more participants and interest.

The language action perspective. "Over the years pragmatic thinking has inspired quite a lot of IS research. The most well known is perhaps that which has been explored within the so-called language/action perspective [LAP]. This research came to focus a lot on the intentional aspects of language use and how IS codify language patterns that facilitate and impose restrictions on activities." (Ågerfalk 2010)

- LAP --> WST: One way in which LAP might contribute to WST is in providing specific, LAP-related concepts and issues that could be used in the work system method. A possible obstacle to this type of contribution is a fundamental mismatch in granularity, with traditional LAP more concerned with conversational elements such as utterances and conversational commitments, whereas WST is more concerned with the creation, structure, operation, and performance results of IT-reliant systems in organizations. Utterances and conversational commitments surely occur within many systems in organizations, but that does not necessarily imply that a focus on conversation at that level of analysis will be of practical use for analyzing work systems and for extending WST beyond its current limitations.
- WST --> LAP: WST might contribute to LAP-related research by providing concepts and methods for creating richer descriptions of the contexts studied in LAP-inspired research. For example, the concept classification matrix could provide a large number of concepts for describing the content of system-related conversations and the contexts within which LAP-related research occurs.

Communication and coordination of business processes (CCBP). The current versions of WST view processes in a relatively traditional way, partially consistent with a characterization by Lind (2006), who cites definitions such as "a collection of activities that takes one or more input and creates an output that is of value to the customer," and Clarke and Goldkuhl (2007), who refer to "a sequence of repeatable activities, linked procedures, or logically related tasks that often cut across functional boundaries to fulfill or serve the needs of internal or external customers by collectively realizing a business objective, goal or policy." Those characterizations fit for manufacturing pharmaceuticals, processing travel reimbursements, and other processes that are highly structured and can be modeled as workflows by emphasizing the sequence, preconditions, and post-conditions of operations, and by viewing the operations themselves as black boxes. Medical diagnosis and many types of creative work do not fit as well because they are far less structured even though they can be described as sets of activities that provide value to customers. Lind notes an alternative characterization based on a communicative view, whereby "business processes

are mainly coordination processes in this communicative view. Business processes arise through requests, offers, agreements and commitments and other communicative acts. The theoretical inspiration comes mainly from speech act theory." Although communication and coordination are obviously very important in many business processes, there are others where the main issues are in other areas such as those mentioned previously: support of individual work, support of individual and group decision making through data analysis and mathematical models, delivery of information products, automatic capture of information, automatic answers to questions, and operation and control of automated production processes In a step toward including such those issues within SIGPrag interests, Clarke and Goldkuhl mention the question of how to emphasize communication in business processes or activities in which little human to human communication occurs. They also mention that computer-to-computer communication is a related phenomenon.

- CCBP --> WST: Insights from applications of LAP in the general area of CCBP might provide a contribution to WST. This paper previously mentioned that WST might be developed further through additional focus on topics that are downplayed in typical process models, which focus mostly on work flows, triggering conditions, resource requirements, business rules, and post-conditions of specific activities. The most likely source was characterized as "research involving gray spaces and emergent phenomena," and "ideas related to articulation work, coordination, and improvisation." WST might benefit from CCBP-specific extensions related to communication and coordination.
- WST --> CCBP: Aspects of WST might contribute to CCBP, for example in the use of WSM templates and the concept classification matrix to differentiate between business processes where communication and coordination are and are not key determinants of performance results. In a possible parallel to Clarke and Goldkuhl's (2007) observation about computer-to-computer communication, the metamodel in Figure 4 identifies automated agents as one of three possible types of actors in an activity. That and related aspects of the metamodel might lead to conceptual insights for CCBP.
- Dual-perspective case studies. Since most contexts of CCBP-related research can be described as work systems, case studies that look at the same situation from CCBP and WST viewpoints might be quite interesting. Dual-perspective case studies might help in clarifying the relative advantages and disadvantages of each approach.

Service orientation in organizational action. LAP's emphasis on contracts and commitments strongly reflects a service orientation in the dictionary sense of doing something for someone else. The work system framework (Figure 1) reflects a service orientation by placing the customer at the top and by showing that work systems exist to produce products and services for customers. The service value chain framework (Figure 3) extends this service orientation by representing stages of customer-provider interactions that co-produce value for the customer. The metamodel addresses service orientation somewhat differently by including non-customer participant and customer participant as two of three types of actor roles, and by permitting both sociotechnical and totally automated work systems to be a work system's customer.

- LAP, CCBP --> WST: It is possible that insights from LAP and CCBP could motivate further development of the underpinnings of the service value chain framework.
- WST --> LAP, CCBP: The work system framework or the service value chain framework might or some variation on it might provide a way to represent or explore service-oriented communication and coordination. For example, WSM analysis and design templates from WST might be used to reinterpret the situations covered in LAP- or CCBP- inspired research on customer service and self-service such as Lind and Salomonson (2008) to see whether WST enriches LAP- or CCBP-inspired descriptions and also to see whether LAP- or CCBP- inspired approaches raise issues that would not be raised in a WST-based approach.

Socio-instrumental pragmatism. Goldkuhl and his co-authors have developed a set of ideas related to what they call socio-instrumental pragmatism. Goldkuhl (2005a) says that the key term in understanding socio-instrumental pragmatism is socio-instrumental action, which "is an attempt to avoid polarized views of action like that an action is either social or instrumental .... the key term socio-instrumental is chosen since the main object to study in the IS discipline, the information system is typically a socio-instrumental artefact. ... An IS is both an instrument for human actors aiming at communication and an agent with capability to perform pre-defined actions."

- Prospects for synergy: The explanations of socio-instrumental pragmatism overlap with WST concepts in some ways but not others. A detailed comparison might lead to clarifications of the assumptions and limitations of both approaches.

Work practices. Clarke (2005) notes, "work practices are generally considered as relatively short, routine patterns of work. They are generally viewed as 'standardised' in the sense that they are 'organisationally endorsed'; a sign of which is that they are usually instantiated in one or more systems features. Goldkuhl (2005b) provides a "generic model of a workpractice" that overlaps in a number of ways with the work system framework. Clarke (2005) mentions "the relationship between the enactment of a workpractice and system feature/s that 'support'it. ... Users may renegotiate one or more canonical sequences of activities typically associated with a specific systems feature. They may do this by altering the staging of the workpractice, redefining the workpractice goal, or deviating from the usual role they adopt within the workpractice. The ability to be able to talk about the renegotiation of workpractice - what in classical information systems is called a *manual workaround* - is an unusual consequence of applying this kind of theory."

- Prospects for synergy: WST is fundamentally about work practices, but does not proceed from the same assumptions. Aside from differences in conceptual and philosophical underpinnings, WST views information systems not as tools that are "used" but as subsets of the work systems that they serve, with full recognition that work system participants are also information system participants, not just users. It is quite possible that detailed comparison of WST's concepts related to processes and activities with various views of work practices in the SIGPrag community could lead to greater clarity about the strengths and limitations of both approaches. It would be interesting to see how a work system analysis might be done differently or might turn out differently if work practice ideas from the SIGPrag community were used instead of WST concepts related to processes and activities.

Online communities and virtual teams. WST is about work systems, not communities. On the other hand, virtual teams might be viewed both as online communities and as a boundary case of work systems, with comparatively unstructured processes (e.g., compared to work systems for repetitive manufacturing or repetitive administrative processes), time-varying products, and possibly with uneven attendance by participants.

- WST --> SIGPrag: WST frameworks and concepts might help SIGPrag researchers in describing and analyzing online communities and virtual teams. For example, it might be interesting to review de Moor (2008) using a work system analysis template to identify the topics that were emphasized and other topics that were viewed as peripheral.
- SIGPrag --> WST: If SIGPrag researchers have developed new concepts related to online communities and virtual teams, those concepts might be included in the concept classification matrix and might help in analyzing and designing work systems that have many of the characteristics of online communities and virtual teams. For example, some of the concepts in de Moor (2008) might be incorporated into the concept classification matrix or into the classification of work system types.

Conclusion: Back to the Original Question

The original question posed in this article's title was related to interests of the SIGPrag community but mentioned "the lens of pragmatism" instead of something like "SIGPrag interests." That approach was used partly because it was difficult for a somewhat distant observer to characterize SIGPrag interests in a fair and concise way and partly to raise a question for community discussion at SIGPrag 2010.

In general, WST and its development seem to fit well with the view of pragmatism expressed in Lee and Nickerson (2010) as a stance that supports design science research. It also fits with the three types of pragmatism - functional, referential, and methodological - discussed by Goldkuhl (2008). On the other hand, it may not fit quite as well with views in Ågerfalk's (2010) *EJIS* editorial called "Getting pragmatic." In particular, it is not clear whether the evolution and continuing development of WST is an example of what Ågerfalk really means by "getting pragmatic." It would be interesting to see whether he and other members of the SIGPrag community would view WST's development and content as "more pragmatic" or "less pragmatic" than other theoretical and practical developments in IS, such as structuration theory, TAM, object-oriented programming, agile development, entity-relationship

diagrams, or LAP (the area of research that he cited as the most well known IS research inspired by pragmatic thinking.

The original question. Does the lens of pragmatism help in understanding, using, or improving work system theory? The lens of pragmatism certainly provides a justification for the general content of WST and for the way WST was developed (whether or not certain specifics may seem unpragmatic). As a contribution to the future of WST, that type of justification might serve as a way to counter opinions mentioned by Lee and Nickerson (2010) of "many academics who believe that theories need to be derived from previous theories (the "literature") in order to be considered worthy of testing." In terms of the substance of WST, however, pragmatism as a philosophical stance seems not to suggest new and surprising ways to improve WST that would not be imagined by someone who has studied its current state of development. (An expert on pragmatism might have a more nuanced view of that conclusion.)

In terms of substance rather than philosophical justification, the discussion above showed that there is substantial overlap in the general content and intentions of WST and the SIGPrag community (e.g., theorizing the IT artifact, usefulness linked to values, action, design, and so on). It also identified a number of possibilities of mutual synergy terms of specific research topics such LAP, CCBP, and work practices. Whether these possibilities result in action remains to be seen.

References

Ackoff, R. 1981. Creating the Corporate Future, New York: John Wiley & Sons.

Ågerfalk, P. J. 2010. "Getting pragmatic." *European Journal of Information Systems,* (19)**,** pp. 251–256.

Alter, S. 2000. "Same Words, Different Meanings: Are Basic IS/IT Concepts Our Self-Imposed Tower of Babel?" *Communications of the Association for Information Systems*, (3:10), pp. 1-87.

Alter, S. 2002. "The Work System Method for Understanding Information Systems and Information System Research," *Communications of the Association for Information Systems*, (9:6), pp. 90-104.

Alter, S. 2003a. "18 Reasons why IT-Reliant Work Systems Should Replace the IT Artifact as the Core Subject Matter of the IS Field," *Communications of the Association for Information Systems*, (12:23), pp. 365-394.

Alter, S. 2003b. "Sidestepping the IT Artifact, Scrapping the IS Silo, and Laying Claim to 'Systems in Organizations'," *Communications of the Association for Information Systems,* (12:30), pp. 494-526.

Alter, S. 2004. "Making Work System Principles Visible and Usable in Systems Analysis and Design," *Proceedings of AMCIS 2004, the Americas Conference on Information Systems*, New York, NY, pp. 1604-1611.

Alter, S. 2005. "Architecture of Sysperanto: A Model-Based Ontology of the IS Field." *Communications of the Association for Information Systems*, (15:1), pp. 1-40.

Alter, S. 2006a. "Pitfalls in Analyzing Systems in Organizations" *Journal of Information System Education,* (17:3), pp. 295-302.

Alter, S. 2006b. *The Work System Method: Connecting People, Processes, and IT for Business Results*, Larkspur, CA: Work System Press.

Alter, S. 2008a. "Defining Information Systems as Work Systems: Implications for the IS Field." *European Journal of Information Systems* (17:5), pp. 448-469.

Alter, S. 2008b. "Service system fundamentals: work system, value chain, and life cycle," *IBM Systems Journal* (47:1), pp. 71-85.

Alter, S. 2010a. "Bridging the Chasm between Sociotechnical and Technical Views of Systems in Organizations," *Proceedings of ICIS 2010, the 31st International Conference on Information Systems*.

Alter, S. 2010b. "Including Work System Co-Existence, Alignment, and Coordination in Systems Analysis and Design," *Proceedings of the Sixteenth Americas Conference on Information Systems*, Lima, Peru.

Alter, S. 2010c. "The Need to Include Work System Co-Existence, Alignment, and Coordination in Systems Analysis and Design," *Proceedings of AMCIS 2010, the 16th Americas Conference on Information Systems*, August 2010.

Alter, S. 2010d. **"**Viewing Systems as Services: A Fresh Approach in the IS Field," *Communications of the Association for Information Systems*, (26:11), pp. 195-224.

Alter, S. (2010e) "Work System Theory," JAIS Theory Development Workshop, *ICIS 2010, the 31st International Conference on Information Systems*. available through http://sprouts.aisnet.org/home.html

Alter, S. and Sherer, S. 2004. "A General but Readily Adaptable Model of Information System Risk," *Communications of the Association for Information Systems,* (14:1), July, pp. 1-28.

Alter, S. and Wright, R. 2010. "Validating Work System Principles for Use in Systems Analysis and Design," accepted for publication in the *Proceedings of ICIS 2010, the 31st International Conference on Information Systems.*

Applegate, L. M. 1999. "Rigor and Relevance in MIS Research – Introduction," *MIS Quarterly* (23:1), March, pp. 1-3.

Baskerville, R. 2008. "What design science is not," *European Journal of Information Systems*, (17:5), pp. 441–443.

Baskerville, R. and Myers, M. 2004. "Special issue on action research in information systems: making IS research relevant to practice – foreword." *MIS Quarterly*, (28:3), pp. 329–335.

Benbasat, I. and R. W. Zmud. 1999. "Empirical Research in Information Systems: The Practice of Relevance." *MIS Quarterly* (23:1), pp. 3-16.

Blumer, H. 1969. *Symbolic Interactionism: Perspective and Method*, University of California Press, Berkeley, CA.

Bostrom, R.P. and Heinen, J. S. 1977a. "MIS Problems and Failures: A Socio-Technical Perspective. Part I: The Causes." *MIS Quarterly* (1:3), pp. 17-32.

Bostrom, R. P. and Heinen, J. S. 1977b. "MIS Problems and Failures: A Socio-Technical Perspective. PART II: The Application of Socio-Technical Theory." *MIS Quarterly*, (1:4), pp. 11-28.

Checkland, P. 1999. *Systems Thinking, Systems Practice* (Includes a 30-year retrospective), Chichester, UK: John Wiley & Sons.

Cherns, A. 1976. "Principles of Socio-technical Design", *Human Relations*, (2:9), pp. 783-792.

Clarke, R. J. 2005. "Workpractice Theory as a Foundation for IS Research: A Systemic Semiotic Perspective," pp. 243-247 in Ågerfalk, P. J., Bannon, L, and Fitzgerald, D., *Proceedings of ALOIS 2005*

Clarke, R.J. and Goldkuhl, G. 2007. "Editorial Notes: Communication and Coordination of Business Processes." *Systems, Signs & Actions*, (3:1), pp. 1-8.

Davis. M. (1971) "That's Interesting! Towards a Phenomenology of Sociology and a Sociology of Phenomenology," *Philosophy of the Social Sciences*, (1:2), pp. 309-344.

de Moor, A. 2008. "Activating Online Collaborative Communities," *Proceedings of ALOIS 2008*, Venice, Italy.

Dietz, J.L.G. 200. "DEMO: towards a discipline of organisation engineering," *European Journal of Operational Research* (128:2), pp. 351–363.

Dennis, A., Wixom, B.H., and Tegarden, D. 2002. Systems *Analysis & Design: An Object-Oriented Approach with UML*, New York, NY: John Wiley & Sons, Inc.

DiMaggio, P. J. 1995. "Comments on 'What Theory is Not'," *Administrative Sciences Quarterly*, (40:3), pp. 391-397.

Goldkuhl, G. 2005a. "Socio-Instrumental Pragmatism: A Theoretical Synthesis for Pragmatic Conceptualisation in Information Systems, pp, 148-165 in Ågerfalk, P. J., Bannon, L, and Fitzgerald, D., *Proceedings of ALOIS 2005*.

Goldkuhl, G. 2005b. "Workpractice Theory: What It Is and Why We Need It," pp. 235-240 in Ågerfalk, P. J., Bannon, L, and Fitzgerald, D., *Proceedings of ALOIS 2005*.

Goldkuhl, G. 2008. "What kind of pragmatism in information systems research?" AIS SIGPrag Meeting at ICIS - 2008, Paris, France. Viewed at http://www.vits.org/publikationer/dokument/663.pdf

Goldkuhl, G. and Lyytinen, K. 1982. "A language action view of information systems," *Proceedings of the 3rd International Conference on Information Systems*, pp 13–29.

Gregor, S. 2006. "The Nature of Theory in Information Systems," *MIS Quarterly* (30:3), pp. 611-642.

Hassan, N. and Mathiassen, L. 2009. "Combining Scientometric and Content Analysis Methods for Identifying Core Concepts and Action Principles of Information Systems Development" *AMCIS 2009 Proceedings.*

Hevner, A., March, S.T., Park, J. and Ram, S. 2004. "Design Science in Information Systems Research," *MIS Quarterly* (28:1), pp. 75-105.

Hirschheim, R., and Klein, H.K. 1994. "Realizing Emancipatory Principles in Information Systems Development: The Case for ETHICS," *MIS Quarterly* (18:1), pp. 83-109.

Hirschheim, R. and Klein, H.K. 2003. "Crisis in the IS Field? A Critical Reflection on the State of the Discipline," JAIS reference needed

Hoffer, J.A., George, J. F., and Valacich, J.S. 2008. *Modern Systems Analysis and Design*, 5th Edition. Upper Saddle River, NJ: Pearson Prentice Hall.

Iivari, J., Hirschheim, R. A., and Klein, H. K. 2004. "Towards a Distinctive Body of Knowledge for Information Systems Experts: Coding ISD Process Knowledge in Two IS Journals," *Information Systems Journal*, (14), pp. 313-342.

Kendall, K.E. and Kendall, J.E. 2008. *Systems Analysis and Design*, 7th Ed., Upper Saddle River, NJ: Pearson Prentice Hall.

Lee, A. S. and Nickerson, J. V. 2010. "Theory as a case of design: lessons for design from the philosophy of science." Sprague, R. H., ed., *Proceedings of the 43rd Hawaii International Conference on System Sciences* pp 1–8, IEEE Computer Society Press, Los Almitos, CA.

Lind, M. 2006. " Determination of Business Process Types Founded in Transformation and Coordination," *Systems, Signs & Actions*, (2:1)**,** pp. 60–81.

Lind, M. and Salomonson, N. 2008. "An Efficient Customer Service: Finding a Balance between Self-Service Technology and Inter-Personal Interaction." *Proceedings of ALOIS 2008*, Venice, Italy.

Majchrzak, A. and Borys, B. 2001. "Generating testable socio-technical systems theory," *Journal of Engineering Technology and Management*, (18:3), pp. 1-22.

Majchrzak, A. and Gasser, L. 2000, "TOP Modeler," *Information, Knowledge, & System Management*, (2:1), pp. 95-110

Mathiassen, L., Munk-Madsen, A., Neilsen, P.A., and Stage, J. 2000. *Object Oriented Analysis & Design*, Aalborg, Denmark: Marko Publishing ApS.

Mumford, E. and Weir, M. 1979. *Computer systems in work design – the ETHICS method*, New York: John Wiley & Sons.

Pasmore, W.A. 1985. "Social Science Transformer: the Socio-technical Perspective," Hu*man Relations* (48:1), pp. 1-22.

Sampson, S.E. & Froehle, C. M. 2006. "Foundations and Implications of a Proposed Unified Services Theory," *Production and Operations Management* (15:2), pp. 329-343.

Schmidt, K. and Bannon, L. 1992. "Taking CSCW Seriously: Supporting Articulation Work," *Computer Supported Cooperative Work*,(1:1), pp. 7-40.

SIGPrag, 2010. "Call for papers - SIGPrag 2010 at ICIS in St. Louis, MO, USA," Viewed at http://www.sigprag.org/stlouis_2010_cfp.html

Spohrer, J., Vargo, S.L., Caswell, N., and Maglio, P. P. 2008. The Service System is the Basic Abstraction of Service Science. *Proceedings of HICSS-41, The 41st Hawaii International Conference on System Sciences, Waikoloa, HI.*

Star, S.L. and Strauss, A.L. 1999. "Layers of silence, arenas of voice: The ecology of visible and invisible work," *Computer-Supported Cooperative Work (CSCW): The Journal of Collaborative Computing*, (8), pp. 9-30.

Suchman, L. 1987. *Plans and Situated Actions: The Problem of Human-Machine Communication*. Cambridge, UK: Cambridge University Press

Thomas, D.M., Gupta, S., and Bostrom, R.P. 2008. "A Meta-Theory for Understanding IS in Socio-Technical Systems," *Proceedings of the 41st Hawaii International Conference on System Sciences*.

Trist, E. 1981. "The Evolution of socio-Technical Systems: A Conceptual Framework and an Action Research Program." in Van de Ven and W. Joyce, *Perspectives on Organizational Design and Behavior*, NY:Wiley Interscience.

Truex, D., Alter, S., and Long, C. 2010. "Systems Analysis for Everyone Else: Empowering Business Professionals through a Systems Analysis Method that Fits their Needs," *Proceedings of 18th European Conference on Information Systems*, Pretoria, South Africa.

Vargo, S. L., and Lusch, R. F. 2004. "Evolving to a New Dominant Logic for Marketing," *Journal of Marketing*, (68:1), pp. 1-17.

Weber, R. (2003) "Editor's Comments," *MIS Quarterly*, (27:2), pp. iii-xi.

Weigand, H. 2006. "Two decades of the language-action perspective," *Communications of the ACM* (49:5), pp. 44–46.

Winograd, T. and Flores, F. 1986. *Understanding Computers and Cognition: A New Foundation for Design*, Ablex, Norwood, NJ.

Winter, R. 2008. "Design science research in Europe," *European Journal of Information Systems*, (17:5), pp. 470-475.

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