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## Abstract

This paper describes an exploration of whether ideas related to pragmatism, practical theory, and practice theory provide potentially useful directions for extending work system theory (WST), which is an outgrowth of an attempt to develop the work system method (WSM), a flexible systems analysis method for business professionals. After summarizing WST's basic premises and its two central frameworks, this paper uses a positioning map to explain reasons for considering relationships between WST and a number of topics related to practical issues and practice theory. Based on that positioning map, the subsequent sections discuss relationships between WST and UML, Goldkuhl's workpractice theory, and the more general notion of practice theory. A concluding section briefly addresses a set of questions related to whether WST is a practical theory of practice. This paper's comparisons of WST with the three theoretical perspectives for describing and understanding systems could be a step toward greater practical application of IS research related to the nature and evolution of activities, processes, routines, and practices involving the use of technology in organizational settings.

**Keywords:** Work system theory, Practical theory, Practice theory, Workpractice theory, Heidegger's analysis of equipment

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## 1 An Effort to Extend a Pragmatic Research Stream

An editorial with the title "Getting pragmatic" in the *European Journal of Information Systems* (Ågerfalk 2010, p. 251) notes that "information systems (IS) is often seen as a pragmatic discipline with an emphasis on applied research and practical implications. .... Essentially, a pragmatist outlook implies an interest in change and how people bring about and respond to change. To engage with the action character of the empirical field is at the core of pragmatism. ... As noted 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."

**The challenge.** This paper reports on conceptual research that attempted to extend a research stream that I have pursued for many years, that was energized by pragmatic concerns, and that I view as quite practical. The research stream concerns developing and testing a systems analysis method for business professionals, called the work system method (WSM), and the underlying theory, called work system theory (WST). WSM was developed for pragmatic reasons that are explained in Alter 2006b, 2008, 2013b). It seemed as though most systems analysis methods were for use by consultants and IT professionals, and not by typical business professionals, many of whom lack an organized way to think about systems for themselves. As noted by Beath and Orlikowski (1994), the resulting asymmetry leaves business professionals at a disadvantage when they deal with consultants and IT professionals whose perspectives are often built on tools and methods that business professionals do not use or understand. In addition to addressing a pragmatic purpose, WSM seems to be practical because many hundreds of employed MBA and Executive MBA students have used various versions of it to produce preliminary management briefings related to problematic work systems in their own organizations (Truex et al. 2010, 2011). The underlying theory, WST, which emerged from the effort to develop WSM, seems to be significant on its own right because, as mentioned in Alter (2013b) its main ideas and its extensions have contributed to a diverse group of journal articles by other authors and at least eight completed PhD theses and several others in progress.

Based on reading articles such as Ågerfalk (2010), I wondered whether new directions for extending WST and WSM might be inspired by the interests of researchers associated with SIG-PRAG, the AIS Special Interest Group on Pragmatist IS Research. (This is one of many potential directions for extension that have been considered, as will be explained later.) To pursue this possibility, I presented papers at the 2010 and 2012 SIG-PRAG workshops with the explicit goal of seeing whether the ideas in WST and WSM would resonate with a SIG-PRAG audience. My attempt to find bridges between WST/WSM and what I imagined as the interests of researchers associated with SIG-PRAG started with the two research streams mentioned by Ågerfalk (2010), the language action perspective (LAP) and organizational semiotics. LAP 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 (Goldkuhl and Lyytinen 1982; Winograd and Flores 1986; Dietz 2001; Weigand 2006)." Organizational semiotics (e.g. Stamper et al. 2000; Stamper 2001) "set out to investigate the various levels at which IS as sign systems affect organizations, from their material representations through to social prerequisites and consequences." (Ågerfalk 2010, p. 251).

My initial attempts to visualize how LAP and organizational semiotics might improve WSM were unsuccessful. Ågerfalk (2010) described those research areas as pragmatic, yet discussions related to a presentation of work system theory (WST) at the 2010 SIG-PRAG workshop generated little insight into how those approaches could extend WSM in ways that would be usable in practice by typical business professionals such as the employed MBA and Executive MBA students who had used various versions of WSM. Thus, although WSM was developed for pragmatic reasons and seemed to be practical in use, and although LAP and organizational semiotics seemed to be central topics of pragmatic IS research, it wasn't clear how those ostensibly pragmatic approaches could augment WSM or could be used by business practitioners. A possible obstacle to this type of use is a fundamental mismatch in levels of

focus and levels of abstraction. For example, although work systems use and create information and although research associated with organizational semiotics touches many topics that are relevant to information in organizations, I had difficulty seeing how concepts such as signs, sign systems, and Stamper's semiotic ladder (social, pragmatic, semantic, syntactic, empiric, and physical) could extend WST/WSM beyond simpler concepts that were already included. Likewise, traditional LAP seemed more concerned with conversational elements such as utterances and conversational commitments, whereas WST and WSM are more concerned with the creation, structure, operation, and performance results of IT-reliant work systems in organizations. Utterances and conversational commitments occur within work systems that are not totally automated, 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. It is surely possible that I missed something in this regard, especially since many researchers find LAP useful for topics ranging from communication analysis to summarizing the structure of entire organizations.

As I tried to develop the ideas for the two SIG-PRAG presentations, I encountered other ideas that seemed potentially more useful for my purposes, such as practice theory, sociomateriality, and Heidegger's analysis of equipment. Research related to practice theory spans efforts of a many social scientists and philosophers, whose diversity and lack of agreement about fundamentals of practice theory is widely recognized (e.g., Schatzki 2001; Postill 2008; Feldman and Orlikowski 2011). The articles that I looked at fell under headings such as organizational routines (Feldman and Pentland 2003), communities of practice (Wenger 1998), practice theory (e.g., Schatzki 2001; Feldman and Orlikowski 2011), sociomateriality (Orlikowski and Scott 2008), and Heidegger's notion of equipment in use (Riemer and Johnston 2013a, 2013b).

To date, the effort of producing the two SIG-PRAG presentations has led to several results including this paper, which supersedes both workshop papers. Other results include an AMCIS 2012 paper about the temporal nature of sociomateriality (Alter 2012a) that will be mentioned later, an idea about the temporal nature of workarounds that appears in Alter (2013a), and, as mentioned in this paper's conclusion, preliminary ideas about how certain ideas related to Heidegger's analysis of equipment might help in extending WST/WSM in fruitful directions.

**Practical, pragmatic, practice and related terms**. One of the reasons for pursuing these concepts is the possibility of interrelationships between different streams of research that are associated with the terms practical, pragmatic, and practice. Even though relationships between the following definitions seem ephemeral, there is a tantalizing possibility that the research streams are related in a deep way that could be useful in IS practice and research:

- pragmatic: related to actions and decisions that are useful in practice
- practical: related to action or practice
- practices: "embodied, materially mediated arrays of human activity centrally organized around shared practical understanding." (Schatzki 2001, p. 11)
- use in practice: routine use in relevant settings
- pragmatism: a philosophical tradition focusing on assessment of truth or validity in relation to the usefulness of practical consequences
- practical theory: a theory "presented in a form overtly designed for use in joining with others." (Cronen 2001, p. 26)

- practice theory: "a body of highly diverse writings by thinkers who adopt a loosely defined 'practice approach'" (Postill 2008).

**Research question**. Despite the possible overlaps between these ideas, it was not at all obvious whether and how research under the umbrella of "pragmatist research in IS" and/or practice theory would provide concepts, insights, or case studies that would help in further development of WST/ WSM. This paper pursues a conceptual research question that is unconventional because of its pragmatic purpose, wherein the true value of the knowledge generated involves its utility and usefulness rather than any abstract notion of truth (e.g., above comment about pragmatism in Goles and Hirschheim 2000). The research tried to extend WST/ WSM by exploring a rather amorphous set of ideas that was developed by different researchers largely for different reasons based on different assumptions, and that therefore might not fit WST/WSM in any straightforward way. For the sake of simplicity, the research question was boiled down to this paper's title:

*Is work system theory a practical theory of practice?*

Admittedly, this research question lacks clarity and does not lead to a methodology or research results that can be evaluated based on objective criteria. However, that is sometimes the nature of exploratory research, and often is the nature of conceptual quandaries faced by researchers. To the extent to which WST is a practical theory of practice, it would seem more likely that WST and WSM could be extended and/or improved based on research under an imagined category of "topics that might interest SIG-PRAG members." Not surprisingly, the effort of exploring that question led in a number of directions, several of which will be discussed here. Other directions that seemed to be dead ends will be omitted since they were pursued largely because of my limited understanding of particular topics.

**Contribution**. I think that this paper has value in several areas. Part of the value is simply in the direction that it found for potential extensions of WST/WSM. Another part is related to its possible use as an example (perhaps a cautionary example) that other researchers could consider when they look for synergies between their own research topics and related topics. Development of such linkages could be a step toward making IS research more pragmatic and more useful in practice. Regardless of the specifics of their research, many IS researchers would probably benefit from clarifying the position of their research in relation to pragmatism, practicality, practice theory, and related topics. Finally, in relation to the general interests of researchers who perform what they consider to be pragmatist IS research, this paper's emphasis on using terms such as pragmatic, practical, practices, practical theory, and practice theory may be helpful in clarifying or problematizing the relationship between these terms in various streams of research. Underlying the entire paper is an attempt to consider linkages between practical methods and practice theories.

**Organization**. This paper proceeds as follows. A summary of WST includes basic premises and two central frameworks, with particular emphasis on pragmatic aspects of WST and aspects of how it describes practices. This summary omits many details that are explained in depth in Alter (2013b). A positioning map explains the reasons for considering relationships between WST and a number of topics that seem to be of interest to a SIG-PRAG audience. Based on that positioning map, the subse-

quent sections discuss relationships between WST and UML, Goldkuhl's workpractice theory, and the more general notion of practice theory. A concluding section briefly addresses a set of questions related to whether WST is a practical theory of practice.

## 2 Work System Theory

Work system theory (WST) is a theory for analysis (Gregor 2006) that provides an organized framework of abstract concepts for describing systems in organizations. Based on footnote #9 in Cronen (2001, p. 33), WST might be viewed instead as what Chein (1972) calls a metatheory, much like "most theories in social research." It is also worthwhile to recognize that this paper does not engage in ongoing controversies about whether different types of theories qualify as proper theories (e.g., Markus and Robey 1988; Sutton and Staw 1995; Weick 1995; Gregor 2006; Weber 2012). Since practice theory is a central topic in this paper, we use a definition of theory from the introduction to an influential book covering views of practice theory from many noted sociologists, philosophers, and scholars of science: "Theory means, simply, general and abstract account. A theory of X is a general and abstract account of X."... "Systems of generalizations (or universal statements) that back explanations, predictions, and research strategies are theories. But so, too, for example, are typologies of social phenomena; models of social affairs; accounts of what social things (e.g., practices, institutions) are; conceptual frameworks developed expressly for depicting sociality; and descriptions of social life—so long as they are couched in general, abstract terms." (Schatzki 2001, pp. 12-13)

As is explained in substantial detail in Alter (2013b), WST emerged gradually during an extended effort to develop systems analysis methods that would help business professionals think more effectively about systems in organizations and collaborate more effectively with IT professionals. (Also see Truex et al. 2010, 2011). WST identifies concepts and relationships that need to be understood about the form, function, and context of work systems in organizations. By focusing attention on the work system, not just the information system or IT artefact that is being constructed, WST can help business professionals, IT specialists, and researchers focus on the overall goal of improving the performance of work systems, rather than the much more limited goal of creating an IT artefact. Thus, WST is designed to support practice and is relevant to IT artefact design and related interventions even though it does not contain a direct description of specific practices in either area.

**Basic construct.** The basic construct in WST is "work system," a general case for thinking about systems within or across organizations. A work system is a system in which human participants and/or machines perform processes and activities using information, technology, and other resources to produce products/services for internal or external customers. Enterprises that grow beyond a largely improvised start-up phase can be viewed as consisting of multiple work systems. Typical business organizations contain work systems that procure materials from suppliers, produce products, deliver products, find customers, create financial reports, hire employees, coordinate work across departments, and perform many other functions. Almost all work systems in business and governmental organizations rely on IT in order to operate efficiently and effectively.

**General case and special cases**. WST applies to work systems in general and, by inheritance, to special cases of work systems. By default, the system of interest is assumed to be a sociotechnical system with human participants (who may or may not be users of IT). Special cases that are important in the IS discipline include, among others, information systems, projects, supply chains, self-service work systems, and totally automated work systems. Information systems are work systems whose processes and activities are totally devoted to processing information through activities including capturing, transmitting, storing, retrieving, deleting, manipulating, and displaying information (Alter 2008). Projects are temporary work systems designed to produce particular products and services and then go out of existence. Supply chains are inter-organizational work systems that provide supplies and other resources required for the activities of end-customers. Self-service work systems such as ecommerce from a customer's viewpoint are work systems in which customers perform processes and activities using resources (e.g., ecommerce web sites) provided for their use. Totally automated work systems (including totally automated IS) are work systems all of whose processes and activities are performed by software, machines, and other devices (e.g., automated machine cells and Internet search algorithms). People who create and maintain those programs, machines, and other devices are participants in other work systems that create or maintain the automated work systems.

## 2.1 Basic Premises of Work System Theory

WST is based on the following premises.

**Domain of relevance**. WST is relevant for describing, analyzing, designing, or evaluating systems within or across organizations, whether or not IT is involved, and whether or not the system is totally automated.

**Unit of analysis**. The unit of analysis is a work system, typically within an organization or enterprise. Typically a work system is not an entire organization or enterprise, because most organizations and enterprises consist of multiple work systems that contribute to the organization's charter even though they perform quite different functions.

**Multiple measures of performance**. Understanding a work system's performance requires multiple measures of performance for the system, for its components, and for their interactions.

**Internal congruence and alignment.** A work system's components operate together to accomplish one or more purposes and to satisfy multiple performance goals. Accordingly, the components within a work system should be aligned and generally congruent in terms of platforms and standards.

**Different perspectives and levels of detail**. Different individuals often need to understand, analyze, design, and evaluate work systems from different perspectives and at different levels of detail. For example, the analytical goals, expectations, and perspectives of managers, IT specialists, and social science researchers are often quite different.

**Sociotechnical systems as unified entities**. Although work systems are viewed as sociotechnical systems by default, WST does not follow the tradition of separating social systems versus technical systems. Instead, it views the social and the technical as part of a single system.

**Symmetry between sociotechnical and totally automated work systems**. Despite the default assumption that systems are sociotechnical, WST permits totally automated systems that perform work without human intervention once they are launched into action by an external stimulus. WST treats sociotechnical work systems and totally automated work systems as symmetrically as possible, and many concepts and generalizations apply to both cases. Establishing as much symmetry of treatment as possible provides useful consistency when sociotechnical work systems are decomposed into subsystems as part of analysis and design efforts.

**Boundaries of a work system**. Work system is a mental construct. For purposes of description, analysis, evaluation, and design, the boundaries of the work system of interest are selected by identifying the smallest work system that has the problems, opportunities, and issues that are of interest. Different observers typically define boundaries differently. In a collaborative effort, such as deciding how to create or improve a work system, cooperative determination of the boundaries of the work system is extremely helpful for minimizing confusion.

**System identity and integrity in the presence of change**. A work system's form and function may change incrementally during a limited time frame such as a week or month. During such changes it maintains enough identity and integrity as a system to permit description of its operation and measurement of its performance even as specific features or components change or operate inconsistent with parts of the designer's intentions. This essentially static view of a work system mirrors Brown and Duguid's (1991) distinction between actual and espoused practices and Feldman and Pentland's (2003) distinction between ostensive aspects of routines (their espoused structure) and performative aspects of routines (the activities that occur), which "creates an on-going opportunity for variation, selection, and retention of new practices and patterns of action within routines."

**Evolution through planned and emergent change**. WST assumes that work systems evolve through a combination of planned and emergent change. Planned change occurs through defined projects in which resources are allocated explicitly for the purpose of creating a work system or changing aspects of an existing work system. Emergent or unplanned change occurs through incremental adaptations and workarounds as work system participants try to minimize or bypass obstacles that interfere with expeditious achievement of work goals.

## 2.2 Basic Frameworks

Figure 1 presents WST's two basic frameworks. The work system framework outlines a static description of a work system during a specific interval. The work system life cycle model is a dynamic view of how work systems change over time.

**Work system framework**. The work system framework outlines a static view of a work system's form, function, and context in terms of nine elements that are part of even a basic understanding of a work system. It emphasizes business rather than IT concerns, and 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/services for customers. The arrows say that elements of a work system should be in alignment. Figure 1 identifies four internal elements of a work system (process and activities, participants, information, and technologies) plus five other elements (customers, products and services produced, environment, infra-

structure, and strategies) that are part of even a basic understanding of a work system. Customers of a work system may also be participants in the work system. The elements of the work system framework and many related ideas are explained in Alter (2006b, 2008, 2013b).

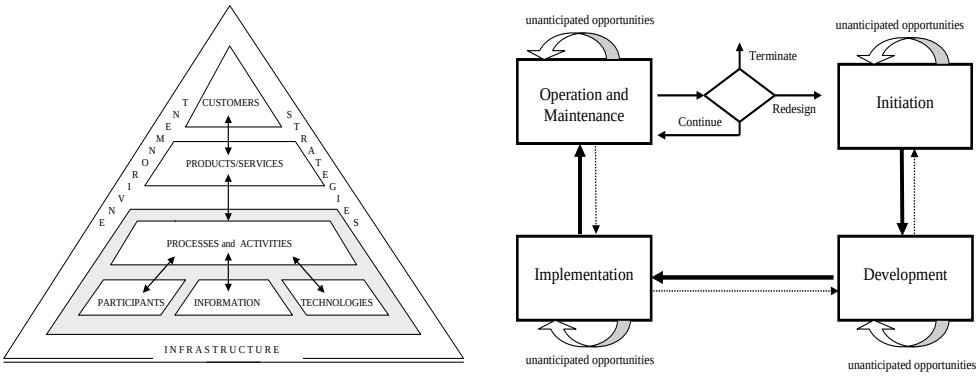


Figure 1. Work system framework and work system life cycle model (Alter 2013b)

**Work system life cycle model**. The WSLC (Figure 1) expresses a dynamic view of how work systems change over time through iterations involving planned change and emergent (unplanned) change. (Alter 2006b, 2008, 2013b). The WSLC represents planned change as projects that include initiation, development, and implementation phases. Development involves creation or acquisition of resources required for implementation of desired changes in the organization. Development may include any of the following: software development, software acquisition, software configuration, creation of new procedures, creation of documentation and training materials, and acquisition of any other resources needed for implementation of the new version of the work system. The WSLC represents emergent change using inward-facing arrows representing ongoing adaptations, bricolage, and workarounds that change aspects of the current work system without separate allocation of significant project resources. With its iterative nature and focus on work systems rather than software per se, the WSLC is fundamentally different from the SDLC, Rational Unified Process (RUP) and other IT-oriented process models that are designed to provide guidance for executing software development projects.

**Work system metamodel**. A basic premise of WST is that different observers use different perspectives and different levels of detail. The work system framework in Figure 1 has proven useful in a high level problem solving sequence of identifying an "as is" work system, exploring important problem and issues, and then recommending proposed changes that create a "to be" work system. IT professionals and others who need to clarify obstacles and other problems or produce software need a more detailed view of a work system. Also, the work system framework might seem rather vague in relation to the spirit of practice theories, which ideally are developed through deep engagement with practitioners and describe the "emergent constitution of the sociomaterial world through the micro-dynamics of everyday life in organizations." (Feldman and Orlikowski 2011, p. 20)

The work system metamodel in Figure 2 (Alter 2010, p. 10) is an extension of WST that addresses fundamental limitations of the work system framework.

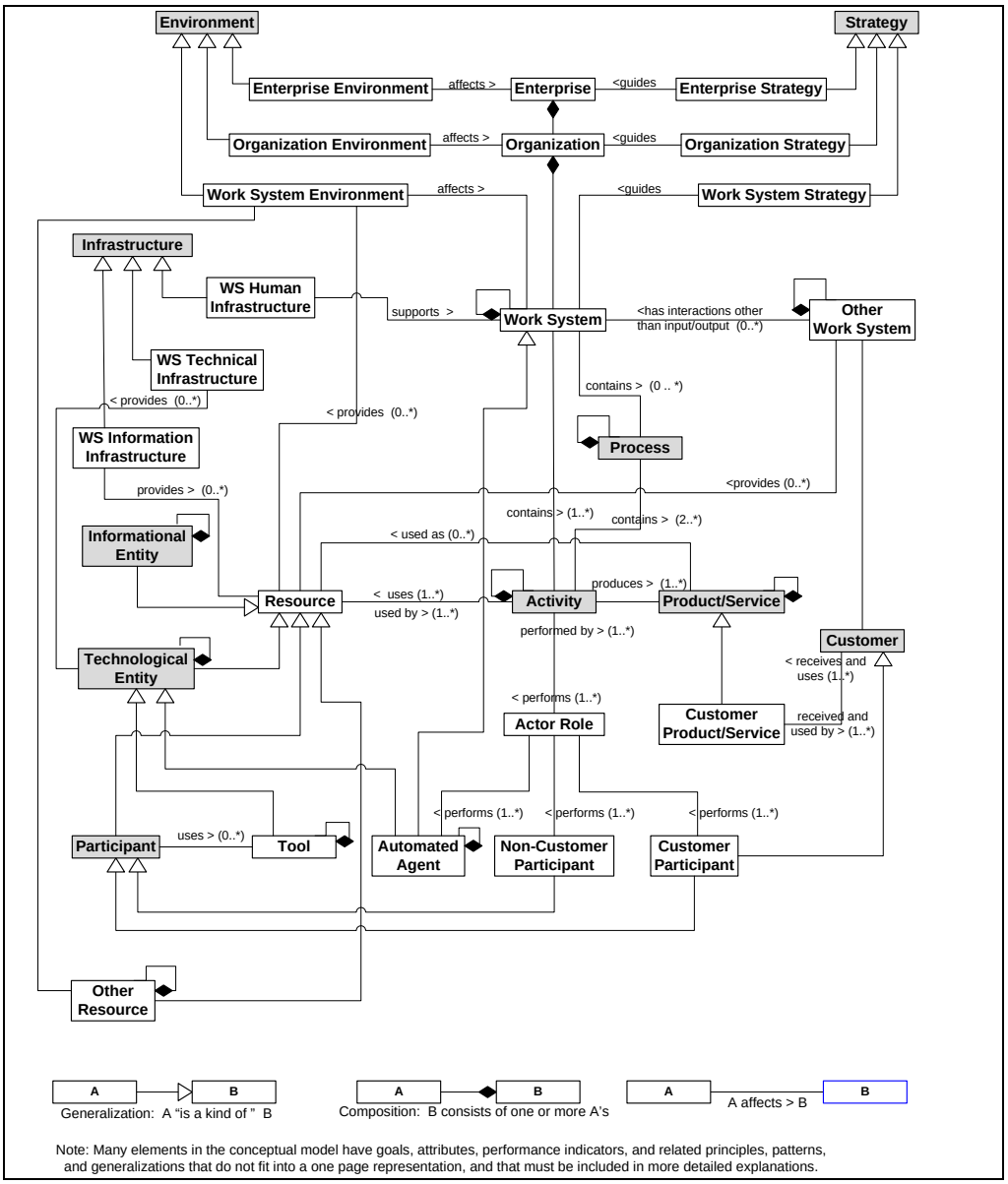


Figure 2. Metamodel Representing a More Detailed Version of the Work System Framework

The metamodel is basically a more detailed specification of the work system framework, with each element re-interpreted in a more detailed way. Information becomes informational entity, technology becomes technological entity and is divided into tools and automated agents, activities are performed by three types of actors, and so on. "Uses" is a relationship between a participant and a tool. Attributes of entity types, such as goals, characteristics, metrics, principles, and other concepts are assumed important even though they are not shown, just as attributes of classes might not be shown in a summarized UML class diagram. Those attributes of various elements of the metamodel would be used while defining problems or opportunities, evaluating "as is" work systems, and justifying proposed improvements. In effect, the

metamodel takes over where the work system framework does not try to describe detailed relationships between elements. For example, every activity produces products/services that may be resources for other activities and/or may be received and used by the work system's customers. Such relationships in the metamodel can be the basis of straightforward tools even though they are not specified in the work system framework.

The metamodel is included in this paper because it serves as an intermediate representation between a summary view of a work system based on the work system framework and the more detailed and technology-oriented representations produced by IT professionals when they use UML. This type of intermediate representation potentially has practical value for guiding analysis processes and because if it can serve as a step in converting from high level summaries to UML models used by IT professionals. For example, Alter and Bolloju (2012) shows how it is possible to convert two different types of work system summaries, one based on the work system framework and one based on part of the work system metamodel, into use case diagrams that are often viewed as the first step in object-oriented analysis and design. The more detailed summary based on the metamodel contains more of the types of information that appear in use case narratives.

Certain parts of the metamodel emphasize topics that are part of shared practical understandings that are emphasized in practice theories. In relation to work system structure, those parts of the metamodel specify things such as:

- which activities are included in a work system
- which resources are used when performing each of those activities
- which tools are used by specific participants while performing specific actor roles
- what knowledge and skill of work system participants is required regarding the use of specific technologies (the metamodel's link between participant and tool)
- how specific technologies affect work system participants, for better or for worse.

The sequence above exemplifies how the metamodel encompasses both structure that might be the focus of more traditional analysis and understandings and perceptions of technology-in-practice or information-in-practice that would be important to practice researchers and theorists.

Finally, in relation to its practical application, the metamodel's representation of work system structure includes automated agents and says that automated agents are totally automated work systems in their own right. That observation is important in IT professionals' practices of decomposing work systems during analysis and design even if it may not fit well with the focus of practice theory on the human understandings, knowledge, and perceptions within the work system that is being analyzed or designed.

## 2.3 Pragmatic Aspects of Work System Theory

WSM exists for practical purposes and is based on a pragmatic mindset. It evolved as a flexible systems analysis and design method for business professionals concerned with creating or improving work systems. It starts with whatever problems, opportunities, or issues launched the analysis. The "as is" and "to be" systems are work systems rather than configurations of hardware and software. Different versions of WSM

have been developed and used over more than a decade. Classroom results from usage of early versions by 202 teams of MBA students led to identification of common difficulties in thinking about systems in organizations (Alter 2006a). Petkov and Petkova (2008) found that use of the work system framework improved undergraduate IS students' understandings of an ERP example. Two more recent papers found generally successful use by 75 and then 301 advanced MBA students who used substantially updated versions at a different university (Truex et al. 2010, 2011). A much simpler version was used for teaching freshmen IS students in Australia (Recker and Alter 2012).

In recent usage of a work system analysis template by employed MBA students, each student identified an IT-reliant work system that had a problem or opportunity. The work system analysis template guided the process of looking at the structure and performance of the "as is" work system in more detail, describing the "to be" work system, and explaining why its performance should be better. The "as is" and "to be" work systems were summarized using the format of a one-page "work system snapshot" such as the one in Table 1, which is related to hiring new employees. The requirement of not exceeding one page avoids excessive detail and helps focus attention on the system's scope. Work system snapshots require rigorous thinking because of internal consistency rules, e.g., each product/service must be received and used by at least one customer group.

<table>
<tr><th colspan="2">Customers</th><th colspan="2">Products/ Services</th></tr>
<tr><td colspan="2">• Hiring manager<br>• Larger organization (which will have the applicant as a colleague<br>• HR manager (who will analyze the nature of applications)</td><td colspan="2">• Applications (which may be used for subsequent analysis)<br>• Job offers<br>• Rejection letters<br>• Hiring of the applicant</td></tr>
<tr><th colspan="4">Major Processes and Activities</th></tr>
<tr><td colspan="2">• Hiring manager submits request for new hire within existing budget<br>• Staffing coordinator defines the parameters of the new position.<br>• Staffing coordinator publicizes the position.<br>• Applicants submit job applications.<br>• Staffing coordinator selects shortlisted applicants.<br>• Hiring manager identifies applicants to interview.</td><td colspan="2">• Staffing coordinator sets up interviews.<br>• Hiring manager and other interviewers perform interviews.<br>• Hiring manager and other interviewers provide feedback from the interviews.<br>• Hiring manager makes hiring decisions.<br>• Staffing assistant sends offer letters or rejections.<br>• Successful applicant accepts or rejects job offer or negotiates further.</td></tr>
<tr><th>Participants</th><th colspan="2">Information</th><th>Technologies</th></tr>
<tr><td>• Hiring managers<br>• Staffing coordinator<br>• Applicants<br>• Staffing assistant<br>• Other employees who perform interviews</td><td>• Job requisition<br>• Job description<br>• Advertisements<br>• Job applications<br>• Cover letters<br>• Applicant resumes</td><td>• Short list of applicants<br>• Information and impressions from the interviews<br>• Job offers<br>• Rejection letters</td><td>• New HR portal that is being built<br>• Word processor<br>• Telephones<br>• Email</td></tr>
</table>

Table 1: Work system snapshot of a recommended "to be" work system

## 3 Possible Directions for Extending Work System Theory

Figure 3 is a simplified combination of Figures 3 and 4 in Alter (2013b). Figure 3 places WST at the center of a "positioning framework" whose four vertices identify broad categories of IS concepts and theories that individually or in combination constitute directions for enhancing WST/WSM to make it more powerful and valuable. Figure 3 shows that the attempt to extend WST/WSM by incorporating insights related to pragmatism, practical theory, and practices is one of a number of similar attempts that occurred over recent years and are continuing. In all cases, the goal was to find ways to make WST/WSM as useful as possible. In all cases there was no obvious reason to believe that a particular direction would generate the most useful insights.

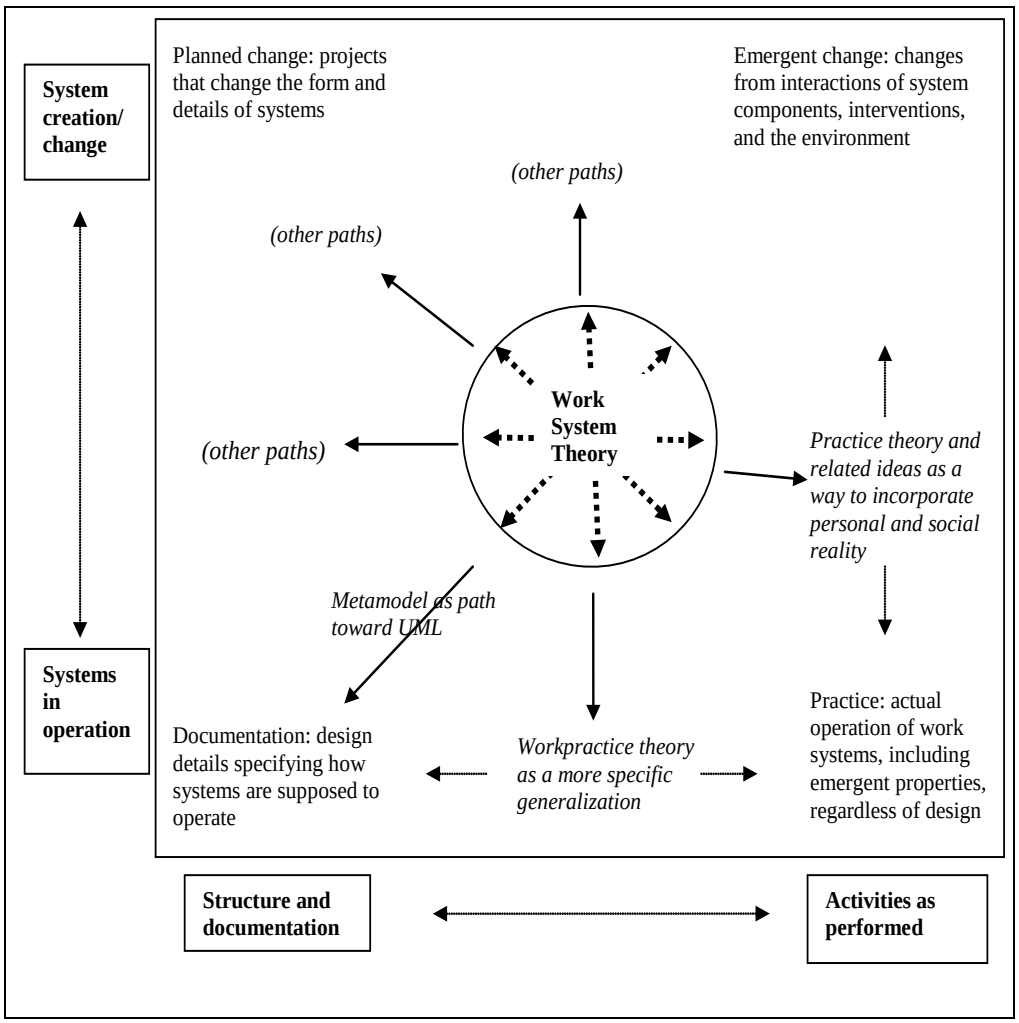


Figure 3. Possible directions for searching for enhancements of WST/WSM

WST appears in the middle of Figure 3 because the entire development of WST/WSM has combined attention to the bottom of Figure 3 (systems in operation)

with the top of Figure 3 (systems changing over time). For example, WST's basic components include the two frameworks shown in Figure 1, one of which concerns work systems in operation while the other concerns how work systems change over time. Likewise, the development of WST/WSM has combined attention the left side of Figure 3 (aspects of formal descriptions of systems and system development methods) with attention to the right side (aspects of actual practices related to systems in operation and system development). This paper's exploration of possible synergies with pragmatism, practical theory, and practices focuses on the lower right side of Figure 3. Other extensions and possibilities mentioned in Alter (2013b) are indicated by arrows annotated with "other path" and will not be discussed here.

The remainder of this section looks at three of many possible directions for enhancing WST/WSM. The immediate goals of this section are to describe parts of the effort to extend WST/ WSM and to provide a backdrop for considering whether WST qualifies as a practice theory. An additional goal is to contribute to the discussion of practice theories in the community of pragmatist IS researchers by exploring the notion of practice theory and how that notion is related to pragmatic concerns. The remainder of this section starts with UML, which does not fit well with concepts and research normally associated with practice theory, but which serves several other purposes in this paper. UML is mentioned as an anchor point related to practicality and also because the metamodel shown in Figure 2 has become a fruitful extension of WST/WSM in the direction of rigorous specification (i.e., toward the lower left in Figure 3), as illustrated in Alter (2012b) and Alter and Bolloju 2012). Next is a discussion of relationships between WST and Goldkuhl's workpractice theory, which is positioned in Figure 3 as a path to be explored for finding new ways to link WST to an intermediate point between specifications about how systems are supposed to operate and abstractions about practice. Figure 3 portrays an exploration of practice theory as a possible path for finding new ways to link WST to an intermediate point between the actual operation of systems and emergent change processes.

## 3.1 UML, a Practical Theory but not a Practice Theory

UML, the Unified Modeling Language, is included in this paper for two reasons: 1) to serve as an anchor point related to practicality and 2) because the metamodel shown in Figure 2 illustrates the idea of extending WST/WSM in new directions.In that instance it serves as the core of a fruitful extension of WST/WSM in the direction of rigorous specification. UML belongs in the practical world because it is used widely even though it has a number of shortcomings. It brings a perspective and set of well-defined concepts that are central to important practices for building IT artifacts. UML was constructed for pragmatic purposes (including reconciliation of three analysis and design approaches by three different developers) and is used widely, but focuses on technical documentation without direct reference to human understanding, skills, and knowledge that are central to practice theories. In this paper it serves as an anchor point for practicality because it expresses a well-developed abstract perspective, has a practical purpose, and has been used widely, even though it is not in the spirit of practice theories as generally conceived by most researchers who are recognized as practice theorists.

UML provides a terse and rigorous way to express activities that occur in totally automated parts of a work system. UML 2.0 provides 14 types of diagrams that can be used by IT professionals for specifying the structure, behavior, and interactions of

components of an IT artefact (viewing an IT artefact as configuration of hardware and software that is used by users). UML expresses a distinct perspective in which the relevant world consists of objects that perform activities triggered by messages passed between objects. Methods for performing each of those activities are stored with the "classes" to which the objects belong.

Based on its use in practice, UML is clearly practical. It qualifies as a practical theory based on Cronen's (2001) definition and evaluation criteria because it is "presented in a form overtly designed for use in joining with others." (p. 26) and is "useful for (1) identifying a situation-in-view, (2) constructing judgments (systemic hypotheses) about the situation that (3) implicate actions leading to (4) the consequence of improving the situation." (p. 29). Practicality does not imply perfection, however. UML uses abstruse concepts and terminology such as objects and classes that are understood and used in practice by only a subset of IT professionals. And when UML is used, often only a subset of UML is actually used. (Dobing and Parsons 2004).

The fact that UML is a practical theory does not imply that it is a practice theory. UML is used to specify business processes and information, but does not fully describe practices if one accepts Schatzki's (2001) definition of practices as "embodied, materially mediated arrays of human activity centrally organized around shared practical understanding." On the other hand, while UML itself is not a practice theory, intensive research on the use of UML within appropriate communities of practice might produce a practice theory related to IT artefact design using UML. Among many other salient factors, a practice theory related to IT artefact design using UML would involve shared understandings of UML as a technology-in-practice, including the parts of UML that were not used for various reasons.

In addition to providing an example that is a practical theory without being a practice theory, UML is included in this paper because the practicality of WST usage will be greater if there are more convenient ways to convert from essentially sociotechnical analyses of sociotechnical work systems into detailed technical specifications that reflect understandings of how the sociotechnical system should operate. The metamodel in Figure 2 seems to be a conduit in that direction.

## 3.2 Workpractice Theory

Workpractice theory (Goldkuhl and Röstlinger 2006) focuses on systematic practices within organizations and therefore is directly related to action and practice. It covers some of the same terrain as WST, with some concepts in common, but with other concepts highlighted that are not mentioned explicitly in the two main frameworks in WST. Despite the inclusion of the word *practice* in its name, it is quite different in content and spirit from research often placed under the broad heading of practice theory, especially since it specifically refers to work in organizations. To date workpractice theory has been used primarily by researchers.

Figure 4 shows a restructured generic workpractice model from Goldkuhl and Röstlinger (2006), which notes that practice is a rather general notion, even though the delineation workpractice makes explicit the work character of their practice notion. The generic workpractice model addresses many of the same topics as the work system framework and work system metamodel (Figures 1 and 2), but uses different terminology and emphasizes some things that are not emphasized in either the framework or the metamodel. Some of the concepts that appear explicitly in the generic workpractice model also appear explicitly but with different names in the work

system framework, e.g., actions (processes and activities), producers (participants and technologies), products and other results (products/services), and clients (customers). Some concepts in the workpractice model can be treated as properties of specific elements of the work system metamodel, e.g., place, time, and capabilities. Other concepts are not mentioned at all in Figures 1 and 2, and do not fit well in either figure, e.g., product orders, compensations, transaction judgements, payers, financial providers, and so on. The latter concepts seem relevant to work systems that process orders, transactions, and payments, but not to other work systems where those concepts are not important, such as performing medical diagnosis, designing new products, and debugging software.

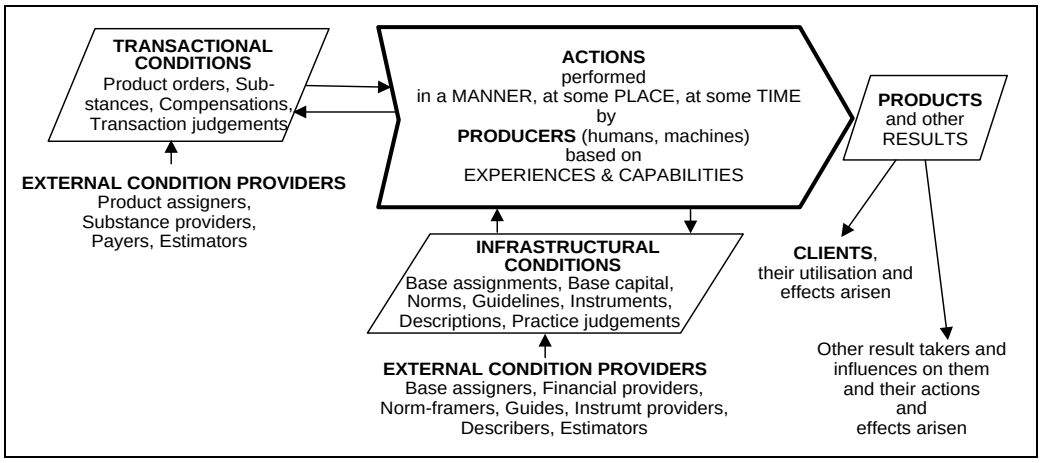


Figure 4: Workpractice model, as revised in Goldkuhl and Röstlinger (2006)

The following are selected comparisons between aspects of workpractice theory and WST:

**Definition of work practice**. From a previous definition cited by Goldkuhl and Röstlinger (2006, p.3), "a workpractice consists of people (the producers) acting in favour of some people (the clients). The producers create results (products) from the workpractice aimed for the clients. This means that workpractice theory emphasizes the intended results and the intended receivers/users of these results." For similar reasons, customers appear at the top of the work system framework and receive products and services that are produced by processes and activities.

**A revised definition (p. 13)**: "A workpractice means that some actors make something in favour of some actors, and sometimes against some actors; this acting is initiated by assignments from some actors, and is performed at some time and place and in some manner, and is based on material, immaterial and financial conditions of transactional and infrastructural character and a workpractice capability which is established and can continuously be changed." The previously mentioned definition of work system is simpler: A work system is a system in which human participants and/or machines perform processes and activities using information, technology, and other resources to produce products and/or services for internal or external customers. The work system framework (Figure 1) and work system metamodel (Figure 2) identify elements of a basic understanding of a work system. Parts of the revised defini-

tion of workpractices would appear as elements of a work system or as properties of elements of a work system.

**"Workpractices consist of conditions, producers, actions and results. Conditions/results are action objects**. An action object is created through some action and used in some other action. Action objects are often given a materialised and persistent form, but some action objects (as e.g. oral utterances) are evanescent. To be sustained as a practice function, such an action object must be internalised and remembered after its original and immediate interpretation." (p. 3) The work system framework (Figure 1) does not address this level of detail. However, the metamodel (Figure 2) views activities as using resources and producing other resources. Products/services produced by any activity may be transient, in which case they are a resource for another activity but then disappear, or maybe persistent, in which case they remain for future use within the work system or are products or services that are transferred to customers and used elsewhere.

**"Producers are humans. However, advanced machines can as well be able to perform certain actions.** For example, IT systems can function as producers for certain types of formalized actions." (p. 4) The metamodel treats specific technologies within a work system as either tools that are used by participants performing specific activities within a work system or as automated agents that perform work autonomously, in essence operating as automated work systems in their own right. That distinction is important in the treatment of totally automated subsystems and subsubsystems of sociotechnical work systems during analysis and design.

**"Workpractice theory is a conceptualisation of workpractices as IS contexts**. It is aimed to be used in IS related inquiries." (p. 5) This is a point where WST and workpractice theory diverge. WST is a theory about work systems in general. Information systems are special case that inherits properties from work systems in general. WST emerged from an effort to develop IS-related systems analysis tools for business professionals, but eventually took on a more general form when it became apparent that most of the properties of information systems in general are actually properties of work systems in general. (Alter 2008, 2013b)

**"The workpractice notion can be seen to be broader than the business process notion**." (p. 6). WST makes a similar point by including processes and activities as one of nine elements in a basic understanding of a work system. Seeing a situation as a work system provides a much broader lens than seeing a situation as a business process whose properties include properties of the activities that are performed, but do not include properties of the people doing the work or of the surrounding environment.

**"Infrastructure is what is used for recurrent transactions, both for support and governance**." (p. 8) Somewhat similarly, WST treats infrastructure as shared resources that are used by multiple work systems. The metamodel points out explicitly that infrastructure includes technical, human, and informational infrastructure.

There many other areas in which workpractice theory and WST agree or overlap some extent. It is interesting to compare the specific terms that are included in the work system framework (Figure 1), work system metamodel (Figure 2), and generic workpractice model (Figure 4). A much more detailed analysis would find that many of the terms that are in the workpractice model are basically properties of elements of one or both of the work system models. A significant area of difference is that WST includes both static views of systems as they operate (the work system framework)

and a dynamic view of how systems change over time (the work system life cycle model). It would be interesting to see any similarities or differences between the WSLC and a model of how workpractices change based on the workpractice model.

## 3.3 Practice theory

According to Postill (2008), "social theorists agree that there is no such thing as a coherent, unified 'practice theory', only a body of highly diverse writings by thinkers who adopt a loosely defined 'practice approach'. Theodor Schatzki (2001) distinguishes four main types of practice theorists: philosophers (such as Wittgenstein, Dreyfus, or Taylor), social theorists (Bourdieu, Giddens), cultural theorists (Foucault, Lyotard) and theorists of science and technology (Latour, Rouse, Pickering)."

Schatzki's definition of theory (mentioned earlier) leads to "using the expressions 'practice theory,' 'practice thinking,' and 'the practice approach' interchangeably." (Schatzki, 2001, pp. 12-13). Concurring with that general view of practice theory, an article called "Theorizing Practice and Practicing Theory" (Feldman and Orlikowski, 2011, p. 3) says that "there is no definitive cannon of practice theory that is widely accepted by most scholars." Schatzki (2001, p. 11) says that a central core of practice theorists "conceives of practices as embodied, materially mediated arrays of human activity centrally organized around shared practical understanding." ... "All practice theorists, meanwhile, acknowledge the dependence of activity on shared skills or understandings." (p. 12) ... "Practice theory also joins a variety of 'materialist' approaches in highlighting how bundled activities interweave with ordered constellations of nonhuman entities." (p. 12). Speaking about practice theories that might be developed from intensive research requiring "deep engagement in the field, observing or working with practitioners as they go about their work," Feldman and Orlikowski (2011) argue that practice theory "provides the basis for powerful theoretical generalizations" and "has the capacity to offer important practical implications for practitioners" (p. 1249), in other words that "practice theory is practical" (p. 1250).

Complicating the claim for practicality of practice theory is the highly abstract conceptually complex form and terminology of most presentations of practice theories. For example, according to Feldman and Orlikowski 2011, p. 18), a challenge to practice theorists concerns finding "language and logic that adequately express the recurrent relational nature of everyday practices. ... One strategy is to create new words: habitus and structuration come immediately to mind. The other is to write sentences that seem to go in circles: 'structured structures predisposed to function as structuring structures' (Bourdieu 1990, p. 53) or "structure as the medium and outcome of the conduct it recursively organizes (Giddens 1984, p. 374)."

It is difficult to say something definitive about ways in which practice theory in general might inform extensions of WST/WSM, especially when leading experts say that there is no unified notion of practice theory. To provide an idea of how research in that area might support future developments for WST/WSM, we will consider two related topics, sociomateriality and Heidegger's analysis of equipment, that address phenomena within Schatzki's view of the typical concerns of practice theorists. Sociomateriality was chosen for consideration because it has received much recent attention, as illustrated by a call for papers for a special issue of *MIS Quarterly* on sociomateriality. Heidegger's analysis of equipment was chosen because it might be incorporated into tools that extend WSM in the direction of change management in projects that change how people use IT.

**Sociomateriality**. Orlikowski and Scott (2008) organizes a number of topics "under the umbrella term of sociomateriality," (p. 434) an area in which "the most prominent body of literature" belongs to actor network theory (p. 456), where performativity (Barad 2003) is a central notion, and in which "a practice lens is particularly helpful in grounding [the] notion of performativity." (p. 462) (Greatly simplifying Barad's explanation, performativity basically means that characteristics are not inherent but are performed, e.g., having manager rank vs. performing as a manager, or having gender vs. performing gender roles). Sociomateriality is potentially relevant because it challenges "the deeply taken-for-granted assumption that technology, work, and organizations should be conceptualized separately." It is used in research that "advances the view that there is an inherent inseparability between the technical and the social." (Orlikowski and Scott 2008, p. 434). With a sociomateriality perspective, "humans/organizations and technology are assumed to exist only through their temporally emergent constitutive entanglement." (p. 457)

While sociomateriality provides many insights and perspectives related to the nature of interactions between people, technologies, and work, attention to sociomaterial issues does not require full-fledged adherence to a sociomateriality perspective (Alter 2012a, p. 4). An attempt to go beyond documentation and accounting in describing, analyzing, evaluating or designing a work system in an organization requires attention to whatever sociomaterial issues are important in the setting, as is illustrated by the inclusion of various types of resources in the work system metamodel, and recognition that material characteristics of resources affect the performance of any activity. Instead of embracing sociomateriality directly, WST provides concepts at three levels, only the last of which is associated with sociomateriality. These three levels include:

- concepts for identifying and understanding interactions of technical, social, and other material components with full recognition that some of the issues are primarily about separate components viewed individually (e.g., the processing power of computers, the weight of mobile devices, or the attention span of people),
- concepts about mechanical interactions between components (e.g., technical inconsistencies, lack of knowledge about specific technologies, and faulty synchronization of activities),
- concepts that are well described by topics addressed by sociomateriality, such as the distinction between built-in functions and characteristics of technologies versus technologies-in-practice. A similar distinction concerns ostensive vs. performative aspects of organizational routines (Feldman and Pentland 2003), expressed through differences between activities as defined by business rules vs. activities as actually performed, sometimes varying due to workarounds, exceptions, and other contingencies.

While the discourse of sociomateriality may produce practical insights for practitioners, it is based on concepts and terminology that are too abstract and unfamiliar to use in everyday practice, especially since it challenges what Orlikowski and Scott (2008) describes as "the deeply taken-for-granted assumption that technology, work, and organizations should be conceptualized separately" and that there is an inherent inseparability between the technical and the social." As a thought experiment, assume that we view sociomateriality concepts and theories as a practice theory that might be used by typical IS/IT professionals and/or business professionals for describing, ana-

lyzing, and designing IT-reliant systems in organizations. Imagine that we were to observe them trying to discuss an electronic medical record system, product design system, or customer service system. It seems unlikely that they would even attempt to use intriguing ideas such as the constitutive entanglement of technologies, people, and organizations (Cecez-Kecmanovic et al. 2011); performativity (Barad 2003); the recursive enactment of different technologies-in-practice (Feldman and Orlikowski 2011); the mangle of practice (Pickering 1995); the double mangle of human and material agencies (Jones 1998); digital formations (Latham and Sassen 2005), the threesome dance of agency (Svahn et al. 2009); digital materiality (Leonardi 2011); and sociomaterial bricolage (Johri 2011). In other words, that theory would have great difficulty attaining sociomaterial entanglement because its complexity and abstraction would engender resistance and rejection. Especially given the existing gaps in language, training, focus, and incentives between business and IS/IT professionals, it seems unlikely that ideas from a sociomateriality discourse about practice can be used directly by practitioners.

**Heidegger's analysis of equipment.** A presentation by Riemer and Johnston (2013b) at SIG-PRAG 2012 and a related paper in *EJIS* (Riemer and Johnston, 2013a) provide a potentially practical direction for extending WST/WSM by using concepts related to Heidegger's analysis of equipment. Riemer and Johnston (2013a) present "an alternative conception of IT as equipment holistically interwoven with other equipment, user practices, and individual identities." (p. 1). In relation to uses of IT, their Table 2, summarizes a number of important points that might be used in analyzing an existing work system with careful attention to what participants do and the role that specific equipment plays in their practices and even their individual identities. A specific concept of equipment is used, whereby a specific IT artifact is not equipment until it is thoroughly integrated into work practices. Before that time, it is experienced as an object with specific properties. As it becomes equipment, those properties recede from attention because the focus increasingly is on the work rather than on the tools. Thus, a key point is the distinction between IT withdrawing from attention when it is used under totally normal circumstances, versus how it becomes a focus of attention when something goes wrong in its usage. "For IT to be equipment, it also has to assume its appropriate place within the holism of other equipment, work practices, and identities that make up the particular work context." (p. 8)

This subtle and complex set of ideas, including a discussion of "appropriating new IT into a practice as equipment" and "reinterpreting post-implementation messiness," may provide a path for extending WST/WSM. For example, existing work system analysis templates could be augmented by adding additional questions that try to elicit the nature of user-equipment relationships in the existing work systems and implications of those relationships for introducing new IT artefacts. Similarly, the relatively limited theoretical view of both planned and emergent change that is summarized by the work system life cycle model (Figure 1) might be augmented by including mechanisms related to how particular IT artefacts that are originally external to a situation eventually become equipment that recedes from view as it becomes taken for granted in practices within the situation. Empirical research that illustrates these phenomena include a study of the implementation and use of the enterprise social networking tool Yammer at Deloitte Australia (Riemer and Scifleet 2012) and another study at Capgemini (Riemer et al. 2012a). Implications for business process modelling are discussed in Riemer et al. (2012b).

# 4 Discussion and Conclusion

This paper inquired about whether WST is a practical theory of practice as a way to search for possible extensions of WST/WSM related to research interests of the SIGPRAG community. Its comparison of WST with three quite diverse theoretical perspectives provided a backdrop for appreciating what WST is, for exploring how its content is related to practice theories, and, indirectly, for exploring ways in which it might be extended in relation to the three theoretical perspectives. This conclusion provides responses to several summary questions.

**How is WST related to the other three theoretical perspectives?** Table 2 compares WST with three theoretical perspectives regarding the central concept, treatment of technologies, and treatment of knowledge and understanding.

| **Theoretical perspective** | **Central concept** | **Treatment of technologies** | **Treatment of knowledge and understanding** |
|---|---|---|---|
| Work system theory (WST) | Work system, as summarized in Figures 1 and 2 | Work system components with objective properties, but also can be understood as technologies-in-practice since perceptions of technology affect usage | Attributes of work system participants and customers. May be built into processes and activities, codified as information, built into technologies, and built into products/services. |
| Unified modeling language (UML) | Objects, classes, methods, properties, and interactions | Technological entities are objects belonging to classes that have specified methods, properties, and interactions | The basis of object-oriented analysis and design, but not represented explicitly as an object or class in most systems. |
| Workpractice theory | Workpractice as summarized in Figure 3 | Parts of the production mechanisms within a workpractice (Figure 3) | Named explicitly as experiences and capabilities that are the basis of actions (Figure 3) |
| Practice theory | Constitutive entanglement of people, technology, and work | Technologies-in-practice rather than objects with defined characteristics | Essential basis of decisions and actions; also the basis of perspectives on technology, organization, and work |

Table 2. Comparison of work system theory and three other theoretical perspectives

These three areas for comparison were chosen because they provide a terse way to visualize essential differences between the perspectives. The central concepts in WST and workpractice theory are relatively similar, but quite different from the central concepts in UML and practice theory. The treatment of technologies in WST, workpractice theory, and practice theory overlaps to some extent even though the primary view of technologies in WST and workpractice theory focuses on built-in characteristics and on technology usage rather than on perceptions of technologies-in-practice. The treatment of knowledge and understanding in WST notes that knowledge may reside in people's minds but also may be built into processes, infor-

mation, technologies, and products/services. Further study of workpractice theory and various examples of practice theory might or might not reveal similar views.

**Is WST a practical theory?** In a formal definition that uses Wittgenstein's notion of grammar, Cronen (2001 p. 26) says that a practical theory "informs a grammar of practice that facilitates joining with the grammars of others to explore their unique patterns of situated action." Primary criteria for evaluating a practical theory involve whether it is "useful for (1) identifying a situation-in-view, (2) constructing judgments (systemic hypotheses about the situation that (3) implicate actions leading to (4) the consequence of improving the situation." (p. 29).

Production of work system analyses by many hundreds of employed MBA students (early career business professionals) over more than a decade indicates that WST satisfies all four of Cronen's criteria for practical theories. Stronger evidence from controlled research studies in business organizations would be preferable, but it would take many years to produce such studies. The same can be said about demonstrating the practicality of any theory or broadly applicable method intended for use by independent practitioners in everyday situations. (i.e., not just by PhD-level researchers in action research projects driven by their personal commitment).

**Is WST a theory of practice?** Concepts in WST form the basis of WSM, which is used to describe aspects of practices (e.g., business process, participants, information used, etc.) as part of the analysis and design of systems in organizations. Despite describing aspects of practices, WST shares the spirit of practice theory only partially. For example, Schatzki (2001, p. 11) says that a central core of practice theorists "conceives of practices as embodied, materially mediated arrays of human activity centrally organized around shared practical understanding." Practice theorists are interested in communities of practice and the shared knowledge that keeps communities of practice alive. They are not particularly interested in general methods for analyzing and designing systems.

The divergence between the core and intention of WST vs. the intention of researchers who use practice theory is clear when one looks at three principles of practice theory proposed by Feldman and Orlikowski (2011, pp. 4-6). The first two principles sound as though WST might fit the mold even though the terminology focuses on issues that are not central for WST. The third principle exemplifies the difference in spirit between WST and practice theories.

**... Principle #1: "Everyday actions are consequential in producing the structural contours of social life." (p. 4)** WST fits this principle at the work system level. Organizations operate through work systems in which people and/or machines perform processes and activities to produce products/services for internal and/or external customers. The structure and context of a work system during a week or month can be summarized in terms of specific elements, with the understanding that its actual operation may diverge from either its designed structure or its structure-in-practice due to exceptions, adaptations, bricolage, and workarounds. Work systems evolve over time through a combination of emergent change and planned change. In other words, everyday actions are consequential in producing the structural contours of the work system. On the other hand, it is not clear how the structural contours of particular work systems are related to the "structural contours of social life" because extrapolating from the contours of work systems to the contours of social life seems a possible exaggeration.

**... Principle #2: "Rejection of dualisms and recognition of the inherent relationship between elements that often have been treated dichotomously" (p. 5)** Without focusing on yes/no dichotomies or classification per se, WST recognizes and includes both sides of many dualisms, such as human vs. technical, social vs. material, subjective vs. objective, and structure vs. change. WST recognizes both sides by including human *and* technical, social *and* material, subjective *and* objective, and structure *and* change. WST assumes by default that work systems contain human and technical elements and recognize their interactions. WST recognizes social and material factors. It also recognizes both objective characteristics of work system elements and subjective perceptions of those elements and their situational relevance. Work systems exhibit structure and ongoing change. Processes within work systems often augment and sometimes undermine pre-designed activities (espoused practices) through adaptations and workarounds that affect actual practices. Overall, a technology's affordances and constraints in specific settings combine effects of built-in, inherent properties and effects of users' skills, knowledge, perceptions, beliefs, and goals related to technologies-in-practice.

**... Principle #3: "Relations of mutual constitution produce the very system of which they are a part."** (pp. 5-6) This "relationality of mutual constitution" goes a step beyond typical assumptions in the Cartesian view that Riemer and Johnston (2013a) contrast with the Heideggerian view that they espouse. The current version of WST and WSM reflects a largely Cartesian view, whereby work systems can be understood and analyzed to a first approximation in terms of separable elements whose inherent properties, mutual fit, agency, internal information flows, and other interactions constitute and regulate the work system. With the relationality of mutual constitution, “no phenomenon can be taken to be independent of other phenomena” (Feldman and Orlikowski, 2011, p. 5). While WST does not reject the latter view in any explicit way, its core is much more aligned with the Cartesian view because it supports a process of describing and analyzing work systems by looking at their elements and related interactions. With its largely Cartesian core, WST is not aligned with the spirit of principle #3. On the other hand, principle #3 provides possibilities for future development of WST/WSM because nothing says that WST/WSM should be prevented from absorbing insights and even methods from aspects of practice theory or related ideas. For example, a direction for deeper understanding of the relationship between tool and participant in the metamodel in Figure 2 could arise from research related to technologies-in-practice and from Volkoff and Strong’s (2013) the view of affordances as specific to particular actors in contexts rather than as inherent characteristics of particular technical artifacts

**Can the future extensions of WST/WSM benefit from more fully from embracing assumptions, concepts, and methods in any or all of the other three theoretical perspectives?** This question is more valuable than the others in relation to the original goals of this research because the others are basically about controversial definitions and classifications. WST is a theory for analysis that grew out of an attempt to develop a systems analysis and design method for business professionals. Every version of this method calls for identifying a work system that exhibits a problem or opportunity, identifying and characterizing that work system's components, describing and evaluating problems and opportunities in more depth, and then proposing and justifying the outlines of an improved version of the work system.

The basic conclusion is that each of the three theoretical perspectives provides a path toward possible extensions of WST/WSM.

**... Synergies related to UML.** The content, structure, and use of UML establish an important direction for future extensions of WST/WSM. Maximizing its practical value calls for extensions in the direction of translating from analysis and design addressing problems fully understood by business professionals into analysis and design addressing technical concerns of IT professionals. The development of the metamodel (Figure 2) was a conscious and hopefully pragmatic step in that direction. For example, Alter and Bolloju (2012) illustrates the possibility of converting two different types of work system summaries into not only use case diagrams, but also use case descriptions, domain class diagrams, activity diagrams, and statechart diagrams. The potential advantage of this approach is that work system concepts are well suited to collaboration with business professionals because they focus on improving the performance of work systems, rather than specifying hardware/software artefacts that satisfy previously defined requirements supplied by others.

**... Synergies related to workpractice theory**. Potential synergies between WST and workpractice theory are more straightforward because most concepts in workpractice theory can be mapped to related concepts either in the work system framework or the metamodel. Examining existing work system analysis templates would probably show where concepts in workpractice theory could or should be included in those analysis templates, depending on the specific purpose of the analysis.

**... Synergies related to practice theory**. Thinking to date about WST has not exploited the more sophisticated ideas related to practice theory, even though concepts such as technology-in-practice fit in the work system metamodel (Figure 2) as part of the relationship between participants and tools they use. Embracing ideas associated with practice theory may generate a path for future extensions of WST, although the path forward is not obvious. The most difficult part is to determine how to translate basic concerns of practice theory into straightforward questions that can be incorporated into work system analysis templates. Research cited earlier by Riemer and colleagues about applying Heidegger's analysis of equipment could provide relevant insights. For example, adoption or translation of Heidegger's distinction between ready-at-hand and present-at-hand (Riemer and Johnston 2013a, pp. 4-5) could be the key to appropriation by WST/WSM of some aspects of the inseparability issues at the core of practice theory. That issue deserves substantial consideration in future research.

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## About the Author

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