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Dialogue Article

Work System Theory as a Platform: Response to a Research Perspective Article by Niederman and March

Steven Alter
University of San Francisco
alter@usfca.edu

Abstract

In this paper, I respond to "Moving the Work System Theory Forward" (Niederman & March, 2014), a JAIS research perspective paper about another paper on work system theory (Alter, 2013e). The research perspective paper recognizes value in the work system approach, suggests that WST is not a proper theory, and suggests areas for related theory development. After summarizing the main ideas in WST, I explain disagreements between Niederman and March (2014) and Alter (2013e)— (hereafter called N&M and the WST paper) about what WST is and what WST should become. I note that N&M interprets basic ideas in WST differently than the WST paper defines them. I note that N&M's critique of WST is anchored in issues about the nature of theory, especially a preference for Gregor's type 4 theory. I explain that WST is a special case of general system theory and, as such, should not and cannot take the form of a theory that expresses relationships between independent variables, moderating variables, and dependent variables. I also explain why the WST paper called WST a theory when it might have been called something else, and also why the WST paper does not treat the development of the work system method (WSM) as a design science research project. Lastly, I respond directly to N&M's title, "Moving the Work System Theory Forward" by explaining that WST is becoming a platform for applications and extensions in IS and other disciplines, which I illustrate with examples under five categories.

Keywords: *Work System, Work System Framework, Work System Life Cycle Model, Theory in IS.*

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Work System Theory as a Platform: Response to a Research Perspective Article by Niederman and March

1. Preface

In this paper, I respond to a *Journal of the Association for Information Systems* (JAIS) research perspective paper entitled "Moving Work System Theory Forward" (Niederman & March, 2014). That paper identifies issues and provides suggestions related to my previous *JAIS* paper "Work System Theory: Overview of Core Concepts, Extensions, and Challenges for the Future" (Alter, 2013e). In the 2013 paper, I present work system theory (WST) as the basic ideas underlying the work system method (WSM), which was developed over many years through iterative improvements across many different versions. The 2013 paper also explains extensions beyond the core concepts, positions WST in relation to other approaches and theories, evaluates progress to date related to WST, and identifies challenges for the future.

This current paper contains many references to Alter (2013e) and to Niederman & March (2014) since I respond here to the latter paper that itself responds to the former (i.e., Alter, 2013e). For ease of reading and interpretation, I use "the WST paper" to refer to Alter (2013e) and N&M to refer to Niederman & March (2014). I handle all other references in the standard manner.

The N&M paper generally supports the work system approach but criticizes aspects of WST as a theory. My general impression of the main points in N&M is as follows:

- N&M recognizes potential value in the work system approach.
- Many of N&M's comments and suggestions about WST actually refer to the work system approach or WSM rather than to WST as it is defined in the WST paper.
- N&M sees WST as an atheoretical model rather than as a theory.
- N&M implies that something called WST should be a type 4 theory (Gregor, 2006) that explains and predicts. Furthermore, WST should be evaluated using criteria for a type 4 theory, including importance, novelty, parsimony, appropriateness of theoretical level, and falsifiability.
- Many of N&M's suggestions for "moving WST forward" are related to possibilities of theory development (in the style of positivist type 4 theory) that might emerge from the ideas in the work system approach.

This response argues that a narrowly focused positivist theory addressing some parts of the domain of WST might fit better with certain views of theory per se but would have much less potential value than the current formulation of WST. More specifically:

- Section 2 summarizes the WST paper's explanation of WST and provides context for the main ideas in this response to N&M's critique.
- Section 3 discusses differences between the content of WST as explained in the WST paper versus the content of WST as portrayed by N&M. While WST is a system theory that necessarily does not have independent and dependent variables, the N&M critique of WST is based on a preference for Gregor's (2006) type 4 theories, which involve independent and dependent variables. Those different views of what WST is or should be lead to strongly divergent views of how to move WST forward.
- Section 4 discusses previously unexplained background and the motivation for writing the WST paper. It explains why I called WST a theory and why I did not explain its development as an instance of design science research.

- Section 5 summarizes conclusions about the best path for developing WST. It also questions the academic IS discipline's commonly held belief that theory is better than other types of knowledge.

- Section 6 extends the discussion of what WST should become. It summarizes my current view that WST is becoming a platform for many future applications and extensions in IS and in other disciplines. Examples are organized under five categories.

Addressing those topics directly and honestly calls for a personal and colloquial tone that bypasses some of the (in my opinion) formulaic, often excessive, and sometimes misleading packaging that suffuses many journal and conference papers. Aspects of the response to N&M explains personal reasons for undertaking a difficult project and personal speculations and ambitions that energized the effort. Useful results were produced even though parts of the research could not be "justified" based on the type of backward-looking, provenance-oriented rationales that are common in IS research papers, such as the assumption that progress must be based on previously published theory.

2. Content of the WST Paper

I arrived at the following general beliefs based on eight years of experience in a successful manufacturing software firm and based on insights from publishing and using four editions (1992, 1996, 1999, 2002) of an IS textbook:

1) Most business professionals could benefit greatly from an organized systems analysis and design method that they can use directly for their own purposes, with or without the help of IT specialists or consultants.

2) The IS discipline had not yet succeeded in providing and disseminating that type of method.

3) The wide availability of that type of method would substantially increase success rates for system-related projects, would improve business/IT alignment at many levels, and would provide opportunities for IS research that is inherently valuable and is likely to have recognizable real-world impacts.

As those beliefs emerged, I started developing what I called the work system method (WSM). I produced different versions of WSM during an iterative process of trying to develop a method that typical MBA and executive MBA students could use effectively and efficiently. As the number of versions increased, I found it more difficult to explain exactly what WSM was. Other frameworks and methods that evolved over time have faced similar issues (e.g., activity theory, soft system methodology, and the creation of UML through several iterations that built on different approaches from different sources).

Three things remained almost constant throughout developing WSM to date: the definition of work system, the work system framework, and the work system life cycle model. I say "almost" because some of the terminology changed incrementally over the years. Two examples are small changes in the work system framework. The first was a change from "business process" to "work practices" to emphasize actual practices rather than documented processes that might or might not be followed in reality. The second was a subsequent change from "work practices" to "processes and activities" because my MBA students seemed to find the term "work practices" awkward to use effectively in presentations and written work.

2.1.Definition of WST

One of the WST paper's main goals was to define and organize the different parts of the work system approach for thinking about systems in organizations. Pages 75-86 of the WST paper define the term work system, the two central frameworks, and each term in those frameworks. As Figure 1 shows, the WST paper says that WST includes:

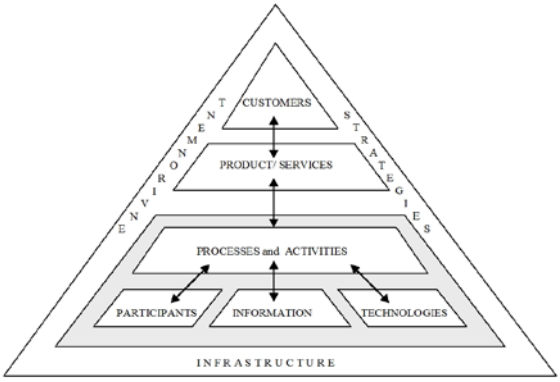
1) the definition of work system

2) the work system framework, a static view of a work system as it exists during a particular time interval when it retains its identity and integrity even though it may change slightly through small adaptations, workarounds, personnel changes, and even unintentional drift (e.g., Pentland, Haerem, & Hillison, 2011), and

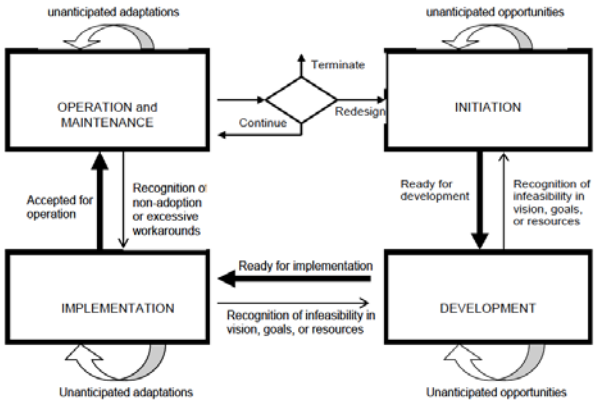
3) the work system lifecycle model, a dynamic view of how work systems change over time through a combination of planned and unplanned change.

Almost all significant work systems in organizations use IT and, therefore, are in the domain of the IS discipline. Most work systems should not be viewed as information systems or IT systems, however, because most of them are not about IT or about processing information, just as work systems that use electricity should not be viewed as electricity systems because they happen to use electricity.

1) Definition of work system: a system in which human participants and/or machines perform work (processes and activities) using information, technology, and other resources to produce specific product/services for specific internal and/or external customers.



2) Work system framework



3) Work system life cycle model

Figure 1. Three Components of Work System Theory (Alter, 2013e)

2.2. Definition of WSM

The various versions of WSM apply WST but are not part of WST. They are WST applications designed to help business professionals, IT professionals, students, and researchers think about current and proposed work systems. The term "method" in WSM refers to a systems analysis and design method for creating or improving work systems that almost always are IT-enabled and may or may not be information systems. The various versions of WSM all involve at least the following steps:

- identifying the main problems or opportunities that launched an analysis.
- identifying the smallest work system that exhibits those problems or opportunities.
- summarizing the "as-is" work system using a work system snapshot, a stylized one page summary that includes customers of the work system, product/services that it produces, processes and activities, participants, information, and technologies in the work system.
- evaluating the work system's operation using measures of performance, key incidents, social relations, and other factors.

- drilling down further as necessary (e.g., by using typical Six Sigma tools such as root cause analysis, swimlane diagrams, and Pareto diagrams).
- summarizing proposed changes by producing a work system snapshot of a proposed "to be" work system that will probably perform better.
- describing the likely improvement in the work system's performance.

Initial versions of WSM were meant for use primarily in the initiation phase of a system-related project as a way to help in defining the work system to be improved and in explaining proposed improvements. Focusing on work systems rather than hardware/software configurations is a step toward overcoming an ingrained tendency to think about system-related projects as little more than producing software to satisfy requirements and installing it on computers. WSM is not a complete system development method, however, because the guidance that it provides does not include explicit methods for developing and testing software. On the other hand, it may support those activities and may lead to better system development results because it leads to clarity about the business purpose, scope, and intentions of system-related projects.

2.3. Extensions of WST

The extensions of WST are various concepts, frameworks, methods, and theories that are based on WST and that can be used whenever appropriate for thinking about work systems in general, about categories of work systems, and about specific systems in organizations. Published extensions of WST that are mentioned later include work system principles, work system design spaces, various versions of a work system metamodel (illustrated later in Figure 2), a theory of workarounds, a taxonomy of work system interactions, and extensions related specifically to service and service systems.

2.4. Earlier Versions of the WST Paper

I started to recognize the need to articulate a conceptual core of the work system approach around 2008. Several years later, I brought a first draft of a WST paper to the 2010 *JAIS* Theory Development Workshop. That draft covered all five of Gregor's (2006) types of theory. The almost unanimous response was that the draft's depiction of WST was unclear about WST's boundaries and about whether WST would expand whenever new ideas related to WST were proposed. After working on several subsequent drafts, I concluded that the WST's three-part definition and the distinction between WST, WSM, and extensions of WST could address several important goals simultaneously:

- provide necessary clarity about what WST is
- overcome confusion resulting from iterations that created successive versions of WSM
- provide a basis for explaining progress to date in developing the work system approach, and
- provide a central core of ideas that forms the basis for deeper examination that could reveal and articulate many distinctions, nuances, special cases, applications, and extensions of WST.

In my opinion, the WST paper succeeded in defining WST and in clarifying how it is distinct from its application in WSM and also distinct from various extensions of WST. I hope it will succeed in overcoming inconsistencies and confusion resulting from previous publications mentioning different versions of WSM and extensions of WST. At minimum, the effort of writing the WST paper created a way of explaining WST, WSM, and extensions that is much clearer and easier to understand than previous explanations.

3. Divergent Views of What WST Is and What WST Should Become

This section discusses divergences between N&M and the WST paper regarding different interpretations of what WST is and what WST should become. It starts with differing interpretations of what WST is. After mentioning differing views of the nature of theory, it discusses differing views of what WST should be. Section 5.2 returns to an issue underlying much of the discussion in this section, i.e., whether the academic IS discipline treats theory, especially Gregor's (2006) type 4 theories, as somehow better or more important than other conceptual artifacts (Bereiter, 2005) such as concepts, frameworks, models, and methods.

3.1. Differing Interpretations of WST

As Figure 1 illustrates, the three components of WST include the definition of work system, a basically static view of a work system as it exists during a particular time interval, and a dynamic view of how work systems change over time. Even though a three-part definition of a theory is atypical, WST includes all three parts because all three are important for understanding, evaluating, and improving work systems.

Defining WST precisely was important for several reasons. The first was to overcome confusion related to WSM's iterative development. As mentioned above, ideas that the WST paper identifies as WST are at the core of all of the versions of WSM. Another reason for defining WST precisely was the reaction to the draft of the WST paper that was presented at the 2010 *JAIS* Theory Development Workshop. The almost unanimous response was that the draft's depiction of WST was unclear about WST's boundaries and about whether WST would expand whenever new ideas related to WST were proposed. After working on several drafts of the WST paper, I concluded that the three-part definition and the distinction between WST, WSM, and WST extensions was the most practical way to provide necessary clarity about what WST is.

N&M defines WST, the work system framework, and the work system method differently from the way those terms are defined in the WST paper and in the summary of WST in Section 2.1. The following comments identify some of those differences and their implications.

3.1.1. N&M's View of the WST Paper

In its abstract, N&M says that the WST paper "*proposes the work system theory (WST) as the transformation of previously developed information system (IS) artifacts: the work system method (WSM), the work system framework, and the work system life cycle (WSLC)*". In contrast, the WST paper states that WSM is not a part of WST but rather that it is an application of WST. Also, the WST paper does not purport to transform information system artifacts. Instead, its contributions are based on updating and clarifying each of three previously existing components, all of which are about work systems in general rather than about information systems per se.

3.1.2. N&M's View of WST

A footnote in N&M says that WST is "*the set of generalized statements and principles underlying the work system approach*" (p. 347). It is not clear which generalized statements and principles N&M means to include in that definition. For example, that definition might or might not include some of the 24 work system principles that the WST paper identifies as an extension of WST.

3.1.3. N&M's View of the Work System Framework

The same footnote in N&M says that the work system framework refers to "*the description and organization of the components used to represent a work system*" (p. 347). The WST paper is much more specific. It says that the work system framework "is a pictorial representation of a work system in terms of nine elements included in a basic understanding of the work system's form, function, and environment during a period when it is relatively stable, even though incremental changes may occur during that period." (p. 77) The pictorial representation of the relationship between the elements is shown in Figure 1 and has been published many times. The names of several of the elements have evolved slightly over the years (as noted earlier).

The work system framework is only one of several summaries of components used to represent a work system. Several versions of a work system metamodel (Figure 2 in Section 6.1) extend WST and provide a more detailed representation of components of a work system. Like different levels of detail in an online map with zooming capabilities, the less detailed work system framework and the more detailed metamodel are related to each other and can be used for some of the same purposes but are designed to be especially useful for their own particular purposes. A service value chain framework (see Section 6.1) adds a service perspective that is not apparent from either the work system framework or the work system metamodel(s).

3.1.4. N&M's View of WSM

The same footnote in N&M says that WSM is "*those processes and procedures by which the components of a work system are identified, analyzed, designed (re-designed), and implemented*" (p. 347). That comment is unclear about whether the ideas in WST are the basis of WSM. Also, it misinterprets the intended scope of WSM, which guides analysis and design but does not provide specific guidance about software development or implementation in organizations. For example, the WST paper (p. 90) says, "Comparing WST with various system development approaches is beyond this paper's scope because WST is not a system development method just as WSM is not a system development method, but rather, an adaptable method for analyzing and designing work systems."

The WST paper (p. 90) also recognizes that "a number of other theories and perspectives provide their own unique lenses related to systems in organizations. … [It] compares WST briefly with seven very different perspectives, all of which are relevant to one or another aspect of understanding systems in organizations. For example, it notes that "although work systems are viewed as sociotechnical systems by default, WST does not follow the tradition [in sociotechnical systems theory] of separating social systems versus technical systems … Instead, it views the social and the technical as part of a single system" (p. 91).

3.1.5. Is the Definition of WST Unclear?

After checking the WST paper again, I think that the definition is clear but that a reorganization of an early draft may have contributed to a somewhat fuzzy impression of WST at the beginning of the published paper. Figures 3 and 4 in the WST paper (pp. 117-118) appeared nearer the beginning of several early drafts to clearly distinguish between WST and its applications and extensions. Later, those figures and the related explanations were moved to an appendix at the end of the paper to improve the paper's flow. While I think that goal was appropriate, it may have brought the disadvantage of deemphasizing WST's precise definition[1].

3.2. Differing Views of the Nature of Theory

N&M anchors much of its critique in issues about the nature of theory. N&M (p. 350) applies Weber's (2012) view, which:

> *Restricts the term "theory" to the Type 4 in Gregor's (2006) taxonomy, which reflects both explanation and prediction. He explains that the elements of theory are (a) constructs measured as precisely as possible, (b) tested relationships among these constructs, and (c) a defined boundary in which these relationships apply. He states that theory must both predict and explain the phenomena under consideration.*

[1] The WST paper explains WST as follows: the second page of the WST paper (p. 74) says that the definition of work system "leads to the two central frameworks in WST: the work system framework and work system life cycle model". Instead of repeating that statement by saying that WST includes the definition and the two central frameworks, the first page of the section on WST (p. 75) focuses on positioning in relation to Gregor's five types of theory and in relation to other topics. It starts by saying that WST "is an integrated body of theory that includes a Type 1 analytical theory (the work system framework) and a type 2 explanatory theory (the work system life cycle model), which in combination give the basis of a Type 5 design theory (WSM)". The section on extensions of WST introduces work system principles, work system design spaces, and a new work system metamodel. It says, "This paper treats these extensions as useful developments that are outside of the core of WST" (p. 87). The three-part structure of WST appears most explicitly in Figure 4 in Appendix 2 (p. 118), which places the work system concept, work system framework, and work system life cycle model inside of a central oval. The accompanying text says, "WST is represented by the central oval, in which arrows say that the work system concept led to the work system framework and work system life cycle model, all three of which have existed for over a decade and now can be seen as forming the conceptual basis of WSM. Figure 4 also shows more recent extensions that build upon those ideas." (p. 119).

The WST paper takes a different approach. It mentions long-standing debates in the social sciences and in IS about the nature of theory but avoids engaging that issue fully because doing so would have been beyond its scope. Instead, it justifies calling WST a theory by citing Schatzki's (2001) view that a theory is an abstract account. I had learned about that view from Feldman & Orlikowski (2011), in which two widely recognized scholars use that view of theory as the basis of a discussion of practice theory.

The list of IS theories in the "Theories Used in IS Research Wiki" (Larsen, Allen, Vance, & Eargle, 2015), which is available in the research section on the Association for Information Systems' website, includes many sets of concepts that are called theories in the IS discipline even though they would not qualify under Weber's (2012) criteria. Examples include actor-network theory, behavioral decision theory, contingency theory, critical realism theory, evolutionary theory, feminism theory, game theory, general systems theory, institutional theory, sociotechnical theory, soft systems theory, and structuration theory. Other widely cited IS-related theories that do not appear in the wiki and that would not qualify include activity theory, coordination theory, and practice theory. Many theories discussed in other disciplines also would not qualify. Examples from mathematics include group theory, number theory, perturbation theory, and set theory.

In other words, WST qualifies as a theory under the Schatzki (2001) and Gregor (2006) approaches to theory and is every bit as much a theory as many other abstractions that are called theories in the academic IS discipline. Section 4.1 will return to the issue of whether WST should have been called a theory. Section 5.2 will discuss a related question about whether theories should be preferred to other types of knowledge.

3.3. Differing Views of What WST Should Be

The WST paper (p. 90) explains that WST is "a special case of general system theory (GST) that focuses on systems in organizations. GST provides basic concepts for thinking of situations as systems, such as boundary, environment, input, output, transformation, and state. WST reframes those concepts in relation to systems in organizations, and therefore is much less general than GST. In relation to WST's domain of application, a shortcoming of GST and various short lists of GST concepts (e.g., open system vs. closed system, subsystem, form, function, boundary, environment, interface) is that the short lists do not provide enough guidance to be helpful in many specific types of situations."

The title of N&M is "Moving the Work System Theory Forward". N&M treats WST as presented in the WST paper as a somewhat amorphous group of concepts, frameworks, models, and methods. N&M suggests that the work system approach seems potentially useful in general (e.g., comments on pages 348, 351, 352, and 355) and that it might become a steppingstone for theory development.

3.3.1. WST as an Opportunity for Theory Development

N&M (p 350) says:

> *By Weber's (2012) definition, the WST would likely be viewed as an atheoretical model. The WST does not present clear, measurable, and indisputable constructs in the same sense as "the construct ease of use can be associated with the construct amount of use"….We propose that the WST, even if viewed as "atheoretical" by this definition, is … a possible precursor to the sort of theory that would satisfy a Type 4 categorization. We see the WST as presenting the IS field with an opportunity to engage in a process of theory development and building.*

N&M seems to imply that concepts in WST such as participants and information are not clear, measurable, and indisputable, even though the WST paper provides clear definitions of every major term in WST. The measure of whether someone is a participant is whether that person performs one or more of the activities in a work system. Similarly, the information in a work system is the information that the work system uses or produces. These are simple, straightforward ideas that are directly relevant to understanding and analyzing systems. The WST paper defines the other basic concepts in a similar fashion. Regardless of whether WST is an atheoretical model or a theory, there

are no benefits in trying to convert a system theory such as WST into a positivist type 4 theory that focuses on constructs resembling ease of use and amount of use, the two constructs mentioned in the above quote from N&M. In fact, those two constructs are associated with one of the many relationships included in the work system metamodel that is an extension of WST (see Figure 2).

3.3.2. WST's Purpose

N&M (p. 350) says that WST's purpose is unclear:

> *"We find that the purpose of WST per se is not clear in its current formulation. After many readings, we do not see clear and general statements about what WST is intended to accomplish."*

I am sorry that N&M finds the purpose of WST unclear. WST's primary purpose is to serve as an organized kernel of ideas for understanding how systems in organizations operate and how they change over time, regardless of whether IT plays a significant role.

Note that I make no claim that WST is the best possible kernel of ideas for that purpose. The WST paper (p. 99) suggests extending its comparison of WST and WSM with other theories and methods "to try to develop hybrids that are better than existing theories and methods. For example, a detailed look at accounts of real world applications of SSM, ANT, organizational routines, practice theory, and activity theory could identify synergies that lead to better theories and methods."

3.3.3. Should WST Become a Type 4 Theory?

N&M (p. 351) wants to convert WST into a positivist type 4 theory instead of a system theory:

> *We can envision a formulation of WST such as: those responsible for business process management will create better (less expensive, more reliable, more effective, etc.) systems using the WST in their system development practices than those not using WST. We think this is what the current formulation proposes, but, if we are wrong, it is at least partly due to this element of the theory not being clearly specified.*

WST is the formal identification and organization of a system view that is useful for many purposes. There is no apparent benefit in transforming WST into a type 4 theory whose content says that using some version of WST's ideas is better than not using those ideas. Much of WST's value is in clarifying, organizing, and extending concepts that have already been used in many different ways. Furthermore, I don't see why a statement that a particular method or set of ideas is useful should be called a theory. Instead of calling something like that a theory, I would call it either a claim of efficacy or the results of an evaluation of efficacy. If claims of efficacy were called theories, then we would have UML efficacy theory, BPMN efficacy theory, portfolio theory efficacy theory, and so on.

In addition, there is no apparent benefit in replacing WST with a type 4 theory that has the same name. WST was developed as a special case of general system theory that provides a system-oriented lens for understanding a broad range of important situations. Like the lens of a camera or a camera as a whole, WST has features and characteristics and can be used for a variety of purposes and at quite different levels of care and expertise. Future research will address many valid questions about the circumstances for effectively using WST, various versions of WSM, and various WST extensions. Those questions are not part of WST, just as questions about conditions for effectively using a camera are not part of the camera.

3.3.4. Combining Issues that should be Viewed Separately

N&M combines several valid issues that should be viewed separately. One issue is whether WST is a "proper" theory and how it might become a seed for theory development in the IS discipline. A completely different issue is how to maximize the value of a set of ideas that already have been used by many researchers, many instructors, many hundreds of MBA and executive MBA students, and some practitioners. In my opinion, maximizing WST's value is related to finding new applications and extensions and is not related to whether it should be more like a type 4 theory.

While I see no reason to convert WST to a type 4 theory, the WST paper explicitly notes the desirability of testing the usefulness of WST and of other theories and methods. The following is the tenth item in a list "next steps in research" (pp. 98-99): "Formulate a type 4 theory for explanation and prediction (Gregor, 2006) related to insights from WST for system modeling techniques in general. Related propositions would say that modeling techniques that encompass all or most of the work system framework will provide more comprehensive, and hence better analysis than techniques that focus on only one or several work system elements.". This item is not about changing WST's nature. Rather, it is about developing and using a separate type 4 theory to investigate whether WST's content matters in practice.

In addition, the work system framework itself contains several assumptions related to internal alignment that could be treated as propositions to be tested empirically in the manner of a type 4 theory. That testing would not involve or necessitate changing the WST's nature as a special case of a general systems theory. The WST paper provides examples of such assumptions (p. 79): "The arrows inside the work system framework say that the specific elements of a work system should be in alignment. For example, the knowledge, skills, interests, and motivation of the participants should fit with the processes and activities in the work system. Conversely, the processes and activities should be appropriate for attributes of the participants. …Similar alignment issues apply for all pairs of elements that are linked by arrows.".

3.3.5. What is the Dependent Variable?

Perhaps motivated by a preference for type 4 theories, N&M tries to build on a claim in the WST paper (p. 79) that "the work system framework is a useful basis for describing and analyzing an IT-reliant work system in an organization because its nine elements are part of a basic understanding of a work system". N&M, (p. 351) says:

> *The assertion that the WS framework is "useful" adds an element of purpose, and thus falsifiability, to the WST. However, the terms "describing and analyzing" present a variety of possible interpretations. Is WST's purpose to present a tool aimed at clarifying business processes or, ultimately, to aid in building better systems? Implicit in the theory is [the] explanation that one could build better work systems … because of the more thorough and diversified analysis induced by the use of the WS framework in whole or in part. In other words, are "thoroughness and diversification" the dependent variables of the theory, or are these moderating variables for an ultimate purpose of a different dependent variable: making better systems?*

The work system framework expresses a claim that information, participants, product/services produced, and its six other elements are part of a basic understanding of a work system. Dependent or moderating variables are not necessary for testing that claim. One can easily identify illustrative examples showing that a basic understanding of a work system should include all nine elements. For example, there are many examples of work system difficulties related to a mismatch with organizational culture (part of the environment) and many other examples of work system stoppages due to failures of infrastructure, another of the nine elements. This is not about dependent and moderating variables. This is about whether each of the elements of the work system framework can be applied usefully for understanding, managing, and improving typical examples of work systems.

Furthermore, the claim that a nine-element framework is useful is not a claim that other ideas are not useful or that the entire framework must be used at all times. WSM is based on WST. The first step in most WSM analysis templates is to name the work system in a single verb phrase. That doesn't say much, but it helps in clarifying what system is being analyzed. A subsequent step is to create a one-page summary of the "as-is" work system using only the six central elements of the work system framework and not using the other three elements. The other three elements are useful for the complete analysis but do not need to be mentioned at the beginning of the analysis. Other types of information and levels of detail are included as the analysis proceeds. This is not about dependent, moderating, and independent variables. It is about providing a cognitively manageable system view of a work system without leading users to become overwhelmed in the myriad of details that might be mentioned.

3.3.6. What are Criteria for Evaluating WST?

N&M (pp. 351-354) discusses how WST would fare if evaluated using five criteria for a type 4 theory: importance, novelty, parsimony, level of theory, and falsifiability. The WST paper (pp. 94-97) evaluates WST based on the first two of those criteria (relevance (importance) and novelty) plus two other criteria (clarity and usefulness) for teaching, research, and practice. N&M's suggested criterion of parsimony makes sense in relation to a type 4 theory but is far less interesting in relation to WST, whose actual use calls for zooming in and out between different levels of description that include different concepts (e.g., see the work system metamodel, Figure 2 in Section 6.1). The criterion of falsifiability fits a type 4 theory but simply does not fit WST or other system theories. WST need not be falsifiable any more than systems analysis and design in general needs to be falsifiable or structuration theory needs to be falsifiable. WST consists of a definition and two frameworks that have been used to describe and analyze a very large number of situations. Since other approaches or tools might be better for that purpose, comparative usefulness is a much more valuable criterion than falsifiability.

Beyond this paper's scope is the broader question of how to evaluate abstract forms of knowledge that might include concepts, frameworks, theories, models, and methods. Alter (2014f) pursues an aspect of that topic by viewing WST and its extensions as conceptual artifacts (Bereiter, 2005) and showing how WST might fare in relation to a set of criteria for conceptual artifacts. Those criteria are broader and more inclusive than the five discussed by N&M. They include value, rigor, testability, parsimony, breadth of use, robustness, durability, generativity, and source. The criterion of generativity leads to the question of whether WST is becoming a platform.

3.4. WST as a Platform for Research, Teaching, and Practice

At this point, five years after the first draft of the WST paper and two years after its publication, I see WST as more than a theory. I see it as a platform for many future applications and extensions in IS and in and across other disciplines. As a platform, it has value when used directly, but it also can be built on in valuable ways, many of which may not be anticipated.

To visualize WST as a platform, consider the characteristics of platform design discussed by Hanseth & Lyytinen (2010, p. 4) in relation to IT platforms such as MS Office, Windows, Linux, and SAP:

> *Platform designs draw on architectural principles that organize IT capabilities into frameworks allowing the software to address a family of generic functional specifications that meet the needs of multiple, heterogeneous and growing user communities. … A platform's initial design starts with a set of closed specifications determining included IT capabilities and anticipated requirements for their extensions and combinations. Their evolution is also governed and constrained by these initial specifications.*

While orders of magnitude simpler and more limited in scope than IT platforms, WST provides a core of ideas (the three components of WST) that can be used for many diverse purposes. That core has sufficient clarity and scope to serve as a basis for developments that expand in different directions to address a variety of concerns. Some of those developments are organized around one of the two central frameworks in WST. Other developments introduce new ideas that initially may seem peripheral but that can be used in conjunction with the central frameworks. An example is a "service value chain framework" (Alter, 2008, 2010d) that helps in understanding work system-related value creation. It does that by focusing on customer and provider responsibilities and on front stage and back stage activities, topics that do not appear in the three components of WST.

Examples in five overlapping categories illustrate how WST can serve as a platform:

1) WST extensions related to work system operation, characteristics, and evaluation.

2) Application of WST for understanding, analyzing, and designing systems in organizations.

3) Linkage of WST and its extensions to concepts, models, and techniques for IT professionals.

4) Use of WST for broader concerns related to the structure and dissemination of knowledge about systems.

5) Diverse WST applications or extensions by researchers with diverse goals and interests.

To simplify this paper's flow, examples under each of the five categories are deferred to Section 6. In combination, the many topics mentioned under the various categories suggest the possibility of a powerful, reasonably unified approach to important issues that have not been addressed in a unified way to date. An integrated platform for thinking about systems in organizations could support system-related research and practice and could contribute to IS/IT pedagogy that is much better than the current disjoined offerings.

A first paper or several initial papers already exist for some of the topics under each category in Section 6. Some are speculative because research is only beginning. Overall, however, many topics derived from WST ideas are internally coherent and have already proved useful in various ways. Examples include use by many hundreds of MBA or executive MBA students in the United States, China, Vietnam, India, and possibly elsewhere and by many researchers including non-trivial use or discussion in over ten PhD theses that I was not involved in.

4. Previously Unexplained Background and Motivation of the WST Paper

N&M (p. 350) contains a possibly surprising comment that was quoted earlier: *"We find that WST's purpose per se is not entirely clear in its current formulation"*. Ignoring any unintended omissions or confusions in my writing, N&M's question about WST's purpose may stem from my intentional reticence about the reasons for trying to articulate WST and reasons for WST's positioning in relation to the nature of theory and other topics. This section fills in some of the details.

4.1. Need for a Theory

As I transitioned from writing IS textbooks to producing conference and journal papers related to work system ideas and WSM, I received several reviewer comments of the following types:

> *This paper is interesting and probably valuable in some ways, but it is not based on theory and therefore should be rejected.*
>
> *This paper is merely practical and therefore should not be published.*
>
> *This paper seems to have some new ideas that might be valuable, but it should be rejected because it is justified based on conference proceedings and minor journals. Real contributions to knowledge need to be based on past publications in major journals.*

I had never encountered such comments during eight years of working in an innovative and successful software firm or in feedback about four editions of an IS textbook. Since when do new ideas need to be based on a theory—preferably a theory that someone else developed years earlier and published in a reputable journal? In addition to implying that no one has the right to develop a totally new idea, that view seemed contrary to the way most new ideas are actually created, developed, and disseminated in the real world.

The clinchers were two journal submissions that were dismissed for different reasons. A paper about a potentially useful relationship between work system snapshots and use cases was dismissed as atheoretical. The lack of theory seemed more important to the reviewers than the potential value of ideas related to a significant pedagogical and practical problem. A different paper about thinking of systems in service terms was rejected partly because one of the central frameworks in the paper had been published in what a reviewer considered an untrustworthy outlet: *IBM Systems Journal.*

The implications seemed obvious to me. To paraphrase N&M's title, moving the work system approach forward at more than a snail's pace required attaining a higher acceptance rate of future research related to work system ideas and WSM. That would require a broadly recognized theoretical basis for those ideas. In other words, it seemed to me that finding or articulating a theory related to work system ideas and WSM was a possible approach for solving a paper acceptance problem rather than a scientific problem related to the situations studied. Almost any plausible theory would suffice as long as it made sense in relation to work system situations and was published in a respected journal. An attempt to figure out whether general system theory would suffice led to a somewhat inconclusive paper about that possible relationship (Alter, 2007). Since no existing theory that I knew about provided a convincing basis for work system ideas and WSM, I decided to try to develop something called work system theory. Even though I had thought a great deal about work systems and IS, I was not sure what WST should be.

After several false starts, I wrote a first draft of what eventually became the WST paper and brought it to the *JAIS* Theory Development Workshop at ICIS 2010. The reactions noted in different ways that the draft covered a lot of material related to work systems but was unwieldy, unfocused, and did not define WST clearly. Those observations were a good reflection of the state of my thinking about WST at that time, when I viewed it as an evolving combination of disparate ideas for understanding, analyzing, and designing systems in organizations. One workshop participant suggested that I should just write a book. I didn't want to do that because journal papers are more accessible than books and because journal papers seem to be the most recognized type of contribution in the academic IS discipline.

Luckily, Shirley Gregor, who was then Editor-in-Chief of *JAIS*, saw potential in the topic and volunteered to serve as SE for the paper. I produced a new manuscript that incorporated some of her initial suggestions and she engaged highly qualified reviewers who were interested in the topic. The reviewers provided lengthy reviews that addressed a wide range of topics but left me uncertain about what to do next because I agreed with some points, disagreed with others, and simply didn't know how to respond to other points. Reading the reviews several times was part of a meandering path toward a moment when I recognized the distinction between WST, WSM, and WST's extensions. I finally knew what WST was, but I worried that I did not have a journal-strength justification or packaging for that view.

4.2. Was the Development of WST a Design Science Research Project?

Since design science research (DSR) is about establishing and applying a rationale for developing new ideas or instantiations, I decided to claim that the effort to develop WSM was, in essence, a DSR project even though it started around a decade before Hevner, March, Park, and Ram (2004) was published. In effect, I would position WST's components as a design theory that motivated WSM's development. I found an *MIS Quarterly* paper (Markus, Majchrzak, & Gasser, 2002) whose argumentation might provide a model for a rationale for WST. I produced a ponderous introduction based on linkage between: 1) a kernel theory consisting of five characteristics of systems thinking performed by business professionals in relation to systems in organizations, 2) a related set of four requirements for methods supporting system thinking by business professionals, and 3) a set of six principles for analysis and design methods for business professionals, which, in combination, should lead to a set of effective concepts and methods for thinking about systems in organizations as work systems. The formulaic result was a cumbersome, lengthy, and totally artificial rationale that tried to overcome the "chicken and egg" problem of how WST's development could qualify as a DSR project. In other words, a mass of verbiage tried to justify the claim that WST could be the basis of WSM even though it wasn't articulated as WST until a decade after the first versions of WSM were produced and used.

Responding to that draft, one of the reviewers who seemed enthusiastic about the importance of the paper's subject matter was still dissatisfied:

> *The first twelve pages were really "slow going" for me. Then, on page 13, I saw something that allowed me to start putting together the paper's argument in a way I could readily grasp: a diagram of the work system framework.*

I immediately understood what to do. I would eliminate all of the DSR packaging and argumentation and would replace it with something simple: "WST is not presented here as a design theory even though it has been used as the basis for proposed improvements in many hundreds of work systems. WST emerged as a byproduct of research that started long before scholars recognized the current tenets of design science. … The development of WSM was guided by the essence of WST, which was not articulated as a theory separate from WSM during the first decade of research. (WST paper, p. 75).

Eliminating the artificial justification allowed the paper to proceed to the main points before the reader lost patience. Instead of slogging through an elaborate after-the-fact rationale, the reader could move directly to the main content and could evaluate it based on whether it seemed clear, internally consistent, and valuable.

4.3. Back to N&M's Question about WST's Purpose

As mentioned earlier, N&M found "*that WST's purpose per se is not entirely clear in its current formulation"*. Ironically, the effort of developing and publishing the WST paper had the purpose of moving the work system approach forward even though that purpose could not be stated explicitly.

4.3.1. WST's Purpose

WST's purpose is the same purpose that the work system approach had for over well over a decade. In a sentence, WST's purpose is to serve as an organized kernel of ideas for understanding how systems in organizations operate and how they change over time, regardless of whether IT plays a significant role.

4.3.2. The WST Paper's Purpose

WST's purpose is different from the WST paper's purpose. The paper's original purpose was to overcome obstacles that made it difficult to publish new developments related to work system ideas and WSM. In other words, the beneficial effort of clarifying WST's scope and details started as an attempt to legitimize work system ideas and WSM by the fact that they were based on a theory.

Despite that inauspicious intention, the lengthy effort of organizing and clarifying ideas that existed in various variations for over a decade already has had many benefits, which is why I greatly appreciate the perseverance of the SE and reviewers in pushing me to produce something coherent. WST's three--part definition makes it possible to explain WST in a 20-minute presentation that includes the difference between WST and the various versions of WSM. Having a clear definition of WST makes it much easier to understand how WST supports a wide range of applications and extensions. Also, it is much easier to explain how WST and WSM are related to other theories and methods.

5. Conclusions and a Question about the Primacy of Theory

This response to N&M covered a range of topics related to different views of what WST is, different views of how to "move WST forward", and background about why WST was called a theory in the first place. This conclusion returns briefly to the question of what is the best path for moving WST forward. It ends by questioning the academic IS discipline's commonly held belief that theory is better than other types of knowledge.

5.1. What is the Best Path for Moving WST Forward?

This paper's response to N&M addresses an implied suggestion in N&M (pp. 350-351) that a beneficial direction for improving WST would convert it into a type 4 theory. I argue for a quite different approach.

5.1.1. Extending WST as a System Theory

WST is a system theory that provides a basis for systems analysis and design methods. Converting WST into a type 4 theory would totally change its nature and would eliminate most of its potential value, its applications in WSM and elsewhere, and most or all of its extensions. Of course, it would be good to have a powerful theory for predicting the success of IT-related interventions or for

demonstrating that using WSM or any other plausible method increases the likelihood of success for system-related projects. Even if that new theory could be formulated, however, calling it WST would only increase the confusion about WST vs. WSM vs. extensions of WST that the WST paper addresses clearly for the first time.

Beyond responding to suggestions in N&M, this paper explains my view of how to attain greater value from WST by emphasizing its nature as a system theory. A direct path for attaining greater value from WST calls for increasing its range of application and developing new extensions, even to the point of seeing WST as a platform for many future developments. Section 6 will expand on that idea by identifying many WST-related topics that are being pursued or might be pursued under five categories.

5.1.2. The Backstory

Contrary to typical norms of academic publishing, this response provides a backstory that reveals more than purely "scientific" concerns. The backstory explains why I called WST a theory instead of something else and why the WST paper does not position the development of WST as a DSR project. Ironically, the WST paper's purpose was directly related to N&M's title, "Moving the Work System Theory Forward".

I leave it to the reader to decide whether the WST paper's definition of WST as a theory was a scientific misdeed, an instance of opportunistic or manipulative behavior, or a typical example of the kind of positioning and packaging that is necessary for bringing new or different ideas into an existing discourse that has established expectations and rituals. Calling WST a theory and minimizing references to DSR pursued a combination of three goals: 1) a "scientific" goal of clarifying ideas and encouraging progress related to understanding systems, 2) a publishing goal of overcoming obstacles that were blocking the scientific goal, and 3) a community goal of attaining greater benefit from WST by making it known to more researchers, instructors, and perhaps even practitioners.

5.2. Are Theories Better than Other Forms of Knowledge?

The academic IS discipline sometimes seems to operate as though knowledge is divided into higher and lower forms of knowledge, where theories, especially type 4 theories, are the higher forms and other types of knowledge such as information, concepts, frameworks, methods, and models are the lower forms. Consistent with the paper titled "Is Theory King?: Questioning the Theory Fetish in Information Systems" by Avison & Malaurent (2014), it is not obvious why theory deserves such high status in an applied discipline such as IS.

Most IS practitioners are not theoreticians. In practice, conscious reliance on explicit theories, especially type 4 theories, is much less present than reliance on information, concepts, frameworks, models, and methods. For example, Ramiller & Pentland (2009) argue that a key problem with IS research is its focus on variables instead of "actors, their actions, and the artifacts they use to accomplish those actions" (p. 475).

It is noteworthy that recognition of the most important contributions in many disciplines often are not specifically for theories or theorizing. Here are three examples:

5.2.1. A Nobel Prize Lecture

The third section of the 2009 Nobel Prize Lecture by the economist Elinor Ostrom was titled, "Developing a Framework for Analyzing the Diversity of Human Situations". The term framework was in the section title because much of her work was based on the IAD (Institutional Analysis and Development) *framework*:

> *The IAD framework is intended to contain the most general set of variables that an institutional analyst may want to use to examine a diversity of institutional settings including human interactions within markets. …. A specific* theory *is used by an analyst to specify which working parts of a framework are considered useful to explain diverse outcomes and how they relate to one another. …* Models *make precise assumptions*

> *about a limited number of variables in a theory that scholars use to examine the formal consequences of these specific assumptions about the motivation of actors and the structure of the situation they face.* (Ostrom, 2010, p. 414).

Viewing theories as an intermediate step between frameworks and models is quite different from assuming that theories should reign over the other two.

5.2.2. Prominence of Methods rather than Theories in Nobel Prizes in Physics, Chemistry, and Medicine

> *There is a much greater frequency of Nobel science awards for contributions to method than for contributions to theory,* [as shown by] *an analysis of the last two decades of Nobel awards in physics, chemistry, and medicine. The available documentation of Nobel awards reveals two forms of method–theory synergy: (a) existing theories were often essential in enabling development of awarded methods, and (b) award-receiving methods often generated previously inconceivable data, which in turn inspired previously inconceivable theories.* (Greenwald, 2012, p. 99)
>
> *82% of the contributions for the 21-year period were for method, and 18% were for theory*. (Greenwald, 2012, p. 103)

5.2.3. Turing Award for Concepts, not Theory

The computer scientist Leslie Lemport received the 2013 Turing Award, the most prestigious award in computing, "for fundamental contributions to the theory and practice of distributed and concurrent systems, notably the invention of concepts such as causality and logical clocks, safety and liveness, replicated state machines, and sequential consistency" (ACM, 2013). In a modest comment, Lemport said, "although I didn't create a theory, I did, with the help of others, create a path that other people have since followed—and turned into a superhighway" (McGoneal, 2014).

In my opinion (surely not shared by part of the IS community), the academic IS discipline's elevation of theory above other types of knowledge stems from a combination of tradition, training, academic politics, physics envy, and other factors that are not substantively related to maximizing its real-world impact. I think little evidence exists that privileging theory over other types of knowledge is beneficial, especially at a time when managers and executives often seem overwhelmed by the speed of technological and social change.

Arguments for the primacy of theory sometimes quote Lewin's (1951) statement that "there is nothing so practical as a good theory". In my experience, there is also nothing so practical as a good framework or a good method or a good model or a good platform.

6. Examples of Research Topics that Use WST as a Platform

As mentioned at the end of Section 3, this final section identifies potentially fruitful research topics that are directly related to WST and/or its applications and extensions, These potentially fruitful research topics all pursue the spirit of moving WST forward. The topics are organized under five categories. The main point is that WST is not an end in itself. It is a possible steppingstone toward applications and extensions in many high-value areas. Like many first steps motivated by long-term hopes and intentions, some of these potential directions might seem like intuitive leaps that cannot be "justified" in a way that many journal reviewers would find acceptable (i.e., by constructing an artificial path through past research that may or may not have served as an inspiration or genuine justification). Appendix 2 at the end of the WST paper hints at some of the topics mentioned here. Other topics from more recent thinking identify possibilities that the WST paper does not mention.

6.1. WST Extensions Related to Work System Operation, Characteristics, and Evaluation

All of the following are extensions of WST rather than changes in the core of WST. Distinguishing between the core and the extensions is important for an evolving body of concepts, frameworks, and theories because it helps in understanding what is central, what is peripheral, and how all of the ideas form a unified whole.

6.1.1. Work System Principles

Alter (2004) uses the work system framework to organize 21 work system principles based partly on sociotechnical principles of Cherns (1976). Those principles were compiled to help in analyzing and designing systems in organizations. Alter & Wright (2010) evaluate a slightly expanded list of 24 principles based on opinions of six small cohorts of executive MBA students. The data concerned the extent to which they believed that each principle should apply to most work systems in their organizations (average score around 6 out of 7) and the extent to which they believed that the operation of most of the work systems in their organizations seemed to conform with each of the 24 principles (average score around 4.5 out of 7).

6.1.2. Work System Design Spaces

Shortcomings of initial use of WSM by MBA and executive MBA students implied the potential usefulness of a series of design spaces for thinking about possible improvements in work systems. Alter (2010b) defines a sociotechnical design space as an organized, interrelated set of factors or topics that are amenable to design, that frequently affect system performance, and that should be considered during the process of sociotechnical design. The design spaces are organized based on the elements of the work system framework plus a tenth category, "work system as a whole". As the WST paper notes (p. 88), the respective design spaces focus on different topics such as possible changes in each element, characteristics of each element, risks related to each element, alternative locations of knowledge in a work system, and so on. For example, in the design space that focuses on work system characteristics, scalability, flexibility, and resilience are characteristics of a work system as a whole, whereas skills and knowledge are characteristics of work system participants.

6.1.3. Work System Metamodel

Figure 2 is the fifth version of a metamodel that reinterprets elements of the work system framework to support more detailed analysis and design of work systems than is supported directly by the work system framework. The first version was proposed in Alter (2010a). A subsequent version adapted for service systems appeared in *Service Science* (Alter, 2012a). The fourth version appeared in conference and workshop proceedings related to the following topics: a unified, operational view of service and service systems (Alter, 2014a); encouraging beneficial directions for emergent change (Alter, 2014b); and design thinking in IS (Alter 2014c). One of the fifth version's incremental improvements is greater clarity about the different types of informational entities that might be used, created, or updated by a specific work system activity. Another incremental improvement is mentioned in relation to the next research topic.

6.1.4. Visualizing and Analyzing Service Systems as Work Systems and Work Systems as though they Provide Services

IBM, HP, Cisco, and other technology companies have supported a cooperative attempt to develop a science of services that might help in developing their businesses (e.g., Chesbrough & Spohrer, 2006; Spohrer, Maglio, Bailey, & Gruhl, 2007). Alter (2008, 2010d) introduces a service value chain framework that can be used in conjunction with the work system framework to accentuate service-related ideas such as provider responsibilities versus customer responsibilities, the intensity of interactions between providers and customers, value capture by customers and providers, and ideas from service blueprinting (Bitner, Ostrom, & Morgan, 2008) such as onstage and back stage activities, line of interaction, and line of visibility. The idea of "value blueprinting" (Alter, 2013d) goes a step further by combining the "value capture" concept with basic ideas from service blueprinting. In relation to service concerns, the additional contribution of the metamodel in Figure 2 involves visualizing links between provider resources and value creation by customers. Those topics are of special interest to

researchers who focus on the nature of service and service systems. For example, they are mentioned in "foundational premises" in important papers on service-dominant logic (Vargo & Lusch, 2004, 2008) that already have been cited thousands of times).

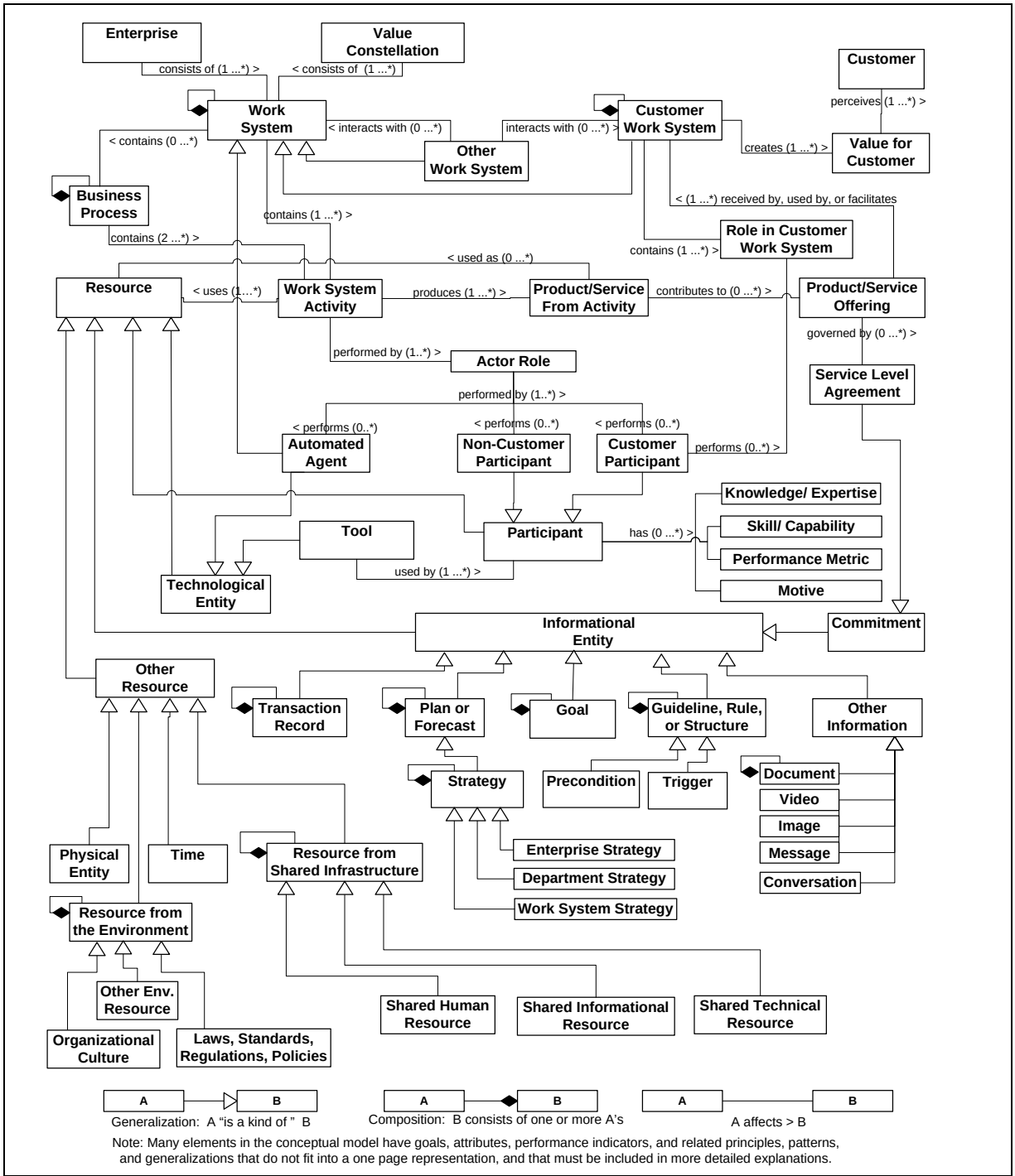


Figure 2. Work System Metamodel (Version Five)

6.1.5. Concepts and Metaphors Related to Specific Types of Subsystems

Current systems analysis and design textbooks say almost nothing about concepts and metaphors related to decision making, communication, sense making, sociality, and other aspects of systems in

organizations that are relevant for understanding and improving work systems. That void might be addressed by viewing work systems as though they contain subsystems specifically devoted to decision making, communication, and other types of human activity and interaction. Alter (2013b) provides a step in that direction by identifying concepts and metaphors related to decision subsystems, communication subsystems, social subsystems, and other types of subsystems. Explicitly considering the special nature of the different types of activities and/or subsystems could be extremely useful in understanding and analyzing work systems in which decision making, communication, sociality, and other specific types of activities are especially important.

6.1.6. Theory of Workarounds

WST's work system life cycle model contains inward facing arrows that represent ongoing adaptations that occur endogenously from within the work system without external interventions or formal projects. Many of these adaptations are workarounds or are based on learnings from workarounds. Curiosity about the nature of those adaptations led to developing a theory of workarounds (Alter, 2014e) based on hundreds of descriptions of workarounds found through secondary sources. Ideas from that effort were used by Röder, Wiesche, and Schermann (2014a, 2014b) in empirical research related to workarounds.

6.1.7. Taxonomy of Work System Interactions

Interactions between work systems may involve any of the elements of either interacting work system. For example, interactions between some work systems may cause problems related to double booking of work system participants, whereas interactions between other work systems may cause problems related to inconsistent data definitions. Designed interactions between work systems such as supplier-customer relationships are essential for work system operation. Unplanned, indirect, or accidental interactions of various types may have a variety of impacts. Alter (2010c) introduces an initial taxonomy of work system interactions that spans planned, unplanned, indirect, or accidental interactions involving any or all of the elements of the interacting work systems. The taxonomy and underlying rationale can be developed much further. The inquiry in Alter (2010c) led to inclusion of the entity type "other work system" in the metamodel in Figure 2. A more developed taxonomy of system interactions potentially could support systems analysis and design by identifying and classifying some of the many ways in which the work system being analyzed or designed might be affected by other work systems.

6.1.8. Concepts and Theories Related to Work Systems that Cross Multiple Organizations

Winter, Berente, Howison, and Butler (2014) note that "many important work practices, routines, and digital artifacts occur outside of organizational containers; increasingly work is not cleanly encapsulated within a single organization's boundaries" (p. 4). They propose an updated sociotechnical framework (neo-STS) that recognizes how work and infrastructures may be distributed across multiple organizations, thereby calling for concepts such as multi-encapsulation, complex relations among elements, multi-inheritance, and continual negotiation (pp. 26-27).

WST and the work system metamodel might support these ideas in several ways. The WST paper notes that "work system is a general case for thinking about systems in or across organizations" The special cases of work systems include information systems, supply chains (which cross organizations), projects (which often cross organizations), self-service work systems (which often cross organizations, as in e-commerce), and totally automated work systems (which also may cross organizations) (p. 77). The concept of value constellation (from strategy studies and marketing) is included in the work system metamodel in Figure 2 because work systems sometimes cross enterprises. The metamodel's concepts of customer participant and customer work system provide a basis for clarity about the often muddy concepts of co-production and value co-creation (Alter, 2014a). An agent-based simulation of a work system based on the metamodel would likely consider the fact that individual work system participants often play disparate roles in multiple work systems. Thus, there is some possibility that WST and the work system metamodel might support the research proposed by Winter et al. (2014).

6.1.9. Enriching WSM and Extensions of WST by Incorporating Additional Concepts and Theories

The existing literature of IS and other disciplines provides a large number of concepts, frameworks, and theories that apply to most or all of the entity types and relationships in the metamodel in Figure 2. For example, TAM, the technology acceptance model (Venkatesh & Davis, 2000), is directly relevant to the relationship between participants and tools in Figure 2. Other concepts and theories that can be associated with that single relationship might provide richer insights for analyzing or designing work systems, e.g., concepts and theories related to affordances (Leonardi, 2011; Volkoff & Strong, 2013) and Heidegger's concept of equipment (Riemer & Johnstone, 2014). Similar possibilities apply to other entity types and relationships throughout the metamodel.

6.2. Using WST for Understanding, Analyzing, and Designing Systems in Organizations

To date, WST has been used in many classroom settings, although the extent of usage has never been tracked. Precursors of WSM appeared in introductory chapters in the second (1996), third (1999), and fourth (2002) editions of Addison-Wesley and Pearson Prentice Hall information system textbooks that many thousands of students used. Subsequent usage was evident from adoptions of Alter (2006). Based on many comments at conferences (and also based on occasional requests for help from students and instructors from many countries), it is clear that some introductory IS courses and systems analysis courses introduce the work system framework or aspects of WSM as a way to think about systems in organizations.

More intensive use of WST involves individual or group assignments in which students follow WSM guidelines in the form of a template to identify a problem or opportunity in a work system, perform an analysis, and explain why proposed changes to various parts of the work system (i.e., not just the technology) should result in better work system performance. Most of the intensive use of WST/WSM has involved MBA and executive MBA students, many of whom have strong business experience. As reported in Truex, Alter, and Long (2010) and Truex, Lakew, Alter, and Sarkar (2011), that type of usage has demonstrated that ideas in WSM can be used by business professionals. To date, there have been no case studies or surveys about the use of WSM by business professionals in work settings not associated with coursework or research. On the other hand, based on comments from students it is clear that some of the undergraduate, MBA, and executive MBA students who learned about WST/WSM have used aspects of it such as the work system framework and work system snapshots in real-world practice. Unfortunately, there have been no long-term follow-ups concerning the intensity and effectiveness of applications in WST/WSM in real-world practice. WST has started to become visible in the corporate world (e.g., Mason, 2012; Koehler, Cameron, Sweeney, & Harrison. 2013) but is still is not widely recognized there. Obviously. the current state of adoption calls for extensive research related to teaching and application.

6.2.1. Understanding Usage of WST in Classroom Settings

It is easy to introduce the work system framework in classroom settings. To support further application in teaching, it would be useful to compile examples of WST usage in classroom settings and to assess the effectiveness of different teaching approaches. Getting students with little business experience to use those ideas with insight is difficult, but the same comment applies for getting those students to apply almost any non-mechanical conceptual material related to business situations.

There is an additional practical challenge in asking students or student teams to use WST for describing and analyzing work systems. Reading student papers and providing meaningful feedback requires more effort than grading typical tests or analyses of pre-packaged case studies that the instructor is familiar with or for which teaching notes may exist. Compiling and analyzing instructor and student experiences with intensive use of WST/WSM might help in developing more efficient or effective approaches.

6.2.2. Developing New Templates for Using WST

Below are two examples of trying out new templates. I hope that using many other templates will help in learning how to use WST most effectively and efficiently in classroom assignments.

Example 1: the "business case template". For the last several years, I used versions of a WSM template that I called a "business case template" (i.e., guidelines for quickly analyzing a work system and producing a "business case" for improving it in a particular way). The course time for using this material is often too short to allow a convincing cost/benefit study, and many students do not have enough background to produce meaningful cost/benefit studies for situations that are not pre-packaged for them. Therefore, I always try to emphasize that a real-world decision about which changes to pursue should include costs, benefits, and risks of the related project even if the students won't have enough time to produce convincing estimates.

Example 2: adding a new questionnaire. In a small executive MBA class, I tried out a new variation that added a four-page questionnaire that encouraged teams to at least consider a large number of ideas that they easily could overlook, such as scalability, flexibility, incentives, knowledge, corporate culture, and so on. Student teams analyzing a particular work system of their choice had to rate around 100 topics 1, 2, 3, or not applicable (1 for no problem, 2 for minor problem, 3 for serious problem) in relation to that work system. Most of the topics came from the design spaces mentioned earlier. Student feedback suggested that they found the questionnaire easy to use and useful for identifying issues that deserved discussion. Based on that result, I used the questionnaire with a larger group from a different country. I was surprised and pleased by creative ways in which several teams incorporated a summary of the questionnaire into their presentations.

6.2.3. Incorporating WST into Agile Development Projects

An issue in many agile development projects is the lack of easily used methods for clarifying the business goals and scope before launching a sequence of incremental software improvements. At least one set of European researchers is considering a research project that uses a quick work system analysis as a lightweight front end to agile development projects. Part of their rationale is that some business professionals involved with agile projects seem to have no organized way to visualize how those projects are going to produce genuine improvements in business performance, rather than just producing software changes that someone wants.

6.2.4. Engineering for Emergent Change

The topic of emergent change in systems has been discussed in a variety of ways (e.g., Orlikowski, 1996; Feldman & Pentland, 2003; Germonprez, Hovorka, & Gal, 2011; Pentland et al., 2011). Ideally, it should be possible to design IT-enabled work systems in a way that recognizes that emergent change will occur. WST and some of its extensions might contribute by explaining how workarounds occur (Alter, 2014e) and how work system design should try to identify and take into account foreseeable workarounds of repetitive types, such as when a small work group agrees to use one user account to avoid wasting time with multiple logins or when a purchasing agent divides a large transaction into small transactions to avoid triggering the organization's control limits (Alter, 2015). As Alter (2014b) discusses, those ideas could contribute to ongoing European research efforts related to enterprise engineering (e.g., Dietz, 2011; Dietz et al., 2013) and service engineering (e.g., Böhmann, Leimeister, & Möslein, 2014) by providing a way to consider how enterprise engineering and service engineering should account for the high likelihood of emergent change after initial implementation.

6.2.5. Supporting "Design Thinking" Related to Systems in Organizations

Frequent calls for digital innovation assume that business people will be able to identify ideas that are the basis of a path toward innovation. It is possible that WST and its extensions such as work system design spaces could provide knowledge-based support for design thinking related to information systems (Alter, 2014c).

6.2.6. Demonstrating that Using WST and its Extensions Increases the Likelihood of Project Success

Most of the WST research to date has been motivated by unverified assumptions about the potential benefits of using WST and its extensions. Validating those assumptions would require research demonstrating that using WST increases the likelihood of project success in real-world projects. I think that is the essence of the suggestions in N&M that WST should be converted into a type 4 theory directed at explaining and predicting.

CRM implementation is an area where WST-related research about increasing the likelihood of project success would be possible. The hypothesis would be that CRM projects organized around improving the performance of specific, clearly identified customer-facing work systems will lead to greater improvements in business performance than CRM projects organized around installing and using CRM software. Similar research could look at the implementation of ERP and other packaged software. The same general approach also could be used for analyzing the business impact of custom programming projects. All of that research would focus on the benefits of managing projects as work system improvement projects instead of thinking of them as IT projects, IS projects, or software projects.

6.3. Linkage of WST and Its Extensions to Concepts, Models, and Techniques for IT Professionals

Although WSM was initially developed to help business professionals understand systems in organizations, there is great value in linking WST and its extensions to concepts, models, and techniques used by IT professionals. Establishing such links will make it easier to move from summary-level discussions to detailed descriptions of the type that IT professionals need for developing software.

6.3.1. Linking WST to Use Cases

In effect, a use case answers the following question: "which activities will use a technical artifact that is being built?". That is far from the best question to ask business professionals whose main concern is improving the efficiency and effectiveness of work systems with human participants, not just users of technology. With a WST approach, the fundamental question is how to improve a work system, not how to clarify where a proposed artifact might be used. Greater clarity for business and IT professionals would come from describing the proposed work system and then using the metamodel to clarify which work system activities will use which IT-based tools. Future research could show the benefits of deriving use cases from instantiations of the metamodel. (Alter & Bolloju, 2012).

6.3.2. Linking WST to BPM

The gap between managerial and technical perspectives on business process management (BPM) reveals a significant challenge for BPM practice and research. Consider, for example, differences in scope and emphasis between typical managerial BPM topics (organizational change, process organizations, TQM) and typical technical BPM topics (detailed modeling, programming techniques, automated process control, process mining). WST and its extensions could help in addressing that gap through links between the managerial view outlined by the work system framework and the more detailed view from the work system metamodel (Alter, 2013c).

A possible contribution based on the metamodel could be a set of design patterns for different types of processes, including 1) largely unstructured creative processes (such as various types of design) that might use tools but that have no pre-specified sequence, 2) semistructured knowledge processes (such as medical diagnosis or legal analysis) that use tools and procedural knowledge but also have no pre-specified sequence, 3) workflow processes (such as invoice or reimbursement processing) that have a prescribed flow but may treat individual steps as black box subroutines whose details are unknown, and 4) highly structured processes (such as pharmaceutical and semiconductor manufacturing), where both the workflow sequence and the details of each step must be specified and followed precisely.

6.3.3. Linking WST to Modeling Frameworks Used by IT Professionals

Alter & Bolloju (2012) provides an example showing how WST and the work system metamodel could provide a front end to object-oriented analysis and design (OOAD). Potential benefits of this approach stem from focusing more fully on business and process issues before diving into concepts and notations that most business professionals do not understand. In another case, Alter (2014d) uses a standard Object Management Group (OMG) example to illustrate possible overlaps between WST and a modeling method called the Design and Engineering Methodology for Organizations (DEMO) (Dietz, 1999, 2006). That exploration could be a step toward finding synergies between DEMO and WST and its extensions. DEMO's rigorous underpinnings based on communication theories could provide guidelines for producing models of work systems that might lead to improved versions of WSM and possibly to new extensions of WST. From the other direction, such research might suggest avenues for making DEMO more accessible and usable by business professionals. Similar efforts could explore relationships between WST and many other tools and methods for IT professionals, including Archimate (Lankhorst, Proper, & Jonkers, 2009), MEMO (Frank, 2002), semantic object models (Ferstl & Sinz, 2006), and e3 value (Gordijn & Akkermans, 2003).

6.4. Using WST for Broader Concerns Related to the Structure and Dissemination of Knowledge about Systems

WST and its extensions should support big-picture understandings of systems in organizations, better appreciation of important details that business professionals should understand, and better collaboration between business and IT professionals. An ambitious version of that goal is to provide a language for discussing and understanding the operation and evolution of systems in organizations. An incomplete step in that direction was a paper proposing "Sysperanto", an imagined language for talking about systems in organizations (Alter, 2005). Ideas in that paper reappear in the design spaces mentioned earlier. Subsequent thinking includes the following:

6.4.1. WST as an Area of Overlap and Conduit between Different Disciplines

As portrayed in Figure 3, there is a substantial area of overlap between disciplines such as IS, operations management, industrial engineering, business informatics, service science, marketing, organizational behavior, and management. That area of overlap involves operating and improving systems in and across organizations. While each discipline has its own areas of special concern (e.g., queuing theory in operations management and co-creation of value in service science), the area of overlap between disciplines could be a conduit for overcoming intellectual silos that inhibit exchange of ideas and possibilities for collaboration. WST and some of its extensions inhabit the area of overlap, perhaps leading to opportunities to use or adapt WST in many different disciplines that already focus on related issues but use different vocabulary.

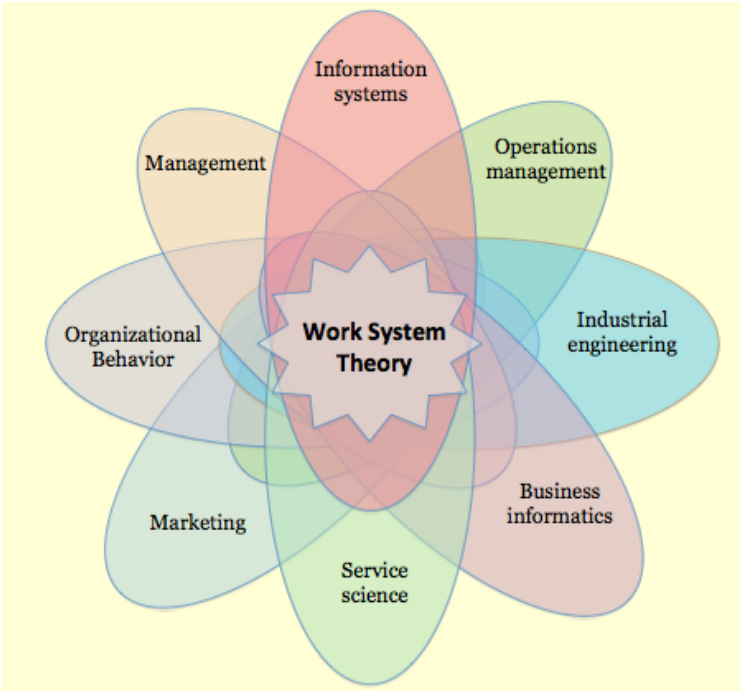


Figure 3. Work System Theory as an Area of Overlap Between Multiple Disciplines

6.4.2. Scaffolding of a Body of Knowledge for Work Systems and IS

Alter (2012b) proposes a "knowledge cube" whose three dimensions are 1) work systems in general and the nine elements of the work system framework; 2) ten types of knowledge entities, such as nouns, verbs, adjectives, and generalizations; 3) different special cases of work systems including work systems in general, information systems in general, supply chains, and projects. Many of the concepts that belong in cells for work systems in general are inherited by the special cases of work systems. One implication is that the search for native theories in IS (e.g., Straub, 2012) may bump into the fundamental issue that most of the concepts and knowledge that apply to information systems in general are actually concepts and knowledge about work systems in general (Alter, 2012b, p. 12). A bit of evidence in that direction is that over half of the IS-related risk factors found in a study of IS risk (Sherer & Alter, 2004) were actually risk factors for work systems in general, such as management support, staff competence, and appropriate incentives.

6.4.3. "Interpretary" for Different Views of Systems

Alter (2013a) proposes the idea of an interpretary, a compendium of interpretations of common system-related terms from the viewpoint of different conceptual lenses (e.g., interpreting the terms system, requirement, and implementation based on a work system lens or a typical IT-centric lens). Developing an interpretary based on a WST lens, an IT-centric lens, and possibly other lenses could contribute to deeper understanding of advantages and shortcomings of specific systems analysis methods and might also help in the study of communication between business and IT professionals and its effect on business/IT alignment.

6.5. Diverse WST Applications or Extensions by Researchers with Diverse Goals and Interests

N&M notes that I have been involved in much of the research to date related to WST. I agree with that and find it gratifying that other researchers have applied WST or its extensions in research that I was not involved in at all and in areas where I have never worked. For example, in the first year after its publication, the WST paper was applied in a diverse group of papers whose topics include high performance teams (De Leoz & Petter, 2013), alignment of business and application services (Rudzajs, Krikova, & Strazdina, 2013), education related to project management (Pirhonen, 2013),

industrial product-service systems (Voigt, Mänz, & Wilkens, 2013), commentary on whether IS research is sociotechnical (Sarker, Chatterjee, & Xiao, 2013), implications of academic service e-mobility (Basitt, Noor, & Aljund, 2013), comparison of different views of service and service systems (Cardoso, Lopes, & Poels, 2014), electronic currencies (Vitari, 2014), business process modeling for an emergency plan (Hamid et al., 2014), and transformation from product-centric to customer-centric services (Murthy & Marjanovic, 2014). The breadth of those initial citations implies that WST is likely to prove useful in research on many topics by many authors.

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About the Author

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