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Extending a Systems Analysis Method for Business Professionals

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Abstract. Despite having been explored, described, theorized, and measured in hundreds of IS research articles, frequent difficulties related to user participation and business/IT communication persist in relation to project management, specification of requirements, implementation in organizations, business/IT alignment, and IS failures. We report on an extension of a long term design science research project that previously demonstrated a possible path toward addressing these longstanding problems by empowering business professionals to analyze systems in business terms rather than in formalisms for IT specialists. Previous research demonstrated that most of 75 working business professionals with extensive business experience were able to use the then current iteration of a work system analysis template to analyze IT-reliant work systems in their own organizations, and to recommend improvements. The current research extends the previous efforts by evaluating natural field studies by managers taking coursework for advanced degrees in MBA and MSIS. We analyze 84 examples collected over 7 consecutive academic terms to evaluate the success of several successive versions of the design artifact, concluding that business and IS professionals are able to use the design artifact effectively and that a revised template generated better results.

Keywords: work system, work system method (WSM), design science,

1 Introduction

We use a design science research approach to extend results to date of a long-term research effort to develop the work system method (WSM) and related concepts and frameworks, an effort that will be summarized later. The original research was motivated by dissatisfaction with the seemingly common practice of putting IT at the forefront in systems analysis by emphasizing the creation of computerized artifacts by IT professionals. Creating requirements for computerized artifacts in that way may overlook problems and opportunities related to the work systems that use those artifacts. An approach that is more likely to engage business professionals emphasizes short-

comings of a current, “as is” work system and reasons why it needs improvement. The resulting recommendation starts with the “to be” work system, and involves much more than just improving technology that the work system uses. Our research on the development, testing, use, and refinement of WSM follows "the fundamental principle" of design science research, that "knowledge and understanding of a design problem and its solution are acquired in the building and application of an artifact" [1].

Organization of this paper. We start by summarizing previous progress in developing the work system method. Next we use guidelines from [2] to explain how both the entire research effort and the current extension fit into the design science research paradigm. The current research shows improvement in the ability of the design artifact to support systems analysis by business and IT professionals. A qualitative analysis of a large sample from 301 natural field studies by users of WSM and written feedback from users of WSM confirms the utility of the overall approach and provide direction for future extensions.

2 Progress to Date

Over more than 15 years, Alter worked on developing a systems analysis method that can be used by business professionals for their own understanding of systems in their organizations and can support communication between business and IT professionals. (Alter [3] provides a lengthy set of references - starting in 1995 - that could not be included here due to length limitations). That research anticipated tenets of design science research that were articulated in *MISQ* by Hevner et al [2], such as relevance, testing, evaluation, and iterative improvement. The research produced a body of theory that included theories for analysis, evaluation, prediction, and design [4].

Some of the products of the research to date are summarized next. Developments specifically related to WSM are impossible to disentangle from developments involving work system concepts and related frameworks because all of these ideas were developed over time in relation to the same purpose.

Definition of work system. In WSM the unit of analysis is a work system, a sociotechnical system (by default) in which human participants and/or machines perform work (processes and activities) using information, technology, and other resources to produce specific products and/or services for specific internal or external customers. Almost all value chain systems (e.g., systems for inbound logistics, operations, sales and marketing) and support systems (e.g. systems for procurement and human resources) are IT-reliant work systems. Information systems, supply chains, and e-commerce systems are special cases of work systems.

Work system framework. WSM is based on two central frameworks. The nine elements of the work system framework (Figure 1) are the basis for describing and analyzing an IT-reliant work system in an organization. The framework outlines a static view of a work system’s form and function at a point in time and is designed to emphasize business rather than IT concerns. It covers situations that might or might

not have a tightly defined business process and might or might not be IT-intensive. Figure 1 says that work systems exist to produce products and services for customers. The arrows say that the elements of a work system should be in alignment.

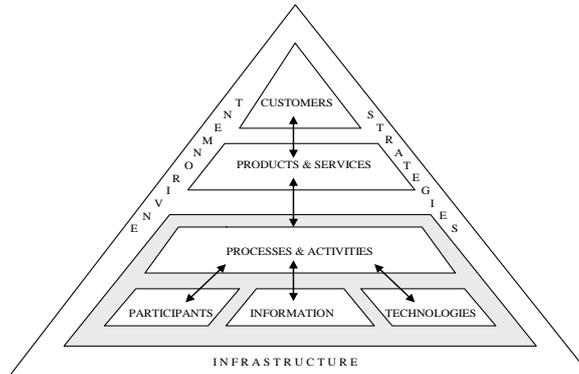


Fig. 1. Work system framework

The other central framework (not pictured due to length limitations) is the work system life cycle model (WSLC), which expresses a dynamic view of how work systems change over time through iterations involving planned and unplanned change. 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. Unplanned changes are ongoing adaptations, experimentation, and workarounds that change aspects of the current work system or of ongoing work system projects without separate allocation of significant project resources. WSM is designed to be used during the initiation phase, although the concepts and frameworks developed during WSM research can be used in any phase.

Work system method. WSM is a flexible systems analysis method that starts by identifying the work system that is to be created or improved. WSM uses tools such as a "work system snapshot" to summarize the "as is" work system and the "to be" work system that will exist after any proposed changes are implemented. The natural field studies analyzed in the current research used successive versions of a work system analysis template that guided a simplified analysis process and also provided an outline of a management report. These templates were designed for use in time-limited projects in advanced MBA and MSIS coursework. Many aspects of the knowledge developed through WSM research to date were not represented explicitly in those templates because of the limited amount of time that was available both for teaching and for application. Both templates support the following sequence of activities:

- Define the system as the smallest work system that exhibits the problems, issues, or opportunities that led to the need to perform an analysis.
- Describe and evaluate the "as is" work system in whatever level of depth, and with whatever level of rigor is appropriate for the user's purposes.

- Identify additional problems, issues, and opportunities with the "as is" work system by looking at each part of the work system more closely.
- Select among possibilities for improving the "as is" work system and propose a "to be" work system.
- Justify the proposal based on the likely impact of the proposed changes.

WSM applies general problem solving to a work system rather than just an IT application. WSM is designed to be quite flexible and is usable for different purposes and at different levels of detail. . An executive can use WSM at a highly summarized level to think about whether a system-related investment proposal is actually about improving a work system (rather than just acquiring software), and whether the comparison of the "as is" and "to be" work systems convincingly implies that business performance will improve. Implementers, change agents, and work system participants can use aspects of WSM to think about how the "as is" work system operates, how well it operates, and how and why possible changes might generate better results. IT professionals can use WSM in the same type of thought process for understanding system-related situations from a business viewpoint and for communicating with business professionals more effectively.

Other developments related to WSM. The effort to develop WSM and related concepts and frameworks led to other concepts and frameworks that are beyond this paper's scope. Those developments include, among others: work system principles, work system design spaces, a meta-model underlying the work system framework, links between the work system framework and a service-oriented view of a work system, a theory of system interactions based on work system concepts, and a theory of workarounds based on work system concepts. (See references in Alter [3].)

3 The Current Research

The initial ideas in WSM were an attempt to distill, combine, and simplify industry experience plus ideas from many sources including the general systems, sociotechnical, and system development literature. Over many years, MBA and Executive MBA students at the University of San Francisco used successive versions of a work system analysis template to write group papers analyzing IT-reliant work systems in their own organizations. The papers from each semester revealed confusions, knowledge gaps, and other problems that led to revisions in the work system analysis outlines for subsequent semesters. For example, Alter [5] identifies pitfalls observed in 202 group papers between 1997 and 2002 and approaches that were attempted for minimizing those pitfalls. Other sources of improvements included examples in newspapers and the popular business press that illustrated omissions or confusions in a then-current version of WSM, and research journal articles that identified issues or topics not yet included within WSM.

The current research is based on a review and analysis of a sample of 84 out of 316 natural field studies produced by advanced MBA students at Georgia State University between 2009 and 2011. As reported in Truex et al. [6], which analyzed the first 75 of the 301 field studies, the deliverable was a five part management report (executive

summary, background, system and problem, analysis, recommendation and justification) written based on a work system analysis template that included tables for summarizing the “as is” work system, assessing how well it operates and where problems exist, summarizing a proposed “to be” work system, and clarifying why proposed changes probably would improve performance.

The current research extends previous research. Analysis of the first 75 field studies identified a number of shortcomings that an improved work system analysis template might minimize or eliminate. We will call the template for the initial 75 field studies "Template #1," and will call the improved version "Template #2." We will use the 7 guidelines from Hevner et al. [7] to explain our efforts in the context of design science research methods and design science theory.

Guideline 1: Design as an Artifact. Hevner et al. [7] notes that IT artifacts may be constructs, models, methods, and instantiations. WSM’s development to date includes artifacts of each of those types. Publications related to WSM have presented many constructs and models, have explained WSM as a method, and have described the use of specific work system analysis templates (e.g., Truex et al. [6]).

==> The current research evaluates the use of Templates #1 and #2.

Guideline 2: Problem Relevance. The lack of effective analysis methods that can be embraced fully by business professionals contributes significantly to the widely discussed user participation problem (e.g., Markus and Mao [8] ; Alter [9]). There is a growing literature about limitations of systems analysis tools for IT professionals (e.g., Dobing and Parsons [10], [11], Siau et al. [12]). The relatively rare ability of some IT analysts to engage with business professionals while using these tools in no way implies that existing methods and tools for IT professionals fully address difficulties in collaboration between most business and IT professionals. Business professionals often are at a disadvantage when IT professionals use their own methods and tools to frame the conversation, the problem, and the solution [13]. To participate on an equal footing, business professionals should have methods and tools that they can use for thinking about IT-reliant systems with or without the help of IT specialists.

==> The entire WSM research effort addresses important practical issues related to the development and use of information systems.

Guideline 3: Design Evaluation. Alter [5] identified common pitfalls in using early versions of work system analysis guidelines that were available before 2006. Truex et al. [6] evaluated the usefulness of a more recent work system analysis template and concluded that business professionals could use it successfully.

==> Iterative evaluation has been a factor in the entire WSM research program since its inception. The current research extends the previous research by using a substantially larger dataset than that used by Truex et al. [6] and by introducing Template #2 that was developed in response to results reported in Truex et al. [6].

Guideline 4: Research Contributions. Research to date in developing WSM has generated publications related to topics including the work system framework (Figure 1), work system life cycle model, work system method, work system principles, work system design spaces, and a meta-model underlying the work system framework. In addition to creating and testing specific tools, this research produced publications related to a range of concepts, theories, and frameworks. (See Alter [14]).

==> The current research produces research contributions related to creation and evaluation of a new version of the work system analysis template (Template #2).

Guideline 5: Research Rigor. The research process to date has been based on a cycle of assessing recent use of a work system analysis guidelines or templates, looking for gaps in the ideas or in the use of the ideas, seeking retrospective user comments on how WSM fit and felt, creating or improving concepts and frameworks, revising the previous guidelines or templates accordingly, and, coming full circle, testing those improvements formally or informally.

==> The current research improves the informal evaluation methods that were used previously in the development of WSM. The current research applies improved versions of the underlying work system theory and uses established means of qualitative coding, tagging, and analysis of the field studies that used Templates #1 and #2.

Guideline 6: Design as a Search Process. A variety of work system analysis guidelines and templates evolved over time through cycles that combined theorizing with a trial and error approach for developing and testing artifacts. Iterative search logic was appropriate because the initial theory and other available theories were too abstract and/or vague to support any other approach.

==> The current research continues to use a search process. Given progress to date, the search is more informed by theory than some of the initial research.

Guideline 7: Communication of Research. The development and use of WSM has been documented in over 20 papers since 1995. The many references in Alter [15] communicated a large number of results related to concepts, frameworks, analysis techniques, and various versions of WSM.

==> Additional, more extensive publications are planned.

4 Research Method and Examples of Evaluation and Iterative Redevelopment of WSM

Section 4 summarizes three ways in which we analyzed the data and demonstrates the progress in the evolution of the design artifact. First, we identify shortcomings that were addressed in improving the artifact. In section 4.2 we present the descriptive statistical results including the consistency and distributions of the data. In section 4.3, we provide examples of the reflexive qualitative data in our sample set.

4.1 Issues Revealed using Template #1

Template #1 was used during the Summer and Fall of 2009. Based on shortcomings that were observed, we created template #2 and used it for the rest of the field studies in our sample. Template #2 and the related explanations addressed the following problems that Truex et al. [6] reported in relation to use of Template #1:

Difficulties naming the work system. Neal Postman (1988) said: “So in naming meaning begins.” Although Template #1 required a name for the work system nearly half of the papers did not name the work system or named it in an overly general manner that was not as informative as it could have been. (e.g., “financial accounting

system” instead of “generating month ends financial statements”). Clarifications in instructions for using Template #2 included a list of typical work system names.

Confusion about the definition of concepts. WSM uses terms such as a customer, products and services, and processes and activities in particular ways. Better explanations of these concepts addressed a series of issues such as the distinction between a work system's customers and stakeholders such as managers and executives who care about outcomes do not receive products and services that the work system produces.

Lack of clarity about the desired use a tool called a service responsibility table. Template #1 contained a blank service responsibility table [9], which was to be used to identify customer responsibilities related to each step in the processes and activities. More than half of the initial reports reflected confusions in using this tool. Concluding that its initial form was inadequate, we eliminated it from Template #2 to focus more attention on work system performance.

Non-attention to column headings. In a number of papers, entries in the cells in certain tables seemed to ignore column headings and simply used the tabular format to identify problems, issues, and recommendations, many of which made sense when read without considering the column headings. Instructions for using Template #2 were clearer about the meaning and interpretation of tables.

Problem Definition and Eventual Recommendations. Since we noticed that many recommendations were unclear using template #1, Template #2 gives more emphasis on providing a meaningful recommendation for the problems that were identified. This, in turn results in a clearer problem definition in the report. We saw that progress as we analyzed the briefings from Templates #1 and #2.

4.2 Evaluation of Improvements Incorporated into Template #2

The process for initial evaluation of improvements incorporated into Template #2 was based on the assumption that the effectiveness of those improvements would be revealed by comparing results from 3 course sections in which Template #1 was used (Spring and Summer 2009) and 11 course sections in which Template #2 was used subsequently through Spring 2011. In total we collected 301 briefings produced by 14 course sections across seven different terms. Six briefings were selected randomly from each of 14 sections to reduce the number included in the initial analysis. Five criteria were used for evaluating each of the briefings on a scale of 1 to 4: a) clarity in the identification of the work system, b) clarity of the problem definition in the management report, c) meaningfulness of the recommendations, d) internal consistency of descriptions of activities and their participants, and e) clarity in the identification of performance gaps. The 84 briefings were randomized rather than ordered chronologically to protect against ordering bias in the analysis. Each of the briefings had been read previously by one of the authors and by one or for some course sections two highly qualified research assistants. In the current evaluation, all 84 of the papers were additionally read and re-read and then coded by a highly qualified PhD candidate whose years of business experience provided sufficient background for recognizing meaningful descriptions of situations and meaningful recommendations.

The mean overall quality score for the 84 briefings was 3.40 with a standard deviation of .463 and a range from 2.2 to 4.0. Figure 2 shows the frequency distribution of scores by academic term. The scores are the sum of the five criteria for each of the briefings. The first use of Templates #1 and #2 occurred in terms 1 and 3. The average scores for the five terms other than those start-up terms were quite consistent, with a range from 3.54 to 3.73. In other words, average results for the second term in which Template #1 was used were similar to average results for most of the terms in which Template #2 was used. However a comparison of the averages scores does not tell the full story. A fuller picture emerges from other aspects of the data including a comparison of business-focussed vs IT-focussed courses, correlations by term and comments related to the criteria.

Overall Evaluation	Frequency of scores in each term (for our sample of 84 briefing)							Terms
	-Template #1-		-Template #2-					
4.0		4		1	5	3	1	1- Spring '09 2- Summer '09 3-Fall '09 4- Spring '10 5- Summer '10 6-Fall '10 7-Spring '11
3.8		3		3	1	2	3	
3.6	4	2		3		1	1	
3.4	2	5		3	3	1	1	
3.2	1	2	2	1	1	3		
3.0	2	1	3	1	2	2		
2.8	2	1	1					
2.6	3							
2.4	2							
2.2	2							
Number of briefings	18	18	6	12	12	12	6	
Average	2.94	3.54	3.03	3.55	3.60	3.52	3.73	
Term >>	1	2	3	4	5	6	7	

Fig. 2. Distribution of scores by term

The population of participants include business professionals from many management disciplines as well as IS/IT specialists. The courses were eight MBA level IS management classes (236 students), five enterprise architecture classes (55 students), and one ERP implementation and management class (10 students). Figure 3 shows overall results from all 14 sections, with emphasis on comparing scores in generalist MBA courses and scores in courses for IT specialists. Scores in both types of courses demonstrated that the students could use the template. The average scores in the MBA courses after the first term were very close to average scores in courses for IT specialists. Thus, IT specialists seemed not to have an advantage in performing this type of analysis. Stated differently, business professionals were roughly as empowered as IT professionals in using the Template #2.

Table 2 shows correlations between five criteria across the 84 briefings. All of the correlation coefficients are positive and statistically significant. The correlations may be interpreted in general as "clarity begets clarity." In particular, one fact stood out: the clearer the problem statement the better the result. The strongest correlation was

between the clarity of the problem definition in the management report and the meaningfulness of the recommendation. This should not surprise anyone with experience in software development or in software project management since a key tenet of both disciplines that one cannot hit a target if one is aiming somewhere else.

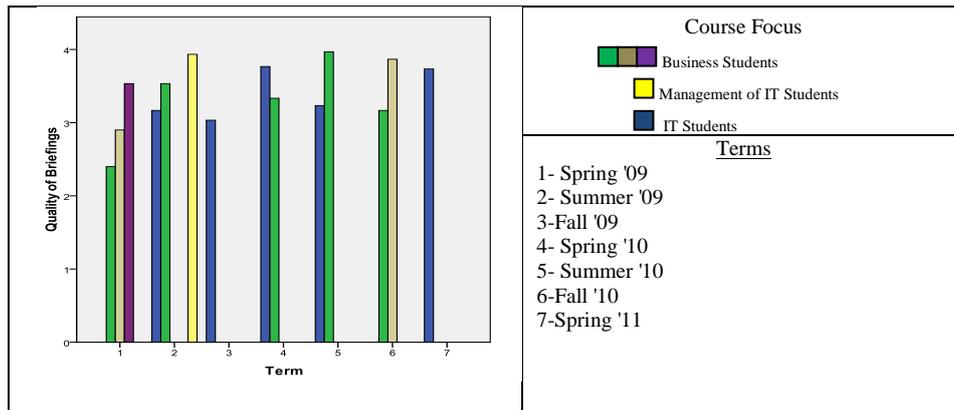


Fig. 3. Comparison of results by term for business and IT professionals

To compare results from Template #1 and Template #2, we randomly selected six briefings that used each template and counted the number of sentences that mentioned the essence of each criterion. Table 3 shows low to high ranges for Template #1 and #2 for each of the five criteria. For three of the criteria, clarity about the work system, clarity about performance gaps, and meaningfulness of the recommendations, the maximum score for Template #1 was lower than the minimum score for Template #2. In other words, Template #2 elicited substantially more clarity about the situation and recommendation than Template #1.

	clarity in the identification of the work system	Clear problem definition in the management report	Meaningful recommendations	Consistency of descriptions with activities and their participants	clarity in the identification of performance gaps
clarity in the identification of the work system	1				
Clear problem definition in the management report	.325**	1			
Meaningful recommendations	.393**	.559**	1		
Consistency of descriptions with activities and their participants	.436**	.399**	.545**	1	
clarity in the identification of performance gaps	.511**	.395**	.329**	.239*	1

** Correlation is significant at 0.01 level (2-tailed) * Correlation is significant at 0.05 level (2-tailed)

Table 2. Correlation of five criteria used in all 84 briefings

	Template #1		Template #2	
	Min	Max	Min	Max
clarity in the identification of the work system	7	14	16	22
clarity of problem definition in the management report	5	10	7	14
meaningfulness of the recommendations	9	13	20	25
internal consistency of descriptions of activities and their participants	4	5	3	7
clarity in the identification of performance gaps	8	11	12	16

Table 3: Clarity of system description and meaningful recommendation

4.3 Examples of Retrospective Feedback

Periodically, participants were asked to provide an evaluation of WSM template after completing a management briefing. For illustration we provide four examples excerpted from an IT management class. The first example illustrates a problem with Template #1 that we tried to eliminate in Template #2. (Appendix 1 was basically a one page summary that helped in focusing the rest of the Template, which went into more detail.)

“... Appendices 3, 4, and 5 are somewhat redundant. Information is repeated across all three appendices, which could be incorporated into one table instead. This would eliminate the need to flip back and forth between pages to cross reference information during the preparation of this analysis as well as during its review.” (Tagged - 309M4)...

The next two comments illustrate that even Template #1 led to a deeper thinking about a business situation.

“...I think this process was extremely effective in fleshing out issues and recommendations that were apparent, but hard to articulate. After identifying the current work system compared to the work system a year ago, I’m able to propose a work system that takes what worked from both versions.... This process never let me complete and then ignore any section; it always brought new points to the surface and kept them there.” (Tagged – 209M12)...

“... I have never thought about breaking down a process into each step and examining each step for inefficiencies. Mistakenly, I feel like I should be able to spot the inefficiencies just by thinking about the process in its entirety. This is clearly not true as I became aware of several inefficiencies that I would never have considered otherwise... I became aware of several inefficiencies that I would never have considered otherwise.” (Tagged – 209M16) ...

A final example is someone who believed that the template interfered with his/her creativity, an interesting comment when an important purpose of MBA and MSIS courses is teach people to think in ways that they might not pursue on their own.

... However, I saw the outline as a creative constraint that guided my thoughts a little too much. I feel that coming up with an outline given less constraints would have been more useful of an academic exercise for me. (Tagged – 209C06)...

5 Discussion and Future Research

Our analysis of the use of the design artifacts, Work System Analysis Templates #1 and #2, suggests that the templates were usable by both business and IT professionals and that the second template was more effective in eliciting clearer and more extensive descriptions and recommendations. Our results confirm that it is possible to encourage greater clarity of analysis by providing a structure that allows people to articulate and share a basic understanding of the work they do and then drill down deeper in exploring some of the nuances of that work system. However, one of the shortcomings of the overall approach is suggested by the last of the reflexive statements quoted above, *i.e.*, some people may feel constrained by the design artifact.

We interpret this as follows. The work system template structure requires a user to think about certain topics in an organized and disciplined way to provide a parsimonious and cogent description of the system. The logic of the template starts with overview ideas and then drills down for more detail. It requires that people use work system concepts to articulate situational specifics that may be taken for granted and are implicit in the work being done, but which need to be made explicit to have meaningful conversations about making improvements in the work system. The templates also require people to explicitly identify improvement metrics, even if only in a generalized and qualitative description. Once an improvement metric is identified and named people can then begin to consider what might be meaningful measures for those improvement criteria. The work system template should be quite natural in two ways. First it calls for descriptions in the user's native everyday work language using an almost universal business tool, an MSWord document. While it is possible to fill in the template in any order, some potential users may simply resist the discipline required to use this type of tool even though it supports coherent analysis and coherent discussions with others.

Our continuing research proceeds along several paths. We are using grounded theory methods in order to better understand the concepts that these managers used in talking about their problem situations. In addition, we intend to explore a number of issues that we observed in analyzing the current papers. Since the briefings use the concept of customer in a number of different ways (e.g., internal vs. external customer, the firm as a customer, self-service, and so on) we will review the use of the concept of customer, with special emphasis on planning and accounting systems in which the customer is the firm itself or its departments. With the widespread attention to the service economy and the importance of services in general, we also intend to explore the relative balance of production vs. service orientation in the briefings. We believe that a future Template #3 might contain a greater emphasis on service issues, and we intend to use critical instances of service or non-service orientation in the existing briefings for guidance in developing the next version.

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