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Validating Work System Principles for Use in Systems Analysis and Design

Steven Alter
University of San Francisco, alter@usfca.edu

Ryan Wright
University of San Francisco, rwright3@usfca.edu

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Completed Research Paper

Steven Alter
University of San Francisco
2130 Fulton Street
San Francisco, CA 94118
alter@usfca.edu

Ryan Wright
University of San Francisco
2130 Fulton Street
San Francisco, CA 94118
rwright3@usfca.edu

Abstract

This research validates 24 work system principles that emerged from the effort to develop the work system method, whose goal is to help business professionals understand and analyze systems in organizations in their own terms, and also to help bridge the communication gaps that have undermined IS projects and reduced business/IT alignment. The research validates the principles based on questionnaire responses submitted by six cohorts of Executive MBA students, who rated each of the work system principles on two criteria: 1) normatively, to what extent should work systems in their organizations conform to each principle, and 2) descriptively, to what extent do most existing work systems in their organizations actually conform to each principle. An analysis of the results reveals statistically significant gaps between their perceptions of normative principles and their perceptions of how well typical work systems operate in organizations. The findings are statistically significant for all 24 principles.

Keywords: Work system principles, work system,

Need for Normative Work System Principles

The Call for Papers for the System Development and Alternative Methodologies track of ICIS 2010 notes that "despite 50 years of ISD experience, the perception of the so-called "software crisis" still persists. Unfinished and run-away projects, systems poorly aligned with businesses and user requirements and the pervasive problem of the costs required simply to play in the IS game even before realizing any tactical or strategic advantage all continue to top the list of executive concerns about the IS function." (Truex and Kautz, 2010)

A factor that often contributes to disappointing results is the disconnect between the everyday worklife of people who use software as a personal or organizational tool and the needs of IT specialists who create and test software. Most business professionals are not adept at specifying software requirements or visualizing how software that will be built from today's specs will have positive benefits months or years in the future. Part of the problem is that the interactions of business and IT professionals often over-emphasize specification and approval of software details and under-emphasize clarification of how work is actually performed in organizations and why performance results might improve after new software is deployed (Wu and Zmud, 2010). The work system approach (Alter, 2003, 2006, 2008a) was developed to help business professionals think about IT-reliant systems in organizations by viewing systems as sociotechnical systems rather than as technical "solutions" that are "used" by "users." With that approach, the question about current and proposed software is whether work systems will operate more effectively and efficiently after new software is deployed, i.e., will the "to be" work systems perform better than the "as is" work systems?

Lack of normative principles. Although system and project success factors and risk factors (e.g., statistical correlates of success or failure) have been studied frequently (e.g., Straub and Welke,1998; Wixom and Watson, 2001; Sherer and Alter, 2004), normative principles governing the operation of IT-reliant work systems in organizations have received relatively little attention. In contrast, normative principles are common other applied disciplines. Fields such as education, law, management, human-computer interaction, and others have extensive literatures that present and explain normative principles for practitioners. Table 1 shows examples of principles drawn from a number of disciplines.

Table 1. Examples of seminal principles for applied fields

Domains	Application	Author	Three Examples Principles for Each Domain
Law	Privacy	Freiwald (2007)	1. Government searches should proceed in private. 2. Inquiries require a judgment about levels of intrusiveness. 3. Indiscriminate investigations implicate the core concerns of the Fourth Amendment.
Education	Undergraduate Education	Chickering & Gamson (1987)	1. Encourage contact between students and faculty 2. Develop reciprocity and cooperation among students. 3. Encourage active learning.
Human-Computer Interaction	Usability	Nielsen (1994)	1. Match between system and the real world 2. Recognition rather than recall. 3. Help users recognize, diagnose and recover from errors
Web Site Design	Accessible	Rowland (2010)	1. Provide appropriate alternative links. 2. Provide headings of data tables. 3. Ensure users can complete and submit all forms.
Management	General Management	Fayol (1911)	1. Unity of command 2. Unity of direction 3. Subordination of individual interests to general interests
Manufacturing	TQM	Deming (1986)	1. Create constancy of purpose toward improvement of product and service, with the aim to become competitive and stay in business, and to provide jobs. 2. Cease dependence on inspection to achieve quality. Eliminate the need for massive inspection by building quality into the product in the first place. 3. Institute training on the job.

Many books and articles in the IS discipline propose and explain principles for creating, testing, and maintaining software. Such principles are designed for use by IT professionals. The IS literature says much less about general principles that business and IT professionals might use for evaluating the "as is" or "to be" versions of the IT-reliant work systems that are supported by software. Lack of such principles makes it more difficult to assess whether potential changes might have positive or negative effects on business performance. For example, Valacich et al. (2010) describes principles for selecting software but offers little in terms of principles that help in evaluating the "as is" or "to be" versions of the work system that is being improved. Further, the 2010 version of the AIS curriculum guide for undergraduate IS majors (Topi et al., 2010) says almost nothing about this topic. One rarely sees guidelines for evaluating operational systems in organizations other than:

- meeting management objectives (which may not be realistic, and may change when management changes)
- satisfying users and other stakeholders (who may view software and other IT artifacts as relatively unimportant in comparison with other business concerns)
- making sure that software intended for long term use is designed for testability, maintainability, and scalability.

Given the high rate of disappointment and failure of IS and IS-related projects, it is surprising that principles related to IT-reliant systems in organizations receive so little attention in training or techniques for analysis and design.

This paper validates a set of normative work system principles that can be used to evaluate current or proposed work systems in organizations. Almost all work systems of significance rely on IT in order to operate. Except for projects related to technical infrastructure that is basically invisible to end users, the business and management goal of most IS projects is to improve the performance of one or more IT-reliant work systems. Managers and other business professionals should have good ways of evaluating current and proposed versions of those work systems. Meeting management objectives, satisfying users and other stakeholders, and providing well designed software is not enough. It should be possible to provide a set of criteria that apply to all systems in organizations and that might help in identifying problems and issues that might otherwise be missed. At minimum, a broadly applicable set of work system principles could be used in evaluating business cases for proposed system improvements. The business case for a proposed system improvement would be stronger if the proposed work system conforms to work system principles more closely than the existing work system. Conversely, nonconformance of aspects of a proposed work system should be an early warning of risks and should lead project managers to pursue risk reduction strategies.

Goal. The goal of the current research is to validate a set of 24 work system principles that emerged from the effort to develop the work system method (Alter, 2003; 2006, 2008a). That systems analysis and design approach was developed to help business professionals understand and analyze systems in organizations in their own terms, and also to help bridge the communication gaps that have undermined IS projects and reduced business/IT alignment.

The current research validates the principles based on questionnaire responses submitted over four years by six cohorts of Executive MBA students, who rated each of the work system principles on two criteria: 1) normatively, to what extent should work systems in their organizations conform to each principle, and 2) descriptively, to what extent do most existing work systems in their organizations actually conform to each principle. An analysis of the results shows statistically significant gaps between their normative and descriptive views for all 24 principles.

This paper proceeds as follows. First it summarizes the iterative process through which the work system approach and the work system principles were developed. It briefly describes each of the 24 principles. It presents a straightforward statistical analysis of the responses. A concluding section identifies areas for future research.

Background on the Work System Approach

A long term project extending over more than 15 years (Alter 1995, 1999, 2003, 2008a, 2008b, 2010b; Truex et al. 2010) tried to develop a systems analysis method that can be used by business professionals for their own understanding and can support communication between business and IT professionals. That research anticipated many of the goals of design science research (Hevner et al., 2004; Winter, 2008), such as relevance, testing, and iterative improvement. For example, Alter believed that the problem was relevant based on his experience in a manufacturing software firm and based on reports by his Executive MBA students that, unlike well-trained IT professionals, most business professionals in their firms were not aware of well articulated analysis methods that they could use for thinking about systems and system improvement. Work system concepts and methods were developed through numerous iterations. The initial ideas were an attempt to distill, combine, and simplify industry experience plus ideas from many sources including the sociotechnical literature (e.g. Cherns, 1976; Mumford and

Weir, 1979; Trist, 1981; Pasmore, 1985), systems theory (e.g., Ackoff, 1981; Checkland, 1999; Churchman, 1979), and systems analysis textbooks. For many successive semesters, the latest versions of work system analysis outlines were provided to MBA and Executive MBA students, who used those outlines 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 assignments for subsequent semesters. The core of the resulting approach was a set of ideas of a type that Gregor (2006) described later in *MIS Quarterly* as a "theory for understanding."

A work system approach assumes that the unit of analysis is a work system, a sociotechnical system in which human participants and/or machines perform work (processes and activities) using information, technology, and other resources to produce specific products and/or services for specific internal or external customers. Almost all value chain systems (e.g., systems for inbound logistics, operations, sales and marketing) and support systems (e.g. systems for procurement and human resources) are IT-reliant work systems that rely on IT but are not IT systems. Information systems, supply chains, and ecommerce systems are special cases of work systems. Table 2 lists a subset of 75 IT-reliant work systems that were analyzed by advanced MBA students at a major East Coast US university who looked at work systems in their own organizations for class projects in spring 2009. 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. (Truex et al. 2010)

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

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

Work system framework. The work system approach contains two central frameworks. The work system framework (Figure 1) identifies nine elements that can be used to summarize how a work system operates at a particular time, including who the customers are, what products and services are produced, what are the major processes and activities, and so on. These elements were defined in Alter (2006, 2008a) and are explained further in the discussion of the metamodel. 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. The other central framework in the work system approach is the work system life cycle model (explained in Alter (2006, 2008a, 2008b, 2010b), but not discussed here) which expresses a dynamic view of how work systems change over time.

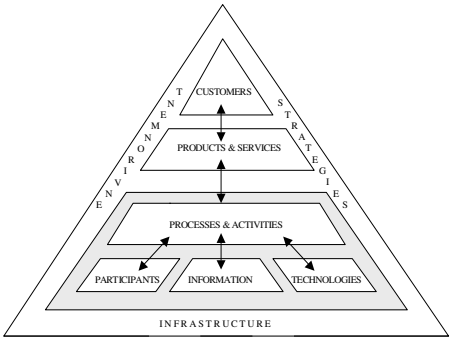

Figure 1. Work System Framework

Usage to date. The work system framework and other aspects of the work system approach for understanding systems have been used in North America, Europe, Asia, and Australia as a component of university courses for undergraduate business majors, undergraduate IS majors, generalist MBA students, and MBAs majoring in IS. The courses have included introduction to IS, systems analysis and design, business process improvement, IS

development, and ERP systems. In some cases the usage involved one or several lectures to provide context for the course or for important topics. Some courses asked students to apply the work system framework to create "work system snapshots," which summarize a work system using the six central elements of Figure 1. The work system framework, work system principles, or sets of questions related to work system elements have been used to establish the rationale for programming projects by computer science students. The ideas have also served as the conceptual core of projects in generalist undergraduate and MBA classes (e.g., the projects mentioned in Table 2).

Beyond its use in teaching, a number of researchers other than Alter have applied or cited the work system framework and other aspects of the work system approach in a broad range of contexts (e.g., Luukkonen et al. (2010), Granlien (2010), BenMoussa (2010), Kampath and Röglinger (2010); Madsen and Vigden (2009); Gericke and Winter (2009); Ou and Banerjee (2009); Adams (2009); Lafaye (2009); Pinhanez (2009); Kosaka (2008, 2009), Lyytinen and Newman (2008), Mettler (2008); Singh and Woo (2008); Petersson (2008); Petkov and Petkova (2008); Kurpjuweit and Winter (2007); Sewchurran, and Petkov (2007); BenMoussa (2007); Goodhue (2007); Cuellar et al. (2006); Curtin et al. (2006); Davamanirajan et al. (2006); Gray (2006), Møller (2006), Lucas and Aggarwal (2005), Dumas et al. (2005), Irwin and Turk (2005); Casey and Brugha (2005), Fortune and Peters (2005); Munk-Madsen (2005); Patten et al. (2005); Petrie (2004); Rowe et al. (2004); Siau et al. (2004); Walls et al. (2004); Mora et al. (2003), Nurminem (2003); Mursu (2002); Ramiller (2002); Hedman and Kalling (2002), Borrell and Hedman (2001)). Other related research is in progress.

Compilation of Work System Principles

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

An initial set of nine principles was proposed in early articles about the work system method (Alter, 2002a; 2002b), based on the goal of identifying a single principle for each work system element. As shown in Table 3, the result was one principle each for seven work system elements, one shared between customers and products & services, and one for the work system as a whole.

Table 3. Original set of work system principles (Alter, 2002a; 2002b)

Principle	Related Work System Element
#1: Please the customers.	Customers, Products & Services
#2: Perform the work efficiently.	Processes and Activities
#3: Serve the participants.	Participants
#4: Create value from information.	Information
#5: Minimize effort consumed by technology.	Technologies
#6: Take full advantage of infrastructure.	Infrastructure
#7: Minimize unintended conflicts and risks.	Environment
#8: Support the firm's strategy.	Strategies
#9 Maintain balance between work system elements	All elements in combination

Those principles were presented to a SIGSAND (SIG for Systems Analysis and Design) symposium in Miami in April 2003, with a request to criticize the principles and provide additional principles. That feedback, plus subsequent review of the sociotechnical literature (especially the sociotechnical principles proposed by Cherns, 1976) and comments from MBA and EMBA students increased the total to 21 principles that were discussed in an AMCIS paper (Alter, 2004). Discussion of those principles with MBA and EMBA students during 2004 led to the addition of three more principles, bringing the list of work system principles to the 24 that this paper discusses.

Note, again, that these are principles of operational work systems, not principles related to creating or modifying work systems. A separate set of principles in that area would be based on the work system life cycle model (mentioned earlier), not on the work system framework, which provides a somewhat static view of the form and operation of a work system at a particular point in time.

Nature of the desired principles

Normative principles are statements about how things should be rather than about how things are in reality. For example, the Ten Commandments speak of how people should act rather than how they do act. Similarly for the rules of etiquette (Post, 1997), the principles of total quality management (Deming, 2000) and the ideal style of prose (Strunk and White, 1979). In contrast, Bernoulli's Principle describes how fluids actually do flow and therefore is not a principle of the type we are discussing. Unlike principles in the natural sciences, the types of principles we are discussing are open to debate on practical and cultural grounds.

This paper focuses on normative principles related to work systems. Based on the inheritance relationships explained in Alter (2003, 2008a), principles that apply to work systems in general should apply to special cases such as information systems and projects, although those special cases might have additional principles that do not apply to work systems in general. Principles are stated in the following forms:

- Systems {of type X} that are operating well *should* exhibit {a particular property}.

  Or

- Systems {of type X} that are operating well *should* accomplish {a particular goal}.

As with principles in other fields in social science, system principles are potentially very useful even though they do not necessarily describe how systems actually operate. For example, optimization of subjective utility is a useful principle within decision theory even though behavioral studies of decision-making sometimes show that people may not follow their own monetary interests or stated preferences. Part of the value of the principle is in the way it motivates insight and research about how and why actual decisions deviate from theoretically optimal decisions or from the personal beliefs of the decision makers themselves.

Principles of work systems, not technologies or specific situations. A number of researchers have proposed principles related to specific technologies and their application. For example there are principles about how to create and manage databases, principles of business intelligence applications, principles of successful ERP applications, and so on. Other researchers and pundits have proposed principles for specific situations, such as principles for managing your boss or principles for managing meetings. In any of those cases, the topic might be described as principles, success factors, or approaches for reducing risk. In contrast to research that looks at specific technologies or application areas, our concern involves broader principles that apply to almost any work system in an organization. Thus, although principles related to specific types of technologies and technology applications are surely valuable, we focus on principles that are more fundamental because they are more universal.

Useful for typical business professionals. Normative principles of work systems should be stated in a way that is easily understandable by typical business professionals who should be able to use those principles in evaluating any current or proposed work system. Principles that are couched in academic or technical terminology will not meet this criterion. In order to be adopted and used, normative principles of work systems also need to be intuitively plausible to most business professionals. Otherwise they will probably be ignored. Since the 24 principles were developed to support the needs of business professionals trying to understand and analyze IT-reliant work systems in their own terms, it was especially important that these principles could be understood and applied easily by business professionals. Generality and straightforward interpretation were more important than subtlety and analytical precision.

Ideally independent of culture and local conditions. Ideally, system principles should be culture independent, and should apply in any national or organizational culture. Also, they should apply to almost any work system, and therefore should be equally valid regardless of organizational hierarchy, power relationships, and other unique local conditions. Thus, culture and local contingencies should not affect basic principles for operational systems even though such factors may affect the way specific systems in specific situations are discussed, analyzed, designed, and evaluated.

Different from success factors. System principles differ from system success factors. Principles are generalizations that apply to all systems of a particular type, whereas success factors are (assumed to be) statistically correlated with success. For example, the principles "systems should please their customers" and "systems should perform work efficiently" apply to almost every system in an organization. In contrast, the success factors "top management support' and "prior experience with the technology" are only correlates of success. These factors may be absent from successful systems, such as systems that are invisible to top management and systems that use new technology but succeed anyway.

Different from design patterns. Normative principles also differ from design patterns originally proposed by Alexander (1977) for architecture and later appropriated by software engineers (e.g., Gamma et al., 1995). As explained by Appleton (2000), the following essential elements should be clearly recognizable in a design pattern: name, problem, context, solution, examples, resulting context, rationale, related patterns, and known uses. In contrast, normative system principles are simple imperative statements intended to apply to almost every system of a particular type rather than to just certain situations that might be encountered.

Different from principles governing design processes. Normative principles of work systems are different from normative principles of system design processes or system development. For example, Clegg (2000) proposes 19 sociotechnical principles for system design. When those principles are examined in detail, it becomes clear that some are about the process of design (e.g., design is systemic, values and mindsets are central to design, design involves making choices, design is contingent, and so on) whereas others are about the thing being designed (e.g., systems should be simple and make problems visible, problems should be controlled at the source, core processes should be integrated).

Potentially supporting different information system development paradigms. Hirshheim and Klien's (1989) seminal paper on the IS development processes provided insights into the assumptions adopted in order to develop information systems. Indirectly calling for the type of principles that are proposed here, their paper says, "We contend that advancement could come about from the explicit documentation of the assumptions underlying the various paradigms. It would permit the generation of creative solutions to practical problems to proceed in a more conscious and systematic way." (p. 1212). An important set of assumptions underlying any ISD paradigm involve the normative principles or criteria that should be used for evaluating the system that is being built and/or the performance of the work systems that it supports. For this reason, we propose and test a set of principles that may be used guide system analysis and design process.

24 Work System Principles

24 work system principles in Table 4 provide a normative set of guidelines that can be applied to work system evaluations and development. As mentioned earlier, some of the work system principles were adapted from Cherns (1976) sociotechnical principles to make them more understandable to typical business professionals. Additional principles were added based on comments and feedback from academic colleagues and executive MBA students. The current set of 24 work system principles seemed sufficient in 2004. Table 4 uses the format of a "work system snapshot" to identify the principles and to show that they are related to specific elements of the work system framework.

Principle #1: Please the customers. Work systems exist to produce things for their customers. One of the tenets of total quality management (TQM) is that customers evaluate the product and the work system is effective if the customer is pleased. Relevant performance metrics include cost to the customer, quality perceived by the customer, reliability, responsiveness, and conformance to standards and regulations. This principle is also consistent with the tenets of service-dominant logic (Vargo and Lusch, 2004), which has been proposed as one of the fundamental ideas in "service science" (e.g., see Chesbrough and Spohrer, 2006; Spohrer, 2007), an evolving field whose development is being supported by IBM and other technology companies based on the observation that over half of the revenue of many technology companies is in services.

Proposition 1: A work system should conform to pleasing the customer.

Principle #2: Balance priorities of different customers. Many work systems have multiple customers with different goals and needs related to the products and services the work system produces. Ideally, whatever resources are available for the work system should be deployed in a way that reflects the relative priority of different groups of customers. That may lead to different versions of the same products and services, much like the airlines' distinction between first class, business class, and coach class. It may also lead to producing fundamentally different products

for different customers, such as services for primary customers and performance information for managers who are secondary customers of a work system.

Proposition 2: A work system should conform to balancing priorities of different customers.

Table 4. 24 work system principles

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

Principle #3: Match process flexibility with product variability. This is the sociotechnical principle that technological flexibility should match product variability. The arrows in the work system framework (Alter, 2006, 2008a) say that processes and activities should match the products and services just as they match the participants, information, and technology.

Proposition 3: A work system should conform to matching process flexibility with product variability.

Principle #4: Perform the work efficiently. Effectiveness is about pleasing customers (principle #1). In contrast, efficiency concerns the internal operation of the work system and how well it uses its resources. Relevant performance indicators including rate of activity, rate of output, productivity, consistency, speed, downtime, and resistance to intrusions.

Proposition 4: A work system should conform to performing the work efficiently.

Principle #5: Encourage appropriate use of judgment. This is a restatement of the sociotechnical principle of “minimal critical specification,” (Nonaka 1994) i.e., that no more should be specified in the design than what is absolutely essential. In work system terms this is reflected in the appropriate degree of structure in the processes and activities. If work practices are structured too tightly, work system participants will not be able to use their judgment. If they are not structured enough, participants will be more likely to apply inconsistent judgments to questions and issues that have known answers and approaches.

Proposition 5: A work system should conform to encouraging appropriate use of judgment.

Principle #6: Control variances (problems) at their source. This is sometimes called the "sociotechnical criterion." It is also consistent with Deming's view that the people should monitor the quality of their own work and should be responsible for it, rather than making inspectors responsible for quality. Many work systems will have to operate with inputs that contain errors, noise, incompleteness, and timeliness problems whether or not those variances should have been corrected elsewhere.

Proposition 6: A work system should conform to controlling variances at their source.

Principle #7: Monitor the quality of both inputs and outputs. This is related to the sociotechnical principle that feedback systems should be as complex as the variances that need to be controlled. In work systems the variances might be observed at the inputs, during the process steps, or in the outputs (the products and services produced).

Proposition 7: A work system should conform to monitoring the quality of both inputs and outputs.

Principle #8: Boundaries between business process steps should facilitate control. This is a restatement of the sociotechnical principle of "boundary location," i.e., those boundaries between units should facilitate variance control. According this principle, any redefinition or reorganization of those steps should set the boundaries between steps in a way that makes it easy to check that the step is producing the right results and using resources efficiently.

Proposition 8: A work system should conform to creating boundaries between business process steps that facilitate control.

Principle #9: Match the work practices with the participants. Work practices well matched to some participants might be poorly matched to others with different interests and capabilities. Consequently, different workers may perform even well defined work practices at different performance levels (e.g., great programmers versus mediocre programmers); similarly, different managers may use different types of information when performing the same management role. When the participants have significantly different capabilities and interests, the design of the system may have to accommodate those differences.

Proposition 9: A work system should conform to matching the work practices with the participants.

Principle #10: Serve the participants. This includes providing healthy work conditions and resources needed to do the work effectively and efficiently. Healthy work conditions include meaningful work, appropriate levels of challenge and autonomy, and possibilities for personal growth. Serving the participants is consistent with the sociotechnical principle of providing a high quality of work life.

Proposition 10: A work system should conform to serving the participants.

Principle #11: Align participant incentives with system goals. Participants in many systems have incentives that are inconsistent with system goals, for example, when management says that quality is the top priority but rewards people only based on their rate of production. Alignment of participant incentives with system goals reflects the sociotechnical principle of "support congruence," whereby systems of social support should reinforce desired behaviors.

Proposition 11: A work system should conform to aligning participant incentives with system goals.

Principle #12: Maintain clear roles and responsibilities. Viewing a situation as a work system assumes at least some regularity about how work is done, who does it, and under what circumstances. Clear roles and responsibilities are part of the regularity within a work system. When roles and responsibilities are less clear, work system participants are less sure about who should do which work within the system. This uncertainty leads to continual negotiation and re-negotiation of who should do what. Such negotiations may be necessary in unusual, extremely novel situations, but in most situations clear roles and responsibilities lead to greater efficiency and effectiveness.

Proposition 12: A work system should conform to maintaining clear roles and responsibilities.

Principle #13: Provide information where it will affect action. This is the sociotechnical principle of "information flow." Participants in many work systems have access to information that is never used; participants in other work systems lack access to information they need. In both cases, better system performance might result from system changes that facilitate creation of value from information.

Proposition 13: A work system should conform to providing information where it will affect action.

Principle #14: Protect information from inappropriate use. As system-related information is increasingly computerized, protection of information has become more important because of the threat of information misuse and heightened vulnerability to misuse, inappropriate modification, and theft.

Proposition 14: A work system should conform to protecting information from inappropriate use.

Principle #15. Use appropriate technology. Inappropriate technologies may be poorly tailored to the situation, inadequate for doing the job, or too expensive in capital costs and effort. The frequent use of inappropriate technologies implies that this should be included as a separate work system principle even though "performing the work efficiently" (principle #4) usually requires use of appropriate technology with appropriate interfaces and other features. For example, this principle can be used to think about a customer tracking system that uses a spreadsheet to store critical information. Use of the spreadsheet may seem simple and straightforward, but the high error rates in using spreadsheets imply that this may be an error-prone choice. The risk is even higher if the spreadsheet was created by a non-programmer with little skill in debugging.

Proposition 15: A work system should conform to using appropriate technology.

Principle #16: Minimize effort consumed by technology. Unfortunately, even seemingly appropriate technologies consume effort in learning about the technology, performing set-ups and technology tweaks, recovering from crashes and mistakes in using the technology, and generally just "messing around" with the technology. Additional effort consumed by technology often implies less effort devoted to the work system's value added work.

Proposition 16: A work system should conform to minimizing effort consumed by technology.

Principle #17: Take full advantage of infrastructure. There are sometimes improvement opportunities involving better, fuller use of shared human, informational, and technical resources that the work system can use but does not own or control. For example, it may be possible to offload effort and improve productivity by using slack resources that are readily available in the infrastructure. A related sociotechnical principle is "core absorbs support." (Reunite core and support functions to adjust to variances more expeditiously.)

Proposition 17: A work system should conform to taking advantage of infrastructure.

Principle #18: Minimize unnecessary conflict with the external environment. Work systems that fit the organizational, cultural, competitive, technical, and regulatory environment typically operate with less stress and excess effort than work systems containing inherent conflicts with the environment.

Proposition 18: A work system should conform to minimizing unnecessary conflict with the external environment.

Principle #19: Support the firm's strategy. Consistent with the many articles that have been written about business/IT alignment, the form and operation of work systems should fit with the firm's strategy and definitely should not oppose it unless there is a conscious reason for doing so in a particular situation. For example, a firm that positions itself as a top of the line retailer should have customer service and product returns systems that are consistent with its top of the line image.

Proposition 19: A work system should conform to supporting the firm's strategy.

Principle #20: Maintain compatibility and coordination with related work systems. Every work system receives inputs from other work systems and produces products and services that are used by other work systems. Relationships between work systems operate much more smoothly and efficiently when the producer system's product is compatible with the customer system's standards and procedures. Other aspects of compatibility and coordination are more related other types of interactions. (e.g., Thompson (1967), Crowston et al. (2006), Orton and Weick (1990), Alter (2010a)).

Proposition 20: A work system should conform to maintaining compatibility and coordination.

Principle #21: Control the system using goals, measurement, evaluation, and feedback. A basic tenet of quality control is that feedback loops should help work system participants identify and evaluate gaps between goals and measured results. This type of feedback helps the work system stay on course. The related sociotechnical principle is that feedback systems should be as complex as the problems that need to be controlled. In practice, this means that a single goal with an associated metric is often insufficient for controlling a system. For example, trying to control a factory using the single metric of meeting monthly production quotas ignores other aspects of performance such as quality, productivity, and employee satisfaction.

Proposition 21: A work system should conform to controlling the system using goals, measurement, evaluation and feedback.

Principle #22: Minimize unnecessary risks. Most work systems have meaningful risks related to at least several work system elements. Risk cannot be eliminated, especially when people perform some of the work. However, unnecessary risk should be avoided by identifying important risks in a current or proposed system and deciding what can or should be done to minimize those risks.

Proposition 22: A work system should conform to minimizing unnecessary risks.

Principle #23: Maintain balance between work system elements. Work system performance depends on the balance between the elements, as is indicated by the two headed arrows in the work system framework (Figure 1). If the work system contains inherent conflicts, such as a mismatch between participants and the work practices or imbalance between inconsistency of work practices and the desired quality level of the products and services, system performance will often suffer and other negative consequences such as employee turnover may occur. From a different direction, productivity will suffer if the system contains slack resources or uses excessive resources.

Proposition 23: A work system should conform to maintaining balance between work system elements.

Principle #24: Maintain the ability to adapt, change, and grow. Because a system's environment will probably change over time, a work system should have the capability of adapting, changing, and growing. In some cases the use of computerized information systems supports adaptability. In other cases, the computerized capabilities seems like "electronic concrete" that prevents change by making it excessively difficult or expensive to convert to different software that supports different work practices that use different information.

Proposition 24: A work system should conform to maintaining the ability to adapt, change, and grow.

Both internal consistency and the external validity must be assessed in order evaluate these propositions. The next section outlines how this process was undertaken using a group of managers enrolled in an Executive MBA program. This includes first examining the internal consistency of the set of principles followed by a straightforward analysis to examine if the propositions are in fact valid to our subjects.

Internal Consistency of the 24 Work System Principles

Ideally, the work system principles should lead directly to easily supported system improvement proposals. Unfortunately, groups of two or more principles may contain mutual contradictions. Consider the three principles #1 (please the customer), #4 (perform the work efficiently), and #10 (serve the participants). These were the first three in the shorter set of principles that was used initially. (Alter, 2002a; 2002b) Assume the work system involves a service situation such as providing medical care or teaching. Typical customers would like to receive services when, where, and how they want those services, regardless of the convenience or efficiency of the providers. Typical work system participants and their management would prefer to provide those services in an efficient way that does not put the participants under undue stress. The system design issue is finding an appropriate compromise. Many other combinations of principles call for similar tradeoffs.

The internal contradictions between different work system principles do not make them invalid. Our everyday lives at work and at home are filled with compromises between valid, but contradictory principles (e.g., being ambitious but not trampling others, using resources efficiently but not being a miser, disciplining children but not being a tyrant, and so on). Although there is no formula for making the tradeoff in most of these situations, greater awareness of the underlying principles can help in making informed decisions and not ignoring important factors that should be considered.

Validation of the 24 Work System Principles

As mentioned earlier, the work system principles started with one general principle per work system element. Next, sociotechnical principles from Cherns (1976) were added after adapting them to make them more understandable to typical business professionals. Additional principles were added based on comments and feedback from academic colleagues and Executive MBA students. In 2004 the current set of 24 work system principles seemed to strike a reasonable compromise between completeness and complexity.

The Respondents. The 24 principles were presented to six relatively small cohorts of Saturday Executive MBA students at the University of San Francisco between 2005 and 2009 as part of a course in information systems. The EMBA students averaged over 10 years of business experience. Many were in sales or administration roles, with a smaller number in operations or IT. Their employers were in a range of industries include manufacturing, software, healthcare, consulting, retailing, consumer products, education, real estate, and the military. A total of 101 usable responses were collected.

Depending on the cohort, the course included between seven and nine 4-hour class sessions. The work system principles were introduced during the 2nd or 3rd session for the first four cohorts, and during the 5th session for the fifth and sixth cohort. In all cases, the work system approach had been introduced previously, and the students knew

that the final deliverable for the course would be a group paper analyzing a real world work system and recommending improvements.

Data Collection. The data for validating the principles was collected through a student assignment using a "work system principles spreadsheet" that had the same general format as the first three columns of Table 5, which summarizes the statistical results. The students knew that the assignment would be used for a classroom exercise and would be graded only as part of a cumulative diary that they would submit at the end of the course primarily as an indication that they prepared for each class. In other words, there was a mild incentive to submit the homework assignment on time, but no external incentive to answer the questions in any particular way.

The instructions to the respondents were to download a work system principles spreadsheet and look at each principle in turn, "using an integer scale from 1 to 7 to express the extent to which you agree with the following two statements:

> 1) "The operation of almost all work systems SHOULD conform with this principle." A "7" indicates strong agreement that almost all work systems SHOULD conform. A "1" indicates strong disagreement because the principle may be unimportant, because it may not apply to most systems, because it doesn't make sense, or for other reasons."
>
> 2) "The operation of almost all work systems in my organization ACTUALLY DO conform with this principle." A "7" indicates strong agreement that almost all work systems ACTUALLY DO conform. (If your organization is too small, provide answers for another organization you are familiar with.)"

The assignment called for the respondents to submit the spreadsheets before the next class.

During the next class session the students received and discussed a consolidated spreadsheet containing three tables. The first table contained each student's response to the first question, plus a column for the average value for each principles and an extra row for the average value for each student. The second table contained the same information for the second question. The third table showed the differences between "should conform" and "actually does conform." The tables identified respondents only as student #1, student #2, etc. Students were asked to spend several minutes examining the tables and coming up with their own interpretations. The classroom discussion elicited and compared interpretations of the results, e.g., the meaning of the extent of the differences between "should conform" and "actually does conform" for the principles as a whole and for specific principles, the interesting outliers, and the possible implications for management action.

Data for validating the principles. The first step in validating the principles was to determine whether the respondents perceived the principles as plausible in general and applicable to the work systems they were familiar with. The opinions of the respondents were viewed as meaningful data for validating the principles because the respondents had been admitted to an Executive MBA program based on their significant business experience and other qualifications. While random sampling from a broader universe of business professionals might have been preferred in some ways, benefits of using this non-random sample of respondents included the pre-screening of their qualifications and the likelihood that they would pay attention to the principles since those principles were presented as part of an academic program to which they had a high level of personal commitment.

For the purposes of the analysis the "should conform" questions are labeled *correctness ratings* (extent to which the respondents believe each principle is normatively correct) and "actually do conform" questions are labeled *conformance ratings* (extent to which real world systems actually conform to the normative principles).

Figure 2 show the histograms for both the correctness and conformance ratings. The average of the correctness ratings is relatively high (mean = 5.94) with no low outliners. However, there are 5 respondents who have an average of 7.0 on the correctness ratings. Either those respondents agreed strongly that work systems should conform to all 24 principles or they simply filled in 7 for each principle because they did not exert enough effort to make distinctions, thereby creating these data runs. Since we cannot be sure about the intent of the respondents, this data is included in the analysis. Examination for other instances of data runs (e.g., all 1s or all 5s, etc.) found the only one other data run of all 6s. For conformance there was a moderate average score (mean = 4.25) and only one data run of all 2s. On its face the data seems appropriate for straightforward statistical analysis.

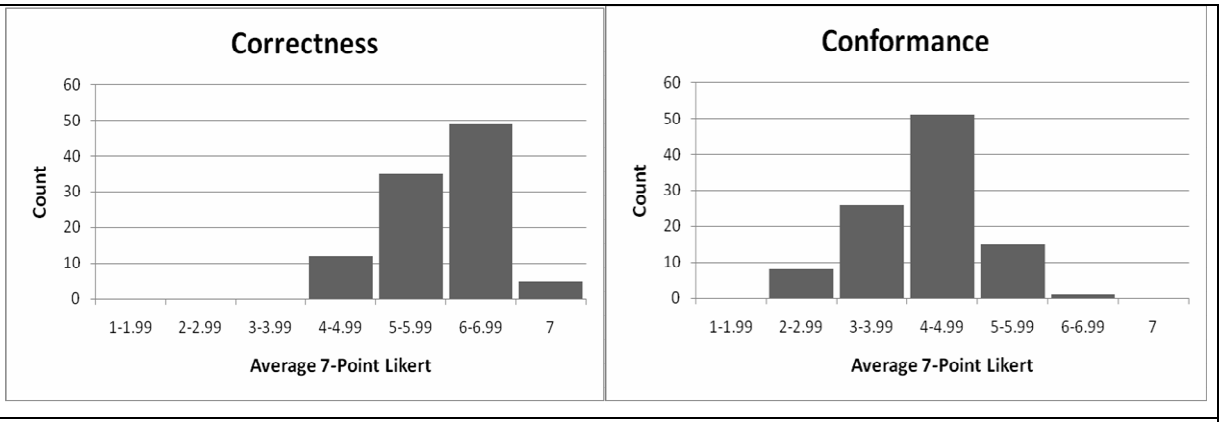

Figure 2. Histograms for the average of correctness and conformance

Table 5, below, shows the statistical results, including the average correctness and conformance ratings for each principle, the gap between the averages, and a T-value. The mean scores for correctness ranged from 5.37 and 6.35, with an average of 5.95 on the 7-point scale. Average conformance scores for the principles ranged from 3.72 to 5.12, with a global average of 4.25. The gap between the average correctness rating and average conformance rating ranged from 1.01 to 2.29, with a global average of 1.70. The lowest average correctness rating (5.37) was higher than the highest conformance rating (5.12).

The high mean scores for the work system principles support all 24 propositions mentioned earlier. The respondents were selected based on their business experience and other qualifications related to being accepted into an Executive MBA program, Their high ratings of the correctness of each principle provide plausible evidence that each principle is normatively correct in relation to typical work systems in organizations. Their lower ratings of conformance provide plausible evidence that many work systems exhibit important gaps between normative principles and actual operation.

To assess the statistical significance of the gaps between correctness ratings and conformance ratings, we used a paired analysis of the means as per Keppel (1991) to compare the correctness and conformance ratings for each principle. The T-values shown in Table 5 reveal that the difference between the correctness rating and conformance rating for all 24 principles is statistically significant at the 0.001 level.

Post hoc Analysis of Gaps

Next is a post hoc analysis to identify to identify low and high correctness and conformance scores for the principles and to identify significantly large gaps between the correctness and the conformance metrics.

Correctness scores: Average correctness scores (between 5.37 and 6.35, with a global average of 5.95) reveal that the respondents as a group believe that the principles are correct, in that work systems should operate consistent with each of the 24 principles. Eleven of the 24 principles received average correctness scores of 6.0 or higher. Tables 6 and 7 shows the correctness and conformance scores respectively for principles with the highest and lowest scores.

Conformance scores. Since there is a high degree of general agreement about the normative correctness of the work system principles, it is worthwhile to examine the extent to which the respondents believe that work systems typically conform to the 24 principles. Average conformance scores for the principles ranged from 3.72 to 5.12, with a global average of 4.25. Principles whose degree of conformance was highest include #1, 12, 14, 19, and 22. Notice that principle #14, protect information from inappropriate use, receives by far the highest score. That score, 5.12 out of 7.0 is still somewhat problematic, given all of the difficulties that have occurred with inappropriate data use.

Table 5. Statistical Results of Work System Principles Validation

Work system principle	*Correctness Should conform*	*Conformance Does conform*	*Diff.*	*T-Value*
#1: Please the customers.	6.29	4.51	1.77	11.60*
#2: Balance priorities of different customers.	5.77	4.21	1.56	9.73*
#3: Match process flexibility with product variability.	5.62	4.02	1.60	9.46*
#4: Perform the work efficiently.	6.35	4.23	2.12	14.34*
#5: Encourage appropriate use of judgment.	5.37	4.11	1.26	6.96*
#6: Control problems at their source.	5.96	3.94	2.02	11.11*
#7: Monitor the quality of both inputs and outputs.	6.15	3.93	2.22	14.18*
#8: Boundaries between process steps should facilitate control.	5.52	4.42	1.11	6.97*
#9: Match the work practices with the participants.	5.97	4.35	1.62	9.65*
#10: Serve the participants.	5.84	4.31	1.53	9.26*
#11: Align participant incentives with system goals.	6.01	3.72	2.29	13.13*
#12: Operate with clear roles and responsibilities	6.15	4.56	1.58	8.95*
#13: Provide information where it will affect action.	6.23	4.36	1.87	12.58*
#14: Protect information from inappropriate use.	6.13	5.12	1.01	6.23*
#15: Use cost/effective technology	5.95	4.47	1.49	7.87*
#16: Minimize effort consumed by technology.	5.41	3.89	1.51	8.57*
#17: Take full advantage of infrastructure.	5.95	4.10	1.85	9.69*
#18: Minimize unnecessary conflict with the external environment	5.80	4.32	1.49	10.37*
#19: Support the firm's strategy	6.33	4.65	1.67	10.85*
#20: Maintain compatibility and coordination with other work systems.	6.11	4.10	2.01	12.27*
#21: Incorporate goals, measurement, evaluation, and feedback	6.08	3.90	2.18	12.88*
#22: Minimize unnecessary risks.	5.95	4.54	1.41	8.18*
#23: Maintain balance between work system elements.	5.55	4.04	1.51	10.33*
#24: Maintain the ability to adapt, change, and grow.	6.31	4.13	2.18	13.88*
AVERAGE	5.95	4.25	1.70	-

Note: 7-point Likert scale was used (Strongly Disagree =1 to Strongly Agree=7)
* $p < 0.001$ for a two tailed paired test

Table 6. Highest and lowest correctness scores

Work system principle	*Highest correctness scores*	*Lowest correctness scores*
#1: Please the customers.	6.29	
#4: Perform the work efficiently.	6.35	
#13: Provide information where it will affect action.	6.23	
#19: Support the firm's strategy	6.33	
#24: Maintain the ability to adapt, change, and grow.	6.31	
#3: Match process flexibility with product variability.		5.62
#5: Encourage appropriate use of judgment.		5.37
#16: Minimize effort consumed by technology.		5.41
#23: Maintain balance between work system elements.		5.55

Table 7. Highest and lowest conformance scores		
Work system principle	***Highest conformance scores***	***Lowest conformance scores***
#1: Please the customers.	4.51	
#12: Operate with clear roles and responsibilities	4.56	
#14: Protect information from inappropriate use.	5.12	
#19: Support the firm's strategy	4.65	
#22: Minimize unnecessary risks.	4.54	
#6: Control problems at their source.		3.94
#7: Monitor the quality of both inputs and outputs.		3.93
#11: Align participant incentives with system goals.		3.72
#16: Minimize effort consumed by technology.		3.89
#21:Incorporate goals, measurement, evaluation, and feedback		3.90

Gap Analysis. To evaluate the difference between the *correctness* and the *conformance* scores, all difference scores were normalized (i.e., converted to mean = 0 in order to do perform a comparison based on which differences were within one standard deviation of the adjusted mean). A plus one or minus one standard deviation above or below the mean of the difference score is a statistically large gap between *correctness* and *conformance* scores. This exploratory analysis found that five principles had a statistically large positive deviation from the average difference and three had a statistically large negative deviations from the average difference. Table 8 lists the raw scores (i.e., difference between the correctness and conformance) and the standardized scores for the principles with the highest and lowest gaps between *correctness* and *conformance*.

While the differences between perceived correctness and perceived conformance is statistically significant for all 24 principles, the principles with the greatest perceived deviation between correctness and conformance might be interpreted as the top candidates for management attention. Thus, the respondents' perceptions of work systems in their own organizations imply that the greatest need for improvement involves doing work efficiently; monitoring quality; aligning incentives; using goals, measurement, evaluation and feedback; and maintaining the ability to adapt, change, and grow. In the other direction, the principles with smallest deviations between correctness and conformance might be viewed as the areas where organizations are doing much better in regard to following these principles. Those areas include encouraging use of judgment, setting proper boundaries between process steps, and protecting information.

Table 8. Principles with highest and lowest gaps		
Work system principles with highest gaps	***Raw Diff. Score***	***Stand. Diff. Scores***
#4: Perform the work efficiently.	2.12	1.18
#7: Monitor the quality of both inputs and outputs.	2.22	1.46
#11: Align participant incentives with system goals.	2.29	1.66
#21: Incorporate goals, measurement, evaluation, and feedback.	2.18	1.35
#24: Maintain the ability to adapt, change, and grow.	2.18	1.35
Work system principles with lowest gaps	***Raw Diff. Score***	***Stand. Diff. Scores***
#5: Encourage appropriate use of judgment.	1.26	-1.27
#8: Boundaries between process steps should facilitate control.	1.11	-1.69
#14: Protect information from inappropriate use.	1.01	-1.97

Conclusion and Future Research

This research emerged from the development of the work system approach, whose fundamental premise is that business professionals should have organized methods that they can use independently or in collaboration with IT professionals for understanding and analyzing IT-reliant work systems in organizations. Enhanced ability to think

about work systems should help business professionals communicate with their business peers and IT associates, and should lead to fewer disappointments related to systems and system projects.

One of many tools that should be available to typical business professionals is a set of easily understood, general principles that apply to any system in an organization. A set of 24 such principles emerged from work system research between 2001 and 2004. The principles extend the sociotechnical principles of Cherns (1976) with a set of additional principles suggested by academic colleagues and employed MBA and Executive MBA students.

The current research validated the work system principles based on the assumption that business professionals will not use such principles if they seem implausible or are difficult to understand and apply. Executive MBA students averaging ten years of business experience served as proxies for typical business professionals who might use the principles. The average correctness scores between 5.37 and 6.35, with a global average of 5.95 demonstrate that as a group the respondents believe that the work system principles should apply to most systems in organizations. The average conformance scores between 3.72 to 5.12, with a global average of 4.25 out of 7.0 show that conformance to many work system principles is disappointing. The difference between correctness and conformance ratings shows that employed business professionals perceive a large gap between the guidelines provided by work system principles and the way typical work systems operate in organizations.

Possibility of additional validation. The validation involved perceived correctness and perceived conformance scored by Executive MBA students serving as proxies for business professionals who might use the principles. Additional validation could replicate the data collection with other groups of managers or executives to see whether they have similar views. Additional validation could encompass other populations as well. For example, it would be very interesting to see whether academic experts, IT professionals, and consultants have similar views. Further, given the wide use of normative principles in other disciplines, another possible avenue for validation is a logical and/or empirical comparison with principles in related disciplines, such as operations management and TQM (e.g., Deming's principles noted in Table 1). Also, further research is needed to explore the assumption that work systems principles are context-independent,. A possible follow-up might include empirically comparing the principles within different business contexts (e.g., banking, ecommerce and so on). An additional follow-up might ask experts in various national cultures (e.g., China, Germany, Brazil) to identify specific principles that might not fit those cultures.

Testing the effectiveness of the principles in relation to organizational success. The work system principles should be studied in an organization context. This research would focus on relationships between organizational outcomes and conformance or nonconformance to the principles in mission-critical work systems. For example, if managers and executives at an organization were asked to evaluate the conformance of their mission-critical work systems to the 24 principles, it might be possible to develop correlations between conformance of those work systems and corporate performance metrics, such as productivity and customer perceptions of quality. Strong correlations would support the case for generality of the principles.

Incorporating work system principles into systems analysis and design. The format of the first three columns of Table 5 can be adapted to create a straightforward systems analysis tool. The first column names the principles. The second column is an evaluation of the "as is" work system on a 7 point Likert scale. The third column is an evaluation of the "to be" work system on the same scale. This tool can be used in several ways. First, any situations in which the "to be" work system is evaluated as less than 5 should be explored. While it is possible that there is no way to attain an improvement, moving forward with the intention to produce a work system that is unlikely to conform to normative principles seems risky at best. Another way to use the tool is to simply compare the "as is" and "to be" evaluations for each principle. Ideally, the "to be" work system should be as good or better than the "as is" work system on all principles. Wherever it is worse, there should be a reason for the diminution in quality.

Another possible avenue for application of the work system principles into systems analysis and design is to provide a work system checklist that will match the specific work system principle to the degree of concern (this could be on a 1 to 3 scale with 1 = no problem and 3 = significant problem) with comment or explanation. Table 9 below shows a hypothetical example of a possible work systems checklist of this type drawn from Alter (2009, p. 234).

Testing the principles in the practice of systems analysis and design. Having relatively simple methods for using the principles in systems analysis and design is a step toward illustrating the feasibility of their use, but does not demonstrate whether they are actually helpful in the practice of systems analysis and design. The main question in this area is whether the principles help people identify problems that they otherwise might have ignored. Research about the practical use of the normative principles can be pursued in several ways. For example, past research on

the application of systems analysis and design frameworks (i.e. object-oriented) has used experiments to compare the quality of design (Shoval and Shiran 1997). A field experiment using the work systems principles could assess the usefulness of the principles as a group while also examining each principle's contribution to the system design process. Interpretive studies, action research, and design science research provide other possible approaches for future research about the effectiveness of the principles in practice.

Table 9. Example of a Checklist Based on Work System Principles.

Work system principle	***Degree of Concern***	***Comment or explanation***
Customers		
#1: Please the customer	3	Several groups of customers have concerns. Top management is concerned about inadequate quality of the loan portfolio….
#2 Balance priorities of different customers.	2	Management and loan officers are caught in contradictions between short-term profitability and long-term quality of the loan portfolio. Loan officers want to maximize dollar volume of approved loans, because that is the basis…
Products and Services		
#3: Match process flexibility with product variability	1	The current work system already handles larger and more complex loans differently from the way it handles small loans....
Processes and Activities		
#4: Perform the work efficiently.	3	Aspects of the work are not performed efficiently. The loan officers might be more efficient if they could use a loan evaluation model to help establish realistic expectations. Credit analysts use disjointed tools that exacerbate ....
#5: Encourage appropriate use of judgment.	2	Moving to a more controlled decision process would constrain judgment, but should not preclude the use of judgment because no known procedure takes into account all possible factors and contingencies related to the client and ....

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