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Steven Alter

University of San Francisco, alter@usfca.edu

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Ten Lightweight SA&D Tools Based on Work System Theory and Its Extensions

Completed Research

Steven Alter

University of San Francisco
alter@usfca.edu

Abstract

This paper illustrates ten lightweight SA&D tools that could support initial deliberations about system requirements and subsequent sanity checking for high-level designs and for proposed functions and features. The tools are as relevant to agile development as to other approaches related to work systems in organizations. A brief introduction to the work system perspective leads to a section that illustrates ten SA&D tools based directly on work system theory or its extensions. The tools are applied to the same situation, a hiring system at a technical firm. These tools are not part of established SA&D pedagogy or practice. This paper's ideas provide a context for comparing the focus of established SA&D methods and tools with a broader view of SA&D that engages managers and other business professionals more fully.

Keywords

Systems analysis and design, work system perspective, lightweight tools

Addressing Part of a Difficult Challenge

The challenge of IS success has been a central topic in the IS discipline for decades. Too many projects fail to meet their objectives. Too many systems fail to meet expectations for improving business results. Too many systems are viewed as an obstacle rather than a support for accomplishing personal and group goals. At least some of the difficulties are attributed to flawed requirements, which in many cases result from inaccurate and incomplete communication between business professionals and IT professionals.

This paper assumes that a mutually understandable set of requirements need to include requirements for the new or improved work system that new or improved software will support. More limited requirements focusing mainly on technology architecture and operation often do not communicate enough about how that technology could improve business activities. Fulfilling requirements focusing on IT functions and features may still ignore or downplay many important practicalities and issues in the business setting.

This paper illustrates a series of lightweight SA&D tools that could support initial deliberations about system requirements and subsequent sanity checking for both high-level designs and proposed functions and features. The tools presented here build upon several decades of research that produced various versions of the work system method (WSM), formalization of its conceptual core as work system theory (WST), and development and publication of various extensions of WST.

Goal and organization. This paper's goal is to illustrate a series of lightweight SA&D tools that in combination go beyond the content of the limited WSM outlines that guided a major component of many MBA and EMBA courses. A brief introduction to the work system perspective leads to this paper's main section, which illustrates 10 SA&D tools based directly on WST or its extensions. The tools are applied to the same situation, a hiring system at a hypothetical technical firm whose hiring difficulties combine challenges observed in a number of technology firms. We assume that firm's established hiring system has encountered significant problems related to delays in hiring, high cost of hiring, ineffective interviewing, and inappropriate selection of engineers who did not succeed at the firm. Management has asked for an analysis of the system in the hope that it can be improved substantially. The system uses an online HR portal, but that is only part of a hiring work system that has not produced satisfactory results.

This paper's contribution focuses on presenting a series of lightweight tools, all of which can be used individually or in combination in deliberations about requirements, high-level designs, and proposed

system functions and features. Most of these tools express novel approaches for exploring different aspects of requirements for an IT-reliant work system. All can be used in agile or waterfall projects for sanity checking about whether progress to date and the current backlog will lead to better business results. Tools such as these do not appear in typical SA&D courses, which focus much more on how to create technical specifications expressed using BPMN, UML, and other methods and tools whose complexity and notation make them difficult for business professionals to use independently or understand fully. A second contribution is providing a point of comparison for contrasting the focus of established SA&D methods and tools with a broader view of SA&D designed to help deliberations involving business professionals.

Background: The Work System Perspective

Sociotechnical researchers have used the idea of work system for decades (e.g., Trist, 1981; Mumford, 2006). That term appeared in the first volume of *MIS Quarterly* (Bostrom and Heinen, 1977). WSM is a flexible SA&D method designed to help business professionals understand and analyze IT-reliant work systems in their own organizations. Between 2003 and 2017 individual students or student teams (mostly MBA and Executive MBA) used various versions of WSM to produce over 700 management briefings recommending improvements of problematic IT-reliant systems, e.g., 75 and 301 briefings at a university in the Southeastern USA analyzed in Truex et al. (2010, 2011). Some of the other briefings were produced in courses in China, Germany, India, and Vietnam. While details of the courses varied, all of the assignments involved identifying a problematic work system (usually at a student's employer) and producing an analysis and explanation guided by a WSM outline. The outlines reflected the timeframe and pedagogical needs of specific courses. The core ideas in WSM were articulated as work system theory (WST) in Alter (2013). Those ideas also provide a usable systems perspective in research concerning a variety of topics, e.g., use of aspects of WST in recent research concerning IS user satisfaction (Laumer et al., 2019), alternative views of digitalization (Wolf et al., 2019), open innovation platforms (Daiberl et al., 2019), crowdworking (Mrass and Peters, 2019), information security (Jeon, 2018), knowledge sharing (Wong, 2018), enterprise modeling (Köhler et al. 2018), and use case creation in classroom settings (Bolloju et al. 2017)

The work system perspective assumes that systems in organizations can be viewed as work systems and can be described by WST, which consists of three parts: 1) the definition of work system, 2) the work system framework, which outlines a static view of a work system during a period when it is relatively stable, and 3) the work system lifecycle model, which expresses a dynamic view of how a work system changes over time. A work system is defined as a system in which human participants and/or machines perform work (processes and activities) using information, technology, and other resources to produce specific product/services for internal or external customers. That definition allows for both sociotechnical work systems with human participants and totally automated work systems. Figure 1 shows the work system framework, which forms the basis of many of the tools discussed here. The work system life cycle model (not shown) describes how work systems change through planned and unplanned change.

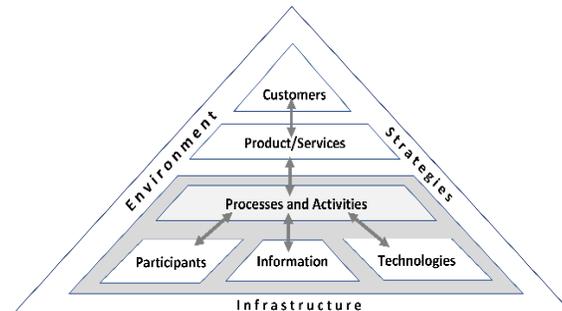


Figure 1. Work System Framework (Alter, 2006; 2013)

Conceptual relationships between information systems (ISs) and work systems (WSs) are worth noting. An IS is a WS most of whose activities are devoted to processing data/information, i.e., capturing, transmitting, storing, retrieving, manipulating, displaying, and/or deleting data/information (Alter, 2008). Some ISs are sociotechnical, e.g. a sociotechnical accounting system in which accountants produce financial reports with the help of a totally automated IS that stores the data and mechanically generates the reports. Relationships between specific ISs and WSs that they support can take many forms. In some cases, the IS is basically a subsystem of the WS, i.e., the parts of the WS that are devoted to processing information. In other cases,

the IS is best understood as a separate entity that provides information for a WS. In yet other cases, an IS may support multiple work systems and may overlap with them in a variety of ways. Thus, an IS is much more than a technology and cannot be understood fully without understanding WS(s) that it supports.

The current research is consistent with an explanation (Alter and Bork, 2019) of how *work system* might serve as a “modeling metaphor” (Ferstl and Sinz, 2013) supporting different modeling techniques for different stakeholder purposes. That could address model-related problems discussed by Sandkuhl et al. (2018), van der Aalst (2012), Karagiannis (2015) and many others. Bork and Alter (2020) placed that idea in a deeper theoretical framework by discussing how relaxing Karagiannis and Kühn’s (2002) modeling criteria could produce flexible, controllable, and usable modeling methods. Alter and Bork (2020) proposes development of a toolkit for modeling, analyzing, and designing work systems, but does not illustrate the proposed tools with a rich example. This paper’s hiring example illustrates those tools, whose effectiveness for the hiring example varies, with some more effective than others (which is not surprising).

Ten Lightweight SA&D Tools

This section uses the hiring example to illustrate the SA&D tools that are described as lightweight because they do not require complex concepts, notation, or extensive training. The first tool, the work system snapshot, appears in almost every WSM outline used to date by undergraduate, MBA, and Executive MBA students. It probably would be called a work system canvas (analogous to business model canvas) if it were invented today. The other tools are based on published extensions of WST.

Tool #1: Work System Snapshot. This one-page summary of the work system is an organized approach for summarizing a work system’s scope and operation. It provides enough detail to support collaboration by helping people discuss what should be a work system’s scope, but makes no attempt to be precise about specific information and technologies used in individual steps. That type of detail is very important when producing software, but is not very important for visualizing a work system’s scope and general operation.

Customers		Product/services	
<ul style="list-style-type: none"> • Hiring manager • Larger organization (which will have the applicant as a colleague) • HR manager (who will use the applications to analyze the nature of applicants) 		<ul style="list-style-type: none"> • Applications (which may be used for subsequent analysis) • Job offers • Rejection letters • Hiring of the applicant 	
Major activities and processes			
<ul style="list-style-type: none"> • Hiring manager submits request for new hire. • Staffing coordinator defines job parameters. • Staffing coordinator publicizes the position. • Applicants submit resumes. • Staffing coordinator selects shortlisted applicants and sends the list to the hiring manager. • Hiring manager identifies applicants to interview. 		<ul style="list-style-type: none"> • Staffing coordinator sets up interviews. • Interviewers perform interviews. • Interviewers provide feedback from the interviews. • Staffing coordinator sets up other interviews • Hiring manager makes hiring decisions. • Staffing assistant sends job offers or rejections. • Successful applicant accepts or rejects job offer. 	
Participants	Information		Technology
<ul style="list-style-type: none"> • Hiring managers • Applicants • Staffing coordinator • Staffing assistant • Other employees who perform interviews 	<ul style="list-style-type: none"> • Job requisition • Job description • Advertisements • Job applications • Cover letters • Applicant resumes 	<ul style="list-style-type: none"> • Short list of applicants • Information and impressions from the interviews • Job offers • Rejection letters 	<ul style="list-style-type: none"> • HR portal for communicating with applicants • Word processor • Telephones • Email

Table 1. Work System Snapshot (based on Alter, 2006; 2013)

A work system snapshot can be produced or used in any order. E.g., it is possible to start at the lower left by identifying participants, then identifying processes and activities, then identifying the product/services produced for customers, and so on. Any current version of a work system snapshot can be modified as an individual or group’s understanding of the situation evolves. Although meant as a lightweight tool, a work system snapshot is rigorous and is governed by a conceptual model. Participants (roles) must perform at least one step listed under processes and activities. Product/services must be produced by some

combination of the activities that are listed. Product/services must be received by the customers of the work system. Informational and technological entities that are included must be used in at least one step.

Tool #2. Service Responsibility Table. Service responsibility tables were first discussed in Tan et al. (2011) but were never used in WSM outlines. This tool is based on the service value chain framework (Alter, 2010), which tries to bring more of a service mindset into descriptions of systems. Its two-sided form says that services often are coproduced by providers and customers. It combines concepts such as customer and provider responsibilities, service instances, service interactions, and frontstage and backstage. Value capture for both customers and providers is described as occurring during negotiation, set-up, service request, fulfillment, and follow-up phases, and also can extend long beyond specific service instances.

Table 2 is a service responsibility table for the hiring example. The activities come from the work system snapshot in Table 1. The provider and customer responsibilities listed in the table are a reminder that typical SA&D tools express a mechanical view of processes but say little or nothing about responsibilities of both providers and customers who perform activities within each step. The blank cells in the customer responsibility column recognize that applicants have responsibilities in some steps but not in others.

Provider responsibility	Activity (from the work system snapshot)	Customer Responsibility
Request for new hire only if that fits within an relevant budget.	Submit request for new hire.	
Conform with corporate standards in specifying job parameters.	Define job parameters.	
Publicize in places that are likely to be visible to appropriate candidates.	Publicize the position.	
Provide a convenient way for applicants to submit resumes.	Submit resumes.	Submit honest, well-constructed resume
Use manager's criteria when producing the short list.	Select shortlisted applicants.	
Avoid wasting time on applicants who probably would not take the job.	Identify applicants to interview.	
Find mutually convenient times.	Set up interviews.	
Be considerate. Help the applicant explore relevant topics and issues.	Perform interviews.	Be on time. Tell the truth. Learn more about the company.
Provide feedback related to job responsibilities, not just like or dislike.	Provide feedback from the interviews.	
Find mutually convenient times.	Set up additional interviews.	
Use interview responses rather than just personal likes and dislikes.	Make hiring decisions.	
Follow corporate policies.	Send job offers or rejections.	
Respond to applicant's requests, etc.	Accept or reject job offer.	Select appropriate job.

Table 2. Service Responsibility Table (based on Tan et al., 2010)

Tool #3: Value Capture Table. Value capture tables are also based on the service value framework (Alter 2010), which says that both providers and customers may perceive value related to almost any of the activities performed within the work system. For example, the provider might find value in the fact that interactions with some customers tend to be very efficient, especially compared with interactions with other customers that absorb excessive time of sales and service employees. Note that provider value capture may involve activities that are directed internally (toward the organization) or toward the customer.

Tool #4: Facets of Work. The idea of facets of work grew out of an attempt to facilitate analyst/stakeholder interactions through richer and more evocative concepts for SA&D. This idea was imagined as analogous facets of a polished diamond. A similar notion of facets has been used in psychology in describing different facets of psychological characteristics. Each facet of work is identified using a verb or verb phrase since work in business settings always involves activities that can be expressed using verbs. This application of a facet metaphor provides a straightforward way to bring a great deal of knowledge into SA&D. An iterative process led to the tentative identification of 18 different facets of work, each of which brings related concepts, evaluation criteria, trade-offs, sub-facets, and other knowledge that can be used in SA&D (Alter, 2019). Table 4 illustrates that all but one of the 18 facets identified thus far in ongoing research might help in identifying insights about the hiring system.

Aspects of value for the provider	Activity (from the work system snapshot)	Aspects of value for the customer
Lean staffing levels	Submit request for new hire.	
Accuracy of job parameters	Define job parameters.	
Efficient use of advertising budget	Publicize the position.	
Few interactions with the applicants related to mechanics of submission	Submit resumes.	Convenience and efficiency in submitting resumes
Applicants satisfy manager's criteria	Select shortlisted applicants	
Interview people likely to accept an offer	Identify applicants to interview.	
Minimum inconvenience	Set up interviews.	Minimum inconvenience
Minimum inconvenience	Perform interviews	Useful exchange of information
Actionable feedback	Provide feedback from the interviews.	
Minimum inconvenience	Set up additional interviews	Minimum inconvenience
Consider value for the organization	Make hiring decisions.	
Minimize time absorbed	Send job offers or rejections.	
	Accept or reject job offer.	Clarity about the opportunity

Table 3. Value Capture Table (based on Alter, 2010)

Facet	Opportunities, problems, and issues
Making decisions	Past hiring decisions often were not well considered. Too many engineers left the company before they add a lot of value.
Communicating	Communication with interviewers was often ineffective. In some cases the manager seemed unwilling to engage seriously about interviewer criticisms of candidates.
Processing information	Compilation of interview feedback often seems slow and ineffective.
Thinking	Applicants complained that some interviewers seemed most interested in finishing interviews and not so interested in responding to applicant questions and issues.
Representing reality	The coding sheets used to summarize interviews seemed ineffective for describing the real qualities and potential of the applicants as future employees.
Providing information	Managers often viewed the interview feedback as sloppy and inadequate. The feedback for too many interviews often seems to provide minimally useful information.
Applying knowledge	Some interviewers did not have sufficient knowledge for understanding the nuances of what engineering applicants have accomplished or what they knew.
Planning	Inadequate planning for times when the interviews could occur caused substantial inconvenience.
Controlling execution	There is no reliable way to assure that interviews would be performed well and would provide the information needed about the applicants.
Improvising	The interviewing process involves too much improvisation and sometimes degenerates into a nice conversation that does not provide the clarity that is needed.
Coordinating	Coordination between simultaneous searches is often a problem. Several employees were scheduled to interview different applicants at the same time.
Performing physical work	(Not relevant to this situation.)
Performing support work	The staffing coordinator and staffing assistant focus on their own jobs but often could do more to help the interviewers, who are often overloaded with work separate from the interviews.
Interacting socially	The social aspect of the interviews generally seems to go very well. Most applicants say that the social aspects meet their expectations.
Providing service	The hiring system might be viewed partly as a service for applicants, which might lead to trying to provide more value for those applicants without using more of our resources.
Creating value	Some managers have questioned whether the interview process really creates value. They note hiring of a number of people who did not fit.
Co-creating value	The interview process might be viewed as co-creating value with the applicants. The firm wants to find out about them and they should be able to find out more about the firm to ensure a good fit.
Maintaining security	Last month one of the firm's competitors somehow obtained a list of the firm's active applicants. They convinced one of those applicants not to take a job that was offered.

Table 4. Opportunities, Problems, and Issues for 18 Facets of Work (Alter and Bork, 2019)

Tool #5: Problems, Opportunities, or Issues Related to Elements of the Work System Framework. Software projects sometimes define problems and goals quite narrowly to minimize project

escalation. Table 5 uses the work system framework to help in identifying relevant topics that might be ignored even though they might lead to problems in implementation or in system operation.

Element (or entire system)	Related problems, opportunities, or issues
Work system as a whole	Too much time is spent on interviewing unqualified applicants and overqualified applicants who want to work elsewhere.
Customers	Some applicants complain that the online HR portal is poorly designed. Others feel that they are treated poorly. Hiring managers are not getting the results they want.
Product/services	Inadequate results: Too many new hires have had trouble adjusting to the firm, have not produced high quality work, and have moved elsewhere before they produced a lot.
Processes and activities	Interviewing absorbs too much time in general. Many interviewers are annoyed that the interviews absorb time that they think they need for doing their own jobs.
Participants	Some of the interviews are performed by employees who do not have enough knowledge of the technical content of the jobs, and therefore cannot evaluate applicants adequately.
Information	Current methods for assessing applicant knowledge are inadequate. There is no problem with contact information, educational background, etc.
Technologies	The HR portal was built four years ago and already seems a bit outdated in comparison with HR portals use by some of competitors.
Environment	In the current competitive environment many applicants would prefer to go to work for other firms, especially those that offer higher salaries.
Infrastructure	Coordinating around the interview processes proved difficult when the corporate computer network went down for several hours on several occasions.
Strategies	The corporate strategy of keeping salaries in line across the various divisions is an obstacle to hiring because local salaries for technical work often exceed company guidelines.

Table 5. Opportunities, Problems, and Issues Linked to the Work System Framework

Tool #6: Interactions with Other Work Systems. Work systems do not exist in isolation. As open systems they obtain inputs from other systems and produce outputs for other systems. Many work systems interact with other work systems in unintended ways that may lead to important disruptions. Examples include accidentally contaminating resources needed by another work system and an emergency where participants in one work system to stop their assigned tasks to help with the emergency. A complex theory of system interactions (Alter, 2018) is a WST extension that summarizes how system interactions have a variety of purposes and/or causes, may have many characteristics and details, may be described using a variety of system interaction patterns, and may have a variety of direct effects that lead to responses and affect outcomes of the interactions. Table 6 aims at identifying relevant system interactions. Many other versions of Table 6 could be developed based on different combinations of factors in the underlying theory.

Element (or entire system)	Related Interactions with other Work Systems
Work system as a whole	Our hiring system is basically part of a hiring marketplace in which it competes with other hiring systems. Unanticipated changes in those work systems could affect ability to hire.
Customers	Interviews often require employed applicants to take time off from their participation in work systems in other firms. Sometimes that causes conflicts.
Product/services	The hiring of applicants triggers activity in other work systems that assign office space, enable network access, facilitate insurance sign-ups, and perform other functions.
Processes and activities	The hiring of some applicants requires interaction with work systems in the legal and HR departments if the applicants need new visas or security clearances.
Participants	People perform interviews in this work system also have responsibilities in other work systems. Some interviewers may have been focusing more on their main responsibilities.
Information	Some of the information in this work system is not consistent with similar information other work systems, which sometimes causes annoying rework.
Technologies	The HR portal is no longer interoperable with the parts of our HR software that were upgraded. Those incompatibilities caused extra clerical work by managers.
Environment	We are in an extremely competitive environment where many applicants would prefer to go to work for other firms, especially those that offer higher salaries.
Infrastructure	Our network went down for a day and we think that some potential applicants may have looked for other jobs elsewhere.
Strategies	The strategy in this work system is constrained by with the corporations general strategy of maintaining relatively low salary levels.

Table 6. Interactions with Other Work Systems (based on Alter, 2018)

Tool #7: Design Principles. A series of 24 normative principles for work systems were developed iteratively starting with simplified versions of sociotechnical principles proposed by Cherns (1987). Alter and Wright (2010) explains how additional principles were added over several years based partly on usefulness evaluations by employed Executive MBA students. Table 7 illustrates how the principles might be applied to the hiring case. The “fit” column presents perceptions as 1 to 5 ratings about how well each principle describes the system (from no problem to serious problem). The third column is a very brief related comment. A table based on design principles could take many different forms and could use principles from other authors, some of which are mentioned in Alter and Wright (2010). Notice that each principle makes sense by itself but may conflict with other principles in specific situations, as when pleasing the customers might make it difficult to do the work efficiently. Overall, design principles provide a normative basis for comparisons that might help in recognizing problems, opportunities, and key tradeoffs.

<i>Work system principle</i>	<i>Fit</i>	<i>Comment</i>
#1: Please the customers.	3	No one really satisfied
#2: Balance priorities of different customers.	3	Manager versus applicants
#3: Match process flexibility with product variability.	2	Flexible enough
#4: Perform the work efficiently.	3	Too much wasted time
#5: Encourage appropriate use of judgment.	1	---
#6: Control problems at their source.	3	Need earlier evaluation for applicants
#7: Monitor the quality of both inputs and outputs	2	Sufficient monitoring
#8: Boundaries between process steps should facilitate control.	1	---
#9: Match the work practices with the participants.	3	Mismatch of skills and knowledge
#10: Serve the participants.	3	Interviewers feel inconvenienced.
#11: Align participant incentives with system goals.	3	Unclear incentives for interviewers
#12: Operate with clear roles and responsibilities	2	Enough clarity about roles
#13: Provide information where it will affect action.	3	Feedback is often inadequate
#14: Protect information from inappropriate use.	3	List of applicants was leaked.
#15: Use cost/effective technology	1	---
#16: Minimize effort consumed by technology.	3	HR portal consumes too much effort
#17: Take full advantage of infrastructure.	1	---
#18: Minimize unnecessary conflict with the environment	3	Salaries are not fully competitive
#19: Support the firm's strategy	3	Firm's strategy is inconsistent
#20: Maintain compatibility and coordination with other work systems.	2	Most compatibility and coordination issues are manageable
#21: Incorporate goals, measurement, evaluation, and feedback	3	Inadequate evaluation and feedback
#22: Minimize unnecessary risks.	3	Too many risky hires.
#23: Maintain balance between work system elements.	3	More focus on process than output
#24: Maintain the ability to adapt, change, and grow.	3	Change is difficult in this company.

Table 7. Evaluation Table Based on Normative Design Principles (Alter and Wright, 2010)

Tool #8: Workarounds. A workaround can be defined as “a goal-driven adaptation, improvisation, or other change to one or more aspects of an existing work system in order to overcome, bypass, or minimize the impact of obstacles, exceptions, anomalies, mishaps, established practices, management expectations, or structural constraints that are perceived as preventing that work system or its participants from achieving a desired level of efficiency, effectiveness, or other organizational or personal goals.” (Alter, 2014). A theory of workarounds that is a WST extension provides an abstract explanation of how workarounds occur in organizational settings. Both the theory workarounds and the text in Alter (2014) explain that workarounds may be beneficial or harmful. A number of other papers have looked at how workarounds sometimes are a source of innovation (e.g., Safadi and Faraj 2010; Beerespoort et al. 2019).

The notion that workarounds may be beneficial or harmful is related to another WST extension (Alter, 2015) concerning compliance versus noncompliance that could be the basis of related tools. Tools focusing on compliance versus noncompliance could look for instances related to beneficial noncompliance (e.g., beneficial workarounds of established practices) and detrimental compliance (following established practices when workarounds would yield better results for the organization and/or for customers). The tools for those issues could look like Table 8 except they would ask specifically about beneficial noncompliance and detrimental compliance, rather than about workarounds.

Element	Workarounds that have occurred in the hiring system
Work system as a whole	Some hiring occurs completely outside of the hiring system. In those instances, data is entered into the system mainly after the hiring occurs.
Customers	Some important hires occurred when applicants went directly to employees that they knew instead of starting their applications through the HR portal.
Product/services	In conflict with a privacy pledge for applicants, the HR department previously combined information from resumes with ostensibly private information from other sources.
Processes and activities	The process described in Table 1 describes how hiring should occur. There are many instances where some of the steps were skipped or performed in a different order.
Participants	Employees who perform interviews often find them to be impositions on their time. An ineffective workaround was to have HR contractors perform some of the interviews.
Information	Some interviews obtain and record information about private matters (e.g., health, family, religion) that are not supposed to be discussed according to company and legal guidelines.
Technologies	Personal data for some of the less tech savvy applicants is sometimes entered by HR employees when those applicant have difficulty using the HR portal.
Environment	(no known workarounds)
Infrastructure	When the corporate network went down last month the HR department used social media to develop a temporary workaround.
Strategies	Various maneuvers such as exaggerated wording of job descriptions have been used to work around corporate salary guidelines.

Table 8. Workarounds that Might Be Considered when Improving a Work System

Tool #9: Product/Service Design Dimensions. Every work system’s purpose is to produce product/services for its customers. Table 9 is based on design dimensions for product/services that may raise design related issues concerning whether a proposed work system improvement would lead to better product/services for its customers. Each dimension goes from an endpoint that is frequently associated with products in everyday life to an endpoint that is frequently associated with services.

This tool does not seem very useful in relation to the hiring system, where the sliding scale C vs. D responses in the central column basically say that stakeholders would like a somewhat higher level of characteristics typically associated with services. Situations where it might provide more insights include a discussion of expectations for an ERP system (Alter, 2010, p. 207) and a comparison of different medical services (Alter 2017, p. 6), each of which uses a slightly different set of dimensions.

End point frequently associated with products	Current (C) and Desired Position (D)	End point frequently associated with services
Standard	<---C---D----->	Customized
Transferred and used	(not applicable)	Consumed as produced
Produce	<-----C----D-->	Co-produce (with customers)
Persistent or durable	<-----CD-->	Ephemeral
Goods	(not applicable)	Experiences
Tangible	<-----CD-->	Intangible
Minimal interaction with customers	<-----C----D-->	Extensive interaction with customers
Transaction-based	<---C---D----->	Relationship-based
Value created by producer	<-----C----D-->	Value co-created with customers

Table 9. Product/service Design Dimensions (based on Alter, 2010; 2017)

Tool #10: Process Design Dimensions. A set of concepts related to each of the elements of the work system framework can be viewed as an early (Alter, 2006) extension of WST. Table 10 illustrates a tool related to characteristics of processes and activities. In contrast with tools like BPMN that are used to document exactly how a process is supposed to operate, the characteristics in Table 10 are useful for discussing directions in which a process might be changed, e.g., whether it should be more structured, whether more people should be involved, whether it should be more complex, and so on. That type of tool could provide significant insights related to work systems that use AI, big data, Internet of things, social media, and other technical innovations that are often discussed in relation to the wonders and mysteries of technologies rather than their application as part of work systems.

Design dimension	Low	Current (C) and Desired Position (D)	High
Degree of structure	Unstructured	<----C----D----->	Highly structured
Range of involvement	Few participants	<---D --- C ----->	Many participants
Level of integration	Not integrated	<-----CD----->	Highly integrated
Complexity	Simple	<---D---C----->	Extremely complex
Variety of work	Highly repetitive	<-----C---D----->	Great variety
Degree of automation	Manual	<--- CD ----->	Totally automated
Rhythm – frequency	Infrequent	<--- CD ----->	Frequent
Rhythm – regularity	Irregular	(not applicable)	Regular
Time pressure	Leisurely	<-----CD----->	High time pressure
Interruptibility	Non-interruptible	<-----CD----->	Easily interruptible
Error-proneness	Not error-prone	<---D---C----->	Error-prone
Feedback and control	Informal	<-----C---D----->	Formal
Exception handling	Informal	<-----C---D----->	Formal

Table 10. Process design dimensions (from Alter, 2006)

Conclusion

This paper presented 10 lightweight SA&D tools that can be used individually or in any combination to support deliberations related to the design of IT-reliant work systems. These tools can be used during initial requirements determination and when sanity checking the usefulness of proposed features, functions, or systems. All are potentially useful in many situations, yet are not part of SA&D as it is taught and practiced. It is possible that organized use of these tools or other tools in the same general spirit could lead to better results in system improvement projects. The 10 tools illustrated here are only a subset of the possible tools that might be created. Other tools included in WSM outlines for MBA or EMBA courses (e.g., tables of performance gaps or listings of strengths and weaknesses) are not included here due to length limitations.

One might ask whether these are genuinely lightweight tools. After all, some of them call for at least some attention to a large number of topics. The underlying assumption is that business professionals are more willing and able to pay attention to ideas that can be discussed easily and that are not expressed in complex notations that seem obscure, mysterious, and usable mainly by technical experts. All of the tools mentioned here can be adapted in various ways for different purposes of different stakeholders.

One also might ask whether the illustrative hiring example is somehow biased or cherry-picked. That example was selected because it is easy to understand and does not involve specialized knowledge of unusual processes. Developing these tools further calls for using them in a variety of real-world situations in order to identify circumstances under which each tool tends to be more useful or less useful.

In combination these tools raise a challenging issue for SA&D. All of the tools address important topics that are touched indirectly or not at all by what is usually considered the core content of SA&D education, i.e., rigorous specification and documentation using BPMN, UML, and other tools for IT professionals. The challenge is to explain why easily understood tools such as those presented here should not be part of typical SA&D or, alternatively, to explain how to incorporate such tools without undermining the obvious importance of rigorous tools and methods that programmers need.

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