12-11-2021

A New Reconceptualization of System Usage Based on a Work System Perspective

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

A New Reconceptualization of System Usage Based on a Work System Perspective

Completed Research Paper

Steven Alter
University of San Francisco
2130 Fulton, St., San Francisco,
CA 94117, USA alter@usfca.edu

Abstract

The DIGIT 2021 CFP emphasizes "building resilience with information technology in a time of disruptions." This paper addresses that issue by going back to basics. It argues that typical uses of the common concept of system usage are insufficient for supporting insightful discussions of using IT for resilience. It proposes a reconceptualization of the concept of system usage in which the concept of IS usage is defined based on a work system perspective in which an IS is a type of work system. The reconceptualization is applied to two case studies, one involving mission- critical workarounds of an ERP system and one involving an electronic medical records (EMR) system. Those examples illustrate many important aspects of IS usage that tend to be ignored in discussions of variables related to a typical notion of system usage. This reconceptualization of system usage has many implications related to describing information systems and the ways they support, control, or perform activities in other work systems. That approach provides a deeper appreciation of where and how IT can support resilience in a time of disruptions.

Keywords: IS usage, system usage, information system, work system perspective

A New Reconceptualization of System Usage Based on a Work System Perspective

Completed Research Paper

Toward a Richer, More Useful Concept of IS Usage

IS research often treats "system usage" as a synonym of IT usage, e.g., "System usage, the utilization of information technology (IT) by individuals, groups, or organizations, is a core variable in IS research. (Straub, et al., 1995, p. 1328). System usage (or a synonym such as usage behavior or utilization) is a dependent variable in prominent IS research streams such as TAM (Davis, 1989), the IS success model (DeLone and McLean, 1992), task/technology fit (Goodhue and Thompson, 1995), and UTAUT, the unified theory of acceptance and usage of technology (Venkatesh et al., 2003).

An influential article about reconceptualizing system usage notes "there is no accepted definition of the system usage construct in the IS literature" and "there is no accepted approach for selecting the relevant content of usage for any given study context." (Burton-Jones and Straub, 2006, p. 231). That article uses the triad of "user-system-task" to define system usage. More recently, an *MIS Quarterly Research Curation* (Burton-Jones, et al., 2017, updated 2020) says that IS use "is arguably the most consequential construct in our field" (p. 1) and identifies 107 *MISQ* articles on IS use through Dec. 2019. It says, "IS use connotes an actor's employment of an information system to perform an activity, where an actor refers to the individual, group, organization, or other collective using the system."

Motivation. The traditional "user-system-task" notion of system usage is increasingly inadequate for describing the full range of IS usage today and in the near-term future. This paper proposes shifting the focus by using a systems perspective and reconceptualizing IS usage to encompass functions performed by an IS, especially regarding needs of a work system (WS) that it supports. The following are examples of such functions go beyond just providing access to information: defining and enforcing rules for collecting or sharing information, providing methods for aggregating information, providing methods for analyzing information, controlling the sequence of activities in workflows, enforcing compliance with business rules, producing alarms when predefined conditions occur, controlling or facilitating coordination, controlling physical devices and processes, suggesting or evaluating decisions, enabling communication between individuals and/or groups, triggering automated functions, and performing automated tasks.

Those examples extend to many functions that go far beyond the assumption that ISs exist to provide information or representations of systems. Contrary to many past assumptions about system usage, users may be collectives; often the system is not described well as an object or artifact that is used, especially when ISs are sociotechnical systems with human participants; system functions may be performed automatically and without direct operational involvement or interaction by any individual or collective; the purpose of many ISs is not about providing representations even though some kind of representation is involved in many cases; in some cases the IS performs activities instead of just providing features that support functions in task domains.

A systems perspective. This paper focuses on *IS usage* (not *system usage*) to emphasize the use of an *information system*, not just an instance of IT that might be called a system without paying attention to its system properties. Its definition of IS treats the IS as a system that performs activities, i.e., not a tool or object or a representation of a system. This paper's systems perspective on IS usage builds on conceptual and theoretical developments from the last 20 years. This perspective highlights the vast gap between *system usage* (or a synonym) as a dependent variable in TAM, the IS success model, task/technology fit, and UTAUT, and the idea of *system* discussed by system theoreticians such as Ackoff, Checkland, Churchman, and Emery.

Table 1 uses the format of a table in Baird and Maruping (2021, p. 320) to compare part of the new reconceptualization to definitions in Burton-Jones and Straub (2006, p. 231).

Table 1. Reconceptualizing "user-system-task"

Term	Definition in Burton-Jones and Straub (2006, p. 231)	Proposed reconceptualization
User	"A *user* is an individual person who employs an IS in a task." (Updated by Burton-Jones and Gallivan (2007) to include individuals, groups, organizations, or other collectives)	In organizational settings, *work systems* (WSs) can be viewed as direct users of ISs. Both the WSs and ISs that they use may be sociotechnical (some activities performed by people) or totally automated. Indirect uses by individuals or collectives involve pursuing goals by influencing or requiring direct uses.
System	"An *IS* is an artifact that provides representations of one or more task domains. ... ISs provide features that are designed to support functions in those task domains."	"The system" used is an IS that serves the WS by providing information, providing capabilities, controlling activities, performing delegated activities, and/or collaborating to achieve goals. IS is a type of WS (not an artifact). An IS often does more than providing representations or features.
Task	"A *task* is a goal-directed activity performed by a user." Once again, this can be expanded to collectives as users.	"Task performed by a user" is replaced by goal-directed activities performed by the WS or delegated to its agents. This can be explained in depth by focusing on relevant facets of work.

This paper's reconceptualization of system usage as IS usage moves into territory that is unfamiliar in the IS field. The presence of systems perspectives in IS research is sparse at best. For example, Burton-Jones et al. (2015) notes a small resurgence in interest in the systems perspective despite the way that past papers about theoretical perspectives tended to focus on the variance/process dichotomy (p. 669). A former editor-in-chief of *MIS Quarterly* says, "It is no exaggeration to describe most IS researchers as having used the term 'system' or 'systems' to refer to just about anything that involves electronic information processing" (Lee, 2010, p. 339). Demetis and Lee (2017, p. 164) say "there has existed no overall body of literature indicating a general acceptance and broad application of systems theory in the information systems field. Apart from the few individual exceptions noted, the term 'systems' in information systems has been an empty honorific, where the phrase "information systems" is largely interchangeable with "information technology" or even just "the computer."

Pursuing IS usage as a central topic in today's IS field calls for focusing directly on the system nature of ISs and their usage contexts. Traditional uses of a variable called *system usage* simply do not do that even though the existing legacy of system usage research has generated an important basis for comparison and a point of departure for new ideas. A richer understanding of ISs based on a systems perspective could lead to attaining more value from ISs in practice and more value from IS research. The topic of IS usage is increasingly important for practitioners and should be important for researchers, especially as IS applications continue to change with advances in automation, collaboration with automated agents, and artificial intelligence. This paper's goal is as follows:

> Show how defining an IS as a type of work system leads to a new definition of IS usage that helps in visualizing and analyzing many types of IS usage that are not described well by the traditional "user-system-task" notion of system usage.

This paper's systems perspective on IS usage starts with viewing ISs as WSs, which leads to visualizing how ISs may support, control, or perform activities in other WSs. It also helps in visualizing the importance of interactions and overlaps between ISs and WSs that they support and in recognizing potential impacts of ISs on many different facets of work.

Organization. A background section focuses on ideas that lead to this paper's systems perspective on IS usage. IS is defined as a type of work system (WS) that may be a sociotechnical system or a totally automated system. ISs often exist to support other WSs, some of whose participants are IS users. ISs also may provide product/services for users outside of a WS context and may interact with totally automated WSs. The wide range of relationships between ISs and WSs that they support demonstrates the need to see IS usage through an approach much broader than an HCI lens of requesting and receiving information through an interface. Looking at ISs deeply calls for recognizing that ISs may support, control, or perform any of a series of facets of work in activities in WSs. The reconceptualization of IS usage is applied to two examples. One involves mission-critical workarounds of an ERP system whose effective usage in a specific setting was impossible due to local realities. The other involves an electronic medical records (EMR) system whose usage achieved some of its goals but had important negative impacts on many physicians. Those examples illustrate aspects of IS usage that tend to be ignored in traditional discussions of system usage as a dependent variable related to the extent to which a technology is adopted and used. The reconceptualization of system usage has implications related to describing different forms of usage and recognizing limitations of incremental extensions of TAM, UTAUT, and the IS success model. In relation to the DIGIT CFP, it provides a deeper appreciation of where and how IT can support resilience in face of disruptions.

Background

System usage has been studied for more than four decades. An *MIS Quarterly* Research Curation (Burton-Jones, et al., 2017) identified 107 *MISQ* articles on IS use published through to Dec. 2017, later updated to 2019. To leave room for this paper's new ideas, this background section is not a full literature review and instead mentions only a few of the conceptual developments that gradually moved a bit closer to a systems perspective. Basic ideas about systems are also summarized.

System Usage, Collective Use, and Agentic Use

System usage. Questions about IS utilization and its antecedents and outcomes have been studied since at least the mid-1970s (e.g., Barkin and Dickson, 1977). Much of the early research related to *system usage* was based on an explicit or implicit assumption that a decision to use IT for a specific purpose and the amount of usage were largely discretionary. This does not fit well for corporate transaction processing capabilities whose use is mandatory, for electrical or mechanical design systems that are integrated into product development and manufacturing systems, for infrastructural applications that enforce corporate standards and procedures, and for ISs that support, control, or automate production of product/services that need to be interoperable with complementary capabilities of internal and/or external customers.

Measuring system usage. Burton-Jones (2005) noted three broad measures of system usage in terms of information usage (extent of use, nature of use, frequency of use) and 11 broad measures of use of the IS, such as proportion of use, duration of use, frequency of use, decision to use, and so on. (p. 3). Research that applies the system usage construct typically pursues a variance approach in searching "for perspectives of system usage that will improve explanations of relationships between system usage and other phenomena, such as user performance." Burton-Jones and Straub (2006) builds on those ideas.

Usage as a multilevel phenomenon. Burton-Jones and Gallivan (2007) argue that individual and collective usage should not be viewed as totally separate. Accordingly, researchers need to understand relationships between individual and collective use. This includes the function of use, the structure of use (interdependencies-in-use and forms of collective use), and the context of use (user, task, system, and time).

Theory of effective use. Burton-Jones and Grange (2013, p. 633) define effective use as "using a system in a way that helps attain the goals of using the system." This theory's three dimensions are: 1) transparent interaction, "the extent to which a user is accessing the system's representations unimpeded by its surface and physical structures," 2) representational fidelity, "the extent to which a user is obtaining representations from the system that faithfully reflect the domain being represented," 3) informed action, "the extent to which a user acts upon the faithful representations he or she obtains from the system to improve his or her state" (p. 654). Those effectiveness dimensions fit best for accounting systems but are less helpful for other types of ISs. ISs based on machine learning may attain goals without providing transparent interaction, as noted in controversies about making AI explainable. Representational fidelity is less relevant for advertising systems that try to influence purchase decisions or even for some accounting systems that are designed to bias legally reported results in favor of owners or managers. Regarding informed action, some ERP systems come close to attaining "the goals of using the system" even though many users do not understand the system's full rationale or operation.

Agentic IS usage. Baird and Maruping (2021) propose a theoretical framework for delegation to and from IS *agentic IS artifacts,* defined as "rational software-based agents that have the ability to perceive and act, such as take on specific rights for task execution and responsibilities for preferred outcomes (Russell, 2019)." Delegation of rights and responsibilities to agentic IS artifacts is part of an increasingly complex IS landscape that is addressed here by using a systems perspective to define IS and analyze ISs.

A Systems Perspective

"A systems perspective focuses on wholes, parts, and emergent properties that arise from interactions among parts." (Burton-Jones et al. 2015, p. 668). Ackoff (1971, p. 662) says, "a system is an entity which is composed of at least two elements … each of a system's elements is connected to every other element, directly or indirectly. No subset of elements is unrelated to any other subset." A "fundamental limitation of any modeling of a system [is] that the system is always embedded in a larger system." (Churchman 1979, p. 76). Checkland (1999, p. 121) goes further by saying that systems thinking starts "with an observer/ describer of the world outside ourselves who … wishes to describe it 'holistically', … in terms of whole entities linked in hierarchies with other wholes." … At minimum, the observer's description will include: "his purpose, the system(s) selected, and various system properties such as boundaries, inputs and outputs, components, structure, the means by which the system retains its integrity, and the coherency principle which makes it defensible to describe a system as a system." Notice the vast gap between those statements about systems and Lee's (2010, p. 339) previously mentioned statement that "it is no exaggeration to describe most IS researchers as having used the term 'system' or 'systems' to refer to just about anything that involves electronic information processing."

Types of systems. The term system is used in many different ways for many different purposes. For example, many systems analysis and design (SA&D) textbooks imply or state that "the system" is a configuration of hardware and software that is used by users or that is a component of a larger configuration of hardware and software. In systems research broadly construed, "the term system is used to cover a wide range of phenomena, [such as] philosophical systems, number systems, communication systems, control systems, educational systems, and weapon systems. Some of these are conceptual constructs and others are physical entities. Even without further refinement of this definition it is clear that in systems research we are interested only in those systems which can display activity – that is behavioral systems. (Ackoff, 1969, p. 332). This paper pursues that spirit by emphasizing *work systems*, a term has been used for decades and traditionally has been applied to sociotechnical WSs under the assumption that WSs have human participants who perform work with the help of technologies. In contrast, the work system perspective used here covers both sociotechnical WSs and totally automated WSs that perform work autonomously.

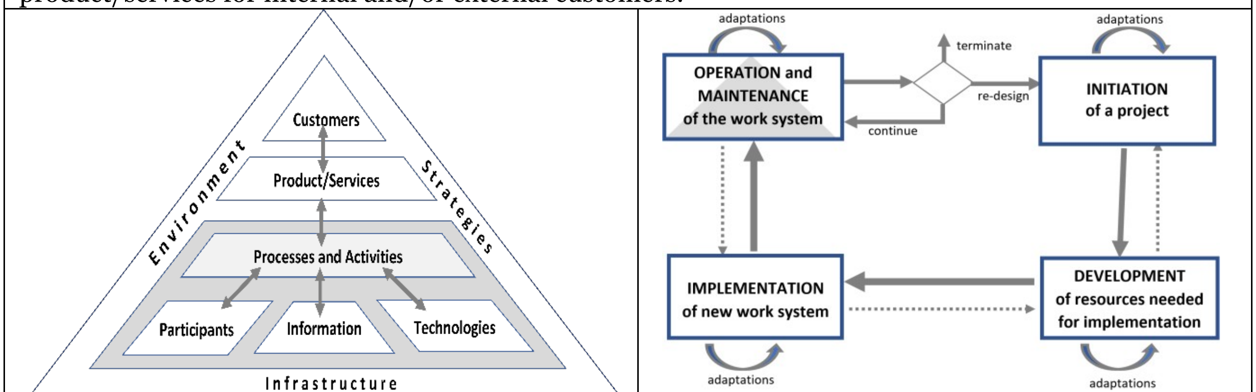
A Work System Perspective on IS Usage

A work system perspective on IS usage starts with the definition of WS from work system theory (WST) and the related definition of IS. WST assumes that enterprises try to achieve their goals through the operation and interactions of multiple WSs. A deep understanding of IS usage for a specific IS requires an understanding of the functions it performs for itself and for other WSs, its overlaps and interactions with other WSs (which may be ISs), and different facets of work that it may support, control, or perform. The definition of IS usage will be presented after those topics are discussed.

Work systems. In this context, work is defined as the application of human, informational, physical, and other resources to produce product/services for oneself or for an organization's internal or external customers. Figure 1 shows WST's three components (Alter, 2013), starting with the definition of WS. The work system framework identifies nine elements of a basic understanding of a WS's form, function, and environment during a period when it is stable enough to retain its identity even though incremental changes may occur, such as minor substitutions or technology upgrades. The core of the work system framework consists of *processes and activities*, *participants, information*, and *technologies* that are completely within the WS. *Customers* and *product/services* may be partially inside and partially outside because customers often participate in activities within a WS and because product/services take shape within a WS. *Environment, infrastructure*, and *strategies* are outside of the WS even though they have direct effects within a WS. The third component of WST is the work system life cycle model (WSLC), which summarizes how WSs evolve iteratively through a combination of planned change through projects with initiation, development, and implementation phases and unplanned change via adaptations and workarounds.

Sociotechnical WSs and automated WSs. The first *and/or* in the definition of WS in Figure 1 says that WSs can be sociotechnical WSs whose human participants perform some of the activities that produce product/services or totally automated WSs all of whose work is performed by machines. The term work system typically has been applied to sociotechnical WSs. Today and in the near-term future, inclusion of WSs that are totally automated systems is especially relevant as digitalization increasingly produces totally automated subsystems of sociotechnical WSs and totally automated systems that operate independently. Those discussed explicitly or implicitly in conjunction with automation of work, robotic process automation, service robots, smart service systems, artificial intelligence, and digital transformation.

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



Work System Framework | **Work System Life Cycle Model (WSLC)**

Figure 1. Three components of work system theory

IS as special cases of WS. An IS is a WS most of whose activities are devoted to capturing, storing, retrieving, deleting, transmitting, manipulating, and/or displaying information (Alter 2006; 2008). Saying *most* activities rather than *all* activities recognizes situations where ISs require physical work, e.g., carrying laptops or delivering paper printouts. This definition of IS was noted as a definition representing a process view of IS (rather than a technical, social, or sociotechnical view) in Boell and Cecez-Kecmanovic (2015), which found 34 definitions of IS. This definition also differs from defining an IS as a means of providing representations or as a tool that is "used," as noted earlier.

Sociotechnical ISs and totally automated ISs. An example of a sociotechnical IS is an accounting IS in which accountants decide how specific transactions and assets will be handled for tax purposes and then produce financial statements. This is an IS because its activities are devoted to processing information. It is a sociotechnical IS because people perform some of its activities. An integral part of this sociotechnical IS is a totally automated IS that performs calculations and generates reports. The sociotechnical accounting IS cannot be analyzed, designed, or improved thoughtfully without considering the functions performed by the totally automated IS. The totally automated accounting IS cannot be analyzed, designed, or improved thoughtfully without considering how it supports the sociotechnical IS.

More generally, totally automated ISs operate autonomously after being triggered by direct inputs from people, by direct inputs from other totally automated ISs, by schedules, or through other signals. For example, an IS that assigns resources to production jobs could be a totally automated IS that produces efficient assignments based on mathematical algorithms (or it could be a sociotechnical IS whose participants use algorithms to support negotiations about priorities and alternatives that might not be visible to the algorithms). Totally automated ISs currently are created and maintained by sociotechnical WSs that produce and maintain ISs. Those sociotechnical WSs are viewed as separate from the ISs because they do not perform any of the activities through which the ISs produce their product/services.

ISs and WSs that they support. Understanding an IS requires understanding its relationship to WSs that it supports and to the surrounding environment.

Some ISs are designed to provide useful information without being tied to specific WSs, e.g., an online search engine that identifies webpages related to queries often is not associated with specific WSs. Many other ISs support or serve as integral components of WSs that may or may not be ISs. For example, a package tracking IS is an essential component of a package delivery firm's WS of moving packages while also performing other important functions such as providing package status information to customers. In other cases, an IS uses or includes another IS. An example mentioned above is the sociotechnical accounting IS that uses a totally automated accounting IS that performs calculations and generates reports. For both examples, an IS that is an integral part of another WS cannot be understood, analyzed, designed, or improved thoughtfully without considering how it affects the WS being supported.

Different types of interaction between an IS and a WS. A complete understanding of IS usage requires attention to different types of system interactions between the IS and a WS that uses the IS. Those interactions may be intentional or unintentional; may be instantaneous or may occur over a noteworthy timespan; may be direct or indirect; may occur through physical contact, material transfers, formal or informal communication, induced effects, or through other means; may be one-way, bilateral, or multi-directional; may result from planned or unplanned activities and/or from expected, unexpected, or accidental situations or occurrences.

Different degrees of overlap between an IS and a WS. In many situations the relationship between an IS and a WS is described more realistically as an overlap rather than an interaction. Overlaps between ISs and WSs can take many forms that are introduced in Alter (2006). The following five cases are listed in order from low degree of overlap to high degree of overlap:

- **Non-overlap (including interaction through a boundary object)**. An example is a market analysis produced by a consulting firm and delivered as a computer file or paper document.
- **Overlap through a simple interface**. A self-service ATM user participates in a personal self-service system of withdrawing cash from an account by entering information into the ATM owner's system of operating ATMs.
- **Minimal overlap**. A user of a travel web site interacts with the web site as part of a temporary personal system for identifying suitable travel options. The web interface is the small visible part of a very large WS that compiles, offers, updates, and sells travel options.
- **Substantial overlap**. Electronic medical records systems are ISs that frequently overlap with a primary care physician's WSs of treating patients. That overlap is often so substantial that patients complain that physicians pay as much attention to data entry as to their patients.
- **Enclosure**. A factory uses a dispatching IS that helps in deciding which customer order to start next after completing a current customer order. That dispatching IS is an integral part of the factory's production system. The production system would operate differently if the dispatching system did not exist and the dispatching system is of no use outside of the context of the factory.

None of the types of interaction require a specific medium for user interactions, as when voice recognition capabilities allow users to interact with some ISs by typing or speaking. Likewise, interactions between totally automated ISs may occur via wired or wireless transmission of data.

Facets of work supported by ISs. The idea of facets of work grew out of research attempting to bring richer and more evocative concepts to systems analysis and design and to facilitate interactions between analysts and stakeholders. The notion of facet is an analogy to how a cut diamond consists of a single thing with many facets. Each of the 18 facets of work identified in Table 1 can be used for discussing and exploring unique aspects of activities that might occur in a WS.

• Making decisions	• Learning	• Performing physical work
• Communicating	• Planning	• Performing support work
• Providing information	• Controlling execution	• Interacting socially
• Representing reality	• Improvising	• Providing service
• Applying knowledge	• Coordinating	• Creating value
• Thinking	• Processing information	• Maintaining security

Table 1. 18 Facets of Work

The facets in Table 1 were identified through an iterative process described in Alter (2021). They were chosen because they are easily understood, widely applicable, and associated with concepts and knowledge related to business situations. All 18 facets satisfy the following criteria related to usefulness in relation to a wide range of systems in organizations: They apply to both sociotechnical systems and totally automated systems; they are associated with many concepts that are useful for analyzing system-related situations; they are associated with evaluation criteria and typical design trade-offs; they have sub-facets that can be discussed; they bring open-ended questions that are useful for starting conversations. Other researchers might have identified 15 or 23 facets of work that satisfy those criteria. Many of the facets are not independent, e.g., making decisions often involves thinking, communicating, and processing information. The main point is that each facet brings a set of ideas that potentially serves as a lens for visualizing and analyzing important aspects of WSs that an IS might or might not support.

Table 2 summarizes the terms used thus far in the discussion of the work system perspective.

Concept	Definition within the work system perspective
Work	The application of human, informational, physical, and other resources to produce product/services for oneself or for a firm's internal or external customers. Work can occur in homes, businesses, governments, and other settings.
Work system	A system in which human participants *and/or* machines perform work (processes and activities) using information, technology, and other resources to produce specific product/services for internal and/or external customers (or for themselves).
Information system	An IS is a WS most of whose activities are devoted to capturing, storing, retrieving, deleting, transmitting, manipulating, and/or displaying information. An IS can be a sociotechnical WS or a totally automated WS.
Sociotechnical work system	A WS in which people perform at least some of the activities that produce product/services. Many ISs are sociotechnical WSs.
Totally automated WS	A WS in which all of the activities that produce product/services are performed by computers or other machines. Many ISs are totally automated WSs.
Work system framework	Diagram (see Figure 1) identifying nine elements of a basic understanding of a WS's form, function, and environment during a period when it is stable enough to retain its identity even though incremental changes may occur, such as minor substitutions or technology upgrades. The nine elements are defined in Alter (2013, pp. 80-81)
Work system life cycle model (WSLC)	Diagram (see Figure 1) summarizing the iterative process by which work systems evolve over time through a combination of planned change (projects) and emergent (unplanned) change that occurs through bricolage, adaptations, and workarounds.
Work system theory (WST)	The core of the work system perspective for visualizing, understanding, and analyzing work systems. Figure 1 shows that WST consists of the definition of WS, the work system framework, and the WSLC.
Interactions and overlaps of WSs	Various ways in which WSs (which may be ISs) interact and/or overlap: an important part of an understanding of any IS or WS.
Facets of work	Aspects of work such as making decisions, communicating, providing information, etc. Functions performed by an IS for a WS always involve at least one facet of work.
Work system method (WSM)	A systems analysis and design method developed for business professionals who need to understand WSs, especially to collaborate with IT professionals.
Work system perspective (WSP)	In a general sense, viewing situations as though they are fundamentally about work systems. In a more specialized sense, an extensive set of ideas for viewing situations as though they are work systems. Those ideas include WST, WSM, and various extensions of WST.

Table 2. Terms Used in Describing a Work System Perspective on IS Usage

Definition of IS Usage

This paper's reconceptualization of *system usage* is a definition of *IS usage* that is designed to help business and IT professionals describe, analyze, design, and evaluate ISs by helping them think about where, how, for what purposes, and with what outcomes usage has occurred or may occur. The new definition emerges from ideas introduced above such as the definitions of WS and IS, the fact that usage may refer to sociotechnical and/or automated WSs or ISs, different degrees of overlap between ISs and WSs, and facets of work. A parsimonious definition like the "user-system-task" definition from Burton-Jones and Straub

(2006, p. 231) would not be as helpful in visualizing the range of possibilities for *IS usage*. The proposed definition recognizes that IS usage may involve multiple human participants and/or automated entities. It treats ISs as WSs that might do much more than producing representations and it assumes that relevant tasks might be sociotechnical or totally automated.

Definition of IS usage. IS usage is the use of an IS's product/services by activities in a WS or by activities delegated by that WS, plus intended direct and indirect effects on those activities. An IS's product/services may include providing information, providing capabilities, or performing activities to achieve individual, group, organizational, ecosystem, or societal goals by supporting, controlling, or performing one or more facets of work in activities that use the IS's product/services. Unpacking that elaborate definition points to many IS usage topics and issues that are relevant for describing, analyzing, designing, or evaluating an IS:

- *An IS as a system that performs activities*. An IS is a type of WS, and it may be a sociotechnical IS or a totally automated IS. Its usage differs from usage of things that are not viewed as performing activities, such as a paper book, a PDF, an algorithm, or a design principle.
- *Application by individuals, groups, organizations, ecosystems, or society*. An HCI-oriented view of an IS user as an individual using an IS through a computerized interface does not consider many forms of IS usage by groups, organizations, ecosystems, or society, such as using an IS to enforce regulations, to control the flow of traffic, to maintain coordination within an industry ecosystem, to manage learning by robotic devices, or to collect and maintain information about security threats.
- *Operational and/or managerial application*. Direct operational and/or managerial applications typically involve direct interaction with information, technologies and/or activities within the IS in order to fulfill (or evade, in some instances) responsibilities. Indirect applications occur through direct use by others, e.g., management use of ISs expressed by quotations in an article about ERP: One executive said, "We plan to use SAP as a battering ram to make our culture less autonomous." Another said, "We've had a renegade culture in the past, but our new system's going to make everybody fall into line."(Davenport, 1998, p. 127).
- *Differences between application of information, of activities that an IS performs, and of capabilities that an IS provides*. An application of information produced by an IS is the use of Census data by marketing analysts. An application of activities that an IS performs is data analysis tasks outsourced to a data analysis firm's sociotechnical IS for analyzing client data. An application of capabilities that an IS provides is the use of a software vendor's cloud-based analysis tools.
- *Individual, group, organizational, ecosystem, or societal goals*. IS usage may involve goals at any of those levels, not just the individual level. Goals at those different levels may conflict, as when individuals or groups use an IS to pursue their own interests through workarounds that might involve bypassing established processes or purposefully entering misleading data.
- *Supporting, controlling, or performing*. An IS that provides information for physicians supports a medical WS. The two quotations about using enterprise systems (above) involve using an IS to *control* work. A totally automated IS that *performs* work is a traffic control system that switches traffic signals between green or red based on local traffic conditions across a road network. A sociotechnical accounting IS *performs* activities related to producing financial statements. An automated accounting IS *performs* computerized processing of information to support that effort.
- *One or more facets of work*. A detailed understanding of an application of IS should recognize which facets of work the IS supports, controls, or performs, e.g., how does the IS contribute to decision making? communication? coordination? value creation? and so on.
- *Usually in the context of a work system*. Most applications of ISs in business and society occur in the context of people and/or machines performing activities within a WS (which may be an IS).
- *Omissions*. The definition of IS usage focuses on topics and issues related to instances of IS usage. It says nothing about whether an instance of IS usage is successful or unsuccessful, efficient or inefficient, conforming or conflicting with established practices, or ethical or unethical.

IS Usage for an ERP System and Mission-Critical Workarounds that Address its Shortcomings

This example illustrates how this paper's approach to *IS usage* leads to important insights, especially when compared to typical views of *system usage* as a dependent variable in a model. As discussed in Davison et al. (2021), this example involves Hong Kong operations of Scatex (a pseudonym), a multinational firm in the retail industry. Prior to 2010, each of Scatex's operating sites was free to implement and operate its main ISs on a local basis. As part of a corporate standardization effort, Scatex's global headquarters decided to implement Microsoft Navision, an ERP system, in all operating locations. The global roll-out to over 400 stores in over 50 countries occurred over multiple years. As one of the last locations, Scatex's Hong Kong implementation finally went live in November 2016, with five Navision installations in Hong Kong: one in each of the four retail stores and one more in a consolidated warehouse/distribution center that services the four stores. Scatex's global ERP project team opted for a pure vanilla implementation in which warehouse replenishment orders could only be placed by using Navision. Unfortunately, the detailed logic built into Navision conflicted with the logic of performing warehouse-based work routines in Hong Kong. Navision was able to support work that was directly connected to global headquarters (e.g., replenishment, order management, finance, accounting), but did not fit with critical local processes such as stock picking, warehouse operations, and customer delivery.

In most Scatex retail locations, a purchased item that needs to be delivered to a customer is removed from the storage facility or warehouse near the store and electronically tagged for delivery. This is called 'instant picking' because the item is instantly picked from the warehouse shelf and put aside ready for delivery. That process logic works well in most Scatex stores but is impossible in Hong Kong because its four urban stores do not have their own individual warehouses. Instead, a single consolidated warehouse in a rural location services all four stores. Storage space in the warehouse is inadequate for setting aside instantly-picked items in the warehouse. Also, the delivery teams are outsourced contractors whose schedules do not allow for immediate pick-up and delivery. A store that sells an item can update its local Navision database to reflect the sale, but the warehouse's Navision database is not updated until the item leaves the warehouse for delivery to the customer, sometimes a week later. This delay creates discrepancies between inventory levels across different databases. For example, the sale of 50 units of item X in one store and 70 units of X in another store might seem feasible to each store at a time when the warehouse has 100 items, but problems would ensue when picking and shipment of either order leaves insufficient inventory for the other order. That is just one of a number of conflicts between Navison's capabilities and local realities in Hong Kong.

The warehouse staff in Hong Kong responded to these problems by developing an elaborate set of workarounds that were updated when needed. They used Microsoft Excel for data entry, data storage, scheduling, and reporting. They used WhatsApp as a communication and coordination channel to support a variety of activities across the warehouse. Many of the warehouse employees said that their ability to meet their job responsibilities relied heavily on those workarounds. The warehouse manager was careful to document workarounds to make sure that they were understood and applied properly.

Table 3 uses an extended version of the format of a work system snapshot (a central tool in the work system method) to summarize the situation. Each section of Table 3 underlines items (people, activities, artifacts) directly involved in the workarounds. Activities and artifacts that are not underlined are handled by using Navison software or consistent with the logic in Navison. Table 3 can be most read easily by starting at the lower left, looking at WS participants, then looking at the processes and activities, then at the product/services, and filling out the story with customers and information and technology that were used.

IS usage in this case. If research about this case tried to determine whether Navison was used, the answer would be yes. In fact, it was used in important ways to send orders to Scatex headquarters and to provide operational results that headquarters needed. Navison was successful in that way but was a complete failure with regard to information and processing logic needed to perform local operations. That failure forced Hong Kong employees to produce workarounds that may or may not have caused other problems.

The main point for our purposes is that understanding IS usage in specific situations requires understanding the way the IS supports, controls, or performs activities in a WS. Research results related to correlations between variables covered by the most prominent streams of IS research would have been borne out by many different individual stories in the case, but would not have provided genuine insights (e.g., Navison supported tasks related to interactions with headquarters but many users were highly dissatisfied with its failure to address other needs). WS participants in this situation did not need system usage research results to help them decide what to do. The key challenge was to figure out how to develop workarounds that allowed them to succeed in fulfilling their responsibilities with reasonable efficiency, in satisfying the needs of their customers, and in satisfying important corporate information needs.

<table>
<tr><th colspan="3">CUSTOMERS</th><th colspan="3">PRODUCT/SERVICES</th></tr>
<tr><td colspan="3">• End customers who buy Scatex's products
• Headquarters operations
• Headquarters marketing
• Headquarters finance
• Local management in Hong Kong
• Outsourced delivery contractors</td><td colspan="3">• Sale of items to customers
• List of customer order details for delivery
• Delivery of items to customers
• Inventory replenishment orders
• Forecasting reports for local management
• Sales and accounting data for local management
• Sales and accounting data for headquarters</td></tr>
<tr><th colspan="6">MAJOR WORK PROCESSES AND ACTIVITIES</th></tr>
<tr><th colspan="6">Production Processes</th></tr>
<tr><td colspan="3">• Inventory control staff determine replenishment requirements and submit orders to headquarters using Navision
• Warehouse staff receive and store replenishment orders to inventory using Navision
• Customers purchase Scatex's products at stores; Navision is used to record purchase transactions
• Sales staff create customer orders using Navision
• Inventory control staff extract data from Navision, then manipulate it with Excel in order to pick and pack customer orders before delivery. (standard process: extract data from Navision to pick and pack customer orders)
• Customer delivery staff extract data from Navision, manipulate it with an Excel plan for delivery capacity and create a delivery list for the outsourced delivery contractors. They also manage the rescheduling of delayed deliveries. (standard process: deliver customer orders)</td><td colspan="3">• Outsourced delivery contractors deliver orders (standard process: does not exist)
• Customers receive purchased products
• Product returns staff process returned goods with Navision
• Forecasting staff estimate future product demands with Navision
• Local management staff extract data from Navision, and manipulate it with Excel to generate customised business analysis and forecasting reports (standard process: view/generate regular business analysis reports with Navision)</td></tr>
<tr><th colspan="6">Activities Related to Coordination of Workarounds</th></tr>
<tr><td colspan="3">• All staff, particularly team leaders, functional managers, and supervisors meet to design, coordinate and confirm workaround arrangements that apply to many processes in the HK warehouse.</td><td colspan="3">• All staff coordinate/share information across the stores and the warehouse using phone, email, WhatsApp, USB drives and Share Drives</td></tr>
<tr><th colspan="2">PARTICIPANTS</th><th colspan="2">INFORMATION</th><th colspan="2">TECHNOLOGIES</th></tr>
<tr><td colspan="2">• Inventory control staff
• Local management staff
• Warehouse staff
• Sales staff (in stores)
• Customer delivery team
• Outsourced delivery contractors
• Product returns staff
• Forecasting staff
• HK managers</td><td>• Inventory levels
• Replenishment orders
• Receipt documentation for replenishment orders
• Customer orders</td><td>• Delivery schedules
• Customer orders (both inside and outside Navision)
• Deliveries
• Product returns
• Estimate of future demand by product</td><td colspan="2">• Navision
• MS Excel
• Phone
• Email
• WhatsApp
• USB Drives
• Share Drives</td></tr>
</table>

Table 3. Expanded Work System Snapshot* of Mission-Critical Activities in the Hong Kong Warehouse. (Davison et al., 2021, p. 5)

* Items underlined in each section of the expanded work system snapshot are involved in workarounds.)

IS Usage for an Electronic Medical Records System

An EMR example illustrates other aspects of the reconceptualization of IS usage. The example is a case study called "The Update: Why Doctors Hate Their Computers" (Gawande, 2018). Its author, a surgeon, describes experience related to the $1.6 billion implementation of the EPIC electronic medical records (EMR) system in Partners HealthCare, which has 70,000 employees, 12 hospitals, and hundreds of clinics in the northeastern USA. Under $100 million was for software. Most of the rest was for "lost patient revenues and all the tech-support personnel and other people needed during the implementation phase." Gawande's account does not support aspirational views of EMR as providing the best possible patient information, eliminating vulnerabilities of paper, facilitating communication, assuring consistency, and improving evaluation of medical treatments. EPIC was implemented and became an integral part of the organization's medical practices, which might seem like success. Nonetheless, the author said, "something's gone terribly wrong. Doctors are among the most technology avid people in society; computerization simplify tasks in many industries. Yet somehow we've reached a point where people in the medical profession actively, viscerally, volubly hate their computers."(p. 62). The definition of IS usage leads to wondering whether those feelings are about computers or about activities that use computers.

The chief clinical officer who supervised the upgrade saw important benefits in standardization and in benefits for patients. In contrast, the author says, "I've come to feel that a system that promised to increase my mastery over my work has, instead, increased my work's mastery over me. I am not the only one. A 2016 study found that physicians spent about two hours doing computer work for every hour spent face-to-face with the patient - whatever the brand of medical software. ... [A study] found the average workday for family physicians had grown to 11 ½ hours. The result has been epidemic levels of burnout among clinicians." The author mentioned "signal fatigue" and said that "just ordering medications and lab tests triggers dozens of alerts each day, most of them irrelevant, and all in need of human reviewing and sorting." A primary care physician described erasing EMR-generated alerts and emails that had become overwhelming. Those included automated email reminders that previous emails had not been answered. Contrary to expectations about better communication, the author "began to see the insidious ways that the software changed how people work together. They become more disconnected, less likely to see and help one another, and often less able to [help]." Access rights to patient information were denied to a medical support worker who formerly organized that information to help physicians work more efficiently. A surprising adaptation for some physicians was a new work role, a "scribe" who attended patient visits and entered data to offload that burden from the physician. Other physicians used "virtual scribes," licensed physicians residing in India who earned their living by entering data for physicians in the USA instead of caring for patients in India. Many related issues reappeared in "Death by a Thousand Clicks" (Fry and Schulte 2019).

The IS and the WS. The identity of "the system" in this situation not obvious. The above summary mentions at least three WSs directly or indirectly. Other WSs that link to those WSs were barely mentioned. For simplicity, the three WSs will be named MED, EMR, and INT. MED is a complex WS in which physicians, nurses, and other medical staff provide medical care. EMR is the Electronic Medical Records system. It is an IS that captures, transmits, stores, retrieves, deletes, manipulates, and displays patient medical information and other medical information from other sources. Figure 2 represents INT as a WS that provides a two-way interface between MED and EMR that overlaps with both MED and EMR. An IT-centric view might treat INT as part of EMR, but that would ignore how physician time and attention to INT are intertwined with performing participant roles in MED.

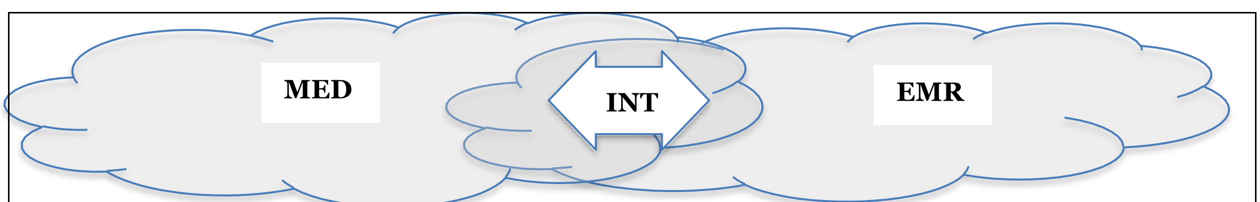


Figure 2. Three Work Systems in the Electronic Medical Records Case

INT is a sociotechnical IS because its participants (physicians and nurses) perform activities such as verifying patient identity, accessing medical history data, entering patient data, ordering lab tests, entering drug prescriptions, entering referrals to specialists, and making follow-up appointments.

The details of INT and EMR have major impacts on MED because those details constrain how MED operates and creates demands on the time and attention of MED's participants. Some of those details were designed to monitor, control, and standardize aspects of the work that occurs in MED, both to facilitate billing and to help in identifying deviations from prescribed best practices. In summary, MED, INT, and EMR are all relevant to the situation described in the case study. For some purposes, seeing MED as "the system" could make sense. For other purposes seeing either EMR or EMR + INT as "the system" might make sense. A different view of "the system" might be better for other purposes. The overall conclusion is that EMR and INT qualify as ISs because both are devoted to processing information while MED is a highly information-intensive WS that is not an IS because it also performs many other types of activities.

IS usage in this situation. The definition of IS usage can be applied to this case in many ways because the case involves operational and managerial applications of an IS that is applied by individuals, groups, organizations, and a medical ecosystem with effects on society. Since the previous example did not touch on facets of work, Table 4 shows instances of how all 18 facets of work are supported, controlled, or performed by the EMR, sometimes successfully and sometimes unsuccessfully. The breadth of that coverage illustrates how much could be missed easily in research on system usage that ignores how ISs affect various facets of work in WSs such as MED.

Facet	Example of how EMR supported, controlled or performed a facet of work
Making decisions	The author noted a situation in which EMR did not highlight a highly relevant history of skin lesions and thus did not provide possible guidance in analyzing a patient's medical condition.
Communicating	A physician's EMR inbox was perpetually clogged with lab and radiology results, messages from colleagues, and even messages about not responding to previous messages.
Providing information	The author could quickly learn about the vital signs of patients recovering from surgery and could quickly obtain previous results from other institutions that use the same software.
Representing reality	A physician was pleased by the way that EMR represented the status of individuals within a large number of addicted patients. This helped in identifying which patients needed help.
Applying knowledge	EMR allowed the shortcut of pasting blocks of information such as lengthy imaging reports. The sheer bulk of that information made it more difficult to find relevant information.
Thinking	A multitude of alerts about possible connections between medications, lab tests, and other conditions were often irrelevant. Signal fatigue became a problem for some physicians.
Learning	Learning about the EMR proved to be a daunting task for most physicians because of the very large number of screens, fields, options, and connections.
Planning	Typing a treatment plan for patient with a complex condition was frustrating because it created even longer delays for other patients.
Controlling execution	The chief clinical officer who supervised the software upgrade said that change control processes and execution controls would help the hospital avoid nonstandard treatments.
Coordinating	Shared problem lists for individual patients were intended to help clinicians. Anyone could modify problem lists. Careless or hurried changes made the problem lists less and less useful.
Improvising	The author believed that "artisanship has been throttled, and so has our professional capacity to identify and solve problems through ground-level experimentation."
Processing information	A physician was frustrated by the number of clicks needed to enter a diagnosis or order a test. Why was it necessary to enter the current date if the computer already knew the current date?
Performing physical work	The author was a surgeon whose surgical work benefited from EMR information about his patients and allowed him to avoid many negative aspects of the EMR felt by other physicians.
Performing support work	Lack of access privileges to patient records prevented an office assistant from aiding physicians by drafting letters, doing scheduling, and prepping routine prescriptions.
Interacting socially	The author believed that using the EMR changed how people work together and made them less connected and less likely to see and help one another.
Providing service	The case cited a 2016 study saying that physicians in examination rooms devoted half of their patient time to facing the screen to do electronic tasks (i.e., less attention to the patients).
Creating value	The chief clinical officer noted new value for patients as the EMR allowed them to see their lab results, to see their medications prescriptions, and to read their physician's notes.
Maintaining security	Restricting support staff access to patient information maintained security but prevented the support staff from unloading many patient-related routine tasks from overworked physicians.

Table 4. Examples of impacts of INT and EMR on facets of work in the EMR case study

Discussion and Conclusions

This paper provides a rich and broadly applicable approach for describing and analyzing IS usage, which is one of the IS discipline's most fundamental ideas. Its systems perspective on IS usage leads to topics and issues that are downplayed or ignored by much of the existing research associated with system usage.

Viewing ISs as WSs in their own right, not just as tools used by users for performing tasks, leads to visualizing how ISs may support, control, or perform WS activities in a WS.

The ERP and EMR cases were selected to illustrate how the proposed definition of IS usage points to many important topics that would be missed in tool-oriented definitions in most research related to IT adoption, acceptance, and success. The ERP and EMR cases exemplify the multifaceted nature and complexity of IS usage in important situations that are genuinely challenging for both practitioners and researchers, i.e., situations where a mandatory IS does not fit or where an IS causes many problems for users even if it accomplishes some management goals. Focusing primarily on variables related to IT quality, adoption, or acceptance in those cases would not come close to telling those stories or making sense of what happened, especially where ISs succeed in some ways and fail in others and where ISs interact or even overlap with other WSs. Seeing ERP and EMR as sociotechnical ISs leads to understandings that are richer and more valuable than limited descriptions and evaluations based on seeing ERP and EMR as tools. More generally, important operational and management challenges in those situations cannot be described by reducing complex real world situations to variables that are proxies for adoption, acceptance, usage, and impact.

The existing legacy of system usage research is far from useless, however. Careful specification of variables and models has tested and clarified many concepts and factors that can be used in designing and monitoring ISs and in future research. For example, Blut et al. (2022) uses a meta-analysis of past research to "develop a clear current state-of-the-art and revised UTAUT that extends the original theory with new endogenous mechanisms" (p. 1) and to propose a research agenda. Key ideas from past research include the importance of expectations and perceived ease-of-use, the distinction between usage and effective usage, ideas related to affordances, issues about whether ISs produce adequate representations, and so on. Some of the research in the tradition of TAM and UTAUT is especially relevant to voluntary uses of ISs in situations that do not require careful coordination and where role responsibilities do not require mandatory IS use in routinized work practices. Typical examples include personal uses of websites and uses of videoconferencing to communicate with family members. TAM, UTAUT, and the IS success model and their extensions probably fit better for that type of IS usage than for IS usage in complex business situations such as the two examples presented here. Those approaches also fit well if the goal is to maximize attention to websites or online ads.

This paper's use of a systems perspective to reconceptualize IS usage conveys an approach that is more directly related to the DIGIT 2021 CFP's focus on building resilience with IT in a time of disruptions. The ERP and EMR case studies are examples of situations where building resilience requires a systems perspective that pays attention to ISs and WSs, not just to IT-based tools. This paper's definition of IS usage is appropriate for discussions about IS/IT-related resilience because the behavior of an IS affects the form, content, quality, and outcomes of its usage. The complexity of the definition of IS usage results from focusing attention on important topics that a resilience discussion should include:

- Exactly what IS (a type of WS) is being used and what WS is being supported?
- Is the IS sociotechnical or totally automated?
- What are the operational and/or managerial uses of the IS by individuals, groups, organizations, ecosystems, or society?
- How does IS usage in specific cases involve application of information that it provides, activities that it performs, and capabilities that it provides?
- What individual, group, organizational, ecosystem, and societal goals are being pursued?
- In what ways does the IS support, control, or perform activities in a target WS?
- Which important facets of work in the target WS are affected by current IS usage and how might an improved form of usage generate better results related to those facets and other facets of work?

Follow-on research using a systems perspective on IS usage could apply this paper's ideas many ways.

Systems analysis and design. SA&D research could observe the extent of use or disuse of something like a systems perspective on IS usage in determining and validating requirements in real world SA&D. Analysts, designers, and stakeholders using that perspective might look more deeply at what stakeholders want and at how an IS might address those wants and needs. This could occur through relatively simple discussion points such as identifying different goals of different types of IS users, identifying different forms of usage ranging from providing information to supporting, controlling, or performing activities, and explaining how usage of a proposed IS or an IS improvement would affect specific facets of work that are important in the situation. Observers of an SA&D effort might look at the extent to which various facets of work actually were discussed and whether there was real agreement about impacts of changes in IS usage.

Action research and case studies. Both the systems perspective and the definition of IS usage could guide aspects of action research and case studies. Researchers could use WS ideas to describe an IS and the WS that it supports. Depending on the nature of the interaction between the focal IS and the focal WS, even the interface might be described as a WS (as in the EMR case). Topics mentioned in the definition of IS usage could be applied as an outline for creating an application-oriented description of how the IS operates and how and where IS usage has impacts. That description would support the analysis of how well the IS operates, whether it generates the expected benefits for its beneficiaries, and how it might be improved.

Theory development. Examination of case studies of IS usage might lead to improved characterizations of IS usage, perhaps separating that idea into several important types of usage that differ in fundamental ways. Different types of system interactions and system overlaps could be an especially interesting area to explore. That research could reveal shortcomings of the current ideas, which in turn could lead to a better conceptualization of WS interactions and overlaps. The same approach could be used to improve the current conceptualization of facets of work. For example, that idea might be extended through a new synthesis with affordance networks and affordance actualization (e.g., see Burton-Jones and Volkoff, 2017)

IS user satisfaction. A paper presented at DIGIT 2019 extended past research on IS user satisfaction by proposing that "the primary driver of user satisfaction for an IS that supports a WS is the degree to which the IS contributes to an individual user's efficiency in executing responsibilities within the WS and effectiveness in serving the WS's customers." (Laumer et al., 2019, p. 13). The new definition of IS usage could be applied to the five case studies analyzed in that article to see whether the new ideas provide additional insight about the nature of IS user satisfaction in those situations.

Analyzing and designing hedonic IT applications. Communicating with family and friends, playing IT-based games, and enjoying entertainment through the internet are hedonic IT applications. These are quite distant from ERP, EMR, and other "Big System" applications that need careful attention to both ISs and WSs that they support. Nonetheless, this paper's ideas about IS usage might provide interesting insights by imagining that the user's activities are part of a temporary work system that might have a variety of strengths and weakness and might be improved in a variety of ways in relation to interests of the users, interests of the application providers, affordances and limits of technical infrastructure, and societal concerns.

Applying the metaphor of service. A speculative path forward tries to build on the metaphor of service, which provides a concise way to encapsulate the assumption that important ISs are a type of WS that usually exists to support, control, or perform activities in other WSs. By that metaphor, ISs exist to serve the needs of other WSs or needs of isolated individuals or groups. From a service perspective, the IS could be treated somewhat like as a provider and user WSs could be treated somewhat as customers (even though the provider IS and customer WS might overlap, as happened with the EMR and MED systems in the second example). It might be possible to develop a service-oriented framework for describing ISs, where "services are activities or groups of activities performed to produce or facilitate benefits for others." (Alter, 2017). The following premises might lead toward that kind of framework for IS usage:

- IS users (customers) are WSs some of whose participants may interact directly with the IS.
- Activities in ISs support, control, or perform WS activities to produce outcomes or conditions for the benefit of WS customer/users that may be sociotechnical WSs or totally automated WSs.
- Alternative patterns of interaction between provider and customer systems include: none (unexpected interaction), subscription (interaction via boundary objects), customer request, scripted transaction, customer-driven dialogue, and collaboration (where either the provider IS or customer WS can initiate interactions based on its own state or the state of its counterpart).
- ISs and their customer/user WSs might have varying degrees of mutual visibility concerning services performed by ISs and the details of how customer/user WSs apply those services.

This type of service perspective on IS usage is little more than a speculative possibility at this point. It is presented in this conclusion as an indication that a systems perspective on IS usage potentially might lead to new conceptualizations and new understandings of IS usage.

References

Ackoff, R.L. 1969. “Systems, Organizations, and Interdisciplinary Research, pp. 330-347, In: F. E. Emery (ed.) *Systems Thinking*, Penguin, Baltimore, USA.

Ackoff, R.L. 1971. Towards a system of systems concepts. *Management Science*, (*17*:11), pp.661-671.

Alter, S. 2006. *The Work System Method: Connecting People, Processes, and IT for Business Results*. Work System Press, Larkspur, USA.

Alter, S., 2008. “Defining information systems as work systems: implications for the IS field,” *European Journal of Information Systems*, (17:5) pp. 448-469.

Alter, S. 2013. “Work System Theory: Overview of Core Concepts, Extensions, and Challenges for the Future.” *Journal of the Association for Information Systems*. (14:2) pp. 72–121.

Alter, S., 2017. "Answering key questions for service science." *European Conference on Information Systems*.

Alter, S. , 2021. “Facets of Work: Enriching the Description, Analysis, Design, and Evaluation of Systems in Organizations. Communications of the Association for Information Systems, (49:11), pp. 321-354.

Barkin, S. R., G. W. Dickson. 1977. An investigation of information system utilization. *Information & Management*, (1:1), pp.35-45.

Baird, A. and Maruping, L.M., 2021. “The Next Generation of Research on IS Use: A Theoretical Framework of Delegation to and from Agentic IS Artifacts.” *MIS Quarterly*, *45*(1), pp. 315-341.

Blut, M., Yee Loong Chong, A, ; Tsigna, Z., and Venkatesh, V., 2022. "Meta-Analysis of the Unified Theory of Acceptance and Use of Technology (UTAUT): Challenging its Validity and Charting a Research Agenda in the Red Ocean" (2022). JAIS Preprints (Forthcoming).

Boell, S.K. and Cecez-Kecmanovic, D., 2015, “What is an information system?” In *2015 48th Hawaii International Conference on System Sciences* (pp. 4959-4968). IEEE.

Burton-Jones, A. 2005. *New perspectives on the system usage construct*. PhD thesis, Georgia State University.

Burton-Jones, A., and Gallivan, M. J. 2007. “Toward a Deeper Understanding of System Usage in Organizations: A Multilevel Perspective,” *MIS Quarterly* (31:4), pp. 657-679.

Burton-Jones, A., and Grange, C., 2013. “From use to effective use: A representation theory perspective.” *Information systems research*, (*24*:3), pp.632-658.

Burton-Jones, A., McLean, E. R. and Monod, E. 2015 "Theoretical perspectives in IS research: from variance and process to conceptual latitude and conceptual fit." *European Journal on Information Systems,* (24: 6) pp. 664-679.

Burton-Jones, A., Stein, M., and Mishra, A., 2017. “IS Use,” in *MIS Quarterly Research Curations*, A. Bush and A. Rai, Eds., http://misq.org/research-curations, December 1, 2017; updated March 2020.

Burton-Jones, A. and Straub, D.W., 2006. “Reconceptualizing system usage: An approach and empirical test.” *Information Systems Research*, (*17*:3), pp.228-246.

Burton-Jones, A. and Volkoff, O., 2017. “How can we develop contextualized theories of effective use? A demonstration in the context of community-care electronic health records.” *Information Systems Research*, (*28*:3), pp.468-489.

Checkland, P. 1999. *Systems thinking, systems practice*, Wiley, Chichester.

Churchman, W. 1979. *The Design of Inquiring Systems: Basic concepts of Systems and Organizations*, Basic Books, New York, NY.

Davenport, T.H., 1998. “Putting the enterprise into the enterprise system.” *Harvard Business Review*, (*76*:4) pp. 121-131.

Davis, F.D., 1989. “Perceived usefulness, perceived ease of use, and user acceptance of information technology.” *MIS Quarterly* (13:3), pp 319-340.

Davison, R.M., Ou, C.X., Wong, L.H. and Alter, S., 2021. “The coordination of workarounds: Insights from responses to misfits between local realities and a mandated global enterprise system,” *Information & Management*, 58, pp. 1-11.

DeLone, W.H. and McLean, E.R., 1992. “Information systems success: The quest for the dependent variable,” *Information Systems Research*, (*3*:1), pp.60-95.

Demetis, D.S., and Lee, A. S. "Taking the first step with systems theorizing in information systems: A response." *Information and Organization,* (27:3), pp. 163-170.

Fry, E. and Schulte, F. 2019. “Death by a Thousand Clicks: Where Electronic Health Records Went Wrong,” Fortune, March 18, 2019. http://fortune.com/longform/medical-records/

Gawande, A. 2018. "Why Doctors Hate Their Computers," *New Yorker*, Nov.12, 2018.
Goodhue, D.L., and Thompson, R.L., 1995. "Task-technology fit and individual performance." *MIS Quarterly*, (19:2), pp.213-236.
Laumer, S., Alter, S., and Maier, C., 2019. "A Systems Perspective on IS User Satisfaction in Digitalized Enterprises: Conclusions from Five Case Studies". *DIGIT 2019 Proceedings*.
Lee, A. S. 2010. "Retrospect and prospect: information systems research in the last and next 25 years," *Journal of Information Technology*, (25) pp. 336-348.
Russell, S. 2019. *Human Compatible: Artificial Intelligence and the Problem of Control*, New York: Viking Press.
Straub, D.W., Limayem, M. and Karahanna, E. 1995. "Measuring System Usage: Implications for IS Theory Testing." *Management Science*, (41:8), pp. 1328-1342.
Venkatesh, V., Morris, M.G., Davis, G.B. and Davis, F.D., 2003. "User acceptance of information technology: Toward a unified view." *MIS Quarterly*, (27:3), pp.425-478.