A SYSTEMS THEORY OF IT INNOVATION, ADOPTION, AND ADAPTATION

Research paper

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Abstract

This conceptual contribution presents a new systems theory of IT innovation, adoption, and adaptation that suggests a direction for moving beyond IT adoption research in the style of TAM and UTAUT. Its literature review covers three topics: 1) the contexts of adoption research to date in IS, 2) background about systems theories, and 3) a brief summary of work system theory, which is the basis of this paper's proposed systems theory. The subsequent section presents a new systems theory of IT innovation, adoption, and adaptation. Individually and in combination, that theory's six parts can contribute to research and practice related to the adoption and adaptation of IT innovations.

Keywords: Systems theory, Work system, IT adoption, IT adaptation, post-adoption behavior, compliance, noncompliance, adaptation, workaround

1 Moving beyond antecedents and correlates of adoption, satisfaction, and continued usage

Many researchers have questioned prominent approaches to technology acceptance and adoption. The CFP for DIGIT 2015 invited "papers to reflect on and move forward from the dominant stream of research work on technology acceptance" exemplified by "seminal adoption papers such as "Davis (1989), Davis, Bagozzi, Warshaw (1989) and Venkatesh at al., (2003), which collectively have garnered more than 25,000 citations according to Google Scholar. These influential theoretical models have been extensively applied, modified and discussed regarding antecedents, contingency variables and construct refinements." A 2017 CFP for IFIP W.G. 8.6 requested papers proposing new directions because "the Working Group's original focus, on technology diffusion and adoption, has been overtaken by myriad technical developments." … "The cycle of innovation has sped up, with profound impacts on the way organizations and societies engage with transfer and diffusion of IT systems within and between organizations, in interactions with customers, and throughout society in general."

Leading scholars question whether research in the spirit of TAM generates important knowledge. Grover and Lyytinen (2015, p. 276) says, "TAM in general conveys a sort of axiomatic, common sense theory of human behavior. TAM studies tell us very little about how and why specific classes of IT tools and technologies are adopted and used, or how an IT tool being adopted might reflect back on the individual's intentions. Overall, only a precious few, truly novel theoretical ideas have come from the long legacy of TAM research." Similarly, Straub (2014, p. iv) cites a recent debate about whether "most/many of our theories are axiomatic," i.e., "self-evident, intuitive, and not informing."

Need for a new approach. Today's business and technology context challenges the future value of pursuing the same "script" (Grover and Lyytinen, 2015) in adoption research in the future. Three or four decades ago there were interesting questions about whether managers could or would use computers for their own purposes. Two or three decades ago it was important for the IS discipline to look at psychological antecedents and correlates of adoption and usage of IT. Such questions are less important today, when most businesses cannot operate without mandatory use of IT-based systems chosen or developed around infrastructures, platforms, standards, and business ecosystems.

Even at the level of voluntary adoption and use by individuals, everyday perspectives on technology have evolved from perspectives of two or three decades ago, when IT was experienced directly only by a minority of people. Today, many individuals check their smart phones not only in classrooms and during meetings but also when they wake up in the morning. Those smart phones and their apps led to shared expectations about operational efficiency, speed, and aesthetics that are far beyond expectations of several decades ago. Organizations that create or improve IT-reliant tools and methods recognize those expectations and assume that poorly designed applications and tools will be scorned. With so many available choices, traditional research about voluntary use is less important because many users are satisfied to install, use, evaluate, and abandon a technology when something better comes along.

A new approach. This research essay is a conceptual contribution that outlines specifics of a direction for moving beyond adoption research in the style of TAM and UTAUT. This paper focuses on the organizational level rather than the individual level. It suggests using a work system perspective for considering what adoption means, how adoption occurs, and how whatever was initially adopted may evolve over time through a combination of planned and unplanned change. That perspective helps in visualizing practical management issues that go far beyond antecedents and correlates of usage intentions that have been explored repeatedly. This paper's new perspective recognizes post-adoption environments in which work system participants use mandated tools but still may decide not to comply with prescribed business processes and/or IT usage patterns. This area is under-researched despite its direct relevance to central IS topics including systems analysis and design, management of IT-reliant work systems, organizational value of IT, and value creation for customers.

Organization. The next section's three parts serve partially as a literature review and partially as an introduction to ideas that will be used later. Those parts cover three topics: 1) the contexts of IS adoption research to date, 2) background about systems theories, and 3) a summary of work system theory (WST), which is the basis of the new theory. The subsequent section presents a new systems theory, whose six parts can contribute individually and in combination to useful inquiries and narratives about adoption and adaptation of IT innovations. The discussion of each part of the theory summarizes the main implications of that part for practice and for research.

The application of WST provides a new perspective on the meaning of adoption in the context of the work systems through which organizations operate. The WST-based perspective emphasizes ideas that can be applied directly in research and in the analysis, design, and evaluation of IT-reliant work systems (including totally automated work systems). This approach diverges in fundamental ways from adoption research that validates hypotheses related to psychological variables that are difficult to consider directly in management decisions related to IT innovation and adoption in organizations.

2   Literature Review and Introduction to Central Ideas

This section is divided into three sections, as mentioned above. A full journal article might also include coverage of IT innovation and diffusion of technology as separate research areas.

2.1   Three Broad Contexts of Adoption Research to Date

IS adoption research to date has focused on three broad contexts that will be illustrated through several examples of each. Much of that research involves conceptual models that are tested based on statistical significance of relationships between variables. Many of the independent variables are perceptions or beliefs such as perceived usefulness, perceived ease-of-use, performance expectancy, social influence, and satisfaction. Section 3 will introduce a systems theory whose perspective on IT innovation, adoption, and adaptation expresses a holistic stance that focuses on systemic issues.

Antecedents and correlates of adoption. The most widely cited models that describe antecedents and correlates of adoption are the technology acceptance model (TAM) and the unified theory of acceptance and use of technology (UTAUT). Both models cover conditions that lead to intention to use, which leads to actual usage. Factors in TAM include perceived usefulness, perceived ease-of-use, attitude toward use, behavioral intention to use, and actual use. Factors in UTAUT include performance expectancy, effort expectancy, social influence, facilitating conditions, gender, age, experience, and voluntariness of use. As noted earlier, such models "tell us very little about how and why specific classes of IT tools and technologies are adopted and used." (Grover and Lyytinen, 2015). Both models fall within what Ramiller and Pentland (2009) calls the "variables-centered" research paradigm, which "focuses its attention on covariance among independent and dependent variables. .… Unfortunately, the variables-centered paradigm appears to distance researchers from the organizational actors, such as managers, to whom they would give advice and counsel."

Antecedents and correlates of continued use. Karahanna et al. (1999) looks at continued use through theoretical models based on pre-adoption and post-adoption beliefs about adopting or using "the IT." Those beliefs and attitudes lead to behavioral intentions about adoption and usage if adoption is voluntary. Bhattacherjee (2001) introduces an expectation–confirmation model whose hypotheses express relationships between perceived usefulness, confirmation, satisfaction, and IS continuance intention. Limayem et al. (2003) moves toward an integrative model that spans adoption and post-adoption by including attitudes, subjective norms, perceived behavioral control, behavioral intention, and initial usage. Initial usage enables IS continuance, which is affected by perceived usefulness, confirmation, and satisfaction, leading to continuance intention with the moderating effect of habit.

Evolution of post-adoption practices. Other research addresses post-adoption phenomena. Ahuja and Thatcher (2005) traces the impact of four variables on trying to innovate, autonomy, overload, autonomy/overload interaction, and gender. A conceptual model of post-adoptive behavior in

Jasperson et al. (2005) includes both an organizational action model linking work system outcomes, sensemaking, and interventions and an individual cognition model that includes post-adoptive intentions, behaviors and technology sensemaking. Other variables include individual attention, individual differences, use history, and user- initiated learning interventions. Sorgenfrei et al. (2014) proposes a reference framework for IT adoption that starts with five categories of antecedents and contextual factors that contribute to a series of beliefs which lead to motivation, use, post acceptance beliefs, post acceptance motivation, effective use, and outcomes.

2.2 Background about Systems Theories

The following background helps in visualizing how the new systems theory represents a step in a direction called for by leading researchers. It does not cover the history of general systems theory (GST), nor does it repeat on-going discussions about the nature of theory in IS and in social science, e.g., Markus and Robey 1988; Sutton and Staw 1995; Weick 1995; Gregor 2006; Colquitt and Zapata-Phelan 2007; Weber 2012; Straub 2012; Avison and Malaurent 2014; Grover and Lyytinen 2015. Alter (2017a), a response to Avison and Malaurent 2014, discusses major aspects of that background. Alter (2018) covers the following ideas in more depth in relation to "the pursuit of systems theories."

Relative absence of a systems perspective in research. Burton-Jones et al. (2015) compares variance, process, and systems perspectives in IS research, each of which represents "a researcher's choice of the types of concepts and relationships used to construct a theory." It notes that papers comparing theoretical perspectives tend to "emphasize the variance/process dichotomy without mentioning the systems perspective." Along similar lines, Ortiz de Guinea and Webster (2017) proposes combining perspectives through hybrids of variance and process approaches. It does not mention systems theories but leads to wondering what hybrids of systems theories, variance theories, and process theories might look like. Demetis and Lee (2017) emphasizes the lack of a systems emphasis in the IS discipline: "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."

Moving beyond a reductionist approach. Other authors have criticized the reductionist approach of focusing on relationships between variables rather than dealing with holistic or systemic issues. For example, Sinha and van de Ven (2005) speaks of a "reductionist quagmire" and said that "reductionist research methods that have been used to analyze the external fit between context and design variables one at a time should be abandoned. (p. 399). Svahn and Henfridsson (2012, p. 6) says that "Seeing design as an emergent process is largely incompatible with a reductionist perspective on complexity."

Systems theory. The term *systems theory* is problematic because it is often used as a synonym for general systems theory (GST), which itself is less like a well-articulated theory and more like a list of properties that apply to many systems, such as those presented by Skyttner (2005) and cited by Demetis and Lee (2016): interrelationships and interdependence of objects, holism, goal seeking, transformation process, inputs and outputs, regulation, hierarchy, differentiation, and equifinality and multifinality. Along those lines, Adams et al. (2014, p. 113) "propose[s] that *systems theory* is a unified group of specific propositions which are brought together to aid in understanding systems."

Definition of systems theory. We define systems theory based on Schatzki's (2001, pp. 12-13) very general view of theory related to social phenomena. By that view, "theory means, simply, general and abstract account. A theory of X is a general and abstract account of X. [Theories include] typologies of social phenomena; models of social affairs; accounts of what social things … so long as they are couched in general, abstract terms." The following definition of system theory mirrors the form and reflects the spirit of Schatzki's definition of theory: A *systems theory* of X is an abstract account of X that might take a variety of forms such as typologies, conceptual frameworks, models, metamodels or other descriptions or propositions and that is developed expressly for depicting systems or systems phenomena within its domain. System phenomena are related to the system nature of systems in the domain and are described in relation to those systems or their system properties. Examples include:

- interactions or relationships between a system and its environment, which includes entities that receive or use its outputs,
- interactions or relationships between a system's components,
- capabilities related to obtaining or receiving inputs from a system's environment,
- transformations that create outputs transferred outward to a system's environment,
- regulation of a system's operation,
- maintenance of a system's capabilities,
- system responses to internal and external conditions that change over time,
- relationships to subsystems and supersystems.

2.3 Work System Theory

This paper's approach to IT adoption and use is based on a systems theory called work system theory (WST). Sociotechnical researchers have used the idea of work system for decades (e.g., Trist, 1981. Sinha and Van de Ven 2005, Mumford, 2006). That term appeared in the first edition of *MIS Quarterly* (Bostrom and Heinen, 1977). WST was developed over several decades (Alter, 2006, 2013, 2015c). Its holism and internal consistency enabled use by many hundreds of MBA and Executive MBA students who produced management briefings about problematic IT-enabled work systems in their own organizations (Truex et al. 2011, 2012). As shown in Figure 1, WST consists of three components, the definition of work system, the work system framework (WSF), and work system life cycle model (WSLC). The next section will show how WST is a starting point for new ways to think about IT innovation, adoption, and diffusion.
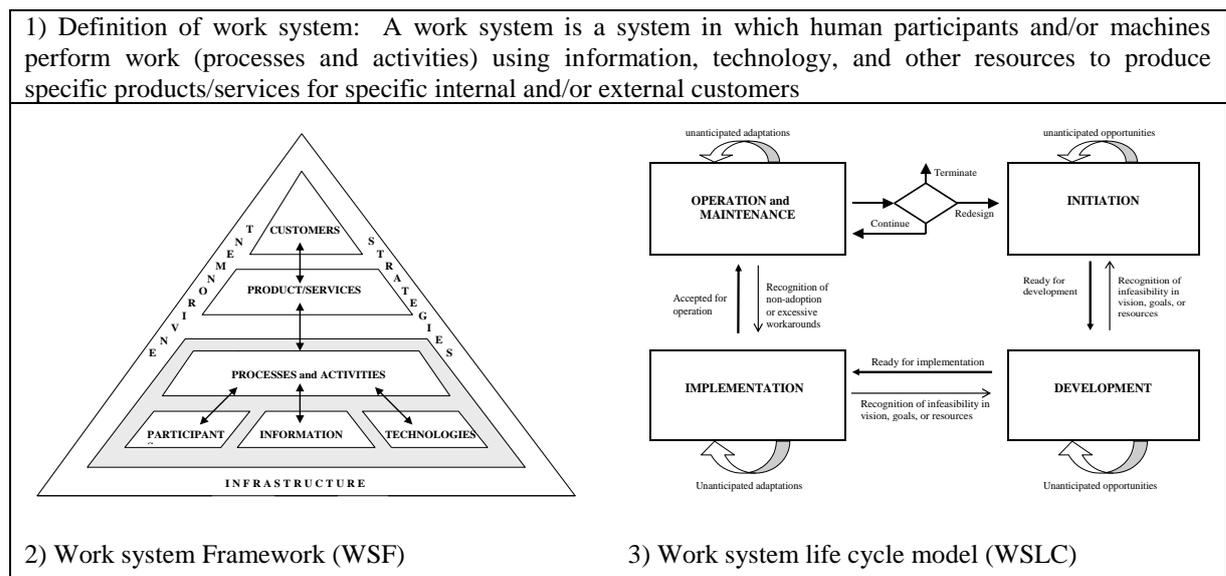

1) Definition of work system: A work system is a system in which human participants and/or machines perform work (processes and activities) using information, technology, and other resources to produce specific products/services for specific internal and/or external customers

2) Work system Framework (WSF)   3) Work system life cycle model (WSLC)

Figure 1.   Three components of work system theory (Alter, 2013, 2015c)

The WSF identifies and organizes nine elements of even a rudimentary understanding a work system's form, function, and environment during a period when it is relatively stable even though incremental changes such as minor personnel substitutions or technology upgrades may occur within what is still considered the same work system. The WSLC model represents the iterative process by which work systems evolve over time through a combination of planned change (formal projects) and unplanned (emergent) change that occurs through adaptations and workarounds. An IS is a type of work system most or all of whose activities focus on processing information, i.e., capturing, transmitting, storing, retrieving, manipulating, and/or displaying information.

The WSLC does not use the term adoption directly, but traverses many aspects of adoption. Consider how the four phases of the WSLC describe the adoption of a new customer relationship work system.

- **Initiation phase**. Managers and other stakeholders conclude that the existing customer relationship work system is inadequate and allocate resources for a formal project. During this phase, some of the variables in TAM, UTAUT, and other variables-centered research might be mentioned, such as perceived usefulness, perceived ease-of-use, attitude toward use, performance expectancy, effort expectancy, and behavioral intention. Those variables and actual use cannot be observed in this phase because the new or improved system has not been implemented in the organization.

- **Development phase**. This phase involves the creation or acquisition of resources that are required in order to implement improvements in the organization. This phase is part of adoption because adoption cannot be completed without the needed resources. The same TAM and UTAUT variables that might have been mentioned during initiation are also relevant here because developers and managers know that low-quality products of this phase will be resisted in the next phase.

- **Implementation phase**. Implementation in the organization includes implementation planning, training, any required reconfiguration, and cutover to the new work system. Adoption in an organization requires an implementation effort, which may range from providing new capabilities to enthusiasts and publicizing their voluntary usage patterns all the way through totally planned corporate rollouts with mandatory schedules and usage expectations.

- **Operation and maintenance**. This is the temporary end state of adoption for a new or improved version of a work system. If one had to identify a precise point of transition from a *not yet adopted* state to an *adopted* state, that point would occur at the instant when the new work system was declared fully operational. On the other hand, the inward facing arrow in this phase of the WSLC highlights the transient nature of adoption, and hence an inherent limitation of seeing adoption as a state transition. There is a high probability that various parts of a newly adopted work system will change organically as the work system participants discover more effective work practices and as they respond to exceptions, contingencies, and changes in the surrounding environment

3   A Systems Theory of IT Innovation, Adoption, and Adaptation

This section shows how system-centric ideas not generally associated with IT innovation and adoption research can be combined into a systems theory that expresses a holistic basis for analyzing and understanding IT innovation, adoption, and adaptation. This theory was developed as part of a long-term attempt to extend the work system perspective into new areas. Feedback from workshop presentations (Alter, 2015a; 2017b) and a paper related to theory in IS (Alter, 2017a) supported the central assumption that IT innovations in organizational settings can be described as work system innovations. The six parts of the new systems theory combine the work system framework, the four phases of the WSLC, five stages of IT-enabled work system innovation, and other ideas. Important precedents for separating a systems theory into multiple parts include the viable systems model (Beer, 1981), which describes five subsystems and Miller's (1978) living systems theory, which has seven layers. Brief comments about implications the new theory's implications for practice and for research follow descriptions of each of the six parts, which are presented in Sections 3.1 through 3.6.

3.1   A Work System as the Entity that is Adopted, Adapted, or Improved

General discussions of adoption and diffusion tend to gloss over the issue of exactly what is being adopted. In relation to IT adoption in business settings, the issue is whether IT adoption means adoption of a hardware/software artifact, whether it means adoption of a work system whose operation relies on that artifact, or whether it means something else. Consider the adoption of new CRM (customer relationship management) software. Central elements in WST's work system framework lead to identifying different aspects of what is being adopted.

- **Technology**. CRM implementations involve installation, configuration, updating, or modification of CRM software that is provided by a CRM vendor.

- **Processes and activities**. The main reason for adopting new or improved CRM technology is to improve processes and activities performed by work system participants.

- **Information**. Significant changes in CRM technology and/or CRM-related processes and activities usually generate or use information that was not available previously. Thus, adopting new CRM software usually implies adopting the use of new information or a new information formats.

- **Product/services**. The new or improved capabilities make it possible for work systems that use the new software to produce better product/services for their customers.

Thus, the work system framework highlights limitations of seeing CRM adoption as nothing more than adopting new CRM hardware/software. That view would miss the necessity of adopting new or improved processes and activities, using information in new ways, providing different product/ services for recipients of CRM-related information, and so on. Similar examples apply for research about adoption of methods and mindsets ranging from agile development or object-oriented methods through reengineering or total quality management. A work system interpretation applies to all four of those cases because nothing will happen until the underlying ideas are incorporated into work systems.

This view of IT innovation, adoption, and adaptation has a distinct organizational focus that does not look at IT product innovations from the perspective of firms that sell IT products, e.g., a software vendor's perspective on a software innovation that makes its CRM product more desirable to its customers. Traditional studies of the diffusion of product innovations, e.g., the Rogers diffusion curve, focus on that type of perspective rather than on incorporation into work systems in organizations.

>>> Implications for practice. A managerial view of the organizational adoption of IT innovations sees it as the adoption of a new or improved IT-reliant work system, not just adoption of technology. The focal point for understanding and managing the IT innovation is changes in the work system.

>>> Implications for research. IT adoption research is more realistic and more beneficial to management if it treats the unit of analysis in IT adoption as adoption of a new or improved work system rather than adoption of new technology. Recall Grover and Lyytinen's (2015) comment about limitations of TAM and UTAUT. In essence, the variables in TAM and UTAUT seem equally relevant to adoption of a new lawnmower or refrigerator as to organizational adoption of new CRM software. Seeing the adoptive entity as a work system addresses Ramiller and Pentland's (2009) earlier comment about the likelihood of generating valuable management prescriptions from research.

3.2 Elements of the Work System Framework as Drivers of IT-Related Change and Obstacles to IT-Related Change.

Each of the nine elements of the work system framework (Figure 1) points to widely observed drivers or obstacles to IT innovation, adoption, and adaptation. Table 1 lists some of the typical drivers and obstacles encountered in many hundreds of management briefings produced by MBA and Executive MBA students who used various versions of the work system method (Alter, 2006, 2013) to suggest improvements in work systems in their own organizations. Many other drivers and obstacles to change could have been listed based on published case studies, industry periodicals, and other sources.

>>> Implications for practice. Again, the adoptive entity is a new or improved work system, not just a new technology. A managerial view of IT innovations should consider the full range of drivers and obstacles in Table 1 because any of them can have important impacts on innovation success.

>>> Implications for research. Typical variance-oriented research that tries to assess correlations between situational characteristics and outcome measures such as usage or success (e.g. adoption and post-adoption studies in the literature review) have found correlations, but have not found many of the drivers or obstacles in Table 1 because those factors were not present in their research models. Ideally, a research paradigm should avoid ignoring drivers and obstacles that experienced practitioners have encountered repeatedly. The new systems theory is designed to cover more of those topics.

Element of the work system framework	Drivers of change directly or indirectly related to IT innovations	Obstacles to change directly or indirectly related to IT innovations
Customers	• Unmet needs of internal or external customers • Customer dissatisfaction • Agreement about unmet customer needs	• Satisfied customers • Customer policies or practices that conflict with the change • Disagreement about unmet customer needs
Product/ services	• Inadequate product/service performance regarding cost to the customer, quality, reliability, speed, customizability, complexity, or other characteristics	• Difficulty in producing fundamental improvements in product/services with available resources
Processes and activities	• Inadequate performance of processes and activities regarding production cost, efficiency, effectiveness, etc. • Inadequate structure of processes and activities.	• Adequacy of the existing processes and activities • Lack of performance information • Lack of knowledge about how to improve processes and activities
Participants	• Knowledge and skill of participants enabling new ways to do work • Motivation and ambition	• Resistance to change • Lack of motivation and ambition
Information	• Inadequacy of existing information that is used in performing processes • Availability of previously unavailable knowledge or information	• Adequacy of the existing information • Unavailability of knowledge and information that would facilitate change
Technologies	• Availability of technology innovations that enable improved ways of working	• Adequacy of existing technologies in cost, maintainability, and reliability. • Difficulty switching from current technologies to new technologies
Environment	• Internal politics, competitive pressures, recent enterprise history, demographics, technological change, and so on.	• Change-resistant organizational culture • External polices and regulations that prevent or delay changes
Infrastructure	• Availability of infrastructure that facilitates change	• Infrastructure inadequacies that make change more difficult
Strategies	• Alignment of enterprise, department, and work system strategies	• Disagreement or misalignment about strategies across levels

Table 1. Elements of the work system framework as drivers and obstacles to change

3.3   Stages of IT-Enabled Work System Innovation

An attempt to theorize about IT innovation in the context of the WSLC required new ideas because the WSLC in Figure 1 does not mention innovation directly. Trial and error with many attempted variations on the WSLC led to the following stage model of IT-enabled work system innovation. Each of the five stages can be related to one or more phases in the WSLC. In effect, the stage model is an overlay of innovation-related issues on top of the existing WSLC.

Stage 1, impetus. The impetus for innovation is the need or performance gap that an invention might answer. The inventors could be work system participants, managers, or external parties in a product/service ecosystem. In the WSLC's *operation and maintenance phase,* the impetus often is measurable performance gaps or key incidents that caused operational interruptions. Significant workarounds also may form the impetus. The impetus can appear in other phases as well. Management might initiate a project in the *initiation phase* based on opportunities. In the *development phase,* analysts and developers might recognize a need that calls for new applications of IT. In the *implementation phase,* work system participants might see a need for missing features or capabilities that are required for successful implementation.

Stage 2, invention. This is the creation of a new idea, device, or work practice before it is used and/or field-tested in real world settings. An invention may exist in an inventor's mind, may exist as a formal specification, or may have been created and tested in a laboratory or developmental setting. As with the impetus stage, the invention stage can occur during or across any of the four WSLC phases based on mechanisms mentioned above. An invention through planned change occurs when managers initiate a project (*initiation phase*) and allocate resources to create an improved version of an existing work system, possibly, but not necessarily using new or improved IT capabilities. Inventions can occur during *development* and *implementation*, as mentioned above. An invention through unplanned change during the *operation and maintenance* phase of the WSLC occurs when adaptations and workarounds allow work system participants to perform their work despite obstacles that they encounter, and sometimes despite inadequacies of available IT.

Stage 3, implementation. This is the process of bringing an invention into use in real world settings. This process may be smooth in some cases, but also may prove difficult or controversial if the invention does not fit needs perceived by potential users, if they or their managers mis understand the invention, or if they simply don't like it (See Section 3.4 on catalysts of IT innovation). The literature of change management in organizations addresses these issues directly. Product development and diffusion literature that takes a producer or vendor's viewpoint is not as relevant to the organizational implementation focus of this stage. Most implementation efforts related to planned change occur during the *implementation phase* of the WSLC. Less visible implementation efforts occur during adaptations and workarounds within the *operation and maintenance phase*.

Stage 4. Post-implementation improvement. Most inventions that are implemented in real world settings are improved after initial implementation because an initial invention and its implementation often address some issues in the setting but not others. Work practice innovations based on IT-related inventions often evolve gradually as work system participants gain deeper understanding of how to do their work more efficiently or effectively by using and/or adapting the IT innovation. Many post-implementation improvements are adaptations or workarounds. Other post-implementation improvements are basically incremental changes, such as moving to a new version of existing hardware and/or software that has advantages over whatever had been implemented previously.

Stage 5. Routine operation. This stage is reached when the innovation is taken for granted as part of established work practices. At this point, the innovation is seen less and less as an innovation as it becomes integrated with organizational routines (Feldman and Pentland, 2003). Consistent with that research stream, routine operation is not an end-state because post-implementation improvements continue, either as formal projects that traverse the WSLC's *initiation, development*, and *implementation* phases or as unplanned change through adaptations and workarounds represented by the inward-looping arrow in the WSLC's *operation and maintenance phase*.

>>> **Implications for practice**. Management should avoid the temptation of declaring victory when an IT artifact is installed and considered operational. Many of the benefits of IT innovation in organizational settings will come from adaptations and workarounds (Alter, 2014), from secondary design (Germonprez and Hovorka, 2011; Huuskonen and Vakkari, 2013) and from the operation of narrative networks (Pentland and Feldman, 2007).

>>> **Implications for research**. Realistic research on IT innovation and adoption should recognize the importance of post-adoption trajectories that emerge through adaptations and workarounds. Important research challenges include assessing the genuine extent of adoption (e.g., full adoption vs. partial adoption or half-hearted adoption), observing and evaluating effects of secondary design, and dealing with appropriate and inappropriate compliance and noncompliance (See Section 3.5).

3.4   Three Catalysts of IT Innovation: Needing, Understanding, and Liking

The fourth part of the new systems theory focuses on the micro-dynamics of adoption by identifying *needing, understanding,* and *liking* as three "catalysts of IT innovation" that drive or inhibit adoption

in each WSLC phase. Each catalyst can operate at three levels: 1) at the individual level (by affecting acceptance vs. resistance), 2) at the level of management vs. employee (agreement or disagreement for each catalyst), and 3) at the group or organizational level (related to business impacts and benefits).

Viewing the catalysts as *needing, understanding,* and *liking* came from a personal effort to develop a questionnaire related to implementation, compliance, and noncompliance for mandated software in organizations. The literature search for that effort started with the previously mentioned topics related to adoption and post-adoption behavior, and then expanded to discussions of intentions and action (Azjen, 1985), resistance to change (Coch and French, 1948; Piderit, S. K. (2000), change processes in organizations (Katz and Kahn, 1978; Weick and Quin 1999; Cummings, 2009), and related topics. I concluded that the simple verb forms *needing, understanding,* and *liking* provided a direct and easily understood way of visualizing practical issues that I had encountered in eight years in a manufacturing software company. Thus, the idea of three catalysts was developed with some consideration of the literature but actually was framed around personal experience.

Needing. This is the extent to which individuals or groups perceive that they need an IT innovation for achieving their own goals. Consistent with TAM, greater perceived need usually leads to greater support of an innovation. Notice, however, that perceptions of need sometimes differ substantially.

Understanding. This is the extent to which individuals or groups understand how an innovation can (or cannot) be applied and how and why it might (or might not) be beneficial. Greater understanding may or may not be associated with acceptance or rejection of an IT innovation. The simplest cases are when people accept an innovation because they understand its genuine benefits, or when they reject it because they understand its shortcomings. Other possibilities are important in some cases. People who understand an IT innovation's beneficial impact for an enterprise still might reject it because its use would conflict with personal or group goals or interests, as with the Luddites (Jones, 2013; Wikipedia, 2018) Similarly, people who misunderstand an IT innovation might accept it because they do not appreciate or cannot foresee its negative implications for them or their group.

Liking. This is the extent to which individuals or groups like an IT innovation. IT innovations that are liked are easier to implement. It is possible to implement IT innovations that are disliked, but often with implementation efforts that are more painful and costly in time and effort.

Thus, the three catalysts expand on process-oriented ideas in the WSLC and the stages of IT-enabled innovation. Needing, understanding, and liking are closer to the micro-dynamics of whether and how people become committed to planned change projects and unplanned adaptations or workarounds.

>>> Implications for practice. Implementation tends to be easier when all or most stakeholders believe there is a need, understand how an IT innovation should help, and like the innovation itself. Various combinations of positive and negative aspects of the three catalysts point to problematic issues that require management attention and action. For example, stakeholders may understand the need at the enterprise or group level, but may believe that an innovation will have negative consequences for them and/or for their colleagues. Stakeholders who think superficially about a proposed innovation may not recognize that it is risky or may cause significant problems. Stakeholders may disagree about the need, may understand the innovation in quite different ways, and may not resolve their disagreements in a manner that is beneficial for the enterprise or for groups or individuals. Management and workers may have conflicting interests that are exacerbated by an IT innovation that results in changes in work conditions, requirements for different skills, or even layoffs.

>>> Implications for research. Each of the three catalysts point toward possible areas of agreement or disagreement at the levels of individual, group, or and manager vs. worker. Focusing on those areas could lead to interesting and readily usable research about the mechanisms, drivers, and obstacles to IT innovation, adoption, and adaptation. Such agreement and disagreement could change over time, as when an IT innovation that is deemed successful today may prove unsuccessful tomorrow, or vice versa. This raises many questions about whose opinions should be used when evaluating an IT

innovation, especially since different stakeholders with different interests and goals may have different or even mutually conflicting criteria.

3.5 Occurrence and Impacts of Compliance, Noncompliance and Workarounds

Compliance, noncompliance, and workarounds may occur anywhere in the WSLC with positive or negative effects. Saying that compliance can have negative effects might seem strange, but compliance with inappropriate processes or rules may be detrimental. Processes and rules sometimes are over-specified in ways that interfere with producive activity when followed. Unions sometimes exploit that phenomenon through an industrial action called "working-to-rule,"whereby union members perform only tasks mentioned explicitly in their contract. Similarly, there are many cases where noncompliance is beneficial, as in workarounds related to unrealistic processes, unduly restrictive controls, inadequate hardware/software, and malfunctions and temporary obstructions (Alter, 2015b).

The entire topic of workarounds is intertwined with compliance versus noncompliance, even though many workarounds occur without any significant issues about compliance versus noncompliance. A theory of workarounds (Alter, 2014) defines workaround in a very general way and says that workarounds occur through a process somewhat parallel with the five stages of IT innovation: Someone perceives the need for a workaround and decides whether to pursue a workaround. The decision of how to proceed is based on a combination of factors including the organization's goals, the obstacles at hand, the monitoring system, the reward system, and the individual's ability to produce the workaround. The workaround is implemented, and the consequences ensue.

As discussed in Koppel et al. (2008), Alter (2014), Röder et al., 2014), Andrade et al. (2015), Koppel et al. (2015) and in many other sources, there is often disagreement about whether workarounds generally are beneficial or detrimental. For example, Alter (2014) summarizes how all of the following perspectives on workarounds can be found in the literature: workarounds as necessary activities in everyday life, workarounds as creative acts, workarounds as quick fixes that don't go away, workarounds as add-ons or shadow systems, workarounds as inefficiencies or hazards, workarounds as means for maintaining appearances, workarounds as resistance, and workarounds as distortions or subterfuge. In many of those cases, whether a workaround is seen on the bright side or on the dark side depends on the interests and concerns of the stakeholders.

>>> **Implications for practice**. Work system participants may or may not comply with practices or usage patterns that are assumed when IT innovations are implemented. Managers often need to decide whether and how to treat different types and instances of compliance, noncompliance, and workarounds. All three may call for management action related to problems or opportunities.

>>> **Implications for research**. The notions of IT innovation, adoption, and adaptation may be even more fluid than how they are portrayed in post-adoption research to date. Today's seemingly successful IT adoption eventually may generate dysfunctional forms of compliance or noncompliance. Intentions underlying the IT innovation may be betrayed in either case.

3.6 Multiple, Sometimes Inconsistent Evaluations of the Same IT Innovation

The form, characteristics, and operation of a work system's components affect attainment of multiple goals related to the work system as a whole, to its components, and to whatever it produces for its beneficiaries. At least some of those goals often are mutually contradictory. That type of phenomenon has been discussed widely in relation to topics mentioned earlier, such as organizational change and resistance to change. At the corporate level, it is a central focus of stakeholder theory (Donaldson and Preston, 1995; Parmar et al., 2010), many of whose ideas also apply at the work system level.

In work systems, many such conflicts stem from divergent goals related to work system components and related to interests of beneficiaries and stakeholders. For example, a work system manager's

efficiency and employee satisfaction goals may be quite distant from a beneficiary's goals related to the form, operation, and quality of product/services that the work system produces. Similarly, a work system's internal efficiency goals may conflict with its customer satisfaction goals, as when greater efficiency calls for devoting fewer resources to interactions and services that customers appreciate. Thus, whatever is declared to be "the goal" or "the goals" of a work system usually is based on implicit or explicit trade-offs. Other designers or managers might have preferred different trade-offs.

Ideally, evaluation of IT-related innovations that are perceptible by work system participants should involve the innovation's positive or negative contributions to the work system's operation and success. This implies that an IT innovation's contributions to the work system's operation and success is more important to users and managers than its technical features or potential affordances, and certainly more important than whether the IT itself seems easy to use. Evaluations by individuals or groups related to personal concerns or interests may stem from concerns or interests that do not conform with interests of the enterprise, as when an IT innovation makes existing job skills obsolete.

>>> **Implications for practice**. Work system management calls for identifying, prioritizing, and reconciling diverse goals such as providing timely information, a satisfying customer experience, low operating costs, and acceptable uptime. Managers should avoid assuming that an IT innovation can be evaluated based on a single, easily observed criterion. A single goal such as cost reduction or profitability may mask important operational issues whose resolution might lead to better performance. While various mathematical combinations of performance metrics may provide a single target, such combinations are likely to hide or smoothe over important operational performance gaps.

>>> **Implications for research**. The common research assumption that systems have a single goal and can be deemed successful or unsuccessful is often insufficient for identifying key issues involving how IT-reliant work systems operate, both before and after implementation of an IT innovation. Imagining that the "success" of an IT innovation or work system is a single variable is no more justified than imagining that wealth is a single measure of success in life.

4   Discussion and Conclusions

This research essay presented a new systems theory of IT innovation, adoption, and adaptation whose form and content differs from the variance theories that dominate the area. By design it does not attempt to measure relationships between variables, which is the focus of those theories. In contrast, it provides an integrated systems view of many phenomena related to IT innovation in organizations.

The new theory should be evaluated based on whether it covers important topics and leads to useful insights. Parsimony was considered to some extent by trying to avoid redundancy, but it is certainly possible that simpler or more complicated systems theories related to the same domain might prove more useful. The main criteria for defining and including each of the six parts was that each part contributed something that is important for both research and practice.

Part 1: A new perspective on the adoptive entity. The basic premise of the new theory is that IT innovation, adoption, and adaptation is fundamentally about IT-enabled changes in organizations. From an organizational viewpoint, the adoptive entity is not hardware/software, but rather an IT-enabled work system that incorporates an IT innovation. That view of IT innovation in organizational settings makes business sense because people whose work is evaluated in business settings care much more about work system performance than about features of whatever hardware/software is used.

Part 2: Drivers and obstacles to IT-related change. Using the elements of the work system framework provides an approach for visualizing drivers and obstacles to IT-related change in the context of the adoptive entity, i.e., the work system that is being created or improved.

Part 3: Stages of IT-enabled work system innovation. The overall dynamics of IT innovation in the context of a work system call for a stage model that builds upon the WSLC. Some of the innovation stages can apply in several phases of the WSLC.

Part 4: Three catalysts of IT innovation. The catalysts of needing, understanding, and liking highlight important aspects of the micro-dynamics of IT innovation. Especially important is the way the catalysts apply across levels, from individual to group to management vs. worker.

Part 5. Compliance, noncompliance, and workarounds. Recognition of these organizational issues is necessary for visualizing how the realities of IT innovation go far beyond merely using new IT.

Part 6. Inconsistent evaluations of IT innovations. Different stakeholders in organizational settings often evaluate innovations using different criteria, especially when innovations affect them or their work groups in different ways. Realistic research and practice should not ignore those differences.

4.1   Next Steps

A more thorough coverage in a journal article would have explained the new systems theory in more detail and would have addressed aspects of the following topics:

More complete links to the literature. The literature review identified research related to three broad contexts of adoption research. A more complete literature review would have looked at additional sources and would have discussed other sources that focus more directly on IT innovation and diffusion of technology. A more complete paper would have returned to the three broad contexts of adoption and would have said more about how the proposed systems theory illuminates topics that are ignored or barely considered in the existing literature.

More about systems theories. A separate paper about "the pursuit of systems theories" (Alter, 2018) addresses this issue by saying more about general systems theory, the systems perspective, and systems theories. It identifies over 10 existing systems theories and explains how a set of systems theories that are extensions of WST have been used for research related to different aspects of IS.

Validation of the systems theory through case studies. This research essay presented a new systems theory but did not apply it to case studies, which would test the theory's usefulness and might lead to clarifications and improvements. Applications of the new theory should test whether it provides a holistic framing that practitioners and researchers can use easily and effectively to produce well-founded narratives that describe and explain IT innovation, adoption, and adaptation in organizations.

Further development and exploration of ideas incorporated into the theory. All six parts of the new systems theory contain ideas that can be explored and developed further. For example, 1) how might seeing the adoptive entity as a new work system provide a lens for visualizing strengths and shortcomings of the existing literature? 2) How could the literature extend this paper's table of drivers and obstacles to IT innovation? 3) To what extent does the literature support the linkage between the WSLC and the stage model of IT innovation? How might this linkage lead to insights on topics ranging from everyday IT innovation to "technochange" (Markus, 2004) that uses IT to drive organizational change? 4) How can the three catalysts be incorporated into systems analysis and design methods? 5) How does the existing innovation literature address compliance, noncompliance, and workarounds? 6) How does the existing innovation literature recognize and address agreement and disagreement in stakeholder views related to the evaluation of the same innovation?

Extension of ongoing discussions of perspectives and theorizing in IS. In combination, Burton-Jones et al. (2015). Grover and Lyytinen (2015), Demetis and Lee (2016, 2017), and Ortiz de Guinea and Webster (2017) all imply or state explicitly that the IS discipline has focused too much on variance theories and theorizing in the style of TAM and UTAUT. None of those sources discussed existing systems theories in depth. A more extensive discussion of that topic might show how the new systems theory is an example of what those researchers called for. It also might identify areas in which the new systems theory does not satisfy their expectations and could be improved accordingly. Systems theorizing remains under-developed in a field whose name refers to systems. This paper's systems theory of IT innovation, adoption, and adaptation could represent a step toward bring systems theories to the foreground in IS research and practice.

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