2017

Nothing is more practical than a good conceptual artifact... which may be a theory, framework, model, metaphor, paradigm or perhaps some other abstraction

Steven Alter

doi: 10.1111/isj.12116

Nothing is more practical than a good conceptual artifact… which may be a theory, framework, model, metaphor, paradigm or perhaps some other abstraction

Steven Alter*

School of Management, University of San Francisco, San Francisco, USA, email: alter@usfca.edu

Abstract. *This research commentary proposes a way to make progress in the IS discipline's inconclusive discussion about the nature and role of theory. In some ways, the creation and testing of theory seems to be the primary goal of IS research. Despite that, there are persistent questions whether theory has become a fetish in the IS discipline and whether the routinized production and testing of mid-range theories is little more than an uninspired script that reduces the value and interest of IS research. This paper reframes the discussion around the idea of 'conceptual artifact' that has been discussed widely in educational psychology for over a decade. Conceptual artifacts are abstract knowledge objects that can be produced, tested and improved. This paper recognizes the value of both abstract knowledge (conceptual artifacts) and non-abstract knowledge. It explains that theorizing produces, evaluates or improves useful conceptual artifacts that may or may not be theories. It validates four premises related to conceptual artifacts by showing that theorizing related to work system theory created or used many different types of conceptual artifacts. It identifies nine criteria for evaluating conceptual artifacts and shows that some of them differ from typical criteria for evaluating Gregor Type IV theories. As a whole, it argues that that privileging theory over other types of conceptual artifacts may not be beneficial in pursuing the research questions that the IS discipline needs to study.*

Keywords: theory, theorizing, conceptual artifact, evaluation of conceptual artifacts, work system theory

WHY BELIEVE THAT THEORY IS BETTER OR MORE PRACTICAL THAN OTHER TYPES OF CONCEPTUAL ARTIFACTS?

This research commentary's title plays on Lewin's frequently repeated and almost taken-for-granted aphorism that 'there is nothing more practical than a good theory.'[1] It argues that theory is a type of conceptual artifact (Bereiter, 2005) and that there is no obvious reason why a good theory should be seen as more practical than a relevant version of any other type of conceptual artifact, such as a good framework, model, metaphor or paradigm that might be used for understanding, analyzing, designing, evaluating, improving or researching information systems.

Attention to the variety and value of conceptual artifacts leads to questioning the primacy of theory per se in highly respected IS journals and in the academic IS discipline in general. The elevated importance of theory over other types of conceptual artifacts in the IS discipline is especially questionable when major conferences frequently feature anxious discussions about how IS research has little impact on real world practice.

This paper advances the notion of knowledge building in IS by seeing theory as only one of a variety of outcomes of knowledge creation and dissemination. It brings the idea of *conceptual artifact* into the foreground by trying to validate four premises:

- Knowledge includes both non-abstract knowledge (e.g. information, examples, and stories) and abstract knowledge consisting of conceptual artifacts that may or may not be theories.
- Theorizing can produce many different types of conceptual artifacts that may be of value on their own right and that may be useful in subsequent theorizing. (Among others, these include concepts, propositions, frameworks, theories, models, metamodels and methods.)
- The uses, strengths and shortcomings of any conceptual artifact may inspire improvements in that artifact and/or creation or improvement of valuable conceptual artifacts of any type.
- Theory is not better than the other types of conceptual artifacts.

Exploring these premises shines a new light on IS theory and theorizing. In combination, the four premises imply that there is no scientific or practical reason to believe that 'theory is king' (a subheading in Straub, 2009) or that theory must be prominent in all respectable IS research and in every respectable IS journal article. Along those lines, Avison and Malaurent (2014) propose that theory has become a fetish in IS. Nuanced responses to that paper provide different levels of support for their argument (Compeau & Olivera, 2014; Gregor, 2014; Henfridsson, 2014; Lee, 2014; Markus, 2014; Silverman, 2014). In a related article, Grover and Lyytinen (2015) suggest that overemphasis on theory per se leads to unproductive focus on creating and validating uninteresting mid-range theories by using what they call a 'mid-range script.' That script can be summarized as follows: identify variables; hypothesize relationships between independent, moderating and dependent variables; obtain enough data to test the statistical significance of relationships between the variables; analyze the data; and determine whether relationships

[1]Repeated use of Lewin's aphorism in IS seems ironic for several reasons. According to Billig (2015, p. 456), 'Lewin did not claim to be the author of that motto: he wrote 'a businessman once stated that 'there is a nothing as practical as a good theory.' (Lewin, 1943/1999, p. 336).' Furthermore, the 'field theory' that is often associated with Lewin (e.g. see descriptions in Deutsch (1968), Parlet (1991), Burnes and Cook (2013)) does not seem very practical and probably would be viewed as an atheoretical framework or model rather than a proper theory by many IS researchers.

between the variables are statistically significant. Since this paper quotes from Grover and Lyytinen (2015) a number of times, it abbreviates that paper as G&L.

Organization

This paper addresses the diversity of views about theory in IS by moving the discussion to a more general level that starts with different types of knowledge. Its focus on conceptual artifacts provides a way to question the IS discipline's seemingly taken-for-granted assumption that knowledge must take the form of theory. This paper explains a framework (Figure 1) that separates knowledge into non-abstract knowledge and abstract knowledge (conceptual artifacts of various types) that may or may not be in the form of theory. It explains that theorizing produces, tests or improves conceptual artifacts that may or may not be theories. It demonstrates the importance of the full range of conceptual artifacts by showing how different types of conceptual artifacts played a role in theorizing related to work system theory (WST). It notes that criteria for evaluating conceptual artifacts include some that are not typical for evaluating Gregor (2006) Type IV theories.[2] It concludes by summarizing how this approach to knowledge, theory and theorizing provides a view of knowledge creation that differs markedly from general debates about the inherent primacy of theory. This paper does not try to resolve the contentious question of whether conceptual artifacts that are not Gregor Type IV theories should be considered proper theories.[3]

SHOULD THE INFORMATION SYSTEM DISCIPLINE TAKE FOR GRANTED THAT KNOWLEDGE MUST BE EXPRESSED AS THEORY?

Inconclusive discussions about the nature and centrality of theory have gone on for decades in IS and other disciplines (e.g. Sutton & Staw, 1995; Weick, 1995; Schatzki, 2001; Gregor, 2006; Weber, 2012; Avison & Malaurent, 2014; Lee, 2014; Rivard, 2014; Grover & Lyytinen, 2015). The diversity of views related to the nature of theory in IS can be illustrated as follows:

[2]According to Gregor (2006, pp. 626), Type IV theory says 'what is, how, why, when, and what will be, and corresponds to commonly held views of theory in both the natural and social sciences.' …. [this type of theory] 'implies both understanding of underlying causes and prediction, as well as description of theoretical constructs and the relationships among them.' … 'Type IV theories include "grand theories" such as general system theory (Ashby, 1956; Von Bertalanffy, 1973) and the related information theory of Shannon (1948). Further examples of type IV theory can be distinguished. The Technology Acceptance Model (TAM) (Davis, 1989) and DeLone and McLean's dynamic model of information success (DeLone & McLean, 1992, 2003) both aim to explain and predict.'

[3]A relatively recent article covering five decades of theory building and theory testing (Colquitt & Zapata-Phelan, 2007, p. 1281) noted two approaches to theory and reviewed many relevant issues. With one approach, theory is defined as relationships between independent and dependent variables. An example is the way Campbell (1990, p.65) defines theory as 'a collection of assertions, both verbal and symbolic, that identifies what variables are important and for what reasons, specifies how they are interrelated and why, and identifies the conditions under which they should be related or not related.' An alternative approach defines theory in terms of 'narratives and accounts'. An example is DiMaggio's (1995, p. 391) definition of theory as 'an account of a social process, with emphasis on empirical tests of the plausibility of the narrative as well as careful attention to the scope conditions of the account.'

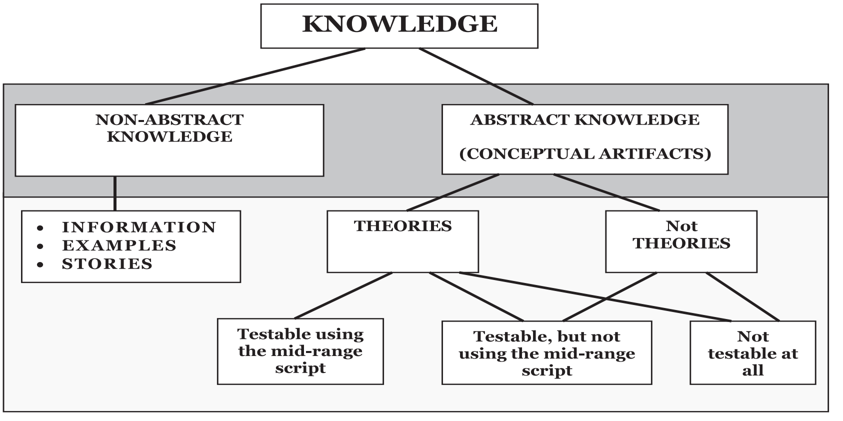

Figure 1. Broad categories of knowledge related to information systems.

- Gregor (2006) identifies five different types of theory, theories for analysis (I), for explanation (II), for prediction (III), for explanation and prediction (IV) and for design and action (V).
- Schatzki's (2001) view of theory encompasses all of Gregor's types: '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 (e.g. practices, institutions) are; conceptual frameworks developed expressly for depicting sociality; and descriptions of social life—so long as they are couched in general, abstract terms.' Many widely respected scholars use that view of theory. For example, Feldman and Orlikowski (2011) applies that view of theory as the basis of a discussion of practice theory. Similarly, Majchrzak and Markus (2013) says that 'affordances and constraints theory' (TACT) is a framework.
- Expressing a very different perspective, Weber (2012), Niederman and March (2014) and others restrict the notion of theory primarily to Gregor Type IV theories. Rivard (2014, p. *v*) seems to say that *MIS Quarterly's* Theory and Review Department welcomes Type II theories in addition to Type IV theories. G&L (p. 272) says that 'most published IS theory falls into this Gregor Type IV category and constitutes the main theoretical body of the field's knowledge.'
- In contrast to frequently espoused preferences for Type IV theory, the list of IS theories in the 'Theories Used in IS Research Wiki' (Larsen *et al.*, 2015) posted on the website of the Association for Information Systems includes many sets of concepts that are called theories in the IS discipline even though they are not Type IV theories. Examples include actor-network theory, behavioral decision theory, contingency theory, critical realism theory, evolutionary theory, feminism theory, game theory, general systems theory, institutional theory, sociotechnical theory, soft systems theory and structuration theory. Other widely cited IS-related theories that do not appear in the Wiki and that would not qualify include activity theory, coordination theory and practice theory. Many sets of ideas that are called theories in other fields also would not qualify. Examples from mathematics include group theory, number theory, perturbation theory and set theory.

With this divergence of views about the definition and nature of theory, it is unclear what is meant by any particular repetition of Lewin's aphorism that 'there is nothing more practical than a good theory.' For example, it is often unclear whether the aphorism covers the non-Type IV theories in the 'Theories Used in IS Research Wiki'.

CONCEPTUAL ARTIFACTS

Figure 1 uses 'conceptual artifact' as a blanket term for knowledge that is abstract (in contrast with other knowledge in the form of information, examples or stories). In Bereiter's (2005, pp. 64–65) use of that term, *conceptual* refers to 'discussable ideas, ranging from theories, designs and plans down to concepts, like unemployment and gravity. *Artifact* conveys that these are human creations and that they are created for some purpose. However, being conceptual, they are not concrete artifacts either, as are books, statues and fire hydrants.' Conceptual artifacts have origins and histories; can be described; can be compared with other artifacts; have varied uses; can be valued or judged worthless; may be modified or improved upon; may have unforeseen attributes, uses or defects that may be discovered; and may be understood and used differently by people with different levels of skill (p. 65).

One of the central purposes of most research disciplines is to create, improve and disseminate conceptual artifacts that express or encapsulate knowledge related to questions that the discipline addresses. The various types of conceptual artifacts include not only Gregor Type IV theories but also research questions, paradigms, analogies, myths, concepts, variables, propositions, hypotheses, frameworks, models, metamodels and methods. Many of these appeared in Hassan's (2014) discussion of products of theorizing. The range of different types of conceptual artifacts that are often useful leads to wondering why theory per se has taken on so much importance in the IS discipline, a concern expressed in various ways by Avison and Malaurent (2014), G&L, and others. Perhaps more important, if theory is overemphasized, then it is possible that current institutional practices in the IS discipline underemphasize the value of other types of conceptual artifacts.

BROAD CATEGORIES OF KNOWLEDGE

Figure 1 diverges from dominant views of theory and knowledge in IS by saying that IS knowledge is not limited to abstractions, and certainly isn't limited to theories. Non-abstract knowledge includes information, examples and stories, as will be explained. Abstract knowledge is an umbrella term for various types of conceptual artifacts including research questions, paradigms, analogies, myths, metaphors, concepts, variables, propositions, frameworks, theories, models, metamodels, methods and other types of abstract knowledge objects. Theories can be divided into categories based on the whether and how they are testable. While it is often assumed that theories necessarily must be falsifiable, views of theory mentioned previously imply that falsifiability may matter in some cases but not others, e.g. Schatzki's view of theory as an abstract account and the inclusion of theories for analysis (type I) and theories for design and action (type V) in Gregor's five types of theory. In those instances, comparison of the practical value of different theories when applied for the same purpose may be more significant than falsifiability. Figure 1 also says that some theories are not testable at all, e.g. general systems theory.

The separation in Figure 1 between conceptual artifacts that are or are not theory and are or are not testable leaves room for evaluating conceptual artifacts in many different ways. The starting point for evaluating conceptual artifacts, regardless of whether they are theories, is to decide which criteria apply to the particular kind of conceptual artifact that is being evaluated. A later section will discuss nine criteria that are relevant for evaluating many conceptual artifacts: value, rigor, testability, parsimony, breadth of use, robustness, durability, generativity and source. The range of those criteria reflects the fact that testability is not a synonym of falsifiability.

It is noteworthy that many conceptual artifacts that attract a great deal of attention not only are not theories, but often are not defined rigorously. Three examples are business process reengineering (Hammer & Champy, 1993), agile software development (Beck *et al*., 2001) and Six Sigma (a mélange of tools and methods described by many authors). All three can be viewed as non-rigorous conceptual artifacts because different proponents of each idea describe the overall approaches in relatively vague, sometimes ideological terms that are inconsistent with other descriptions of the same ideas. Counter to the IS discipline's aspiration to achieve both rigor and real world visibility and influence, it sometimes seems that dramatic claims wrapped around vague ideas may have more real world traction than empirical findings from research guided by carefully crafted theories.

The representation of knowledge in Figure 1 and the explanation that follows clarify why perpetuation of the IS discipline's currently dominant view of theory and knowledge unnecessarily limits the discipline's contribution to the world. The reason is simple and straightforward. Focusing mainly on theory, and in particular on Type IV theory, leads to dismissing or underemphasizing many other types of knowledge. This section's discussion of IS knowledge, theories and theorizing calls for moving beyond the current state of affairs described in three statements from G&L:

> '*The dominant way of producing knowledge in information systems* (*IS*) *seeks to domesticate high-level reference theory in the form of mid-level abstractions involving generic and atheoretical information technology* (*IT*) *components*.' (*p. 271*)
>
> 'Most *published IS theory falls into this Gregor Type IV category and constitutes the main theoretical body of the field*'*s knowledge*.' (*p. 272*).
>
> 'Currently, our top level journals and their gatekeepers often view theory as a goal in itself. It is the basic construct of knowledge in the field, and it defines the identity of the field.' (p. 289)

KNOWLEDGE IN THE FORM OF INFORMATION, EXAMPLES AND STORIES

G&L (p. 271) calls for expanding the breadth of IS research by including '*on the one hand*, *inductive*, *rich inquiries using innovative and extensive data sets and*, *on the other hand*, *novel*, *genuine, high-level theorizing around germane conceptual relationships between IT, information and its (semiotic) representations, and social behaviors*.'

G&L's point about 'innovative and extensive' data sets seems unnecessarily limited if a legitimate goal of IS research is to capture, articulate and disseminate valuable knowledge. Consider the following example from the *Journal of the American Medical Informatics Association* concerning barcode medical administration (BCMA) systems, which are designed to make sure that nurses in hospitals administer the right drug in the right dose to the right patient at the right time.

> 'The authors studied BCMA use at five hospitals … [They] identified 15 types of workarounds, including, for example, affixing patient identification barcodes to computer carts, scanners, doorjambs, or nurses' belt rings; carrying several patients' prescanned medications on carts. The authors identified 31 types of causes of workarounds, such as unreadable medication barcodes (crinkled, smudged, torn, missing, covered by another label); malfunctioning scanners; unreadable or missing patient identification wristbands (chewed, soaked, missing); nonbarcoded medications; failing batteries; uncertain wireless connectivity; emergencies. The authors found nurses overrode BCMA alerts for 4.2% of patients charted and for 10.3% of medications charted.' (Koppel *et al*., 2008, p. 408)

The 'mid-range script' (G&L) for publishing in leading IS journals would surely reject Koppel *et al*. (2008) as atheoretical, especially since the term theory appeared only once in the entire article, in a statement about using grounded theory in performing the empirical research. In contrast, respected journals in medicine probably would view this type of article as a contribution to knowledge because of its evident value for medical practitioners. Also, it is unquestionably a contribution to knowledge for researchers interested in workarounds, a phenomenon that is observed frequently in the operation and use of information systems (e.g. 445 citations in Google Scholar within 7 years of publication, including use as an example in Alter (2014), which applied published examples along with aspects of a number of theories as a basis for a theory of workarounds).

It is widely recognized that examples and stories are types of knowledge even if that thought might seem controversial or even taboo in IS journals and in some courses on research methods. For example, an article about the 'untold story' in IS research (Ramiller & Pentland, 2009, p. 474) explains a significant limitation of what it calls the 'variables-centered' research paradigm.

> [That paradigm] 'focuses its attention on covariance among independent and dependent variables. As the predominant research tradition in the [IS] field, the variables-centered paradigm ought to constitute a major platform from which our community can speak to issues of managerial interest. Unfortunately, the variables-centered paradigm appears to distance researchers from the organizational actors, such as managers, to whom they would give advice and counsel. Particularly disturbing is the systematic erasure of those very actors from the domain of inquiry. Erased, too, are their actions and means of acting. Thus, when it comes time to offer useful prescriptions for action, our community attempts to do so on the basis of research in which, ironically, neither actors nor action directly appear.'

Koppel *et al*. (2008) exemplifies how valuable knowledge can take the form of relatively straightforward information, examples and stories, i.e. not just in sophisticated quantitative analysis of large data sets. Another example is the Bay of Pigs invasion in 1961 and the way it illustrates the dangers of groupthink (Janis, 1972). Someone should collect, compare and contrast 100 such examples to develop criteria for explaining the value, legitimacy and publishability of examples and stories as contributions to knowledge in IS.

NATURE OF THEORIZING

Figure 2 is an influence diagram that illustrates how theorizing often produces conceptual artifacts that may or may not be theories. It summarizes aspects of Weick's (1995) view of theory and theorizing, which notes that theory 'belongs to the family of words that includes guess, speculation, supposition, conjecture, proposition, hypothesis, conception, explanation, model.' …. 'If everything from a "guess" to a general falsifiable explanation has a tinge of theory to it, then it becomes more difficult to separate what is theory from what isn't, especially if theory development starts with guesses and speculations and ends with explanations and models' (p. 386). Guess, speculation, supposition and the other terms that Weick associated with theory are conceptual artifacts. Weick also says, 'Products of the theorizing process seldom emerge as fullblown theories, which means that most of what passes for theory in organizational studies consists of approximations" … [involving] interim struggles in which people intentionally inch toward stronger theories.' (p. 385)

Figure 2 represents that process of 'inching' forward, starting with research questions that are influenced by existing knowledge, often are constrained by existing paradigms, and usually reflect a researcher's personal knowledge and motives. Research questions guide theorizing, which often occurs within a paradigm, and typically attempts to produce new or improved conceptual artifacts and/or evaluations of those artifacts. The process of theorizing usually includes a short term feedback loop in which the most recent improvements and/or evaluations influence the current theorizing effort. Successful theorizing also generates new knowledge through a long term feedback loop that augments existing knowledge with new or newly

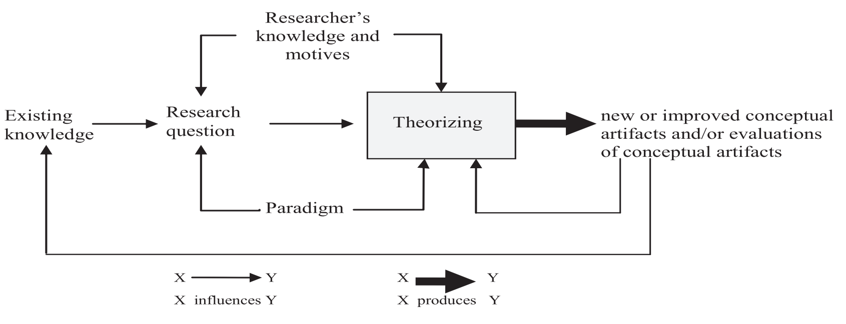

Figure 2. Theorizing produces conceptual artifacts that may or may not be theories.

improved conceptual artifacts and new evaluations of conceptual artifacts. Thus, generally consistent with the spirit of Weick (1995), theorizing may produce and test theories, but it often produces other types of conceptual artifacts that are valuable on their own right. The next section will explain the role of different types of conceptual artifacts in the theorizing related to a specific long-term research project.

AN EXAMPLE: DIFFERENT TYPES OF CONCEPTUAL ARTIFACTS IN THEORIZING RELATED TO WORK SYSTEM THEORY

This section explores the applicability of this paper's view of theorizing (Figure 2) and of conceptual artifacts. It was inspired partly by the way Avison and Malaurent (2014) discussed Schultze (2000) as an example in its analysis of issues related its claim that the emphasis on theory in the IS discipline is exaggerated.

Consistent with Weick (1995) and Hassan (2014), this section illustrates why seeing (Type IV) theory as the main result of theorizing is a myopic view of what theorizing is about and what it accomplishes. It also contributes to doubting whether theory (especially Type IV theory) is either better or more practical than other types of conceptual artifacts.

This section's example is the theorizing that occurred in relation to the body of research involving WST and its applications and extensions to date (Alter, 2013b). Consistent with Figure 2, WST itself can be viewed as just one of the outcomes of a long-term effort to theorize about work systems and related topics.WST consists of three things:

- the definition of work system (p. 75);
- the work system framework (p. 78), which identifies nine elements of a relatively static view of a work system as it operates during a particular time;
- the work system life cycle model (p. 78), which summarizes how work systems change over time through a combination of planned and unplanned change.

The various versions of the work system method (WSM) are applications of WST, not a part of WST (p. 74). Extensions of WST (p. 87) include work system principles, work system design spaces, a work system metamodel and a theory of workarounds, among others.

This section explains how different types of conceptual artifacts played a role, either in theorizing related to WST and its extensions or as a product of that theorizing. It will cite examples based on publications related to WST and will proceed in the same order as Table 2 in the next section, which identifies selected criteria for evaluating conceptual artifacts.

Note that this section and Table 2 discuss 13 types of conceptual artifacts but do not include some of the types mentioned in Weick's (1995, p. 386) previously quoted statement about 'the family of words that includes guess, speculation, supposition, conjecture,' and so on. The types of conceptual artifacts included in the following discussion proved relevant to the development of WST and also are different enough to illustrate the point that theorizing generates many types of conceptual artifacts. Inclusion of other, somewhat overlapping types would have been redundant.

Research question

Alter (2013b, p. 113) describes how the original research question that eventually led to WST was the challenge of developing a systems analysis approach that could be used by typical business professionals. Over time, additional research questions arose, such as how to create a bridge between relatively simple models for business professionals and more rigorous models for IT professionals. The new research questions led to devising the first version of a work system metamodel (Alter, 2010a), which is now in its sixth version after a series of changes to incorporate additional ideas. Those ideas include linkage between provider resources and value for customers, identification of different types of informational entities and inclusion of automated services as a type of actor that performs activities autonomously even within sociotechnical work systems. A quite different research question about how emergent change occurs within a work system's lifecycle led to a theory of workarounds (Alter, 2014).

Paradigm

The central ideas in WSM did not come from formal IS research, but rather from 1992, 1996, 1999 and 2002 editions of an IS textbook (Alter, 2013b, p. 113). The idea of developing a systems analysis method for business professionals did not fit well into the typical paradigms in the IS discipline, such as performing IT-centric systems analysis, studying determinants of whether IT will be used effectively, and or assessing the economic impact of IT. The issue of how to understand systems in organizations from a business viewpoint seemed to reside in an amorphous area somewhere between the disciplines of IS, operations management and general management. A perceived disconnect from established paradigms in the IS discipline led to speculative papers entitled '18 Reasons why IT-Reliant Work Systems Should Replace the IT Artifact as the Core Subject Matter of the IS Field' (Alter, 2003a) and 'Sidestepping the IT Artifact, Scrapping the IS Silo, and Laying Claim to "Systems in Organizations"' (Alter, 2003b).

Almost a decade later, reviewers of an early draft of Alter (2013b), the paper that first articulated WST clearly, expressed serious concerns that the paper did not follow an established research paradigm. As explained in Alter (2015, pp. 497–498) a subsequent draft tried to establish a 'journal-strength justification or packaging' of WST by claiming that in effect it was developed using the paradigm of design science research (DSR). Justification within that paradigm was totally artificial because most of the ideas were developed years before the Hevner *et al*. (2004) paper that established a widely recognized vision for that paradigm. Happily, one of the referees saw little value in the artificial justification, and it was eliminated from the next draft.

Analogy

The idea of developing WSM was based on a direct analogy between IT professionals and business professionals. If IT professionals need systems analysis methods that help them, surely business professionals could use an organized systems analysis method that would suit their needs. That thought was expressed in the title of a paper published more than a decade later, ‘Systems Analysis for Everyone Else: Empowering Business Professionals through a Systems Analysis Method that Fits their Needs.’ (Truex *et al*., 2010).

Myth

The development of WSM was based on what might be viewed as a motivating myth, the unproven belief that business professionals need an organized systems analysis method. The idea of myth also applies to near-mythological names for categories of software such as CRM, ERP and BPM. For example, contrary to their names, CRM software does not manage customer relationships; ERP is not fundamentally about resource planning for an entire enterprise, and BPM software does not actually manage business processes. It would be interesting to pursue that line of thinking through empirical research that explores and contrasts the motivational value and often misleading nature of myths, hype and positioning in the IS discipline, both in academia and in practice.

Metaphor

Alter (2013a, p. 1) reports ‘building on past research highlighting metaphors related to organizations, IS, and projects.’ Metaphor-related publications that inspired the research include Morgan (1986); Kendall and Kendall (1993); Oates and Fitzgerald (2007) and Winter and Szczepanek (2009). Focusing on metaphors eventually led to a broader topic, the possible benefits of ‘considering common, broadly applicable types of subsystems (not standard IS categories such as MIS and DSS) that might provide direction, insight, and useful methods for analysis and design practitioners and researchers.’ The paper identified eight subsystem types (e.g. communication, decision making and control subsystems) that are relevant to many systems in organizations. Each of those subsystem types brings to mind ‘relevant metaphors, concepts, theories, methodologies, success criteria, design tradeoffs, and open-ended questions that could augment current analysis and design practice.’

Concept

WST is based on a series of concepts starting with the definition of work system and the definitions of the terms in its two central frameworks. Extensions of WST such as a set of work system design spaces (Alter, 2010b) identify many concepts for analyzing and designing systems. For example, concepts related to *work system as a whole* include capacity, scalability, resilience and transparency, whereas concepts related to a work system’s human participants include age, skills and interests.

Theorizing related to the work system framework struggled with several basic concepts. Initially, the set of activities performed by a work system were called its *business process*. Later that was changed to *work practices* to minimize confusion between the process as documented vs. the process as performed, and also to avoid assuming that all work systems have well defined processes. *Work practices* was replaced by *processes and activities* because some

MBA students (proxies for potential users of the entire approach) had difficulty using the term *work practices* meaningfully. Another concept that changed was *output*, which sounded computer-oriented, and therefore was changed to *products and services*. Research related to service science led to changing that term to *product/service* to avoid focusing attention on yes/no distinctions between products vs. services. Alter (2012, p. 221) explains why those distinctions are of little use in understanding or improving work systems whose product/services combine some characteristics often associated with products (e.g. tangibility and separation between providers and consumers), and some characteristics that are often associated with services (e.g. customizability and customer experience).

Variable

Some, but not all of the concepts in WST and its extensions, can be viewed as variables. For example, information, technology and processes used in a particular work system are treated as components of a work system rather than as variables that could take on multiple values in a Type IV theory. On the other hand, when analyzing or designing a system it is often useful to think of attributes of its components and of the system as a whole in terms of variables that need to be calibrated. A set of design spaces for sociotechnical systems (Alter, 2010b) identifies relevant variables including how structured a particular work system's processes and activities should be, how complex, how automated, how many people should participate directly and so on.

Proposition

The first extension of WST was a set of 24 proposition-like work system principles that extended the sociotechnical principles of Cherns (1976). Alter and Wright (2010) evaluated the principles using opinions of six small cohorts of Executive MBA students. The criteria were the extent to which cohort members believed that each principle should apply to most work systems in their organizations and the extent to which they believed each principle described how work systems in their organizations actually operated.

Hypothesis

WST and most of its extensions are not stated in terms of explicit hypotheses, although many of them are based on implicit hypotheses of the form 'results of an analysis or design effort would be better if topics X or Y were considered.' For example, a discussion of different versions of WSM (Alter, 2013b, p. 115) expresses the implicit hypothesis that CRM-related design and implementation projects would avoid many pitfalls if project participants and especially project managers viewed the goal as improving a customer-facing work system rather than as an implementation of commercial CRM software with certain features.

Framework

Two of WST's basic components are frameworks: the work system framework and work system life cycle model (Alter, 2013b, p. 78). The latter was given the designation *model* over a decade ago but is more like a framework. An effort to augment the work system framework with more of the spirit of service led to a new framework called the service value chain framework (Alter, 2008). That framework separates customer and provider responsibilities across generic steps in service instances and incorporates ideas such as service interactions, onstage and back stage from service blueprinting (Bitner *et al*., 2008), and value capture by both customer and provider across an entire service instance.

Theory

Whether or not WST is a proper theory is controversial because of disagreements discussed earlier about the definition of theory. Alter (2013b, p. 75) calls WST a theory based on a previously mentioned definition of theory as an abstract account (Schatzki, 2001, pp. 12–13). Niederman and March (2014, p. 350) sees Gregor Type IV theories as the only proper theories and argues that WST is more like an atheoretical model. One of the extensions of WST, a theory of workarounds (Alter, 2014), is a process theory augmented by a set of factors that influence each step.

Model

A basic tool in WSM is a work system snapshot, a tabular one-page summary of a work system identifying customers, product/services, processes and activities, participants, information and technologies (Alter, 2013b, p. 86). Work system snapshots of a particular work system are designed to be useful in preliminary discussions that identify the smallest work system whose problems or opportunities launched the analysis. Models of other types based on techniques such as flow charts, swimlane diagrams and fishbone diagrams are often useful as the analysis unfolds. A commonality across all of those textual and graphical models is that they are approximations to some aspect of reality. In every case, exceptions, workarounds and incompleteness usually are not fully included or explained.

Metamodel

Different versions of a work system metamodel (e.g. Alter, 2010a, 2012, 2015, 2016) are extensions of WST that provide more detailed representations of work system components. Analogous to an online map with zooming capabilities, the less detailed work system framework and the more detailed metamodel are related to each other and can be used for some of the same purposes, but are designed to be especially useful for their own particular purposes. (Note: The designation 'work system metamodel' was initially used to differentiate between the work system framework and a more elaborated version that was similar in form to metamodels produced over many years by many researchers in the German-speaking IS community.)

Method

WSM is a method for describing, analyzing and proposing improvements by identifying the smallest work system that has a set of problems or opportunities. Various versions of WSM have been used in system-related courses at different universities. All of those versions share a common feature of treating a work system as the unit of analysis, describing the ‘as is’ work system, analyzing it and proposing an improved, ‘to be’ work system along with reasons why the changes would be beneficial. As explained in Alter (2013b, 2015), the development of WSM starting in the 1990s, long before the articulation of WST as a theory in 2013. Alter (2015, pp. 496–498.) goes further by explaining how ‘the beneficial effort of clarifying WST’s scope and details started as an attempt to legitimize work system ideas and WSM by the fact that they were based on a theory.’

EVALUATION CRITERIA FOR CONCEPTUAL ARTIFACTS

Many criteria can be used in evaluating conceptual artifacts. Rigor, falsifiability and parsimony are key criteria for theories stated as propositions. Other criteria may be more useful for evaluating other types of conceptual artifacts such as metaphors, models or methods that provide useful but imprecise guidance or insights in many situations. Table 1 presents my highly subjective views regarding the typical importance of each of nine criteria that each apply to many conceptual artifacts even though some may not apply to particular conceptual artifacts.

Table 1 uses an intentionally imprecise 1–2–3 scale because the main point is about the relevance of many different criteria that may be more pertinent in some situations and less pertinent in others. Note also that lists of criteria selected by other researchers surely would overlap with the some of the nine criteria included here, but might eliminate some criteria, might replace some criteria with synonyms and might provide additional criteria. Each criterion in

Table 1. Applicability of criteria to different types of conceptual artifacts

	Value	Rigor	Testability	Parsimony	Breadth of use	Robustness	Durability	Generativity	Source
Research question	3	3	2	3	2	2	2	2	?
Paradigm	3	3	3	2	2	2	2	3	?
Analogy	3	2	2	3	2	1	1	2	?
Myth	3	2	2	2	2	1	1	2	?
Metaphor	3	2	2	3	2	1	1	2	?
Concept	3	3	3	3	2	2	2	2	?
Variable	3	3	3	3	2	3	2	2	?
Proposition	3	3	3	3	2	3	2	2	?
Framework	3	3	2	3	2	3	2	2	?
(Type IV) theory	3	3	3	3	2	3	2	2	?
Model	3	2	3	2	2	3	2	2	?
Metamodel	3	3	3	2	2	2	2	2	?
Method	3	2	2	2	2	2	2	2	?

Scale: *1 = rarely important*; *2 = sometimes important*; *3 = almost always important*

Table 1 will be discussed briefly, with special emphasis on how that criterion is relevant to the discussion of theory and theorizing.

Value

The value of conceptual artifacts is related to whether their use leads to better communication and non-obvious understandings, insights, explanations or predictions. The importance of value does not imply that theorizing produces only valuable conceptual artifacts, however. Consistent with Figure 2, initial phases of theorizing often create conceptual artifacts of little value other than as stepping stones toward more useful ideas.

Rigor

As is discussed repeatedly, much IS research has difficulty achieving both rigor and broad applicability. While rigor is often important, greater rigor may not help in many situations, and may only make ideas more complicated and less understandable or less useful. For example, consider how conceptual artifacts such as UML or BPMN models that can be used for software development often are far too rigorous to be used directly by business professionals. Also note that non-rigorous conceptual artifacts such as the concept of ‘business process engineering’ have received a great deal of attention and have had significant impacts.

Testability

The idea of testability is quite different from falsifiability, a criterion often associated with Gregor Type IV theories but not with Gregor Type I theories for analysis including ‘classification schema, frameworks, or taxonomies.’ For example, testing the usefulness or completeness of models, methods or theories that are basically abstract accounts (Schatzki, 2001) is not fundamentally about whether those conceptual artifacts are true or false in their application to specific situations. In particular, ‘all models are wrong; some are useful’ (attributed to the statistician George Box) because they are models rather than reality itself. Along those lines, Star (2010, p. 608) notes that a particular map of a primate’s brain ‘did not need to be accurate to be useful. It could serve as the basis for conversation, for sharing data, for pointing to things—without actually demarcating any real territory. It was a good communicative device across … worlds of clinical and of basic research.’ Similarly, a heuristic that is not an algorithm may be quite useful even if it does not provide a prescription for many relevant situations.

Parsimony

Conceptual artifacts should be as terse and straightforward as possible, consistent with a comment often attributed to Einstein: ‘Everything should be made as simple as possible, but no simpler.’ A key trade-off is between omitting salient aspects or nuances of an idea by being too simple vs. being unnecessarily complex, and therefore making the idea unnecessarily difficult to use. The criterion of parsimony is especially important for Gregor Type IV theories stated as relationships between variables. Parsimony often matters less for models, metamodels or methods where more complete coverage of multifaceted situations and special cases may be far more significant than parsimony. For example, a metamodel mentioned previously identifies many different types of informational entities. An earlier, more parsimonious version treated information only as a general category. The less parsimonious version is more valuable in analysis and design situations because it reduces the likelihood of ignoring particular types of information that are named in the metamodel because they otherwise might be overlooked.

Breadth of use

The boundaries of applicability of conceptual artifacts should be defined starting with areas of most direct applicability, and also including areas of less useful applicability, and possibly identifying areas where application might be misleading. For example, the widely mentioned technology acceptance model (Davis, 1989) says that perceived usefulness and perceived ease-of-use influence an individual's intention to use an artifact, which in turn affects actual usage. That statement makes sense in situations where usage is voluntary, but is less relevant when usage is mandatory as an essential activity in a work system, e.g. an airline reservation system that reservation agents may or may not like, but must use if they want to do that job.

Robustness

For conceptual artifacts this is a tendency to be appropriate across a specific range of situations and to become less appropriate in more distant situations without generating seriously erroneous results. This is consistent with Star (2010, p. 612) noting that 'all concepts are most useful at certain levels of scale. [For example] the concept of boundary object is most useful at the organizational level.' Similarly, WST is most useful at the level of individual work systems within organizations (e.g. hiring systems and sales systems) and less useful for describing the entirety of large organizations (e.g. the entirety of IBM or Toyota) or the operation of software modules. The robustness of conceptual artifacts that purposefully or accidentally ignore relevant factors is often problematic. For example, the original version of the widely cited IS success model (DeLone & McLean, 1992) basically says that system quality and information quality lead to use and user satisfaction, which lead to individual impact and then organizational impact. That model's lack of robustness is evident from trying to apply it to corporate information systems that suffered security breaches involving millions of user accounts. Those breaches challenge any view that those systems are successful, even if use and user satisfaction may have led to beneficial individual and organizational impacts at some point.

Durability

Ideally, conceptual artifacts should have a long shelf life. Inexorable advances in IT make durability a significant challenge for conceptual artifacts specifically related to IT or its use.

For example, imagine the likely shelf life for the following hypothetical theories that might have seemed reasonably descriptive of real world practices when they were proposed:

- a 1985 theory about how managers use computers;
- a 1990 theory about email;
- a 1995 theory about web sites;
- a 2000 theory about ecommerce;
- a 2005 theory about mobile commerce;
- a 2010 theory about open source;
- a 2015 theory about whatever will change radically in the next 5–10 years.

Even if the hypothetical theories in the list were validated empirically at the times mentioned, there is a good chance that many of them would seem antiquated five or ten years later because the underlying technologies, expectations and practices would have morphed into something quite different. For example, consider the phenomenon of ICT use in the less developed world. It would be interesting to look back and ask what might have been the theories about ICT use in less developed countries in 1985, 1995 or 2005. Stories such as the development of mobile banking in Kenya, the use of social media in the Arab Spring, and the use of mobile phones by migrants during the 2015 migration crisis in Europe easily could have led to more insights and practical understandings than theorizing about related to mobile applications five or ten years earlier.

Notice how the durability issue for IS theories is quite different from the durability issue for theories in the natural sciences, such as physics. In physics, the laws of gravity governing the apple that supposedly fell on Isaac Newton's head would give approximately the same answers today for a similar apple falling on someone else's head in the same place today, three centuries later. In contrast, most non-obvious theories that seemed to describe management use of computers in 1985 probably would have seemed outdated just 10 years later.

Generativity

Part of the value of many conceptual artifacts is in providing a basis for developing other conceptual artifacts and applications of conceptual artifacts. For example, agency theory and institutional theory have had a broad range of applications, as do many individual concepts such as agility, control, affordance, 'anywhere, anytime', service and value. It is difficult to evaluate the potential generativity of a conceptual artifact in advance, just as it is difficult to anticipate how users may use or adapt products in ways that were never imagined by product designers.

Source

The source of conceptual artifacts matters in the IS discipline in several ways. The refereeing of research papers often pays great attention to where conceptual artifacts came from, and sometimes rejects ideas that are not linked directly to previously published theories. Also, the IS discipline often is concerned with whether theories are 'native theories' (Straub, 2012) vs.

'reference theories' which sometimes are called imported, exotic or introduced theories. (G&L, p. 272). The question marks in Table 1 in the column for *source* reflect my view that excessive concern about the disadvantages of importing ideas from other disciplines may be substantively counterproductive even if that concern may be expedient in academic politics. On the other hand, G&L notes that 'when the adopted reference theory is broad, the [mid-range] script is likely to garner a growing number of diverging theoretical interpretations which, as a result, even when the same theory is being deployed, gradually fill IS research with incommensurate mid-level research models and confounding results.' (p. 279)

KNOWLEDGE AND ABSTRACTION, NOT THEORY PER SE

This paper contributes to the discussion of theory and theorizing in the IS discipline by introducing and applying the idea of conceptual artifact as elaborated by an educational psychologist (Bereiter, 2005, pp. 64–65). Overall, it explains and illustrates the four premises stated at the outset:

Non-abstract and abstract knowledge

Figure 1 subdivided knowledge into non-abstract knowledge and abstract knowledge consisting of conceptual artifacts that may or may not be theories. Contrary to frequently repeated textbook distinctions between data, information and knowledge, this paper's example of different types of workarounds of BCMA systems illustrated that information, examples and stories may constitute valuable knowledge even in the absence of theory. G&L's recognition of the value of data-driven research (p. 285) is generally consistent with that view, although possibly with more ambitious aspirations.

Relevance of many types of conceptual artifacts for theorizing

The example of different types of conceptual artifacts in theorizing related to WST and its extensions illustrated that many different types of conceptual artifacts can be products of theorizing and can be useful or essential in subsequent theorizing.

Uses, strengths and shortcomings of conceptual artifacts

The introduction to the idea of conceptual artifacts noted that conceptual artifacts are purposeful creations that can be described, compared with other artifacts, valued or judged worthless; modified or improved upon; may have unforeseen attributes, uses or defects that may be discovered; and may be understood and used differently by people with different levels of skill. The example of WST and its extensions illustrated most of those points. The previous section discussed nine criteria for evaluating conceptual artifacts, emphasizing that typical criteria for evaluating Type IV theories are not sufficient for evaluating all conceptual artifacts.

Non-primacy of theory

The possibility that the IS discipline over-emphasizes theory leads to asking whether there is any reason to believe that theories are better than other types of conceptual artifacts in relation to maximizing the business and societal value of IS research. In relation to that question, this paper noted (1) there is significant disagreement about what theory means, (2) many conceptual artifacts that are called theories in the academic IS discipline do not qualify as theories by some widely accepted definitions of theory and (3) many other types of conceptual artifacts are important if the goal is knowledge creation. Regardless of how many times researchers repeat Lewin's aphorism that 'there is nothing more practical than a good theory,' without looking up the original source it is not obvious whether Lewin was talking about Type IV theories, about the full range of theories in Gregor (2006), or about something even more general.

One way to explore whether theory deserves primacy in relation to other conceptual artifacts, i.e. that 'theory is king' (subtitle in Straub, 2009), is to collect a substantial number of examples and anecdotes illustrating that theories should be considered superior to other types of conceptual artifacts. Table 2 presents counterexamples (most cited in Alter, 2015) suggesting that theory may not be better in general than other types of conceptual artifacts. While those counterexamples might seem cherry-picked, they still present a direct challenge to the possibly excessive primacy of theory in the IS discipline. The challenge is to find a set of convincing examples that illustrate how theory, especially Type IV theory, is more important than other types of conceptual artifacts for addressing significant questions related to the creation, operation and evolution of information systems. The examples should be directly relevant to the IS discipline and should not use physics theories such as relativity, Maxwell's equations or quantum mechanics to demonstrate the centrality of theory in IS.

SUGGESTIONS FOR APPLYING THIS PAPER'S IDEAS

The following list contains suggestions for applying the ideas presented here. Ideally, some of the more controversial suggestions in the list will encourage positive or negative responses that will move the entire discussion forward.

Table 2. Examples suggesting that theories may not be better than other types of conceptual artifacts

Concepts without formal theory. Many of the most important developments related to creating and implementing software systems in organizations were based on concepts but not on theories. Examples include most software development techniques (e.g. entity relationship models) and methods (e.g. agile development).
Theories, **frameworks**, **models**. The 2009 Nobel Prize speech by the economist Eleanor Ostrom specifically mentioned relationships between frameworks, theories and models in her research and contained no implication that theories are more important than frameworks or models in her research. (Ostrom, 2009)
Theories vs. **methods**. In an analysis of Nobel Prizes in physics, chemistry and medicine between 1991 and 2011, Greenwald (2012, p. 102) found that 82% cited contributions to methods and only 18% cited contributions to theory.
Theory vs. **concepts**. The winner of the 2013 Turing Award, the most distinguished award in computer science, noted that he received the award because of concepts related to distributed systems that he helped develop, and specifically not because of theoretical contributions. (McGoneal, 2014)
A '**world view**,' **not a theory**. As demonstrated by over 8100 citations since it was first published, Vargo and Lusch's (2004) first article on service dominant logic has been discussed and cited extensively by scholars in marketing and related fields. The article presents eight 'foundational premises' of a 'worldview,' not a theory.

1) Question this paper's implication that knowledge is king, not theory

As noted at the outset, the on-going discussion of theory in the IS discipline includes views ranging from 'theory is king' (subheading in Straub, 2009) to Avison and Malaurent's (2014) argument that theory has become a fetish in IS. This paper's contribution to the discussion implies that knowledge is king, not theory. Figure 1 distinguishes between non-abstract knowledge (e.g. useful examples, stories and information) and abstract knowledge (i.e. useful conceptual artifacts of various types that include theory and many others). Addressing related issues in a more complicated way, design science research (e.g. Hevner *et al*., 2004) broadens the 'IT artifact' in IS research to include '*constructs* (vocabulary and symbols), *models* (abstractions and representations), *methods* (algorithms and practices) and *instantiations* (implemented and prototype systems).' Instead of taking for granted that theory is king, it is worthwhile to specify what the kingship of theory might mean, e.g. by specifying which types of theory deserve to be part of the royal family and in particular whether design theories are genuine royals or are just pretenders. If yes, why? If no, why not?

2) Validate the kingship of theory, if possible

If the kingship of theory is to continue, then theory's reign should be legitimized based on something other than traditional expectations that are more applicable to the natural sciences than to Simon's (1996) sciences of the artificial. Proponents of the kingship of theory should take up the challenge implied by Table 2, whose examples suggest that theories may not be better than other types of conceptual artifacts. The challenge is to provide examples that illustrate that theory is better or more important in relation to generating value from IS research.

3) Challenge the kingship of theory in new ways

Proponents of a transition from the kingship of theory toward a broader recognition of the value of different types of knowledge should extend or otherwise improve on this paper's ideas about the importance and evaluation of different types of conceptual artifacts. They should provide examples illustrating how to properly recognize and evaluate research contributions that demonstrate the validity and value of different types of conceptual artifacts.

4) Apply this paper's types of conceptual artifacts and evaluation criteria to existing theories in IS

Explore how this paper's ideas can be applied to important theories from the 'Theories Used in IS Research Wiki' (Larsen *et al*., 2015) or other sources. The list of theories might include activity theory, agency theory, coordination theory, institutional theory, the resource based view, sociotechnical theory and so on. For each theory, identify and classify conceptual artifacts that are most relevant to the theory's form and application. Evaluate each theory using the evaluation criteria in Table 1 or an improved set of criteria. The result could include greater clarity about the selected theories and greater clarity about whether the typical criteria of rigor, parsimony and falsifiability are adequate for evaluating the theories that are actually used in much IS research.

5) Explore specific evaluation criteria in depth

Apply criteria such as durability or robustness to a set of IS-related theories and identify factors that determine their durability or robustness. It may turn out that the most durable or robust theories are those that say the least about IT in general or about any particular type of technology.

6) Elevate examples, stories and information as research contributions

As suggested earlier, someone should compare, and contrast 100 inherently valuable examples, stories and other instances of non-abstract knowledge. This would be a step toward developing criteria related to recognizing, legitimizing and rationalizing the publishability of non-theoretical contributions to IS knowledge.

A BROADER VIEW OF KNOWLEDGE CREATION

Overall, this paper supports the conclusion that theorizing is essential for research and that theorizing produces, uses or evaluates various types of conceptual artifacts, some of which are not theories. Yes, good theory is certainly practical, but the same can be said for good conceptual artifacts of any type—good frameworks, models, metaphors, paradigms and so on. It is also true that good information, examples and stories can be quite practical.

If the real goal is to build knowledge, and not just to maintain appearances, then researchers and practitioners should welcome any abstract and non-abstract knowledge that is genuinely valuable. Philosophical debates about the nature of a proper theory certainly can continue, but it would be good to have a parallel set of discussions about how to make all types of abstract and non-abstract knowledge as valuable as possible.

Treating theory (especially Type IV theory) as an ultimate accomplishment in IS is based on tradition, training, academic politics and other factors that may not be substantively related to maximizing the IS discipline's real world value and impact. While theory is obviously important, and while it is obviously important for researchers to understand the value of theory, overemphasis on theory and/or unnecessarily narrow views of theory may result in underplaying the value of other types of conceptual artifacts. It is not at all apparent that privileging theory over other types of conceptual artifacts is beneficial in pursuing the research questions that the IS discipline needs to study at a time of rapid social and technological change.

REFERENCES

Alter, S. (2003a). "18 reasons why IT-reliant work systems should replace the IT artifact as the core subject matter of the IS field," *Communications of the Association for Information Systems*, **12**, 365–394.

Alter, S. (2003b). "Sidestepping the IT artifact, scrapping the IS silo, and laying claim to 'systems in organizations'," *Communications of the Association for Information Systems*, **12**, 494–526.

Alter, S. (2008). "Service system fundamentals: work system, value chain, and life cycle," *IBM Systems Journal*, **47**, 71–85.

Alter, S. (2010a) "Bridging the chasm between sociotechnical and technical views of systems in organizations," *Proceedings of ICIS 2010*, *the 31st International Conference on Information Systems*. St. Louis, USA.

Alter, S. (2010b) "Design spaces for sociotechnical systems," *Proceedings of ECIS 2010*, *the 18th European Conference on Information Systems*, Pretoria, South Africa.

Alter, S. (2012). "Metamodel for service analysis and design based on an operational view of service and service systems," *Service Science*, **4**, 218–235.

Alter, S. (2013a) "Incorporating more system-related knowledge into systems analysis and design," *Proceedings of the 19th Americas Conference on Information Systems*, Chicago, USA.

Alter, S. (2013b). "Work system theory: overview of core concepts, extensions, and challenges for the future," *Journal of the Association for Information Systems*, **14**, 72–121.

Alter, S. (2014). "Theory of workarounds," *Communications of the Association for Information Systems*, **34**, 1041–1066.

Alter, S. (2015). "Work system theory as a platform: response to a research perspective article by Niederman and March," *Journal of the Association for Information Systems*, **16**, 483–514.

Alter, S. (2016). "Encapsulation as a key concern for analysis and design of service systems," *Proceedings of the 22nd Americas Conference on Information Systems*, San Diego, USA.

Alter, S. and Wright, R. (2010). "Validating work system principles for use in systems analysis and design," *Proceedings of ICIS 2010*, *the 31st International Conference on Information System*s.

Ashby, W.R. (1956) *An Introduction to Cybernetics*. Chapman & Hall, London.

Avison, D. and Malaurent, J. (2014). "Is theory king?: questioning the theory fetish in information systems," *Journal of Information Technology*, **29**, 327–336.

Beck, K., *et al*. (2001). *Manifesto for Agile Software Development*, http://www.agilemanifesto.org/

Bereiter, C. (2005) *Education and Mind in the Knowledge Age*. Routledge.

Billig, M. (2015) Kurt Lewin's leadership studies and his legacy to social psychology: is there nothing as practical as a good theory?". *Journal for the Theory of Social Behavior*, **45**, 440–460.

Bitner, M. J., Ostrom, A. and Morgan, F., (2008). "Service blueprinting: a practical technique for service innovation," *California Management Review*, **50**, 66–94.

Burnes, B. and Cook, B. (2013). "Kurt Lewin's field theory: a review and re-evaluation," *International Journal of Management Reviews*, **15**, 408–425.

Campbell, J.P. (1990) The role of theory in industrial and organizational psychology, In: *Handbook of Industrial and Organizational Psychology*, Dunnette, M.D. & Hough, L.M. (eds), **1** pp. 39–74. Consulting Psychologists Press, Palo Alto, CA.

Cherns, A. (1976) Principles of socio-technical design. *Human Relations*, **2**, 783–792.

Colquitt, J.A. & Zapata-Phelan, C.P. (2007) Trends in theory building and theory testing: a five-decade study of the Academy of Management Journal. *Academy of Management Journal*, **50**, 1281–1303.

Compeau, D. R. and Olivera, F. (2014). "From 'theory light' to theorizing: a reaction to Avison and Malaurent," *Journal of Information Technology*, **29**, 346–349.

Davis, F.D. (1989). "Perceived usefulness, perceived ease of use, and user acceptance of information technology," *MIS Quarterly*, **13**, 319–340.

DeLone, W.H. & McLean, E.R. (1992) Information system success: the quest for the dependent variable. *Information System Research*, **3**, 60–95.

Delone, W.H. and McLean, E.R. (2003). "The DeLone and McLean model of information systems success: a ten-year update," *Journal of Management Information Systems*, **19**, 9–30.

Deutsch, M. (1968). "Field theory in social psychology," *The handbook of social psychology*, **1**, 412–487

DiMaggio, P.J. (1995) Comments on "what theory is *not*.". *Administrative Science Quarterly*, **40**, 391–397.

Feldman, M., and Orlikowski, W. (2011). "Theorizing practice and practicing theory," *Organization Science*, **22**, 1240–1253

Greenwald, A. G. (2012) "There is nothing so theoretical as a good method," *Perspectives on Psychological Science*, **7**, 99–108.

Gregor, S. (2006) "The nature of theory in information systems," *MIS Quarterly*, **30**, 611–642.

Gregor, S. (2014) Theory—still king but needing a revolution!. *Journal of Information Technology*, **29**, 337–340.

Grover, V. and Lyytinen, K. (2015). "New state of play in information systems research: the push to the edges," *MIS Quarterly*, **39**, 271–296.

Hammer, M. and Champy, J. (1993). *Reengineering the Corporation: A Manifesto for Business Revolution*, Harper Business.

Hassan, N. R. (2014). "Products of theorizing," Proceedings of ICIS 2014, the 35th International Conference on Information Systems.

Henfridsson, O. (2014). "The power of an intellectual account: developing stories of the digital age," *Journal of Information Technology*, **29**, 356–357.

Hevner, A., March, S.T., Park, J. & Ram, S. (2004) Design science in information systems research. *MIS Quarterly*, **28**, 75–105.

Janis, I.L. (1972) *Victims of Groupthink: A Psychological Study of Foreign Policy Decisions and Fiascoes*. Boston, MA, Houghton Mifflin.

Kendall, J.E. & Kendall, K.E. (1993) Metaphors and methodologies: living beyond the systems machine. *MIS Quarterly*, **17**, 37–47.

Koppel, R., T. Wetterneck, J. L. Telles, *and* B-T. Karsh (2008) "Workarounds to barcode medication administration systems: their occurrences, causes, and threats to patient safety", *Journal of the American Medical Informatics Association*, **15**, 408–423.

Larsen, K. R., Allen, G., Vance, A., Eargle, D. (Eds.) (2015). "*Theories Used in IS Research Wiki*." Retrieved Mar. 15, 2016 from http://is.theorizeit.org/.

Lee, A.S. (2014) Theory is king? But first, what is theory? *Journal of Information Technology*, **29**, 350–352.

Lewin, K. (1943/1999). "Cassirer's philosophy of science and the social sciences" In M. Gold (ed.) *The Complete Social Scientist: A Kurt Lewin Reader* (pp. 23–36). Washington, DC: American Psychological Society.

Majchrzak, A. & Markus, M.L. (2013) Technology affordances and constraints theory (of MIS), In: *Encyclopedia of Management Theory*, Kessler, E.H. (ed), pp. 832–836. Sage Publications.

Markus, M.L. (2014) Maybe not the king, but an invaluable subordinate: a commentary on Avison and Malaurent's advocacy of 'theory light' IS research". *Journal of Information Technology*, **29**, 341–345.

McGoneal, J. (2014). Leslie Lemport '60: Turing winner loves to solve practical problems," *MIT News Magazine*, Aug. 19, 2014

Morgan, G. (1986) *Images of Organization*. Sage, Thousand Oaks, CA, USA.

Niederman, F. and March, S. (2014). "Moving the work system theory forward," *Journal of the Association for Information Systems*, **15**, 346–360.

Oates, B.J. & Fitzgerald, B. (2007) Multi-metaphor method: organizational metaphors in information systems development. *Information Systems Journal*, **17**, 421–339.

Ostrom, E. (2009). "*Beyond Markets and States: Polycentric Governance of Complex Economic Systems*," Nobel Prize Lecture, Stockholm, Sweden

Parlet, M. (1991). "Reflections on field theory," *The British Gestalt Journal*, **1**, 68–91.

Ramiller, N. C. and Pentland, B. T. (2009). "Management implications of information systems research: the untold story," *Journal of the Association for Information Systems*, **10**, 474–494.

Rivard, S. (2014). "The ions of theory construction," *MIS Quarterly*, **38**, iii–xiii.

Schatzki, T.R. (2001). "Practice theory," pp.1–14 in Schatzki T.R., Knorr Cetina, K. and von Savigny, E. (eds.) *The Practice Turn in Contemporary Theory*. London: Routledge.

Schultze, U. (2000). "A confessional account of an ethnography about knowledge work," *MIS Quarterly*, **24**, 3–41.

Shannon, C. (1948), "A mathematical theory of communication," *The Bell System Technical Journal* **27**, 623–656.

Silverman, D. (2014). "Taking theory too far? A commentary on Avison and Malaurent," *Journal of Information Technology*, **29**, 353–355.

Simon, H.A. (1996) *The Sciences of the Artificial*. MIT Press.

Star, S. L. (2010). "This is not a boundary object: reflections on the origin of a concept," *Science, Technology & Human Values*, **35**, pp. 601–617.

Straub, D. W. (2009). "Editor's comments: why top journals accept your paper," *MIS Quarterly*. **33**, iii–ix.

Straub, D. W. (2012). "Editorial: does MIS have native theories," *MIS Quarterly*, **36**, iii–xii.

Sutton, R. I. and Staw, B. M. (1995). "What theory is not," *Administrative Science Quarterly*, **40**, 371–384.

Truex, D., Alter, S. and Long, C. (2010). "Systems analysis for everyone else: empowering business professionals through a systems analysis method that fits their needs," Proceedings of 18th European Conference on Information Systems, Pretoria, South Africa

Vargo, S. L., and R. F. Lusch (2004). "Evolving to a new dominant logic for marketing," *Journal of Marketing*, **68**, 1–17.

Von Bertalanffy, L. (1973). *General System Theory* (Rev. ed.), George Braziller, New York.

Weber, R. (2012). "Evaluating and developing theories in the information systems discipline," *Journal of the Association for Information Systems*, **13**, 1–30.

Weick, K.E. (1995). "What theory is not, theorizing is," *Administrative Science Quarterly*, **40**, 385–390.

Winter, M. & Szczepanek, T. (2009) *Images of Projects*. Gower Publishing Ltd., Farnham, England.