Information Systems Design Science Research and Cumulative Knowledge Development: An Exploratory Study

Completed Research Paper

Introduction

> *The value of an IS design theory is to reduce developers uncertainty [...] and to stimulate research.* (Markus et al. 2002, p. 181)

Design Science Research (DSR) in Information Systems (IS) has gained considerable attention over the past few decades. Much of this attention has been placed on its dual objective (Gregor and Hevner 2013; Hevner et al. 2004; March and Smith 1995; Simon 1969, p. 3): (1) to develop useful artefacts that can be deployed in practice, i.e., to provide utility, and (2) to contribute generalizable knowledge to the IS' knowledge base in a cumulative way. Part of this debate within the IS-DSR community focused on whether creating abstract knowledge about IS artefacts (i.e., constructs, methods, models, and instantiations) (March and Smith 1995) in the form of design theory is a legitimate concern that should be pursued (Gregor and Hevner 2013; Hevner et al. 2004; March and Smith 1995; Markus et al. 2002; Walls et al. 1992). In the pursuit to advance design theories, an extensive set of literature has been published, offering multiple conceptualizations of how design theory should be structured (cf. e.g., Gregor and Jones 2007, and Kuechler and Vaishnavi 2012), how it can be evaluated (cf. e.g., Weber 2012), and how it can be developed (cf. e.g., Mandviwalla 2015). Further agreement exists on design theories' potential to foster the building of a cumulative body of knowledge (Gregor and Jones 2007; Niederman and March 2012), a task which the IS discipline should strive for (Chandra Kruse et al. 2016; Keen 1980). Cumulative knowledge development occurs when researchers "build on each other's and their own previous work" (Keen 1980, p. 13). Concerning knowledge in IS, Hevner et al. (2004, p. 80) propose a broad conception of the 'knowledge base', comprised of 'foundations' (e.g., theories, models, methods) and 'methodologies' (e.g., techniques, measures). With this conception in mind, we explicitly distinguish questions of domain knowledge (Gregor 2006) from meta-level knowledge. While the former comprises knowledge on the problem and solution space investigated by IS research, the latter refers to, e.g., methodology, ontology, or epistemology. In this paper, we are interested in the creation, validation or application of domain-level knowledge, as opposed to meta-level knowledge that describes what IS(-DSR) research *is* or *how it should be done* (Wagner et al. 2017).

Although many theorists and methodologists recognize the potential of design theories to contribute to the building of a cumulative body of knowledge (cf. e.g., Gregor and Jones 2007), very little is known about how subsequent research builds on design theories, or in fact any other artefact produced by IS-DSR. One example of conceptualizing cumulative knowledge development is a study by Offermann et al. (2011). The authors describe what type of design knowledge lends itself, in their words, to be 're-used' and devise strategies on how to accomplish this. The resulting types of possible knowledge reuse are an important first step toward understanding and analyzing cumulative knowledge development through the building on IS-DSR artefacts in general and IS design theories in particular. Another example is a paper by Niederman and March (2012), who discuss the accumulation of knowledge in the IS discipline from a philosophical perspective. For example, in their view, research must better consider both perspectives of IS, i.e., design science and behavioral science, to produce a more integrative as well as cumulative body of IS knowledge. These philosophical and conceptual papers are yet to be complemented by a more comprehensive empirical analysis of cumulative knowledge development through building on IS-DSR.

The scarcity of research into the building of a cumulative body of IS knowledge, in particular through design theories, is quite startling, considering the importance of this collective objective. In this regard, the statement by Keen (1980, p. 9) is as relevant today as it was at the time of publication: "Unless we build on each other's work, a field can never emerge, however good individual fragments may be." In the same vein, Gregor and Jones (2007, p. 331) argue that accumulating the abstract type of knowledge provided by design theories may assist "with raising our discipline above the craft-level." The lack of insights into the degree to which subsequent research has built on design theories leaves open questions regarding the evidence that has been accumulated on different design theories. This may also limit our capacity to communicate cumulative knowledge contributions of and stimulated by design theories to practice in an informed way.

To investigate how and to which extent subsequent research builds on extant design theories, we adopt the established build and evaluate cycle (Hevner et al. 2004), which offers a useful schema for capturing cumulative knowledge development. The iterative process comprises building and evaluating activities, in which continuous (re-)conceptualization, building, testing and subsequent refinements mutually inform each other until a satisficing solution is obtained (Hevner et al. 2004; March and Smith 1995; Markus et al. 2002; Simon 1969). This process applies to the construction of artefacts (Hevner et al. 2004) and the development of design theories alike (cf. e.g., Abbasi and Chen 2008 and Markus et al. 2002). In line with Hevner et al. (2004), we contend that this process should not be restricted to a paper level; rather, in order to build a cumulative body of knowledge, IS research needs to extend this cycle to future research by building on previous work. Similarly, Gregor and Hevner (2013, p. 345) note that "theory building and theory testing activities [are] part of an overarching research cycle."

We believe that Hevner et al.'s (2004, p. 80, Figure 2) IS research framework, which explicates that IS research draws from and adds to the IS knowledge base, is broad enough yet sufficiently clear in the sense that it can be considered appropriate for our purpose, that is, to track the cumulative knowledge development in IS. Specifically, we intend to analyze the presence of a cumulative build and evaluate cycle resulting from design theories. Considering the paucity of insights into the cumulative knowledge development through design theories, we thus pose the following research question:

> *How and to what extent has subsequent research tested and extended Information Systems design theories?*

To address this research question, we select qualitative citation content analysis as a methodological approach, which is appropriate to provide insights into *how* and *to what extent* subsequent research has built on IS design theories (ISDTs). As a basis for this analysis, we identified a set of seven ISDTs and then conducted a forward search for citing papers. Subsequently, we performed the actual citation content analysis considering both the design theories and each citing paper. Since investigate the building on domain-level knowledge, our analysis focuses on two main qualitative categories, namely *testing* and *extending*. Both testing and extending are deliberately broad and open to include conceptual as well as empirical usage types. Considering the above arguments, the two categories are firmly based in the general IS-DSR cycle of build and evaluate (Hevner et al. 2004) or generate and test (Simon 1969).

Our first contribution is the synthesis of literature, including recommendations of methodologists and theorists, on knowledge accumulation and its mechanisms in IS-DSR, in particular through ISDTs. We note a lack of attention on this issue, specifically regarding analyses of actual knowledge development and guidelines that facilitate follow-up research on ISDTs. The main contribution of the paper is to explore how follow-up research tests and extends ISDTs. We thereby offer the first empirical analysis of how and to what extent ISDTs have been used by follow-up research. The analysis uncovers an alarming paucity of follow-up research. We provide additional qualitative insights into the process of cumulative knowledge development and discuss why the paucity of research testing and extending ISDTs constitutes a critical issue. Overall, we further contribute to the discourse on DSR in IS by proposing specific guidelines for strengthening (cumulative) knowledge development. These guidelines for ISDTs and follow-up research specify how authors, reviewers and editors can facilitate the cumulative extension of the IS knowledge base.

The remainder of this paper is structed as follows: First, an overview of work that is relevant to this study is presented. Here we define what we mean by IS-DSR, design theory, and cumulative knowledge development. Next follows a detailed description of our methodological approach, including a description of the data collection and coding process. We then present and discuss our results. Following this, we devise guidelines, and present limitations of this study as well as future research opportunities in the penultimate section. The last section concludes this paper.

Related Work

In this section, we review work related to DSR in IS with a particular focus on role of design theory. Finally, we define what we mean by (cumulative) knowledge development and outline how it can be analyzed.

Information Systems Design Science Research

Design Science has become a key research stream in IS and now complements behavioral IS research (cf. e.g., Hevner et al. 2004). The first of two objectives of IS-DSR, as a *science of the artificial* (Simon 1969), is to create artefacts that work in the 'real world' and provide utility (Hevner et al. 2004; March and Smith 1995). At the core, IS-DSR is an interventionist, practice-based research stream, which distinguishes it from other disciplines that seek to explain phenomena. Despite the practice-based orientation of IS-DSR, it is a *scientific* mode of inquiry. Thus, its second objective is to contribute to a cumulative body of (design) knowledge (Hevner et al. 2004; March and Smith 1995). These two objectives can aptly be framed in the notion of relevance and rigor (Hevner et al. 2004). While relevance refers to providing utility to certain stakeholders, rigor refers to fulfilling scientific standards. To be more precise, artefact construction must be firmly grounded in theory or any other kind of (design) knowledge, including intuition and practice-based experience (Hevner et al. 2004).

The general process of artefact construction involves building a novel artefact (e.g., an instantiation, method or model) and evaluating it (Hevner et al. 2004; March and Smith 1995). The design process usually iterates between further refinements and evaluations until a satisficing solution is found (Hevner et al. 2004; Markus et al. 2002; Simon 1969). Designers aim at both novelty and abstractness of their knowledge contributions. Design science research develops novel artefacts by devising new or better solutions to known or hereto forth unknown problems. This distinguishes it from routine design, which applies known solutions to known problems[1], (Gregor and Hevner 2013). The abstractness of IS-DSR output can be distinguished according to three levels (Gregor and Hevner 2013, p. 342): Level 1 comprises the least abstract IS-DSR knowledge and is represented by 'situated implementations of an artefact', e.g., a tool or an applied algorithm; level 2 comprises 'nascent design theory' in the form of constructs, methods, models and design principles (March and Smith 1995; Markus et al. 2002); level 3 comprises the most abstract and 'mature' type of knowledge in the form of design theories.

To tie the synthesis of IS-DSR to the purpose of this study, the statement by Chandra Kruse et al. (2016, p. 39) is insightful: "The contextual nature of design poses a challenge for the creation and use of codified design knowledge (e.g., in the form of design principles), and thus for the development of a cumulative body of design knowledge" The abstract type of knowledge provided by design theories is expected to assist in tackling the challenges faced by IS-DSR in terms of generalizing its contributions so as to better facilitate cumulative knowledge development.

Design Theory in Information Systems Design Science Research

The debate on the nature, purpose, and components of IS design theory is still evolving. Nevertheless, agreement exists on several grounds. First, design theory is considered a legitimate output of IS-DSR (cf. e.g., Baskerville and Pries-Heje 2010, Gregor and Hevner 2013, and Kuechler and Vaishnavi 2012). As this is *one* of several valid types of output, further types exist, such as situated artefacts that are not complemented with theoretical knowledge but provide a novel solution to a known or yet unknown problem (Gregor and Hevner 2013). Second, design theories are thought to foster the building of a cumulative body of knowledge (Gregor and Jones 2007; Niederman and March 2012), a point which will be elaborated in the next subsection. Third, it is generally accepted that design theory is prescriptive in nature (Gregor and Jones 2007; Gregor 2006; Walls et al. 1992). Even though some academics have proposed design theory for explanatory purposes, they stress that this goal complements rather than opposes prescriptive frameworks (cf. e.g., Baskerville and Pries-Heje 2010, and Kuechler and Vaishnavi 2012). In the following, we present prominent conceptualizations of design theory and discuss their objectives.

The first widely recognized conceptual formulation of IS design theory can be attributed to Walls et al. (1992). The authors proposed a framework for IS design theory (ISDT) comprising four prominent components: (1) meta-requirements (a class of goals to be achieved), (2) meta-design (a class of proposed design solutions satisfying the meta-requirements), (3) kernel theories (natural or social science theories informing the design requirements and providing the boundaries for the design), (4) testable product

[1] Vaishnavi and Kuechler (2015) further distinguish between design science (knowledge in the form of, e.g., constructs or models), design science research (the activity that generates design knowledge), and design research (research into or about design itself).

hypotheses (a set of hypotheses for validating whether the meta-design satisfies the meta-requirements). As goal achievement is intrinsic to design theories, they go beyond explanatory, normative or predictive theories in prescribing the 'how to/because' of artefact construction (Walls et al. 1992, p. 41). In their *The Anatomy of a Design Theory,* Gregor and Jones (2007) prominently extend Walls et al.'s (1992) original framework. In doing so, Gregor and Jones emphasize additional and refined components, such as artifact mutability, justificatory knowledge and expository instantiations. Kuechler and Vaishnavi (2012) take a different perspective on design theory and propose *Design Relevant/Explanatory Predictive Theory* (DREPT), thus complementing the prescriptive purpose of design theory. DREPT focuses on an explanatory objective by elaborating on the role of kernel theories in Walls et al.'s (1992) framework and providing a description of how to derive explanatory statements from kernel theories.

Definition and Analysis of Cumulative Knowledge Development

Consistent with the literature, we conceive cumulative knowledge development as occurring when researchers "build on each other's and their own previous work." (Keen 1980, p. 13) By proposing the notion of the 'knowledge base', Hevner et al. (2004) provide a broad understanding and definition of knowledge within IS. According to this view, the knowledge base is shared by both IS design science and behavioral science research and comprises foundations (e.g., theories, models, methods) and methodologies (e.g., techniques, measures). Thus, both research streams draw on the common knowledge base and contribute back to it. Similarly, Gregor and Hevner (2013) note that IS knowledge comprises two general types of knowledge: descriptive (Ω) knowledge, which characterizes and classifies "natural, artificial, and human-related phenomena" (p. A2) and describes how to make sense of them; and prescriptive (Λ) knowledge, which explicates how to achieve a certain goal. This type of knowledge comprises constructs, models, methods, instantiations, and design theories (Gregor and Hevner 2013, p. A3). Having both concepts in mind (i.e., the 'knowledge base' as well as Ω and Λ knowledge), we explicitly distinguish questions of domain knowledge (Gregor 2006) from meta-level knowledge. While the former comprises knowledge on the problem and solution space investigated by IS research, the latter refers to, e.g., epistemology (March and Smith 1995) theory development (Gregor and Jones 2007), or evaluation guidelines and taxonomies describing how IS-DSR output can be evaluated (Prat et al. 2015). Since the focus of this study is on domain-level knowledge, we will not further discuss other levels of knowledge development.

Both Hevner et al. (2004) and Gregor and Hevner's (2013) conceptualizations of knowledge highlight that design science and behavioral science in IS are interdependent and that both research streams inform each other. This is in line with other literature that aims at bridging the gap between design science and behavioral science research in the IS field. For example, as noted before, Niederman and March (2012) stress the importance of integrating both perspectives when conducting IS research. One line of reasoning is that, as IS research is conducted at the intersection of people, organizations, and technology (Davis and Olson 1984; Hevner et al. 2004), both research streams develop and investigate *socio-technical* artefacts (Gregor and Hevner 2013). IS research, then, should neither ignore the social embeddedness of artefacts nor their technical complexity (Niederman and March 2012). Therefore, distinguishing between knowledge that is advanced by either design science or behavioral science research is not necessary when analyzing cumulative knowledge development in IS (Gregor and Hevner 2013; Niederman and March 2012).

Theorists and methodologists offer rationales that underline the importance of building a cumulative body of knowledge. First, it is imperative to build on the works of others to achieve meaningful research progress by contributing to the validation and commensurable extension of a shared knowledge base. Although each individual paper is in itself a contribution (Hevner et al. 2004), *individual fragments* are not strong enough to create the cumulative knowledge base (Keen 1980) the IS community aspires to. Methodologists of meta-analysis, for example, stress that *no study is perfect* and that there are always errors, in particular regarding the chosen sample (Hunter and Schmidt 2014). As a consequence, studies must be repeated to reproduce and validate previous knowledge. Second, the rigorous building on previous work helps researchers to avoid wasting resources on 'reinventing the wheel'. Gregor and Jones (2007, p. 314) refer to this phenomenon as constructing the same or similar artefacts under 'new labels', an issue that has been highlighted repeatedly (Larsen and Bong 2016; March and Smith 1995, p. 263). Third, cumulative research efforts are necessary to successfully address the 'wicked problems' of IS-DSR (cf. Hevner et al. 2004). These types of problems pose considerable difficulties to the 'transferability' (Guba 1981) and 'generalizability' (Lee and Baskerville 2003; Markus et al. 2002) of IS-DSR artefacts.

IS design theories, as opposed to other artefacts, are seen as particularly useful for facilitating the building of a cumulative body of knowledge (Gregor and Hevner 2013; Niederman and March 2012). First, design theories represent abstract and generalizable knowledge, helping researchers and practitioners alike in comparing, evaluating, and applying existing approaches. Second, as abstract knowledge is considered more ‘mature’, its claims are more trustworthy. This, in turn, may help in informing practice with substantial empirical evidence and well-grounded knowledge (Denyer and Tranfield 2006). Third, the propositions of design theories can be transformed into testable hypotheses (Walls et al. 1992), facilitating their *evaluation* and *application* in the same or a similar context (Markus et al. 2002; Niederman and March 2012). Thus, design theories have the potential to make IS-DSR output more testable and comparable, and to prevent the emergence of a diffusive web of ‘loose ends’ that are largely ignored by both academics and practitioners.

Cumulative knowledge development can be analyzed by an arsenal of methods ranging from citation count analyses and (citation) content analyses to statistical meta-analyses. In the realm of scientometric methodologies, the most prominent means of assessing the knowledge impact of academic literature is citation count analysis (Hassan and Loebbecke 2017). While this methodology can be applied efficiently and produces apparently ‘objective’ results, it says little about *how* the literature is used (Hassan and Loebbecke 2017). For this objective, citation *content* analysis is necessary, as the analysis of in-text citations and their contexts provides a more comprehensive picture of how subsequent research builds on extant work. If a sufficient number of empirical papers is available, review methodologies such as systematic reviews and meta-analyses can be applied to analyze and statistically aggregate the empirical evidence (Paré et al. 2015). These methodologies are considered to produce the most reliable analyses of empirical, as opposed to conceptual, works.

Methodology

We apply citation content analysis to give insights into how and to what extent ISDTs are tested and extended in subsequent research. In order to judge how citing papers make use of cited documents by means of citations, it is necessary to analyze both citing and cited documents (Smith 1981, p. 87). Our approach is grounded in content analysis methodologies and can be considered deductive (Neuendorf 2002), as our study is framed by the established IS research cycle (Hevner et al. 2004). Based on this framework, we created a coding scheme before analysis. We proceed as follows: First we describe our sample (comprising ISDTs and their citing papers) and the process of its collection. Second, we conceptualize and operationalize the categories used in the coding process. And lastly, we outline the coding process itself.

Sample

Information Systems Design Theories: We adopt Walls et al.’s (1992) conception of ISDT, as this is the oldest and most established framework in IS-DSR. Thus, to qualify as a design theory in this study, a published paper must contain all four ISDT components (i.e., kernel theory, meta-requirements, meta-design, testable design hypotheses) as proposed by Walls et al. (1992). In terms of publication outlets for ISDTs, as opposed to their citing papers, we restrict our scope to the eight journals included in the AIS Senior Scholars' Basket of Journals (referred to as *AIS basket* from here). This set of journals is acknowledged as a collection of top IS journals and recognizes topical, methodological, and geographical diversity[2]. It has also been used in previous IS literature studies (e.g., Bélanger and Carter 2012, and Seddon et al. 2010). The considered time frame comprises the years 1992 to 2014. As will be outlined in the following, we identified seven ISDTs fulfilling our criteria by drawing on three prior research projects. Whereas the timespan 1992 to 2004 is covered by Walls et al. (2004), the timespan 2004 to 2014 is covered by Prat et al. (2015) in combination with Wagner et al. (2017).

The first paper we draw on is Walls et al.’s (2004) impact analysis of their 1992 paper. Walls et al. (2004) identified 26 citing papers, four of which actually apply the framework. However, only one of those papers (Markus et al. 2002) meets both our requirements of (a) providing all four ISDT components and (b) being published in an AIS basket journal. Thus far, the timespan covers the years 1992 to 2004. To extend this

[2] https://aisnet.org/general/custom.asp?page=SeniorScholarBasket

scope, we further draw on Prat et al. (2015) and Wagner et al. (2017). In their taxonomic study regarding the evaluation of IS-DSR artefacts, Prat et al. (2015) identified 121 IS-DSR papers published between April 2004 and March 2014 in AIS basket journals. The authors systematically searched all table of contents in the specified timespan and subsequently conducted a keyword search using Google Scholar to verify that all potential IS-DSR papers were included. The list was then scrutinized to only include papers that use DSR as their main paradigm and present an artefact as one of the main contributions (Prat et al. 2015). In addition to the inclusion criteria, papers were excluded if their main objective was descriptive or explanatory (Prat et al. 2015). The resulting set of 121 IS-DSR papers was adopted by Wagner et al. (2017), who coded, amongst other aspects, the level of theorization of the 121 IS-DSR papers. An IS-DSR paper was considered a complete theory paper if all four design product components of an ISDT were present. The authors identified six papers as complete theory papers: Abbasi and Chen (2008), Arazy et al. (2010), Müller-Wienbergen et al. (2011), Närman et al. (2013), Siponen et al. (2006) and Yang et al. (2012).

Due to a possible gap between the publication of Walls et al. (2004) and April 2004, the starting point of Prat et al.'s (2015) analysis, we conducted a table of contents scan of all AIS basket journals published between January 2003 and April 2004. The search resulted in no further additions. Thus, the set comprises seven ISDTs published between 1992 and 2014 in AIS basket journals. As publications arguably need some time to attract citations, we contend that expanding the timeframe to include more recent publications would not offer further insights. Thus, since the nature of this paper is exploratory, this set of ISDTs is sufficient to give first insights into how subsequent research has built on IS design theories.

Citing papers: To identify citing papers[3], a forward search was conducted using the Web of Science[4] (WoS) Core Collection. The search was conducted on the 20th of November 2017 and resulted in a list of 226 forward citations from 211 citing papers, as some citing papers cited more than one ISDT. During the coding process, three citing papers were dropped because they did not actually cite an ISDT. For example, WoS erroneously indexed a special issue introduction as having cited an ISDT; however, the paper neither cites the ISDT in-text, nor does it provide a reference section. The final list thus contains 223 forward citations from 208 citing papers. The total number of analyzed in-text citations is 459.

Conceptualization and Operationalization of the Categories

To track cumulative knowledge development of domain-level knowledge, we analyze the links between citing and cited publication, that is, in-text citations. As the nature and intent of citations varies considerably, frameworks exist that enable the classification of citations according to their intended purpose. A prominent example is the paper on scientometrics in IS by Hassan and Loebbecke (2017). In their paper, they classify citation types along four perspectives, of which the 'symbolic perspective' is most interesting to our purpose as it focuses on the cited *texts* and its *ideas*. More specifically, this perspective, in part, comprises an 'ideational' dimension. Hassan and Loebbecke (2017, p. 4) define these type of citations as "signs for ideas and concepts offered by and imparted onto the cited text". In contrast to other perspectives and dimensions, the ideational dimension concentrates on the *content* of the cited publication. Thus, by restating Keen's (1980) call for a cumulative research tradition, they reason that the ideational dimension is a lens particularly useful for analyzing cumulative knowledge development. Other studies propose a similar view on different citation types. For example, Hansen et al. (2006, p. 412) draw on extant literature to classify citations according to the three categories *central*, *peripheral*, and *perfunctory*. According to this view, a citation belongs to the first category if it is "central to the [citing] author's argument in that the author seeks to establish additional support, counterattack, or reject some arguments made in [the cited publication]". A citation is categorized as peripheral if the cited document is "referenced repeatedly and used to support a concept associated with the primary thesis of the author(s), but the content of [the cited publication] is not the main focus of the [citing] author's argument". And finally, a citation is categorized as perfunctory if it does "not play any significant role in the [citing] author's main argument".

Conceptualization: We conceptualize three broad categories. Two of those are of our main focus and one is used to capture the remaining citation types that are not of primary interest. Both main categories,

[3] It needs to be noted that the analysis comprises design theories and those papers directly citing the design theories; thus, there might be errors of omission. If, for example, a citing paper A tests or extends a design theory, and yet another paper B tests or extends this aspect of A without referencing the original design theory, this case is not included in our analysis. Based on the reasonable assumption that researchers cite appropriately, we believe the possible error of omission is negligible.

[4] https://apps.webofknowledge.com

namely *testing* and *extending*, are directly derived from extant IS-DSR literature, in particular from the build/evaluate or generate/test cycle that characterizes IS research (Hevner et al. 2004; March and Smith 1995; Simon 1969). Although the literature provides guidelines (Hevner et al. 2004) and taxonomies (Prat et al. 2015) for the evaluation of IS-DSR artefacts, we do not distinguish the *type* of testing or extension with additional categories. Knowledge of the literature led us to assume that a further distinction is not sensible; as we will outline in the following sections, our assumption was reasonable. Consequently, we coded both main categories on a binary scale. Whereas the two main categories include *core* citations (Hansen et al. 2006) with an *ideational* dimension (Hassan and Loebbecke 2017), the residual category captures *peripheral* and *perfunctory* citation types (Hansen et al. 2006). As noted above, Hassan and Loebbecke (2017) point out that citations with an ideational intent are signs of cumulative knowledge development. Our adoption of this concept is reasonable since citations indicating testing or extending must provide a clear link to the content of the cited text (Hassan and Loebbecke 2017). The residual category capturing peripheral and perfunctory citation types therefore includes citations that are either rather superficial in nature or references not relating to an aspect of the proposed design theory itself. This category is coded on a binary scale as well.

We define *testing* as the empirical or conceptual validation of an ISDT regarding all or some of its components (i.e., kernel theory, meta-requirements, meta-design, testable design hypotheses). For example, meta-design propositions may be assessed empirically based on a prototype with regard to its utility, usability or feasibility (Hevner et al. 2004, p. 77; Prat et al. 2015, p. 258).

We define *extending* as the conceptual refinement of an ISDT regarding all or some of its components. If a conceptual extension is also tested empirically, *testing* is coded too. For example, subsequent research could revise the meta-requirements of an ISDT and add or refine requirements based on a more comprehensive kernel theory (Markus et al. 2002, p. 207).

Operationalization: The unit of analysis is an in-text citation, i.e., the link between citing papers and the cited ISDT. For each in-text citation the binary categories testing, extending, and peripheral/perfunctory are coded. The coding of in-text citations within a citing paper is independent of each other, since we do not assume dependencies *a priori*. This increases the validity of the results, since not all in-text citations necessarily refer to the same aspect of the cited paper. The analysis involves the full-text reading of each ISDT as well as the reading of each citing paper's title and abstract. In addition, the immediate context of the in-text citation, and, if helpful for a better understanding, the surrounding paragraph is considered. To ensure as much objectivity as possible, we judge citations at their face-value, meaning that we stay as close as possible to the actual statement of the citing authors. Put differently, we consider transparent attributions to an ISDT as a necessary condition for the testing and extending categories; consequently, we code citations that leave the reader to speculate over the precise nature of the link between the citing and cited paper as peripheral/perfunctory. It needs to be noted, however, that we approached the coding openly and considered different ways of giving credit to ISDTs. As such, we considered synonyms like *validated*, *evaluated* or phrases like *applied to context XY* as valid as *tested* and *extended*. For notes on the coding decision and the type of usage we used an additional column in the coding sheet.

We acknowledge that cumulative knowledge development occurs in many shapes and on many levels, e.g., as a discipline, concurring on the epistemological conception of knowledge within IS-DSR; however, we exclude other forms in *our* definition of cumulative knowledge development for the purpose of this study.

Coding Process

The qualitative coding of the citing papers comprises multiple phases, which are described in the following. Both an exploratory pilot and training coding was conducted with n=40 and n=22 in-text citations, respectively. The coding followed extensive discussions to further clarify the conceptualization of the categories. After the coding scheme was refined to its final version, two coders individually coded a reliability set used to measure inter-rater agreement. The set contains n=116 in-text citations, amounting to approximately 25% of all analyzed in-text citations; this well exceeds the threshold of 10-20% suggested by methodologists (Neuendorf 2002, p. 158). Cohen's Kappa was .66, .80, .74 for testing, extending, and peripheral/perfunctory, respectively. All three values indicate sufficiently reliable results (Neuendorf 2002, p. 143). As will be shown in the next section, the sample depicts a skewed distribution. Considering this, the Kappa values are quite high as these types of distributions are known to cause very conservative Kappa values, albeit high (percentage) agreement – in our case above .95 for all categories (Neuendorf 2002, p.

151). The two coders discussed disagreements and reconciled the two sets after consensus was reached[5]. The remaining list of 281 in-text citations was divided in two and coded individually by the two coders.

Results and Discussion

Descriptive Statistics

To explore the dataset, we plot the development of citations and cumulative knowledge development over time (cf. Figure 1). In all cases, most of the citations signify peripheral and perfunctory ways of drawing on the respective ISDT. The ISDTs of Abbasi and Chen (2008) and Markus et al. (2002) have been tested and extended to a limited extent. Specifically, while the former has been tested and extended once, respectively; the latter has been tested and extended by three and five studies, respectively. The remaining (five) ISDTs have not served as a foundation for cumulative knowledge development yet.

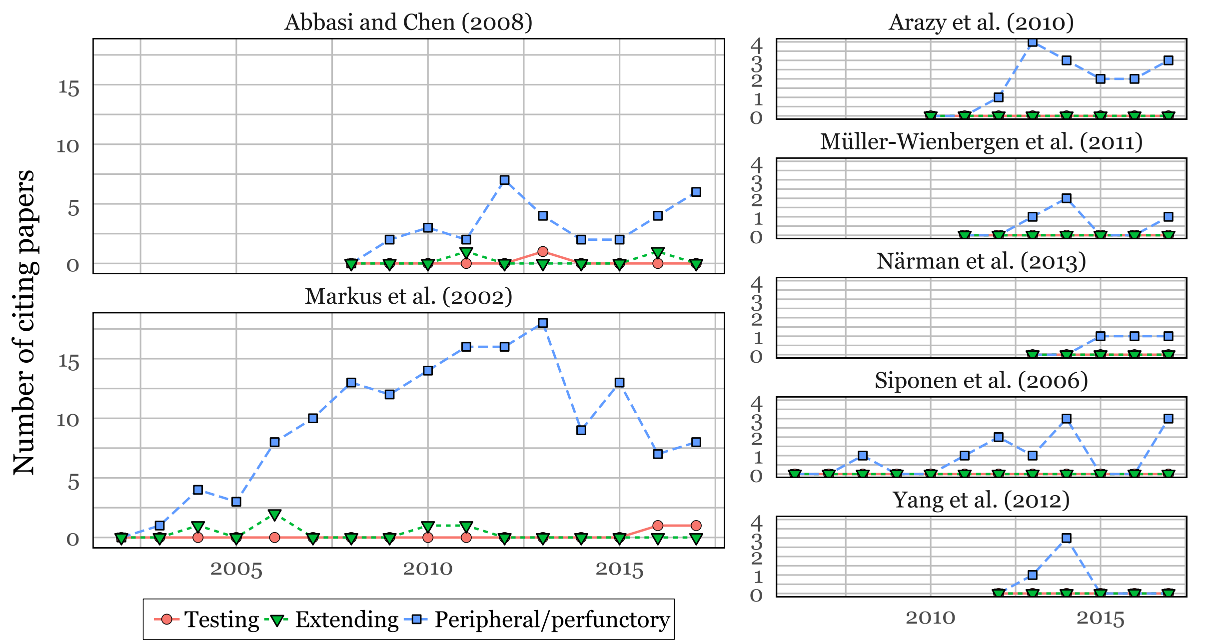

Figure 1. Development of Citations and Cumulative Knowledge Development over Time

To prepare the discussion of the cumulative knowledge development through the building on the selected ISDTs, we aggregate types of use over time in Figure 2. The aggregated figures show that only 4.8 % of citing papers have built on the domain-level knowledge developed in the cited ISDTs.

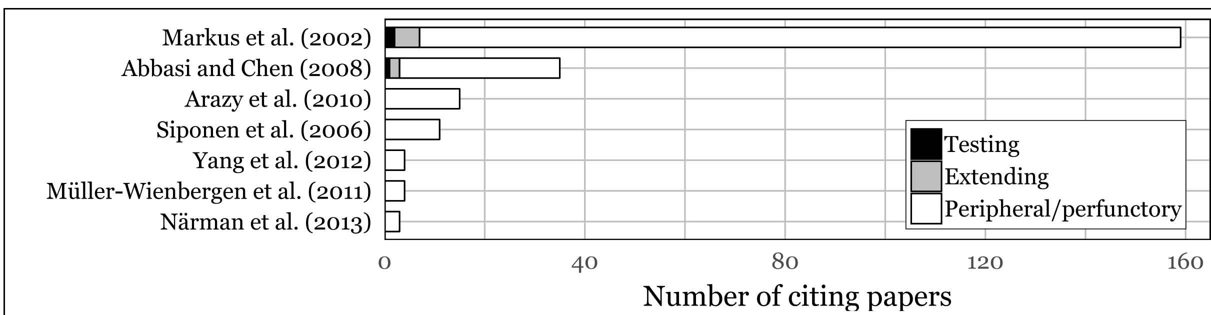

Figure 2. Distribution of Cumulative Knowledge Development per ISDT

[5] After the reconciliation, both pilot and training sets were reviewed and if necessary updated according to the refined conceptualization of the categories. Thus, the two sets were included in the final analysis.

Cumulative Knowledge Development through Building on ISDTs

In the following we will discuss and evaluate the results of our analysis. In doing so, we highlight characteristics of both the ISDTs and the citing papers by explicating the forms of testing and extending. We specifically focus on those ISDTs that have actually stimulated cumulative knowledge development. Table 1 provides an overview of all identified cases of testing and extending. We acknowledge that the ISDTs were published at different times and as publications need some time to attract citations, we refrain from directly comparing different ISDTs. Furthermore, we provide a brief overview of usage types that we characterized as peripheral/perfunctory.

Cybergate: A design framework and system for text analysis of computer-mediated communication (Abbasi and Chen 2008) is one of two design theories that has been tested and extended. The ISDT addresses the need for systems capable of analyzing the content of computer-mediated text in addition to its structural features. According to the authors, the main contributions are (1) the provision of "guidelines for the choice of appropriate [text] features, feature selection, and visualization techniques" (p. 834) for computer-mediated text analysis and (2) the development and evaluation of a prototype (Cybergate). One paper that could be considered testing the ISDT is Abrahams et al. 2013. The citing authors state that they support Abbasi and Chen (2008) in their claim that support-vector machines (SVM) are appropriate for text-classification tasks. However, the application of SVM is not a guideline explicitly proposed by the ISDT. Instead, SVM are used in the evaluation of the proposed visualization methods implemented in the Cybergate prototype. Although the citing authors explicitly support Abbasi and Chen in the SVM argument, they do not test the design theory or its implementation as such, e.g., by applying the proposed feature selection criteria or the visualization tools). We identified one paper (Ludwig et al. 2016) extending the ISDT. Ludwig et al. follow Abbasi and Chen's call for more comprehensive text-mining research. Although it is not clear how exactly and to what extent the citing authors build on the ISDT, we nevertheless coded it as an extension as they stress that their "multilevel approach to deception fully aligns" (p. 520) with Abbasi and Chen's call. Although we took the precaution of only considering transparent attributions to ISDTs, the identified cases could be more precise in describing what specific aspects of the ISDT were tested/extended.

A design theory for systems that support emergent knowledge processes (Markus et al. 2002) is the second ISDT that has received slightly more attention in terms of testing and extending. The identified cases are partly in line with the ISDT's research agenda. Amongst other contributions, the ISDT proposes six design principles to address the need for systems that support semi/unstructured knowledge processes in the context of highly heterogenous use cases with equally heterogenous user types. The theory was developed through an inductive approach, as it was formulated after a prototype (TOP-modeler) has been successfully implemented in several organizations. The ISDT has received testing from two studies, one in support of the tested design principles, and one that resulted in partial or no support. The first study (Durcikova and Fadel 2016), a IS behavioral study, draws twice on the ISDT to derive hypotheses for their survey-based analysis. While in the first case it is clear which design principle is referred to ('design for offline action'), the second case is more ambiguous. Here the citing authors provide empirical support for the proposition that system users should be able to contribute back to a knowledge management (KM) system. However, this feature can only vaguely be related to the design principles proposed by the ISDT, let alone to a specific one. Taking the citations at face value, we 'trust' the citing authors in supporting a principle they ascribe to the cited ISDT. The second (behavioral) study that could be considered testing the ISDT is Zhang and Venkatesh (2017). By drawing on the ISDT, the authors derive three features of KM systems which, in turn, in addition to various other features, were used in a pre-study; in this interview-based pre-study, five selected users rated the ISDT-derived features as having some relevance to work-related purposes; albeit not being considered irrelevant, the ISDT-derived features were not considered important enough to be included in the main study. It needs to be noted though that the study was not explicitly conducted in an environment characterized by 'emergent knowledge processes' (EKP).

The ISDT has further been extended by five citing papers. Two cases are very similar in that they both identify further aspects that should be considered in KM systems. Whereas Wang and Ariguzo (2004) call for a distinction between knoweldge and information in systems design, Huysman and Wulf (2006) call for the consideration of social captial. Both cases are further similar in that neither gives detailed insights into how or to what extent they build on the cited ISDT. It could be argued that the two cases rather complement the ISDT's design principles than extend them. A further paper (Doll and Deng 2010) argues that, based on their results, KM systems should be more successful when empowering, or broadly speaking, motivating its users. Chaturvedi et al.'s (2011) paper is a prime example of extension, as the citing authors explicitly state that they have "modified and extended the design principles for EKPs enumerated by Markus et al. (2002)" (p. 680). The extension is made in the context of agent-based virtual worlds. The fifth and final case is ambiguous in its explicitness. Although Richardson et al. 2006 derive a design principle by directly drawing on the ISDT, it is not clear to which aspect of the ISDT they actually refer to. The citing authors' design principle, in short, prescribes high adaptability for their proposed 'Churchmanian-Habermasian KM system'. Interestingly, they derive this principle by referring to the ISDT's extreme iterative approach (over 70 prototypes were developed in the course of the project). However, it could be argued that this might better be linked to the ISDT's design principle of 'componentize everything'. As in a previous case, we 'trust' the citing authors in their attribution to the cited ISDT.

Table 1 Cumulative Knowledge Development: Building on ISDTs

ISDT	Testing	Extending
A design theory for systems that support emergent knowledge processes (Markus et al. 2002)	**Support for (parts of the) ISDT** • Design principle "design for offline action": supported by a survey in which perceived actionability of knowledge repositories is positively associated with knowledge sourcing from the repository (Durcikova and Fadel 2016) • Support of the hypothesis that "perceived KR [knowledge repository] support for knowledge contribution is positively related to KR knowledge sourcing" (Durcikova and Fadel 2016) is consistent with the ISDT (principles of designing for customer engagement and for implicit guidance) **Partial/No Support** • Some features of knowledge management systems are taken from the ISDT; in a pre-study, users rate them as having some relevance to work-related purposes, but the features taken from the ISDT are not considered important enough to be included in the main study (Zhang and Venkatesh 2017)	• Basic theories of knowledge management systems should distinguish knowledge from information (Wang and Ariguzo 2004) • Social capital should be considered a requirement for knowledge sharing in informal organizational settings (Huysman and Wulf 2006) • Psychological empowerment is suggested as an additional antecedent of successful emergent knowledge processing systems (Doll and Deng 2010) • Modification and extension of the ISDT principles in the context of agent-based virtual worlds (Chaturvedi et al. 2011) • The design of "purposeful, ethical and adaptable systems that create exoteric knowledge (relevant for solving social and managerial problems)" incorporates principles that improve adaptability of the system to changing environments (Richardson et al. 2006)
Cybergate: A design frame-work and system for text analysis of computer mediated text (Abbasi and Chen 2008)	**Partial/No Support** • Confirmation of good performance of support-vector machine (SVM) approaches for text-categorization tasks in the context of social media postings (Abrahams et al. 2013)	• To classify deception in computer-mediated communication, the authors draw on the ISDT by including features that are derived from a multi-level conception of the structure and exchange of text between actors (Ludwig et al. 2016)

Note. Our dataset did not contain papers indicating the testing or extension of Arazy et al. (2010), Müller-Wienbergen et al. (2011), Närman et al. (2013), Siponen et al. (2006), and Yang et al. (2012).

Shifting the focus of discussion, Figure 2 illustrates a stark contrast between (a) follow-up research testing and extending the cited ISDTs, and (b) subsequent research that cites ISDTs superficially or at least not with regard to aspects of the proposed design theory itself. Our coding showed that the bulk of citations are IS-DSR discourse references, that is, the ISDTs (predominantly Markus et al. (2002)) are used to illustrate what IS-DSR *is*, *what it is composed of*, and *how it should be done*. To be more specific, the ISDTs were largely cited for the following reasons (in no particular order): as a justification of the methodological IS-DSR approach (e.g., the iterative build and evaluate cycle), for the existence of different artefacts in IS-DSR, as an example of DSR or for being a design theory, for theorizing about IS-DSR artefacts in general, and to define what constitutes an ISDT. The analysis revealed[6] that nearly half of all analyzed citations are in the realm of IS-DSR discourse, as opposed to referring to the domain-level knowledge (i.e., knowledge pertaining to the problem and solution space) generated by the ISDTs.

To summarize our analysis and results, while few citing authors have been both *transparent* (i.e., explicitly attributing ideas to the cited ISDT) and *precise* (i.e., stating clearly which aspect of the ISDT they refer to) with respect to testing/extending, most papers provide only vague insights into how or to what extent they have built on the cited ISDT. This is an issue we encountered throughout the coding process. Although some of the presented test/extend cases were ambiguous, the discussed cases were nevertheless the *most explicit* ones in our dataset. There were various other cases which would have involved (even more) interpretation. As stated in the method section, we aimed at taking the citations at their face value and were thus fairly conservative in our coding decisions. In conclusion, there are various interesting findings, both explicitly and implicitly stated in the above discussion: First, only a marginal amount of citing papers actually tested/extended the cited ISDTs. Second, citations in the realm of IS-DSR discourse constitute nearly half of all analyzed in-text citations. Third, only those ISDTs that explicitly call for testing/extending have attracted follow-up research. Forth, none of the ISDTs has been used to develop an instantiation based on guidelines proposed in the cited ISDT. And lastly, while extensions of ISDTs are conducted by IS-DSR, in two out of three cases, testing was conducted by behavioral science research.

Guidelines

Our analysis uncovers that within the citation impact of ISDTs, there is an alarming paucity of follow-up research actually testing or extending ISDTs. We stress that the need for further testing and extension exists independent of the quality of the original paper (i.e., the cited ISDT). This is even the case if the ISDT presents several empirical studies that support its contribution, such as Markus et al. (2002), who successfully apply their ISDT's prototype in several organizations. While Markus et al. show that their theory was useful in several organizations, one contribution of follow-up research would be to explore the boundaries of the theory. For example, in which (types of) organizations does it not work as effectively? We contend that behavioral IS research provides a reference point in this regard. For example, the paper by Venkatesh et al. (2003) complements its theoretical contribution with similarly convincing empirical evidence. Nevertheless, subsequent research tested and extended this theory more than 300 times (cf. Hess et al. 2014). In addition, methodologists of meta-analyses emphasize that multiple empirical studies are necessary to control for different types of statistical errors – most importantly sampling errors – and to reliably estimate the true effects (Hunter and Schmidt 2014). These issues may be even more relevant for ISDTs as they address wicked problems in a socio-technical context. We therefore state our central conclusion: There is an urgent need for testing and extending ISDTs. To propose a specific path of action, we formulate five guidelines in the following. We derive these guidelines based on (1) the empirical results, (2) complementary observations during the coding, and (3) our synthesis of the methodological and theoretical literature on IS-DSR. In our guidelines, we focus on constructive recommendations for future research and therefore refrain from criticizing shortcomings of individual papers. These guidelines are directed toward all stakeholders involved in the construction of cumulative knowledge that builds on ISDTs. While guidelines 1 and 2 refer to the development of ISDTs, guidelines 3-5 refer to follow-up research that tests and extends ISDTs (cf. Figure 3).

[6] As mentioned in the Method section, our coding sheet included a column for recording complementary observations. The presented insight is based on an assessment of these notes.

Information Systems Design Theory (ISDT)

Guideline 1 ISDTs should implement better reporting practices by providing specific information about how it can be instantiated.
Guideline 2 ISDTs should include a research agenda to stimulate follow-up research.

builds on ↑ ↓ stimulates

Follow-up Research: Testing and Extending ISDTs

Guideline 3 Follow-up research that builds on ISDTs in terms of testing and extending should be initiated.
Guideline 4 Follow-up research should be more *transparent* and *precise* about how and to which extend they test and extend ISDTs.
Guideline 5 Publishing opportunities should be improved for follow-up research testing and extending ISDTs.

Figure 3. Guidelines to Facilitate Cumulative Knowledge Development through Testing or Extending Information Systems Design Theories

To make the knowledge contributions of ISDTs more accessible to follow-up research, specific information on the instantiation should be provided. Although ISDTs represent design knowledge in an abstract and generalizable form, the implementation of their design principles should be reported as specifically and unambiguously as possible. Behavioral IS theories provide a reference point and set an example by reporting specific measurement items for each construct (cf. e.g., Venkatesh et al. 2003). This parallel is particularly relevant as most of the papers that test ISDTs can be classified as behavioral IS research. As there are major ambiguities regarding their instantiations for many ISDTs, explicit descriptions of the instantiation (cf. Gregor and Jones 2007) or the method for artifact construction (cf. Walls et al. 1992) are critically important from a perspective of cumulative knowledge development. Methodologists need to complement existing guidelines on presenting IS-DSR (Gregor and Hevner 2013; Hevner et al. 2004) with criteria and reporting items that facilitate validation and replication efforts by follow-up research. This is challenging because IS-DSR output varies on a socio-technical continuum. Corresponding reporting practices should consider dependencies on the type of ISDT/artifact and be more formalized (cf. Templier and Paré's (2017) proposition of reporting standards that consider dependencies between the type and goal of a review article). Current reporting practices are not specific enough and should therefore be improved by (prospective) authors of ISDTs as well as reviewers who can push authors for higher levels of transparency (for example by imagining having to reproduce the results or test the hypotheses). These efforts would make it easier for authors of follow-up research to plan, conduct and publish follow-up research. We therefore state the following guideline:

Guideline 1: ISDTs should implement better reporting practices by providing specific information about the instantiation.

To stimulate follow-up research, ISDTs should include a research agenda. Our sample indicates that providing a research agenda may be critical to stimulate cumulative knowledge development. This is relevant for both reviewers and authors of ISDTs. When ISDT authors develop and apply their ISDT in a given context they gain valuable insights. We contend that sharing these insights and making limitations as well as research opportunities transparent is important to stimulate follow-up research. The analyzed ISDTs vary considerably in this regard. While few ISDTs present themselves as conclusive solution to important problem, most ISDTs discuss their limitations and possibilities for future research. For example, Müller-Wienbergen et al. (2011) provide a comprehensive description of research designs that are appropriate for testing their hypotheses. Furthermore, Markus et al. (2002) state that their "conceptualization is only as good as its implications for further research" (p. 207) and offer a detailed call for future research. They also share knowledge gained during extensive organizational interventions and the development of their TOP-Modeler prototype. It is imperative that such knowledge on the mechanisms, details, contingencies and limitations of a design be communicated to follow-up research. We therefore state the following guideline:

Guideline 2: ISDTs should include a research agenda to stimulate follow-up research.

To increase the volume of follow-up research that tests and extends ISDTs, researchers need to initiate and plan corresponding research projects. External testing and improved applicability are critical both from a methodological perspective and from a perspective of informing practice. Although further development by the authors of the original ISDT is an obvious first step, it is crucial that other researchers contribute to this knowledge development to increase external validation and applicability. Similar to behavioral IS research, PhD students could be encouraged to select topics that test and extend their supervisors work instead of solely focusing on radically novel (and possibly incommensurable) projects. These efforts could be supported by funding bodies. As such, it is imperative that abstaining from radical novelty in favor of cumulative knowledge development should not become a disadvantage when it comes to hiring, tenure and promotion decisions. We therefore state the following guideline:

Guideline 3: Follow-up research that builds on ISDTs in terms of testing and extending should be initiated.

To make cumulative knowledge development transparent and to make assessing the aggregated body of ISDT knowledge easier in the future, the *transparency* and *preciseness* of how follow-up research extends and tests ISDTs need to be improved. This guideline is consistent with our experience during the coding process, in which we observed cases in which readers were left wondering to which aspect and how exactly the citing paper uses the cited ISDT. *Transparent* means that attributions to the ISDT should be explicit and clear in relevant parts of the manuscript, such as the background, methodology, discussion and generally in contribution statements. *Precise* means that authors must be specific and detailed when referring to components or principles of the ISDT. In some cases, we observed vague or misdirected references to parts of the cited ISDT. Citing authors may also take into consideration whether they refer to general aspects, such as the iterative nature of development and design processes, or whether a higher level of detail is possible. While authors themselves should pay attention to explicit descriptions, they can also be supported by reviewers. In this regard, we suggest that reviewers should be aware of the cited ISDTs and require authors to provide *transparent* and *precise* descriptions of how and which aspects their work tests and extends an ISDT. If necessary, this could be achieved by reading the ISDT paper during the review. We therefore state the following guideline:

Guideline 4: Follow-up research should be more *transparent* and *precise* when testing and extending ISDTs.

To achieve cumulative knowledge development through building on ISDTs, corresponding research needs to be published. While publication opportunities for IS-DSR have been discussed critically (Österle et al. 2011), there are recent initiatives suggesting that IS-DSR (including DSR building on ISDTs) can be published in premier outlets. These initiatives include special issues at JAIS[7] and BISE[8], for example. In this regard, we suggest that authors should be optimistic about the publication chances of research that builds on ISDTs. Recognizing the importance and urgency of developing a cumulative body of knowledge through ISDTs, editors and reviewers are encouraged to support these efforts. We therefore state the following guideline:

Guideline 5: Publishing opportunities should be improved for follow-up research testing and extending ISDTs.

The underlying theme of these guidelines is that ISDTs should be expected to stimulate cumulative knowledge development. We emphasize that design-oriented knowledge should be accumulated in an explicit and published way. In doing so, we do not intend to understate the importance of tacit, cognitive knowledge accumulation by individual design science researchers. We further suggest considering the established categories of testing and extending as an appropriate starting point, and thus encourage future studies to explore the different facets of testing and extending. As existing ISDTs are comparatively young, we hope that our analysis draws early attention to this pressing issue. We emphasize that the paucity of follow-up research in terms of testing and extending does neither diminish the contributions of the ISDTs nor of their citing papers. As such, not every citing paper should be expected to build on the cited ISDTs. Instead, we consider the theme of our paper as being vital to disciplinary self-reflection and stress that

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[7] http://aisel.aisnet.org/jais/cfp_aekdsr.pdf
[8] http://www.bise-journal.com/?p=1346

cumulative knowledge development requires a concerted effort by various IS(-DSR) stakeholders. In short, this is a community effort for both the design science and the behavioral science community in the IS field.

Limitations and Future Research

To interpret the results of our study, it is critical to consider its limitations. First, we coded what is present in the citing paper, that is, we took the citation sentence and its context at face value. This approach is susceptible to errors when (1) there are data quality problems in the citation index (Web of Science), (2) citations are omitted by the authors, (3) the authors misrepresent their use of the ISDT, or (4) the citation context is not sufficient to convey the *intended* connection with the cited ISDT (cf. e.g., Hansen et al. 2006). Second, we focus on a selective scope of ISDTs that have been published in the AIS Senior Scholars' Basket of Journals. This means that our sample excludes works from (IS-)DSR conferences and other journals, such as those focusing on decision support systems (e.g., *Decision Support Systems*, *Decision Sciences*) and computer science (e.g., *ACM* and *IEEE Transactions*). Third, we implement an analytical (as opposed to an explanatory) research design and analyze a small sample that has been published over a range of years.

The timing of our analyses could be considered pre-mature, as cumulative knowledge contributions may require more time to accumulate. We concur that this critique particularly applies to the ISDTs that have been published recently. Nevertheless, important works on ISDT (Gregor and Jones 2007; Walls et al. 1992, 2004) and ISDTs themselves (Markus et al. 2002; Siponen et al. 2006) have been published several years ago and there have not been any empirical insights yet into whether subsequent research has meaningfully built on the ISDTs. While we do not contend that ISDTs are threatened to be invalidated by the next technological hype, we think the (scientific) goal of achieving cumulative knowledge development is critical enough to warrant both an early as well as future analysis.

Accordingly, there are opportunities to extend our analysis and to complement it with additional methodological guidelines. Most notably, we focus on ISDTs as opposed to nascent design theory or more situated implementations of artifacts (cf. Levels 1 and 2 in Gregor and Hevner (2013)). Although ISDTs have been considered particularly stimulating for cumulative knowledge development, this goal is not irrelevant for less theoretical IS-DSR artefacts. This type of research output could, for example, provide the building blocks for more abstract design theories. In this regard, building on situated artifacts that are developed in IS-DSR papers might be contingent on open access to, e.g., the corresponding source code (Aalst et al. 2016). Furthermore, proprietary knowledge involved in developing situated artifacts and instantiations may be a barrier to accessing knowledge produced by practitioners in the industry. Advances in capturing these insights may stimulate (cumulative) knowledge development in IS-DSR.

Conclusion

In this paper, we explored how follow-up research has tested and extended ISDTs. Our study of how seven ISDTs have been used by follow-up research is the first empirical assessment of cumulative knowledge development through building on ISDTs. The results of this assessment show that the overall number of papers testing and extending the seven ISDTs ranges in the single digits. This paucity of follow-up research is alarming because the power of a cumulative research tradition may be instrumental in capturing the value of design science research and communicating it within and beyond the IS discipline. We draw on these results, additional insights and observations gained during the coding process, and the literature on IS-DSR to propose an actionable path forward. Specifically, we formulate five guidelines that suggest how ISDTs and follow-up research can synergize to drive future cumulative knowledge development. We hope that the insights and guidelines contribute to disciplinary self-reflection in IS(-DSR) and thus lead to an increased focus on accumulating design-oriented knowledge based on ISDTs.

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