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Rethinking the Concept of IT Use

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ABSTRACT

The information systems (IS) community has developed many theories, approaches, and models that identify conditions and determinants of successful IT use. However, each model in the IS literature has evolved to address specific aspects and dimensions. This has led to conflicting results concerning the impact of IT use. Consequently, while a rich body of knowledge has emerged, with prominent models such as the Technology Acceptance Model or the IS Success Model, the complexity of defining a suitable multi-dimensional construct for IT use has largely been neglected. In this paper, we develop a new causal model of IT use. Based on Adaptive Structuration Theory, we argue for the multi-dimensionality of IT use and thoroughly derive its components. Moreover, we introduce two new concepts into studies of successful IT use: functional affordance and symbolic expression. Both establish a relation between the IT system in investigation and its users. In doing so, we provide a novel, synthesized approach for investigating IT use in the context of the IS Success Model and the framework of Adaptive Structuration Theory.

Keywords

IT use, Adaptive Structuration Theory, IS Success Model, measurement model.

INTRODUCTION

Since the end of the 1950s the analysis of the effects of technology on organizational as well as individual productivity stands in focus of both research and practice (Brynjolfsson and Yang 1996; Leavitt 1965; Leavitt and Whisler 1958). The continuous pressures of competitiveness and costs as well as the need to increase productivity are among the main drivers of permanent investment in technology. If a company invests in new technology, it expects the creation of added value and an increase in productivity respectively. Today, expenses in information technology (IT) are comparable to expenses in research and development, ranging typically from 1% to 3% of revenue and extending up to 5% to 10% in some industries (Gomolski, Grigg and Potter 2001). Global spending on IT continues to grow and will total about 2.5 trillion US Dollar in 2010 (Bartels 2010). Analyses of survey data show that the highest IT spending priorities are in the areas of administration, production, and distribution (Cha, Pingry and Thatcher 2009). Other studies, however, suggest that investments in IT do not necessarily lead to an increase in profit or productivity (Brynjolfsson 2003; Brynjolfsson and Hitt 1998; Brynjolfsson et al. 1996; Dempsey, Dvorak, Holen, Mark and Meehan 1998). This problem has been prominently coined the “IT Productivity Paradox” or “IT Black Hole” (Brynjolfsson 1993). IT investments as well as increases in productivity form a complex relation; they are not inevitably connected with each other (Brynjolfsson 2003). The interaction between IT and organization is very complex and influenced by many mediating factors, including the organization’s structure, standard operating procedures, politics, culture, environment, and management decisions (Laudon and Laudon 2005). Consequently, multiple reasons exist as well why people use or do not use IT in their day-to-day working lives (Selwyn 2003).

In the information systems (IS) literature, the interplay between IT and organization has been investigated for several years, especially within two major research streams – the technology acceptance and the user satisfaction literature. A variety of models have been proposed to explain IT adoption and IT use (Venkatesh, Morris, Gordon and Davis 2003). Of these, the most widely tested model is the Technology Acceptance Model (TAM) proposed by Davis (1989). Most of these models, including TAM, aim to understand why people accept or adopt IT. However, they often stop short of addressing how the use of IT leads to an increase in productivity. In order to provide a more general and comprehensive definition of IS success that covers different perspectives, including benefits, DeLone and McLean (DeLone and McLean 1992; DeLone and McLean 2003) proposed the IS Success Model (ISSM). Studies on IS success have mostly addressed issues of user satisfaction, IT quality, and further use (Petter, DeLone and McLean 2008; Petter and McLean 2009; Urbach, Smolnik and Riempp 2009). Consequently, whereas research so far has focused on object-based beliefs and attitudes of IT, the effective use of IT, and the relationship between actual IT use and net benefits, have been neglected and controversially discussed in the IS literature (DeLone et al. 2003; Seddon 1997; Silva 2007). Seddon (1997) even argues for the removal of the IT use construct since IT use does not cause any benefits but only precedes them.

To counter this argument, one might object that IT use is fundamental, and without any use IT benefits cannot be realized. The main problem concerning IT use is not its relevance but its poor operationalization (Burton-Jones and Straub 2006; DeLone et al. 2003). In past studies, the definition of IT use has been too simple and one-dimensional; we suggest that until now it is still unclear how IT use does de facto contribute to the overall success of an IS. IT use is a complex construct that cannot be restricted to one or two components, for example, to the amount of time spent with the IT artifact. Instead we argue that the nature of use has to be considered in more detail. Especially the extent, quality, and appropriateness of use have to be further investigated in order to account for a holistic construct of IT use. Based on this argument, the aim of this research is to conceptually amend the IS success model, especially the construct of IT use, in order to elucidate the importance of IT use in IS research. In this we aim to answer the following research question: *How can we conceptualize IT use in ways that help us to better investigate IS success?*

The remainder of the paper is structured as follows: Section 2 discusses the theoretical background. Section 3 introduces the proposed research model. In section 4 we develop a measurement scale for our research model and apply some first pretests. Section 5 concludes the paper and gives and outlook on future research.

THEORETICAL BACKGROUND

IT Use and IS Success

Benbasat and Zmud (2003) argue for a theoretical link between IT use and IT impact. They suggest that, among other phenomena and factors, the *consequences of IT use* (direct and indirect, intended and unintended) on humans who directly (and indirectly) interact with IT systems should be investigated in more detail. In general, the ISSM (DeLone et al. 2003) is such an attempt to grasp not only the effect of IT use on individual impacts but also to develop different factors that contribute to the overall success of IT systems in organizations. Its basic causal model was developed in the 1990s and assumes a causal link between IT use and net benefits (see **Error! Reference source not found.**). The understanding of this link and the measure of IT use is fundamental in order to determine if and how IT leads to desirable results (Petter et al. 2008).

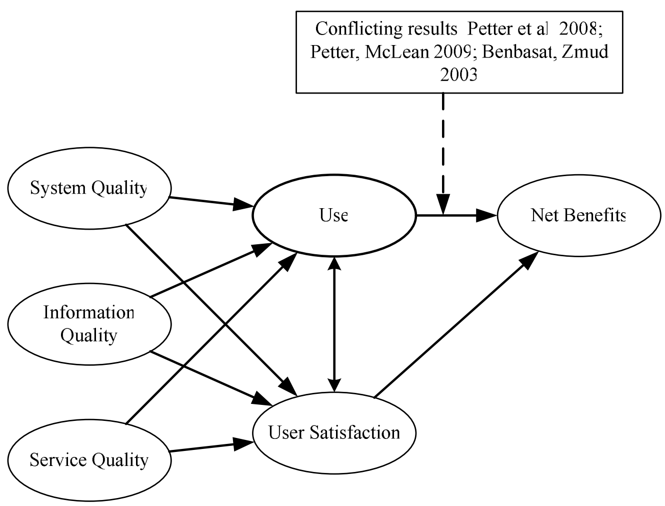

Figure 1. The DeLone and McLean IS Success Model (DeLone et al. 2003)

Recent research argues that *IT use*, as one factor that determines the success of IS, still needs further investigation in order to better understand the effect of use on user satisfaction and net benefits (Petter et al. 2008). One major issue concerning the concept of IT use in quantitative studies is that the construct suffers from poor validation and theoretical foundation (Burton-Jones 2005), even though the IS literature already knows a vast amount of different conceptualizations of IT use such as "actual use" (Devaraj and Kohli 2003), "depth of use" (Venkatesh, Brown, Maruping and Bala 2008), "nature of use" (Igbaria, Zinatelli, Cragg and Cavaye 1997) or "self-reported use" (Igbaria et al. 1997; Venkatesh et al. 2008). Most of these measures of IT use are survey-based and therefore prone to subjective response biases. That is why research on IT use tries to refer to more non-perceptional measures such as computer logs, which capture the amount of activity time that a user spent using an IT system (Sykes, Venkatesh and Gosain 2009; Venkatesh, Morris and Ackerman 2000). Among other conceptualizations, the three most common conceptualizations of actual IT use are duration, frequency, and intensity (or extent) of use (Davis 1989; Taylor and Todd 1995). To sum up, in several domains such as IS success, IS acceptance, and IS for decision-making, a cornucopia of different measures of IT use has been developed and employed (Burton-Jones et al. 2006). Therefore, it is also not surprising that IS research generated mixed conclusions about the relationship between IT use and individual performance (for an overview see Petter et al. 2008; Petter et al. 2009). Whereas some researchers found a strong positive relation between IT use and net benefit (Burton-Jones et al. 2006; Rai, Lang and Welker 2006), other studies found no or only a weak relationship (Iivari 2005).

The core of the problem seems to be that every operationalization of IT use is addressing different aspects of the construct (Petter et al. 2009). In addition, measures of IT use often are chosen for their appearance in past empirical studies rather than for theoretical reasons (Burton-Jones et al. 2006; Petter et al. 2009). The lack of theoretical grounding for the IT use construct could be one explanation why IT use has been operationalized in many varying ways and why its conceptualization has been fairly superficial. IT use is a multifaceted construct that implies more than just the amount of time or the depth of use. The varied, (un-) conscious, and creative ways humans actually make use of IT cannot be simply operationalized by such measures. IT use depends on the IT system itself, the humans that interact with that special system, and a multitude of other social and organizational factors that influence the human-technology interaction (Orlikowski 1992). An IS is a socio-technical phenomenon (Bostrom and Heinen 1977), which emerges from the actions and interactions of its social and technical parts. Recent studies suggest that more attention should be given to the social act and the dynamics of adaptation of IT by human agents (Faulkner, Lawson and Runde 2010; Kjaergaard and Jensen 2008; Vaast and Walsham 2005). The resulting understanding recognizes that it becomes increasingly important to study the meanings that human agents ascribe to IT, given the local context in which they are to use IT, and in which their meanings about the IT systems are constructed (Kjaergaard et al. 2008). This implies a focus on social processes and change, including issues such as meaning construction, cognition, learning, and sense-making (Orlikowski 1992). Consequently, every operationalization of IT use needs to take into account that humans may use IT systems and the functions offered by IT in various ways for various reasons. For example, whereas one person may make use of only a part of the functionality of IT systems, others may make use of every function, or even reject to use any functions at all.

The lack of a theoretical basis for IT use and the fact that IT use is more than the actual time spent with the operation of IT systems requires a theoretical and conceptual deliberation of IT use. Until we have robust, consistent, and reliable measures of IT use, it will be difficult to fully understand the relationships between IT use and other factors of IS success or IT adoption (Wu 2009). Therefore our research is based on the idea that different types of IT uses can lead to different net benefits on the individual or the organization level, which in turn can be desirable or undesirable. We presume that the conceptualization of the IT use construct, as originally explained in the ISSM, is too superficial. Apart from that, IT use should be conceptually connected to the IT system and to the people that are investigated. Therefore, we claim that we are in need of (1) a richer conceptualization of the IT use construct and (2) more comprehensive and consistent measures of IT use in order to better understand the effect of IT use on net benefits.

A Structurational Perspective on IT Use and IT Systems

In order to account for a more detailed conceptualization of the IT use construct, we suggest to utilize the structurational framework proposed by Markus and Silver (2008) which enables a detailed look into human-technology interaction and its potential consequences. The framework is rooted in Adaptive Structuration Theory (AST) developed by DeSanctis and Poole (1994). AST is a theory that describes the interplay between technology, social structures, and human action, and is an attempt to examine the use and the impacts of advanced technologies in organizations. It focuses on social structures, which are defined as rules and resources that are provided by technologies and institutions as the basis for human activity. On the one hand, social structures serve as templates for planning and accomplishing tasks; on the other hand they are reproduced and altered through human interaction (DeSanctis et al. 1994; Poole and DeSanctis 2003). Therefore, social structures can be understood as properties of social systems, whereas a social system can be defined as reproduced relations between actors that are organized as regular social practices. Initially, DeSanctis and Poole (1994) considered social structures embedded in technology in form of the concepts of “structural features” and “spirit”. Structural features are said to bring meaning and control to group interaction. For a group support system, for example, these might include voting algorithms and anonymous recording of ideas. The spirit of a structural feature set is described as its underlying general intent with regard to values and goals. Both concepts serve as a source for social structure and influence the way people actually use IT. However, these definitions are highly controversial as the concepts of structural feature and spirit are conceptualized as properties of an IT system, although such values are fundamentally attributed to human agents (Jones and Karsten 2008; Poole 2009).

To resolve this controversy, Markus and Silver (2008) propose two different concepts that are not defined as properties of a technology but as *relations* between technical objects and human agents: “functional affordance” and “symbolic expression”. In this novel conceptualization, *functional affordances* comprise “the possibility for goal-oriented action afforded by technical objects from designers to a specified user group (potential use of an IT object)” (Markus et al. 2008). It can be understood as potentially necessary (but not necessary and sufficient) conditions for appropriation moves (IT uses) and the consequences of IT use. Therefore, the functional affordances of an IT system refer to the potential uses one can make of a technical object. *Symbolic expressions* are "the communicative possibilities of technical objects for a specified user group" (Markus et al. 2008). They are potentially necessary (but not necessary and sufficient) conditions for user interpretations of IT and the consequences resulting from those interpretations. For example, symbolic expressions include "messages" that help users interact with technical objects, or messages pertaining to designers' or users' goals and values. Symbolic expressions can also refer to expressions about functionality. Such expressions may be erroneous; functional and values-oriented symbolic expressions may be in conflict with each other. Moreover, a technical object may have many different symbolic expressions for a specified user group, just as it may have many functional affordances.

In Markus' and Silver's (2008) conceptualization, human behavior is partly influenced by the structures provided by IT (i. e., functional affordances and symbolic expressions). Since the properties of a technical object are not directly attributed to the technical object itself but to the relation between technical objects and users, this conceptualization emphasizes the importance of technology-human interactions. The outcome of IT use strongly depends on how the user perceives, understands, and grasps the structures that are provided by technical objects and how these structures are enacted in practice.

A RECONCEPTUALIZATION OF IT USE

The framework developed by Markus and Silver (2008) serves us as a foundation to study the effects of IT by distinguishing between technical objects and their relationships with users through the two channels of functional affordances and symbolic expressions. These two relational or bridging concepts contribute to the behavioral outcomes of IT use and second-order effects such as improved decision support (Poole et al. 2003), and help to explain how technical objects affect the user and his/her behavior. We suggest that the framework and the underlying structurational perspective allow for a thorough conceptualization of the IT use construct and provide additional constructs to explain the success of IT systems.

Figure 2 summarizes our research model and provides an overview of the assumed relationships. We claim that the structure provided by an IT system through the channels of functional affordances and symbolic expressions has a direct effect on IT use. The actual behavior in turn is understood as a social process that comprises different types of IT uses.

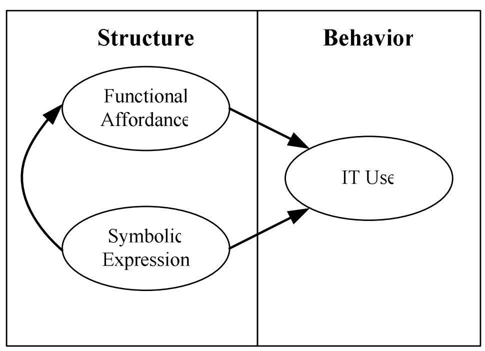

Figure 2. Conceptualized Relationship of Functional Affordance, Symbolic Expression and IT Use

Functional Affordance

The term "affordance" was introduced by Gibson (1977) and refers to actionable properties between an object and an actor. Affordances are relations between objects and actors in special situations. In other words, affordances can be described as cues and instructions that are offered by an object to the user in order to provide opportunities for particular types of individual behavior (Chemero 2003). The concept of *functional affordance* provides a perspective that recognizes how features of certain technical objects favor, shape, invite, or at the same time constrain a set of specific uses (Markus et al. 2008). The affordance is neither the property of the technical object nor of the individual that makes use of the object. The possibilities that technical objects afford for action may be perceived by several individuals in differing ways and therefore elicit different kinds of behavioral outcomes.

A concept similar to functional affordance, "motivational affordances", has already been applied in the field of human-computer interaction and computer design in order to investigate if technical objects determine or support the motivational needs of users (Zhang 2008). Recent experiments on collaborative idea generation show that improving the motivational affordances of IT has beneficial effects on group performance in terms of quantity and quality of ideas (Jung, Schneider and Valacich 2010). Similarly, the concept of functional affordance can be applied in order to investigate the functional needs of users and what kinds of functionalities affect the use of IT. Thus, before studying human-technology interactions, the functionalities relevant to the user-group in focus have to be exposed in advance.

Depending on the IT system in focus, the functional affordances can be described, for example, by the system's restrictiveness or level of sophistication (DeSanctis et al. 1994; Grange and Benbasat 2010). Restrictiveness describes how open respectively how closed a system is with regard to access authorization. The level of sophistication focuses on how advanced a system is with respect to its functionalities and domains that are supported. These dimensions are two examples that allow to describe functional affordances of IT systems (see Table 1, the list is not exhaustive). However, suitable dimensions for the classification of affordances should be chosen depending on what kind of IT system is investigated.

Structure	**Dimensions (Examples)**
Functional Affordance	Restrictiveness
	Level of Sophistication
	Data Evaluation Possibilities
	Data Analysis Possibilities
	…

Table 1. Functional Affordance and Possible Dimensions (for further dimensions see DeSanctis et al. 1994; Grange et al. 2010)

Symbolic Expression

A symbolic expression is defined as the communicative possibilities of a technical object for a specified user group (Markus et al. 2008). As such, it is not a property of a technical object but a relational concept that connects technical objects and users. Symbolic expressions are not to be confused with designer's intentions or user's perceptions. It is true that IT systems express "messages" and provide information intended by designers. However, they may also provide information that is not intended by designers. The same applies to the perception of users. A user may or may not perceive certain signs, symbols, or messages due to the fact that every user has a different background, expertise, or knowledge base.

Referring to de Souza and Preece (2004), Markus and Silver (2008) discuss the concept of symbolic expression in relation to semiotic studies. They confirm that technical objects as well as their component parts and their functions can serve as signs, and therefore convey meanings to the end-user. The symbols and functions of IT systems are representations of the conceptions of IT designers. The designer of an IT system derives meaning from the interpretation of a real world object or problem and chooses a suitable sign or symbol that represents that meaning. The IT user in turn refers to that symbol and interprets it in order to derive the meaning of the underlying real world object or problem. Unfortunately, Markus and Silver (2008) mainly focus their definition of symbolic expression on the conveyance of values, even though the concept is not inherently limited to the domain of values. We argue that symbolic expressions are even more important when it comes to the conveyance of meaning. While meaning of a symbol does also promote some kind of values because the concept is inherently connected to values of a symbol, meaning is mostly considered as the interpretation of the underlying real world phenomenon (or concept) that the symbol refers to by a user (Margolis and Laurence 2006). Successful communication requires the know-how to produce the relevant signs/symbols with the intended meaning (Hesse, Müller and Ruß 2008). In general, IT systems can promote values such as freedom or equality on an aggregate level; however, the understanding of certain perceptual cues needs to be considered in more detail. For example, if we turn to the example of Wikipedia as an IT system, does the user understand what the meaning of the "edit button" is and how it has to be used?

What this discussion amounts to is that we propose to subdivide the concept of symbolic expression into two distinct sub-concepts: *communication of values* and *communication of meaning* (see Table 2, the list is nor exhaustive). Communication of values tries to answer the question what kind of values are conveyed by the IT system, whereas communication of meaning is concerned with the question if the user understands the functionalities, information, and interface of an IT system. Defining the concept this way has the advantage of supporting potential analyses of the relationships between functional affordances and symbolic expressions. Ultimately, this conception allows directly answering the question whether users understand the (intended) functionalities of IT systems.

Structure	Sub-Structure	Dimensions (Examples)
Symbolic Expression	Communication of Values	Freedom (e. g., a system that offers possibilities to discuss topics and to post opinions and so forth)
		Equality (e. g., a system that offers the same access rights to all users)
		Control (e. g., a system that allows to control entire business processes, such as an ERP system)
		…
	Communication of Meaning	Interpretation (how does the user interpret the symbols, signs, or information that are provided by a system?)
		Sense-Making (does the user understand the symbols, signs, or information provided by a system?)
		…

Table 2. Symbolic Expression and Possible Dimensions (for further dimensions see DeSanctis et al. 1994; Grange et al. 2010)

IT Use: The Behavioral Outcome

As has already been mentioned, IT use is a social process that considers the interaction between a user (or user group) and an IT system. Consequently, IT use involves more than the extent or time a user spent with an IT system. The structurational perspective of AST provides a rich theoretical foundation that grasps different kinds of IT use behaviors as well as the quality of IT use through the concept of *appropriation moves* (DeSanctis et al. 1994). In this conceptualization, human behavior, and by implication IT use as well, is partly influenced by the structures provided by IT (i. e., functional affordances and symbolic expressions). Appropriations, the use of the structure provided by IT, are described as immediate visible actions that evidence deeper structuration processes and therefore instantiate structures. They are not automatically determined by IT designs. Rather, people actively select how technology structures are used, and therefore the use practices vary across different users.

DeSanctis and Poole (1994) identify three types of appropriation moves[1]: (a) direct *use of the structure*, (b) *relate the structure* to other structures, (c) *constraint or interpret the structures* as they are used. Direct use includes the direct interaction with IT, whereas the relation of structure and the constraint of structure comprise the adaptation, reinterpretation, and combination of structures provided by IT. Thus, in contrast to already prevalent IT use measures, the definition of IT use from a structurational perspective subdivides the IT use construct in those three sub-constructs and therefore takes different alternatives of possible IT use behaviors into consideration. This is why we suggest that the consideration of different types of appropriation moves provides a much richer conception of IT use. IT use is a social process depending on different structural possibilities a technical object offers and how IT users understand and make sense of them in order to use them. Consequently, if IT use is inconsistent with a technical object's structural potential, the outcomes will be less predictable and generally less favorable (Poole et al. 2003). Figure 3 shows our revised research model as well as the reconceptualizations of symbolic expression and IT use.

[1] A fourth type of appropriation move, *make judgments about the structure*, has been removed, since this type in our conceptualization is attributed to the concept of symbolic expression.

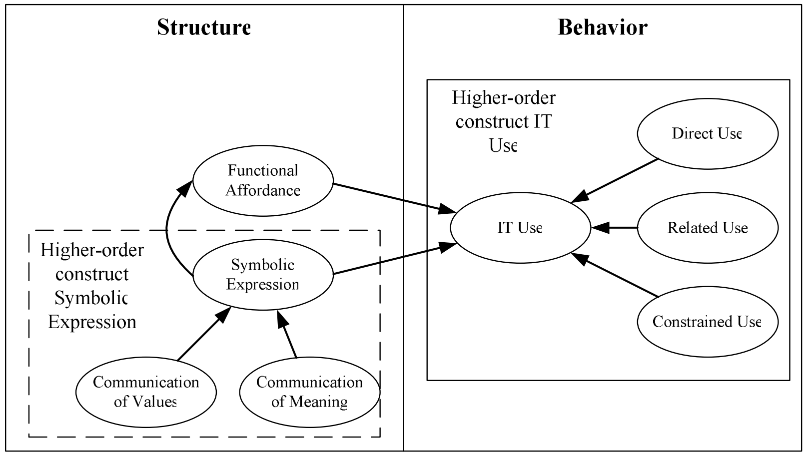

Figure 3. Revised Research Model

A Short Literature Review

We used our proposed research model to perform a quick review of academic IS literature. The goal was to find out to what extent IT use as a construct has been adequately derived from theory in quantitative studies. We followed established and recommended guidelines for literature review (Brocke, Simons, Niehaves, Riemer, Plattfaut and Cleven 2009; Webster and Watson 2002) and inspected the leading basket journals in the IS field: *European Journal of Information Systems, Information Systems Journal, Information Systems Research, Journal of AIS, Journal of MIS, MIS Quarterly,* as well as *Journal of Strategic Information Systems* and *Journal of Information Technology*. We examined every research article published in these journals and scrutinized title, keyword, and abstract to identify research studies that deal with IT use. Table 3 displays the accessed journals as well as the period our literature review has covered. As we only had access to the mentioned journals via EBSCOhost (Business Source Premier) the coverage of our search was limited. In order to achieve extensive search results the following keywords were used: *IT Use/Usage, Information Technology Use/Usage, System Use/Usage, Technology Use/Usage, Information Use/Usage, IS Use/Usage, Information Systems Use/Usage*. In a second step, each article was checked for its relevance to the topic of IT use by reading the respective abstract.

Journal	Coverage	Hits	Relevant after Review	Qualitative Studies	Quantitative Studies
MIS Quarterly	1977-2010	40	15	4	11
Information Systems Journal	1998-2010	5	1	1	0
European Journal of Information Systems	1997-2010	6	2	1	1
Information Systems Research	1990-2010	14	7	1	6
Journal of Management Information Systems	1984-2010	21	8	1	7
Journal of Strategic Information Systems	1991-2010	6	0	0	0
Journal of Information Technology	1990-2010	20	6	5	1
Journal of the Association for Information Systems	2003-2010	7	3	2	1
Sum		119	42	15	27

Table 3. Considered Journals and Identified Articles

Altogether, we identified 42 relevant articles with our literature review. 64% (27 articles) cover quantitative studies and 35% (15 articles) cover qualitative studies. The qualitative studies include studies that focused on theory development, theory extension, or qualitative research. In these studies IT use was either part of a theory or IT use was based on qualitative observations and descriptions and therefore not conceptualized with quantified items. In order to specifically investigate to what extent the IS literature considered different conceptualizations of the IT use construct, we analyzed the quantitative literature from our review (27 articles) with the help of our research model. We developed a concept matrix (see Table 4) based on the constructs of our research model to synthesize the literature (Webster et al. 2002). Although the scope of this literature review is quite limited, the results seem to support our assumption that most quantitative studies on IT use generally apply frequency or time-based items to measure IT use (direct use, see Table 4). Only a few studies try to consider different IT use measures. Srinivasan (1985) uses a rich conceptualization of IT use and does not restrict the items to frequency of use or time per session. Instead, he also asks users if the output of the IT system is relevant to decision-making and problem solving and if the form of the information is useful (functional affordance, communication of meaning, see Table 4). Barki et. al. (2007) provide a "technology interaction behavior" construct that contains different uses for IT systems, such as the coordination of activities, decision-making support, or problem solving (related use, communication of values, see Table 4). Burton-Jones (2009) introduces the construct of "deep structure usage" which can be understood as the extent to which functions are used to support tasks, idea-generation, and performance (related use, communication of meaning, see Table 4). Ahuja and Thatcher (2005) ask if IT systems are used in novel ways in order to innovate (constrained use, see Table 4). These examples as well as the other results of our literature review (see Table 4) show that some studies try to apply different IT use measures in order to account for a more precise and accurate construct of IT use. However, the majority of articles apply traditional frequency or time-based measures without any theoretical foundation. Consequently, we suggest that researchers should focus their main attention on a more sophisticated multilevel perspective of IT use.

	Direct Use	**Constrained Use**	**Related Use**	**Functional Affordance**	**Communication of Meaning**	**Communication of Values**
MIS Quarterly	10	1	1	0	1	1
Information Systems Journal	0	0	0	0	0	0
European Journal of Information Systems	1	0	0	0	0	0
Information Systems Research	4	0	1	1	0	1
Journal of Management Information Systems	6	0	0	0	0	0
Journal of Strategic Information Systems	0	0	0	0	0	0
Journal of Information Technology	1	0	1	0	0	0
Journal of the Association for Information Systems	1	0	0	0	0	0

Table 4. Concept Matrix[2]

INSTRUMENT DEVELOPMENT PROCESS

We are especially interested to investigate if our model can explain the use and subsequently the success of IT systems in different domains. As a starting point, we select data warehousing (DWH) systems as the IT systems in focus. Data warehousing is an important area of practice and research (Watson and Wixom 2007). While many critical success factors for developing such systems have already been investigated (Hwang and Xu 2008; Wixom and Todd 2005; Wixom and Watson 2001), it is still under-researched which DWH systems are successful, why they are successful, and how as well as for what purposes users actually use them. Because the benefits of DWH systems are mostly "soft" (most companies do not consider cost or time savings when investing in data warehouses but instead hope that a good DWH system will lead to a return in the future (Hannula and Pirttimaki 2003)), we see such IT systems as prime candidates for investigating the effects of functional affordances and symbolic expressions on IT use.

Before the model is tested our constructs have to be operationalized for this domain. The operationalization of IT use in the context of IS success is a novelty. In the past, there have already been several endeavors to develop measurement instruments to capture the AST constructs "consensus of appropriation" (Salisbury, Gopal and Chin 1996; Salisbury, Gopal and Chin

[2] We only investigated quantitative studies. In addition, an article might use multiple operationalizations for the IT use construct.

2002) and "faithfulness of appropriation" (Chin, Gopal and Salisbury 1997). Both measurement instruments, however, have been developed in the domain of electronic meeting systems (EMS) and capture to what extent group members have agreed on how to apply structures provided by the EMS, respectively if users believe they have appropriated structures faithfully. A more recent study applied Markus' and Silver's framework in the context of online social shopping in order to investigate how shopper's percept and evaluate online shopping design artifacts (Grange et al. 2010). These research activities provide some first implications on how AST, and especially functional affordances and symbolic expressions, can be operationalized to be suitable and to be integrated into quantitative studies.

To ensure content validity of our measures, the proposed candidate items of the item creation stage have been carefully designed based on existing surveys using AST and based on our derived research model. We do not blindly adopt the existing measurement inventories to our research domain of DWH systems, since it is by no means clear that these instruments are appropriate for this particularly domain. We operationalized the constructs as reflexive effect indicators (the latent variable – the construct – causes the indicator) because the primary goal of our research is to test a theory and only secondarily we want to give guidance for practice, for which the use of (formative) cause indicators is better suited (Bollen and Lennox 1991).

For assessing the validity of our instrument, we follow the procedure proposed by O'Leary-Kelly and Vokurka (1998). In order to counter the many corrupting elements embedded in measures (i. e., measurement error, informant bias), establishing construct validity involves the empirical assessment of the adequacy of a measure and requires that three essential components be established: unidimensionality, reliability, and validity (O'Leary-Kelly et al. 1998). To ensure these and following Moore and Benbasat (1991), the development of our measurement instrument is carried out in three stages. First of all, the new items for the defined constructs were created based on our theoretical deliberations. The second stage was concerned with the item development process and a pretest assessment of the measures. The final stage, instrument testing and factor analysis, is not part of this paper but will be carried out in future.

Item Creation

Based on the theoretical model, suitable items have been created. Concerning the functional affordances, we tried to create items that capture the degree to which a user knows all functionalities that are relevant to him/her. Another question is if the user thinks that the DWH system as a whole is well-engineered. Above this, additional items were developed that ask if the functionalities provided by the DWH system meet all requirements. The concept of symbolic expression was operationalized with the help of the two sub-constructs (communication of values, communication of meaning). Items for the first sub-construct include statements that grasp the overall values of the DWH system, for example, if the DWH system conveys the feeling of control, efficiency, or rationality, since DWH systems in general are applied for decision support. The concept of communication of meaning reflects the extent to which users understand the symbols, functions, and information provided by the DWH system. Here we ask, for example, if users in general understand the functions and information afforded by the DWH system. IT use was conceptualized using the three different appropriation moves. In addition to already established items such as the duration and extent of IT use, we also ask, for example, if some functionalities are neglected or if some information is combined with additional information from other IT systems (see Appendix A for a detailed list of the items).

Scale Development

In order to guarantee construct validity and to identify ambiguous and poorly worded items, we asked 11 PhD students as well as 3 professors with a background in database and DWH systems to sort the items to the aforementioned separate categories. We conducted three sorting rounds using an Excel spreadsheet in which the participants could label each item with one of the aforementioned constructs. After each round, items were either removed, new items were added, or the wording was changed before the next sorting round started.

To predict the performance of our measures after every sorting round, we applied a substantive validity test to the items of interest. The substantive validity of a measure can be defined as the extent to which the measure is judged to be theoretically linked to a construct under study (Anderson and Gerbing 1991). It is "particularly well suited to pretest settings, in contrast with assessments involving correlations, which suffer from the obfuscating effects of sampling error in small samples" (Anderson et al. 1991). The suitable sample size for a pretest setting ranges from 12 to 30 experts. One index which calculates the proportion of substantive agreement, P_{sa}, indicates the extent to which an item reflects its intended construct. However, it does not indicate the extent to which an item might also reflect other items. Therefore we apply a second measure: the substantive-validity coefficient, C_{sv}. It represents to what extent respondents assign an item to its posited construct more than to any other construct. For both indices larger values indicate greater substantial validity. A recommended threshold for the C_{sv} index is 0.5 (see Appendix B).

In the first round we asked the experts to complete the sorting task and to report on poor wording, odd sentences, and spelling. Overall, nearly 10 of the initial 26 items had to be removed. Especially items that captured symbolic expression (meaning of values) had to be replaced by new ones, since all experts stated the initial items were not suitable.

In the second sorting round we asked the experts to complete the sorting task with the newly developed 17 items and computed the substantive validities. As illustrated in Table 5, three of the four (sub-) constructs achieved an aggregated C_{sv} of above 0.5: functional affordance, communication of meaning, and communication of values. Only the IT use construct falls below this threshold. This low value most certainly originated from a misconception of IT use. At this stage of research we did not treat direct use, related use, and constrained use as sub-constructs of IT use but as measures. This caused problems for our raters since questions such as *"I use the DWH system for other uses than intended"* could not be directly associated with IT use. Therefore we created new items and further conceptualized the IT use construct to include the sub-constructs of direct use, related use, and constrained use. Overall, our measurement scale was now composed of 23 items.

(Sub-)Constructs	**Items**	**P_{sa}**	**C_{sv}**
Functional Affordance	5	0.9	0.8
Communication of Meaning	3	0.96	0.92
Communication of Values	3	0.88	0.75
IT Use	6	0.67	0.34
Totals/Averages (rounded)	17	0.85	0.7

Table 5. Second Sorting Round: Substantive Validity Pretest

We conducted a third sorting round in order to test the new items (Table 6). Now, the C_{sv} score falls above the threshold of 0.5 for all constructs. However, it must be noted that the C_{sv} score for the sub-construct communication of meaning decreased between round 2 and round 3 by 0.25. An item a priori assigned to communication of meaning was now considered by respondents to be representative of direct IT use. Since the score is still above 0.5 we did not reject the item.

(Sub-)Constructs	**Items**	**P_{sa}**	**C_{sv}**
Functional Affordance	5	0.95	0.9
Communication of Meaning	3	0.84	0.67
Communication of Values	3	1	1
Direct Use	4	0.94	0.88
Related Use	5	0.9	0.8
Constrained Use	3	0.92	0.84
Totals/Averages (rounded)	23	0.92	0.85

Table 6. Third Sorting Round: Substantive Validity Pretest

The third sorting-round indicates that the item reassignment has improved the overall substantive validity of the measurement scale. This is further shown by the total C_{sv} scores which was 0.7 in the second round and rose to 0.85 in the third round. The P_{sa} scores rose from 0.85 to 0.92, indicating that the items measure the underlying constructs quite well.

CONCLUSION AND FUTURE RESEARCH

This paper argues for the IT use construct as one of the main drivers and factors that contribute to IS success. We clarified why IT use was poorly operationalized in past research and why, consequently, there is a need for a theoretical grounding of IT use. By applying a structurational perspective, we developed a research model that advances the IT use construct and sub-divides it into three sub-constructs: direct use, related use, and constrained use. This new conceptualization has the advantage that IT use is not only considered as the amount or extent a user spent using IT. Rather the type of IT use as well as the user behavior are at the center of attention. Above that, we directly consider the relation between an IT system and IT use through the concepts of functional affordance and symbolic expression and therefore contribute to the understanding why and how certain IT aspects affect the use of IT.

So far, we established the theoretical grounding for our research and we thoroughly developed our research model. The development of our measurement scale for our constructs consisted of a multistage process and first tests for substantive validity could be applied. While all of the items in the measurement instrument appear to reflect the underlying constructs well, we believe it critical to apply a rigorous analysis to the development of this scale. Structural equation modeling allows us to do this by testing a confirmatory factor analysis (O'Leary-Kelly et al. 1998). Therefore we will further test our research model in the domain of DWH systems. First of all, we will conduct a pilot test of our measurement scale and constructs to prove reliability and validity. Not only will our new measurement instrument be applied in the domain of DWH, but also a measurement instrument for the ISSM will be used (Iivari 2005). This is done for two different reasons: firstly, we would like to confront our model with the already established ISSM. The main question that we seek to answer is if our conceptualization of IT use can contribute to the understanding of beneficial effects of IT use and therefore generate new insights into human-technology interaction. Secondly, we expect some possibilities to advance and adapt the ISSM with our research model in order to account for a more sophisticated model of IS success. Until now, for example, it is still unclear how the concepts of "system quality" and "information quality" (from the original ISSM) relate to functional affordances and symbolic expressions. It is possible that both quality constructs are affected by functional affordances and symbolic expressions provided by IT.

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APPENDIX

Appendix A: List of Items by Construct

Construct	**Sub-construct**	**Item**
Functional Affordance		Besides the generation of reports, the DWH system offers additional possibilities for data analysis.
		The existing functionalities of the DWH system do not satisfy my requirements.
		The existing functionalities of the DWH system satisfy my requirements.
		The DWH system is fully mature.
		The DWH system is restricted in its functionality.
Symbolic Expression	Communication of Meaning	I understand the generated reports respectively the outputs of the DWH system right away.
		The graphical interface of the DWH system helps me to understand all relevant functionalities.
		The information is presented in way that I can understand right away.
	Communication of Values	The DWH system gives me the feeling of control.
		The DWH system allows me to work more efficiently.
		The DWH system allows me to make decisions on a more rational basis.
IT Use	Direct Use	How often do you use the DWH system?
		How frequently do you interact with the DWH system (i.e., personally use with keyboard and/or mouse)?
		I use all of the functionality available in the DWH system.
		I use a part of the functionality available in the DWH-system.
	Related Use	I process the reports of the DWH system manually or with the help of other IT systems until I get the required information.
		I combine the information of the DWH system with additional information at hand.
		I use the DWH system in combination with other IT systems.
		I use the DWH system only in combination with … .
		I use no other IT systems besides the DWH system.
	Constrained Use	I use the DWH system for tasks that were not intended initially.
		I use the DWH system for other uses than intended
		I use the DWH system differently than intended.

Appendix B: Substantial Validity

Measures for substantial validity	**Formula**	**Range**
Proportion of substantive agreement	$P_{sa}=n_c/N$	0.0 to 1.0
Substantive-validity coefficient	$C_{sv}=(n_c-n_o)/N$	-1.0 to 1.0
nc: Number of respondents who assigned a measure to its posited construct, N: Total number of respondents, no: Highest number of the item to any other construct		