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The Critical Role of External Validity in Advancing Organizational Theorizing

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Abstract:

The information systems field needs strong cumulative traditions to advance IS theory building and better explain real-world phenomena. Despite the hegemony of theory in our major journals and major improvements in methodology over the years, the field has yet to achieve strong cumulative traditions beyond a few limited areas. In this paper, we propose a methodology for building such traditions by relying on the framework of external validity that Shadish, Cook, and Campbell (2002) suggest. Our methodology classifies accumulated knowledge into four types, highlights several evolutionary pathways for theory building, and explains how researchers can apply it to extend their own theory. To examine the appropriateness of our typology of accumulated knowledge across the IS and management fields, we conducted a literature review of the empirical research in major IS and management journals over a recent two-year period and coded it according to relevant characteristics of Cronbach's UTOS (i.e., units, treatments, outcomes, and settings). The technology acceptance model, IS success model, and resource-based view literatures illustrate how to apply the methodology. This evidence leads us to believe that establishing a cumulative tradition is well within the IS community's grasp.

Keywords: Cumulative Tradition, Knowledge Accumulation, Causal Generalization, External Validity, Cronbach's UTOS, Technology Acceptance Model, IS Success Model, Resource-based View.

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1 Introduction

Like other scientific fields, the information systems (IS) field needs a strong cumulative tradition to advance the field more consistently and efficiently and to have a stronger influence on other fields and on practice (Keen, 1980). A well-integrated body of knowledge is essential for researchers to find, read, and extend established research with greater ease (Pfeffer & Fong, 2005). Also, researchers having similar interests can more readily conduct interdependent research to untangle core unresolved issues in the area (Kuhn, 1970). Furthermore, established core knowledge makes technology-related behaviors more understandable, which can make the field more competitive in the sea of competing ideas (Hirschheim & Klein, 2012). Accordingly, IS knowledge will have more influence on prescriptive actions for practice (Benbasat & Zmud, 1999; Lee & Baskerville, 2003).

Several IS researchers have debated what the field's core research themes should be. Some argue the importance of IT artifact-based micro-level research (Benbasat & Zmud, 2003), whereas others advocate for the necessity of macro-level research to better understand its broader implications (Agarwal & Lucas, 2005). Still others suggest including the gray area lying between relevant research and irrelevant research (Whinston & Geng, 2004). Such debates have raised the importance of explicitly identifying the core themes for IS research and the systematic accumulation of core knowledge in the field. Fortunately, according to Taylor, Dillon, and Wingen's (2010) extensive review, it appears that the field has successfully established its core themes with a central focus on IS development and use and IS strategy. Such progress is supported by the development of native IS theories (Straub, 2012), the publication of impactful research (Lowry et al., 2013), and greater impacts on other fields (Grover, 2012; Karuga, Lowry, & Richardson, 2007). A considerable challenge facing the field is the need to adapt to changing technological developments while maintaining a core body of knowledge (Taylor et al., 2010). Such a challenge is partly attributed to the development of new technologies (e.g., social media, the Internet of things, and business analytics) that spawn new research themes and add new specializations. However, new specializations will not be successfully established unless the field consistently maintains a common body of knowledge via strong cumulative traditions (Schwartz, 2014).

Given the importance of building a strong cumulative tradition (Benbasat & Zmud, 1999; Grover, Ayyagari, Gokhale, Lim, & Coffey, 2006; Keen, 1980; Kraemer & Dutton, 1991), a select few IS researchers have proposed frameworks that help the field build such research programs. Introducing the concept of a research space comprising three key research parameters (i.e., theory, method, and context), Berthon, Pitt, Ewing, and Carr (2002) proposed eight possible research strategies for generating knowledge that can occur through changing or holding constant their proposed parameters. Later, for establishing scientific knowledge claims, Lee and Baskerville (2003) suggested four types of generalizability defined by the distinction between empirical statements and theoretical statements and the distinction between the source (from) and target (to) of generalization. Their conceptualization was later contended by Tsang and Williams (2012), and, in response, Lee and Baskerville (2012) defended their position and went on to enumerate other ways the field can progress. Seddon and Scheepers (2012) has also proposed eight pathways for generalization via study samples.

In IS reference or contributing fields, discussions on cultivating such a tradition have been an ongoing issue. For example, arguing for the necessity of replication for knowledge accumulation, Tsang and Kwan (1999) have proposed six types of replications along the two dimensions of whether same (or different) measurement and analysis are used and whether same (or different) data set/population is employed. In sociology, Cohen (1989) has provided a lengthy discussion on the importance of designing cumulative research programs.

In this paper, we provide a guiding methodology for theoretical generalization that can work in any research stream (i.e., a set of connected theories). We have three research objectives. First, we use external validity as a lens to review and assess the IS field's cumulative tradition. Specifically, we measure: a) the extent to which IS researchers view external validity as being important to their designs and (b) the extent to which IS research deployed across the four major elements of: 1) units, 2) treatment variables, 3) outcome variables, and 4) settings. Second, we put forward a body of knowledge accumulation (BoKA) methodology that identifies four different knowledge types. Third, we provide guidelines for using this BoKA methodology to effectively build evolutionary pathways of interrelated theories in a research stream.

We accomplish the first research objective by reviewing external validity considerations in two major IS journals and two major management journals over a two-year period. Our review captures a trend of

knowledge accumulation for empirical extension among many possible pathways toward theoretical generalization. Since this review covers all papers in the sampling framework, the results display an overall trend of a knowledge accumulation of research streams included in the sampling in two fields. We accomplish the second and third research objectives by explicating the developmental stages of theoretical claims from their initial conceptualization up through theoretical generalization. With respect to the concept of external validity, which is the underlying basis of all three objectives, we employ the framework of Shadish et al. (2002), who define external validity as the study of a cause-effect relationship's stability over variations in units (U), treatments (T), outcomes (O), and settings (S). This framing of UTOS originated with Cronbach (1982).

This paper proceeds as follows. In Section 2, we briefly review approaches to evaluating cumulative tradition in IS and overview external validity. In Section 3, we describe our research method for addressing the first research question. In Section 4, we present the results of this study and assess our framework. In Section 5, we elaborate on the BoKA methodology for building strong cumulative tradition and discuss how to incorporate elements of external validity into a research design. Finally, in Section 6, we conclude the paper.

2 Literature Review

Over the years, IS researchers have attempted to assess cumulative research tradition in the field. While there are numerous ways to approach this discussion, we believe that it can be framed as the historical evolution of thought about the nature and applicability of external validity.

2.1 Cumulative Tradition in IS

IS researchers have repeatedly called for the IS field to build cumulative tradition. Decades ago, Keen (1980) emphasized that IS should build cumulative traditions and urged researchers to create such traditions to make IS a more coherent research field. Later in that decade, Banville and Landry (1989) made a similar argument. Two decades after, Benbasat and Zmud (1999) echoed this view by stating that building cumulative tradition would be useful as a way to increase the relevance of IS research. Similarly, Hirschheim and Klein (2003) recognized the necessity of establishing an IS body of knowledge (BoK) for integrating IS knowledge. After recognizing the importance of such traditions, IS researchers have continuously attempted to evaluate cumulative tradition in the field (Table 1).

Researchers initially assessed knowledge accumulation in the IS field through bibliographic citation analysis (Cheon, Choong, & Grover, 1992; Culnan & Swanson, 1986; Grover et al., 2006) and through examining IS journal papers' reference patterns (Hamilton & Ives, 1982). These early studies (Cheon et al., 1992; Culnan & Swanson, 1986; Hamilton & Ives, 1982) found that the field was increasingly building on prior work and, over time, using the work of other IS researchers. A later study by Grover et al. (2006) showed that the field's degree of reliance on the growing IS knowledge base changed dramatically and for the better over the 1990-2003 period. Based mostly on analyzing citations, these studies show progressive development of the IS field with respect to knowledge accumulation (Wade, Biehl, & Kim, 2006).

Larsen and Levine (2005) performed another, more focused analysis by using a co-word analysis that measures the strengths of association of key terms between related publications. They examined coherence and change in a few IS key areas for the two periods of 1990-1994 and 1995-2000. They found that centers of coherence changed rapidly over time, with only seven out of 33 changes centers remaining largely the same over the two periods. Similarly, Sidorova, Evangelopoulos, Valacich, and Ramakrishnan (2008) employed latent semantic analysis to uncover common research themes on 1615 papers published in three top IS journals over the 1985-2006 period. They found "a stable intellectual core" of IS with respect to five key research areas: (1) information technology and organizations, (2) IS development, (3) IT and individuals, (4) IT and markets, and (5) IT and groups. They suggested that the field is approaching a "conceptually integrated bureaucracy" grounded in the five intellectual cores, which represented a shift from the "fragmented adhocracy" that Banville and Landry (1989) diagnosed earlier. Furthermore, Taylor et al. (2010) discovered that the field has not only developed the intellectual core centering on developing, implementing, and using systems, IS strategy and business outcomes, and group work and decision support but also has explored new research themes (i.e., programs) that include interorganizational systems, Internet applications, computer-supported collaborative work, virtual teams, and knowledge management.

Table 1. Empirical Studies on the Cumulative Tradition in the IS Field

Study	Method	Findings
Culnan (1987), Culnan & Swanson (1986)	• Conducted bibliographic citation analysis on the papers in the six journals and one conference proceedings in IS over the 1980-1985 period	• IS research has relied on prior IS research • The field is pre-paradigmatic but core research themes have begun to form around IS foundations, IS design and use (psychological and organizational approaches), IS management, curricula
Larsen & Levine (2005)	• Performed a co-word analysis for the 1990-1994 and 1995–2000 periods • Focused on the areas of strategy and competitive advantage and decision making, DSS, GSS, GDSS and group systems	• The greatest cohesion discovered in IS/IT and subfields and generic IS terms, but a limited number of centers of coherence displayed on specific theories and methods issues • The centers of coherence have changed rapidly over time • The field has shown weak cumulative traditions of theory building
Sidorova et al. (2008)	• Conducted a latent semantic analysis on 1615 papers published in top three IS journals over the 1985-2006 period	• Five intellectual cores: IT and organizations, IS development, IT and individuals, IT and markets, and IT and groups • The field has approached a "conceptually integrated bureaucracy" grounded in these cores
Taylor et al. (2010)	• Conducted an author co-citation analysis on the papers in the five lead journals in IS over the period of 1986-2005 • Identified representative authors relying on publication count and reputation, and conducted factor analyses	• The areas that have shown focus include the development, implementation, and use of systems, IS strategy and business outcomes, and group work and decision support, whereas those that have shown diversity include interorganizational systems, Internet applications, computer-supported collaborative work, virtual teams, and knowledge management • The field has shown the duality of focus and diversity • The field has moved from a fragmented adhocracy to a polycentric state

Thus, these assessments suggest that the field has shown healthy development dually in unification (i.e., focus) and specialization (i.e., diversity) (Taylor et al., 2010). Unification refers to the integration of diverse fields into a coherent structure, whereas specialization regards the pursuit of small, emerging themes in the field (Schwartz, 2014). In IS, the emergence of new technologies, the pervasiveness of IT in society, and a desire to establish relevance in practice have mostly driven specialization. According to our review, Taylor et al.'s (2010) three research themes can represent key areas for unifying the IS field, whereas the new themes indicate the field's specialization into emerging areas. Grover (2012) corroborates such an assessment by stating that "there is a core set of terms that consistently appear over time" and "the core terms might evolve over longer periods of time" (p. 258).

The IS field's history tells us that maintaining the unification of our field is crucial for the effective evolution of the field with specialization into emerging areas (Hirschheim & Klein, 2012). According to Grover (2012), the IS field is a complex adaptive system—one that has to adapt to a changing environment. Due to the development of new technologies and the pervasiveness of IT in a variety of social and economic activities, the problems that IS researchers address become multi-dimensional and more complicated. The field's evolution and the reshaping of its intellectual cores should indicate its ability to adapt to the changing environment. During the evolution process, the field should maintain its intellectual consistency by dealing with development in the existing frames to manage the complexity (Grover, 2012).

Fortunately, as the reviews above indicate, the IS field is developing along this healthy pathway of unification by providing the basic building blocks on which other research can draw to enable specialization into interesting, new phenomena, topics, and technology. Addressing the concerns of

Hirschheim and Klein (2012), the IS field is much closer to establishing a core body of knowledge that will guide the development of new knowledge.

How can we sustain such healthy development? In our view, above all, it is through careful planning and strategic execution to build cumulative research programs (Cohen, 1989) for establishing or extending our intellectual core (or body of knowledge). As such, it is imperative that, driven by theory, our efforts to build strong cumulative traditions should continue at the research-program level.

2.2 Development of External Validity

In this section, we summarize the historical debates over external validity and describe the four basic elements of external validity that form the foundation of our BoKA methodology.

2.2.1 Earlier Debates on External Validity

Ground-breaking methodologists in the 20th century gravitated toward the concept of external validity as a way to illuminate research projects' underlying nature. Originally, Campbell (1957) and Campbell and Stanley (1963) proposed external validity as the less-important half of a validity scheme that included only internal and external validity. Cook and Campbell (1979) then extended it into the now-familiar fourfold validity scheme. They split interval validity into: 1) statistical conclusion validity (i.e., are the cause and effect related?) and 2) internal validity (i.e., are rival causes ruled out?). They then divided external validity into: 3) construct validity (i.e., can we generalize from the research operations to high-order constructs?) and 4) external validity (i.e., can we generalize the theory to populations of persons and settings?). For Campbell and colleagues, internal validity was the primary factor for solid, experimental research designs. External validity was secondary.

Cronbach criticized this relegation of external validity to a secondary status and, thereby, placed external validity at the forefront of program evaluation (Cronbach, 1982; Cronbach et al., 1980). To explain his point of view, he developed a notational system in which *utos* refers to units of assignment (most often persons) *u,* treatments *t,* observations (including outcomes) *o*, and settings *s* achieved in a study (i.e., the sample of *utos*). He then developed the *UTOS* concept to refer to populations that these instances or samples represent and about which research conclusions are eventually drawn. **UTOS* refers to populations and constructs that have manifestly different attributes from *UTOS.*

Table 2 shows the definitions articulated by Cronbach (1982) and examples from some select IS studies. (See Appendix C for an UTOS example.) A classic example for the variation of unit can be found in Joseph et al. (2015), who used male and female IT professionals in testing for the effect of relative pay gap on patterns of job mobility (turn away, turn over). The variation of treatment is typically made in experiments and has been popular in electronic brainstorming systems (EBS) research (e.g., group size in Dennis and Valacich (1999)). As for the variation of outcome, Sykes (2015) employed IT (system satisfaction) and non-IT outcomes (job stress, job satisfaction, and job performance). An example for the variation of setting can be found in Chae, Koh, and Prybutok (2014), who examined the relationship between IT capability and firm performance in a different time setting.

For Cronbach (1982), internal validity involves generalizing from samples to the domain or conceptual realm about which general conclusions are to be drawn. His definition of internal validity subsumes Campbell's external validity and includes reproducibility or trustworthiness of the inference rather than causal inference (Cook, 2004).

One way of differentiating these types of validity is to think about internal validity as striving for the same results via another investigation. External validity, on the other hand, generalizes the results of one study to *unstudied* populations. This definition of external validity entails extrapolating causal knowledge to a new situation outside the prior research contexts. Using Cronbach's (1982) notation, internal validity involves generalizing from *utos* to *UTOS* while external validity involves generalizing from *UTOS* to **UTOS*.

Table 2. Definition and Examples of UTOS

	Definition	Example	Sample studies
U	• Individuals, communities, firms, inter-firm partners to be investigated • Sampling issues	• Systems users • Online customers • Firms • Countries	• Gefen, Karahanna, & Straub (2003) • Joseph, Ang, & Slaughter (2015)
T	• Planned experimental intervention (treatments or programs) • In field studies, the independent variable corresponds to T	• Group size • Type of computer application • Online products with varying image, video, and narration	• Dennis & Valacich (1999) • Galletta, Henry, McCoy, & Polak (2006)
O	• A variable (or variables) to be measured for events and reactions • Can contain pretests, posttests, and intermediate variables • In field studies, the dependent variable corresponds to O	• Adoption • System use • Performance outcome • Buying patterns of online products	• Straub (1994) • Dennis & Reinicke (2004) • Sykes (2015)
S	• Organizational/social context in which the study is influenced	• Culture/climate • Structure of organization • Technological artifact	• Tan, Smith, Keil, & Montealegre (2003) • Keil, Im, & Mahring (2007) • Chae et al. (2014)
Note: The classification of a variable into U or S depends on the research design. For example, a culture can be an underlying context in a study, whereas it can be a critical unit of analysis in another study.			

2.2.2 Later Developments of the Concept of External Validity

Cook (1993, 2000) performed crucial methodological studies of external validity to better understand the underlying differences between Campbell and Cronbach. His intensive investigation of the differences between these two researchers eventually led to the notion of causal generalization that Shadish, Cook, and Campbell (2002) articulate. With Cook's refinement, external validity refers to "the validity of inferences about whether the cause-effect relationship holds over variation in persons, settings, treatment variables, and measurement variables" (p. 38). This definition involves several fundamental changes to the ideas in Cook and Campbell (1979). First, it accommodates all four elements of a study that Cronbach *(utos)* proposes. Second, the definition includes the idea of a generalization of a causal relationship to the UTOS of target populations (i.e., it targets cause-and-effect constructs and persons and settings) and it covers the *UTOS of unstudied populations (i.e., novel cause-and-effect constructs and novel classes of persons and settings) (Cook, 1993).

Cook argues that this definition covers *UTOS because, in social science, we are ultimately interested in applying acquired knowledge to unstudied populations by incremental extensions of theory and experiments that have practical implications (Cook, 2004). This operational definition is also reasonable because the sampling particulars under which researchers develop a causal relationship are never the same as the contexts in which they later apply the result. Promising as it is, it seems almost impossible to achieve such generalization through a study that does not include *UTOS by design. (See Appendix B for an explanation.)

Finally, a notable aspect of Shadish et al.'s (2002) reformulation is that it departs from formal sampling for generalized causal inference. Shadish et al. encourage researchers to use formal sampling (e.g., random sampling) whenever possible. However, they do not advocate random sampling combined with random assignment to make generalized causal inference because random sampling is not a practical means of achieving generalization. Random sampling is not routinely applied to U-elements and S-elements, and it does not apply at all to T-elements and O-elements (random selection of treatments and observations), or to *UTOS as well (Cook, 2004).

In this research, we adopt external validity's underlying principles (as Cook articulates) and its reformulation (as Shadish et al. (2002) summarize). The context of generalization includes persons, settings, treatment variables, and outcome variables. Causal generalization is possible beyond sample estimates to populations and, indeed, to unstudied populations. We also move beyond formal sampling

theory to a theory grounded in the actual practice of science that does not necessarily involve statistical sampling (e.g., purposive sampling).

2.2.3 Debates on External Validity in the IS Field

Researchers in the IS field have considered external validity to be an important element in advancing IS research. For example, Gefen and Straub (1997) extended the technology acceptance model (TAM) by including gender as a major cultural variable and found significant effects of gender in IT diffusion processes. Similarly, while examining telemedicine technology acceptance, Chau and Hu (2002a) discovered subtle differences between individual professionals (e.g., physicians) and end users in business settings with respect to perceived usefulness, ease of use, compatibility, peer influence, and technology controllability.

Later, Lee and Baskerville (2003) took on the issue of external validity and proposed the four types of generalizability: from empirical statement to empirical statement (EE), from empirical statement to theory (ET), from theory to empirical statement (TE), and from theory to theory (TT). Lee and Baskerville's framework is based on the philosophical traditions of Hume's truism and interpretivism, and it identifies the generalizability types by the distinction between empirical statements and theoretical statements and the distinction between the source (from) and target (to) of generalization. Lee and Baskerville's framework evoked criticism by Tsang and Williams (2012) who suggested that they misunderstood the concepts of theoretical generalization, statistical generalization, and empirical testing. As an alternative, Tsang and Williams proposed the five types of generalization: theoretical, within-population, cross-population, contextual, and temporal. In a rejoinder, Lee and Baskerville (2012) pointed out the similarities between the frameworks and highlighted that their framework is more applicable to qualitative research. According to our research objectives, Tsang and Williams's framework is better aligned with our analysis structure. We do not explicitly incorporate Tsang and Williams's framework because Shadish, Cook, and Campbell's (2002) framework is much broader.

3 Evaluation Method

As in other methodological studies (Boudreau, Gefen, & Straub, 2001; Dube & Pare, 2003), we adopt the scientific approach of the literature review and interpretation to justify the emergent framework that is our primary contribution. This approach addresses the first research objective by assessing 1) the degree to which papers recognized external validity across the four elements (i.e., U, T, O, and S) (hereafter termed research objective 1A "recognition evaluation"), and 2) the degree to which papers employed external validity with respect to these elements (hereafter termed research objective 1B "deployment evaluation").

3.1 Journal Selection

We selected publications from two top IS journals and two top management journals (*MIS Quarterly, Information Systems Research, Administrative Science Quarterly, and Organization Science*) over a recent two-year period for review. These top journals employ similar research paradigms, theories, and methods and are likely to have the same mission of advancing theories. As such, we could draw meaningful comparisons and conclusions about the generality of our methodology across the two fields. We chose the two-year period because we needed to consider the influence of the major publications with respect to the value of generalization by Shadish et al. (2002), Berthon et al. (2002), and Lee and Baskerville (2003). To make the review manageable, we included only papers using quantitative methods such as experiments, surveys, and archival research.

3.2 Coding Strategy

We determined whether scholars formally recognized that they were addressing external validity concerns by content analyzing online full-text manuscripts, abstracts and titles. Once we assigned each paper with relevant keywords such as external validity and generalization, we subclassified it to determine which elements of U, T, O, and S the study used in a substantive way. Thus, the coding captured IS researchers' overall level of appreciation for varying research contexts in order to achieve empirical extension.

We evaluated external validity deployment by identifying how researchers actually incorporated U-, T-, O-, and S-elements into their study. This evaluation helps researchers to more fully comprehend the actual practice of empirical extension. First, we classified each paper according to a pre-defined coding scheme

designed to capture the deployment focus in a few select representative attributes (hereafter termed research objective 1B-I). Our coding scheme focused on U-, T-, and S-elements, all of which provide attributes that are identifiable across different papers. The attributes for O-element were not included because of the difficulty of finding universal attributes for the dependent variable applicable across the two fields. We use the results to describe the actual deployment of these three elements and to identify areas for further attention.

Next, we again evaluated the papers to see whether they actually exercised variations on any of the four elements of external validity in their own research design (hereafter research objective 1B-II). We scanned the variables in each paper for variations across any of the U-, T-, O-, and S-elements[1]. A variation on U-element would be, for example, the introduction of new types of IT users into the sampling frame. In scanning for T-elements, we confined ourselves to experimental research since treatment involves manipulating independent variables. We assessed T-elements by identifying whether the introduction of novel treatment types for the manipulation was intended to test for the theoretical boundary. We checked O-elements by examining whether the papers hypothesized and/or empirically tested new dimensions for the dependent variable(s). We use the results to identify the difference between the degree of recognition and deployment.

We designed the coding scheme for research objective 1B-I to map out papers' areas of deployment focus across the U-, T-, and S-elements. Coding attributes on "U-units" involved sampling methods and non-response bias, which we used to evaluate sample representativeness. We divided sampling methods into formal sampling (simple or stratified random sampling), purposive sampling (modal instance or heterogeneity), and convenience sampling (Trochim, 2001), and non-response error into wave, percentage of response, size of response, and the non-response bias analysis method. Formal sampling comprises simple or stratified random sampling and is a general approach for achieving generalization of findings when units can be chosen by chance (Shadish et al., 2002). Purposive sampling relies on an intentional method, which is not random, and comprises sampling of modal instances or heterogeneous instances (Trochim, 2001)[2]. Following extended roles of purposive sampling for generalized causal inference by Shadish et al. (2002), we trust that formal sampling and purposive sampling are the most efficacious approaches for achieving external validity.

Non-response error occurs when the sample does not represent the population because non-responses could have led to systematic bias. This error degrades the external validity of a study by introducing error wherein the traits of respondents are substantially different from those of non-respondents, which makes generalizing the sample to the population troublesome (Sivo, Saunders, Chang, & Jiang, 2006).

Attributes on "T-treatment variables" include *task type* that is used to classify the background task in experimental research. We employed the typology that McGrath's (1984) task circumplex suggests for classification. This typology groups work tasks into eight types: 1) planning, 2) creativity (idea generation), 3) intellective (problem solving), 4) decision making, 5) cognitive conflict (resolving conflicts of viewpoint), 6) mixed motive (resolving conflicts of interest), 7) competitive tasks (resolving conflicts of power), and 8) psychomotor tasks (executing performance tasks).

Attributes on "S-settings" were firm size, industry, national culture, task, and organizational culture/climate. We selected these attributes as exemplary, but they are not necessarily exhaustive; we drew them from sets of contextual variables in more definitive, lengthy lists of candidates for settings (Porter & McLaughlin, 2006). We based codings for firm size, industry, and national culture on predefined categories (see Table 3 and Appendix F for details). We coded task and organizational culture/climate by examining whether elements of each attribute were present. Exemplary elements include: task complexity and task interdependence for task, and cultural types and norms for organizational culture/climate. For coding, we did not differentiate between organizational culture and climate (see also Porter & McLaughlin, 2006).

[1] We do not evaluate authors' *intent* with regard to external validity but assess the degree of external validity by drawing on their stated or revealed research design.

[2] Modal instance sampling requires clear specification of characteristics of typical persons, treatments, observations, and settings as the target of generalization and the selection of a sample that matches these characteristics (Kruskal & Mosteller, 1979). Heterogeneous sampling calls for selecting instances that have diversity on a study's important attributes.

3.3 Validation of Coding

We, two knowledgeable IS coders, performed the coding independently. We initially used 22 papers as training, which led to a shared coding mental model. During this process, we discussed and reconciled disagreements and refined the coding scheme as necessary. After this initial coding, we coded the next 85 papers independently and calculated inter-rater reliabilities. The first author coded the remaining 26 papers.

Inter-rater reliability assesses the degree to which different coders assign consistent scores to the same attribute. We used Cohen's (1960) kappa as a more stringent coefficient of agreement than a simple correlation coefficient. The calculated Kappa statistics exceeded the 0.70 standard recommended in the literature (e.g., Bowers & Courtright, 1984). First, the result for assessing recognition was 0.89, and the results for evaluating deployment were: sampling methods (0.72), survey wave (0.89), bias analysis (0.85), task type associated with experiments (0.97), firm size (0.96), and national culture (0.93). In addition, we coded the following: research setting (lab experiment, field experiment, survey, archival; 0.93), and research design (cross-sectional, longitudinal; 0.78). We did not calculate the kappas for attributes that could not be classified into clean categories (e.g., response rate).

4 Evaluation Results

4.1 Sample

We analyzed 133 papers over the 2006-2007 period: 38 from *MIS Quarterly*, 27 from *Information Systems Research*, 24 from *Administrative Science Quarterly*, and 44 from *Organization Science* (65 in IS and 68 in management). Our sampling focused on papers that employ quantitative research methods and excluded those that employ simulation, qualitative analysis, and IS papers that appeared in the management journals. The research methods the papers employed comprised experiments (32% for IS vs. 4% for management), field studies (e.g., surveys) (49% vs. 31%), and archival studies (19% vs. 65%). Research design comprised cross-sectional (74% vs. 40%), longitudinal (23% vs. 60%), and cross-sectional + longitudinal design (3% for IS only). The IS literature had more experimental research, whereas the management literature had more archival studies. A heavy reliance on the archival research method in the management literature was accompanied by a higher portion of longitudinal research design (see Table G1 in Appendix for details).

4.2 Research Objective 1A: Recognition Evaluation

Table 3 summarizes the degree to which the IS and management papers recognized external validity. This table shows the frequency of themes emerged across UTOS elements during the coding process. External validity was mentioned in 57% of the IS journals' papers versus 51% in the management journals' papers. IS researchers associated external validity mostly with settings (43%) and units (40%), then treatments (13%) and outcomes (2%), whereas the management researchers discussed it in regard to settings (64%) most, then units (32%), and then outcomes (2%).

With respect to the U-element, the most frequently mentioned attributes in IS were different sub-samples (13%), sample size (10%), and student participants (10%), whereas those in management were industry (9%), sample characteristics (7%), and firm size (7%). The T-element was more highly recognized in IS partly because more IS research relied on experiments. Researchers were mostly concerned with properly operationalizing their treatment variables. The O-element was the least recognized element (2% across the fields). Researchers' prime concern was in establishing construct validity and determining other dimensions of the dependent variable(s). The S-element received more attention than the U-element as a whole. The major themes in IS included country/culture (5%) and number of firms/cases involved (5%), whereas those in management were industry (18%), country/culture (7%), for-profit/nonprofit setting (7%), and other regions/markets (7%). The management literature was more concerned with the S-element and less with the U-element, partly because a larger sample size in archival studies in management poses fewer problems with sampling and also because archival studies that focus on the phenomenon at the macro level are more subject to the influence of surrounding settings (e.g., industry).

Interpreting these data further, we conclude overall that IS and management researchers generally view extending their research along the four elements as being important because about half of the papers across the two fields included some discussion of external validity. Discussions were perhaps more

formulaic than substantive in that they were mostly related to study limitations and, less often, to theoretical boundary conditions to be tested in subsequent research. However, any level of recognition of external validity should not be gainsaid in that researchers can turn their interests into deployment in a later project in their research stream.

Table 3. Recognition of External Validity

	IS		Management	
	Themes	**Frequency**	**Themes**	**Frequency**
Units	Different sub-samples Sample size Student participants Sample characteristics Country/culture **No. of cases**	8 (13%)[a] 6 (10%) 6 (10%) 2 (3%) 2 (3%) **24 (40%)**	Industry Sample characteristics Firm size Country/culture Different sub-samples Sample size Student participants **No. of cases**	4 (9%) 3 (7%) 3 (7%) 1 (2%) 1 (2%) 1 (2%) 1 (2%) **14 (32%)**
Treatments	Realism of experimental tasks Product presentation design Diagram design Treatment levels **No. of cases**	4 (7%) 3 (5%) 1 (2%) 1 (2%) **9 (13%)**	- **No. of cases**	- **0 (0%)**
Outcomes	Success in open source software **No. of cases**	1 (2%) **1 (2%)**	Choice of the ratings for DV **No. of cases**	1 (2%) **1 (2%)**
Settings	Country/culture Number of firms/cases Industry Other communities Communication media Experimental setting Institutional force Nontechnical factors Non-volitional setting Organization size Other knowledge processes Other learning situations Other online marketplaces Other product types Other software categories Other technologies Other text genres Task Transaction types Website characteristics **No. of cases**	3 (5%) 3 (5%) 2 (3%) 2 (3%) 1 (2%) 1 (2%) 1 (2%) 1 (2%) 1 (2%) 1 (2%) 1 (2%) 1 (2%) 1 (2%) 1 (2%) 1 (2%) 1 (2%) 1 (2%) 1 (2%) 1 (2%) 1 (2%) **26 (43%)**	Industry Country/culture For-profit/nonprofit setting Other regions/markets Failure types Network of different clusters Other communities Other competitive arenas Other contexts for meeting Other types of firm Other types of protest Other types of recruitment Other unionization contexts **No. of cases**	8 (18%) 3 (7%) 3 (7%) 3 (7%) 1 (2%) 1 (2%) 1 (2%) 1 (2%) 1 (2%) 1 (2%) 1 (2%) 1 (2%) 1 (2%) **27 (64%)**
	Total cases[b]	**60**	**Total cases**	**42**
	Papers mentioned EV	**37 (57%)**[c]	**Papers mentioned EV**	**35 (51%)**

[a] We calculated the percentage based on total cases identified (60 for IS and 42 for management) that we observed across 37 and 35 papers in IS and management, respectively.
[b] The total number of cases across the themes is greater than the number of papers that mentions external validity (EV) because one paper sometimes associated external validity with more than one theme.
[c] We calculated the percentage based on the total number of papers coded (65 for IS and 68 for management).

4.3 Research Objective 1B: Deployment Evaluation

4.3.1 Research Objective 1B-I (Evaluating Deployment of Focused Attributes)

Table 4 shows the results of deployment evaluation in identifying the deployment focus of the sampled papers on a preselected list of U-T-S attributes.

U-units: with respect to sampling methods, the IS literature mostly employed purposive sampling (76%) followed by random sampling (22%). Regarding non-response error analysis, sampled papers used a

single wave of data collection 50 percent of the time, had an average response rate of 38 percent, and checked for non-response bias 78 percent of the time. The management literature heavily relied on purposive sampling (79%) first and random sampling (16%) next. Research was mostly carried out in a single survey wave (71%), had a 51 percent response rate on average, and analyzed non-response bias 59 percent of the time.

Table 4. Deployment of External Validity of Focused Attributes on U, T, and S

	Attributes	IS		Management	
		N [a]	Frequency	N	Frequency
Units	Sampling methods	65		68	
	Random sampling				
	Simple		13%		13%
	Stratified		9%		3%
	Purposive sampling				
	Modal		76%		79%
	Heterogeneity		-		-
	Convenience sampling		1%		-
	Non-response error				
	Wave	31		17	
	Single		50%		71%
	Response rate	29	38%	19	51%
	Average sample size				
	Experiments	21	141	3	86
	Field studies	32	290	21	756
	Archival studies	12	50,895	44	15,054
	Bias analysis [b]	25	78%	13	59%
Treatments	Task type (experiments) [c]	21		3	
	Type 3: intellective		24%		-
	Type 4: decision making		76%		75%
	Type 6: mixed motive		-		25%
Settings	Firm size	28		36	
	Small		16%		16%
	Medium-sized		24%		16%
	Large		60%		68%
	Industry [d]	29		53	
	Manufacturing		24%		34%
	Finance and insurance		12%		13%
	Professional services		12%		10%
	National culture	65		68	
	US		69%		68%
	Non-US		22%		24%
	US+Non-US		9%		9%
	Task [e]	7	11%	2	3%
	Culture/climate	3	5%	3	4%

[a] N (number of papers involved) varies depending on the attributes because attributes sometimes are not relevant to the papers, not available, or difficult to figure out.
[b] We calculated the percentage based on the number of field studies (32 for IS and 21 for management).
[c] We calculated the percentage for management based on 5 studies identified in 4 papers.
[d, e] See Tables G2 and G3 in Appendix G for details.

A decade ago, Pinsonneault and Kraemer (1993) deplored the fact that more than 70 percent of the IS papers they studied employed a convenience sample or did not describe their sampling method. Our data shows that there have been quite a few improvements in sampling method since 1993. The results of response rate and non-response bias analysis also appear to show improvement over Pinsonneault and Kraemer's (1993) assessment. Assuming that a reasonable, realizable goal for response rate is 60-70 percent (Babbie, 1990) and for testing non-response bias in all field studies, we conclude that, in our reviewed papers, external validity with respect to response rate and non-response bias testing was less than adequate across the two fields. This conclusion is consistent with Sivo et al.'s (2006), and,

consequently, on average, surveyed researchers cannot strongly claim empirical generality in their research.

T (treatments): the distribution of the IS papers across the eight task types was 24 percent for intellective (type 3) and 76 percent for decision making (type 4), whereas the distribution of the management papers was 75 percent for decision making (type 4) and 25 percent for mixed motive (type 6). Thus, the sampled papers were mostly focused on decision making task types.

S (settings): with regard to firm size and national culture, roughly two-thirds of the reviewed papers in both fields drew from large firms and North America. As for industry focus, about 50 percent of the papers across the fields surveyed such industries as manufacturing, finance and insurance, and professional, scientific, and technical services. Task and culture/climate were not well studied across the fields.

4.3.2 Research Objective 1B-II (Evaluating Deployment in Variations)

Table 5 presents the deployment evaluation's results regarding variations on U-, T-, O-, and S-elements.

U (units): six papers in IS introduced variations on the U-element while the management papers showed such variations in four papers. The major element of variation includes demographic characteristics or their varying capabilities.

T (treatments): despite the recognition of potential impacts of different treatments in experiments, no paper actually introduced variations in treatment variables to test for the theoretical boundary conditions. Retrospectively, several researchers in our study raised concerns regarding the generalizability of treatment variables' operationalization. For example, Galletta et al. (2006) mention that their familiarity treatment could be stronger than intended or their breadth treatment could be weaker than intended. One can find actual T-element variations (e.g., group size), in another instance, in the electronic brainstorming systems research that was published earlier than our study dates (see Dennis & Valacich, 1999).

O (outcomes): outcome variations received the most attention among the four elements. The IS papers displayed variations in 7 papers, while the management papers show variations in 10 papers. In IS, the most salient elements were firm performance and decision quality, while, in management, papers gave more attention to job/career performance and box office success.

S (settings): contrary to frequent recognition in settings, actual variations were less frequent, partly because it is costly to implement a study with varying contextual backgrounds. Papers in both fields recognized variations in institutional environments.

Table 5. Deployment of External Validity in Variations on U, T, O, and S

	IS			Management	
	Elements	**Frequency**		**Elements**	**Frequency**
Units	Demographic characteristics Country (IT-intensiveness) EDI users and nonusers Team size **No. of papers**	3 1 1 1 **6 (9%)**[a]		Demographic characteristics **No. of papers**	4 **4 (6%)**
Treatments	- **No. of papers**	- **0 (0%)**		- **No. of papers**	- **0 (0%)**
Outcomes	Firm performance Decision quality Methodology deployment System usage **No. of papers**	3 2 1 1 **7 (11%)**		Job/career performance Box office success Firm performance Relationship performance Personal flexibility Termination decisions Voting behavior **No. of papers**	3 2 1 1 1 1 1 **10 (15%)**
Settings	IT adoption Institutional environments Internet use in two stages Web vs. wireless usability **No. of papers**	1 1 1 1 **4 (6%)**		Institutional environments **No. of papers**	1 **1 (1%)**
	Total papers	**17 (26%)**[a]		**Total papers**	**14 (21%)**

[a] Table G4 in Appendix G describes the details of each papers. We calculated the percentage based on total number of papers coded (65 for IS and 68 for management).

4.4 Assessment of Evaluation Results

As we mention in Section 5 below, the way we assess knowledge accumulation of this external validity type is a snapshot of a particular pathway across research streams among many different routes toward theoretical generalization. From the results, we note three trends in how researchers have used external validity. First, the literature shows a disparity between recognizing and actually deploying UTOS (see Tables 3 and Table 5 for comparison). Although a sizable number of papers across the two fields (about 54% on average from Table 3) appear to have recognized the importance of *UTOS, few papers actually deployed *UTOS (about 24% on average from Table 5).

How does this occur? Authors frequently mentioned external validity in their limitations sections, which qualifies them as showing recognition. This approach accounted for the over 50 percent who recognized the importance of *UTOS. But far fewer (24%) actually examined elements of external validity in their papers. We believe that, when only one quarter of the papers have tested for external validity, we can consider practice-in-use to be abysmally low.

Second, research was still skewed in some focused attributes of U, T, and S and lacked a balance in covering diverse dimensions of the attribute (Table 4). With respect to sampling method and non-response error, research still falls short of the expectations despite an improvement since the turn of the millennium. The average response rate across the two fields was 45 percent—below the threshhold of 60-70 percent (Babbie, 1990), whereas ruling out non-response bias occurred 69 percent of the time. Task types in experiments were mostly focused on decision making (type 4), and no comparative research across the task types has been conducted. Research has been performed with large, U.S.-based firms in such industries as manufacturing, finance and insurance, and professional services.

Last, we did not find any great discrepancies between the IS and management fields in recognizing and deploying external validity. Both showed a comparable level of recognition (57% vs. 51%), similarities in deployment focus, and a comparable rate of variations (26% vs. 21%). Therefore, we conclude that the IS field is comparable to management in its lack of deploying external validation tests.

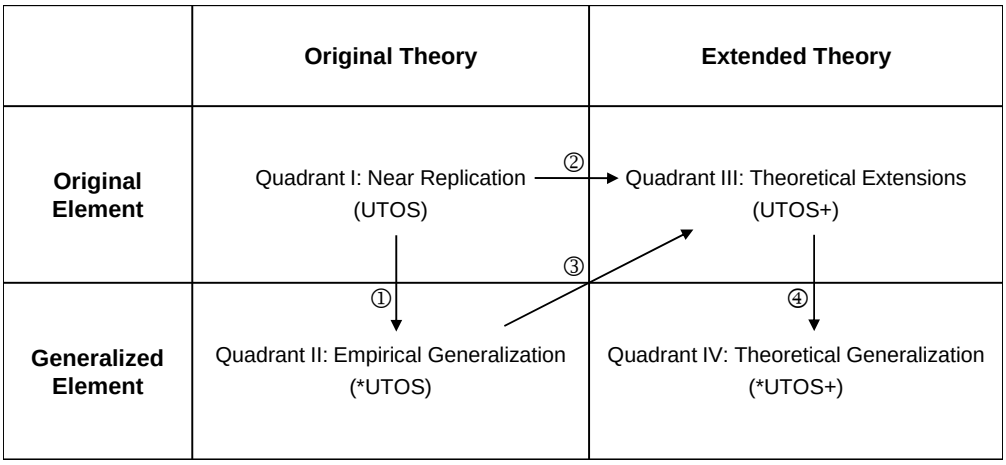
We might ask whether it is possible to generalize beyond our sample to all IS and management literatures. Our study includes top journals in the fields and the period we covered was relatively recent. Hence, the results obtained here reflect the up-to-date thinking of the two fields' leading researchers. If anything, therefore, the results are conservative estimates of the status of external validity in the fields[3].

Reflecting on the results across the three tables, we suggest that, by having a guiding framework for cumulative tradition, researchers can advance their theory better in a balanced way beyond merely recognizing *UTOS. Also, they need guidance about how to extend the theory in other ways than pursuing empirical extension via external validity. Prior literature (e.g., Tsang & Kwan, 1999; Berthon et al., 2002; Lee & Baskerville, 2003) has addressed certain aspects of knowledge accumulation, but their frameworks are not comprehensive and lack detailed guides about how to build cumulative tradition. Our BoKA methodology that we present in Section 5 recognizes all four elements of U, T, O, and S as the proper context of research. After identifying four different types of knowledge accumulation, our methodology depicts the dynamic pathways toward theoretical generalization.

5 The BoKA Methodology for Enhancing Knowledge Accumulation in IS

To provide a common ground for developing strong cumulative traditions in IS, we now present a body of knowledge accumulation (BoKA) methodology that applies basic principles of external validity (Figure 1). The first aspect of this methodology is a typology that classifies accumulated knowledge into four different types. The second aspect explains the interrelationships among four knowledge types and possible evolutionary pathways toward the final destination of theoretical generalization in a research stream. Our methodology should be useful for systematically identifying types of knowledge that have already been accumulated in a research stream and the types of new knowledge that need to be uncovered (Wagner & Berger, 1985). Further, researchers can interrelate new knowledge with already accumulated knowledge and assess the effectiveness of their strategies and pathways they have followed to advance the theory.

[3] It is unlikely that lower-tier journals publish papers that are vitally concerned with external validity issues. The most current thinking in a field usually appears in the higher-tier journals.



*UTOS: variations on U, T, O, or S (i.e., traditional external validity elements).
UTOS+: theoretical changes (e.g., addition, subtraction, or refinement) in U, T, O, or S.
*UTOS+: variations on U+, T+, O+, or S+.

Figure 1. Body of Knowledge Accumulation Methodology

For illustrative purposes, we apply BoKA to the technology acceptance model, one of the most mature research streams in IS. TAM is part of a larger research stream of user acceptance research whose overall research question is to investigate "how and why individuals adopt new information technologies" (Venkatesh, Morris, Davis, & Davis, 2003, p. 427). The goal of user acceptance research is to better understand actual system use by examining the impact of individual reactions to IS on system use intentions and, in turn, actual system use. Since TAM research plays a key role in addressing this research question, we focus our methodology on TAM research. In Section 5.1, we apply our methodology in classifying TAM research into four types of knowledge accumulation.

5.1 Research Objective 2, Part I: Four Types of Knowledge Accumulation

Our methodology classifies accumulated knowledge along two dimensions. The first dimension examines whether the proposed theory has been tested using the original UTOS or UTOS with variations (i.e., *UTOS), whereas the second dimension considers whether the theory is original or extended (UTOS+). By combining these two dimensions, we obtain four types of knowledge accumulation: near replication, empirical generalization, theoretical extensions, and theoretical generalization.

The very first step for knowledge accumulation is to have a new theory solve certain target problem(s). A new theory should have three qualities to become a vibrant research stream (McKinley et al., 1999). First, it should have enough novelty to be visible in the field, attract many researchers' attention, spark debates, and beget continued interest among researchers. Next, it should have a certain level of continuity that aligns it with existing body of knowledge that has been established in the field. Researchers will experience difficulties in making connections with the new theory if it is not grounded in existing body of knowledge, and this disconnectedness will deter its assimilation. Last, the new theory should have a broad scope in which enough abstraction and ambiguity can provoke researchers to pursue multiple interpretations, different operationalizations, and further exploitation. The appearance of a new theory in a field occurs outside the 2x2 matrix representing the existing theory.

5.1.1 Quadrant I: Near Replication (UTOS)

"Near replication" is the starting point for studies following the appearance of a new theory in a field; it assumes the designation of "normal science" in Kuhn's (1970) groundbreaking work. Near replication refers to duplicating a study by closely following the original design, data collection, and analysis procedures (Berthon et al., 2002). Researchers can conduct close replication by exactly duplicating the original study's sampling, measures, and methods with a similar or larger sample (Lykken, 1968); of course, all such replications are carried out at a different point in time so they can never be exact replications. Alternatively, they can employ operational replication by only duplicating a study's methodological procedures. Since it is difficult to exactly replicate social science studies due specifically to

data-collection challenges, the near replication, which approximates the original study with variations, can be acceptable (Singh, Ang, & Leong, 2003).

Researchers perform replication research in an early stage of a research stream and are typically interested in seeing whether the initial findings are reproducible in subsequent studies (Tsang & Kwan, 1999). Certainly, this type of research lacks novelty and, thus, may be valued less, but it is crucial that the original theory is confirmed, refined, or modified in a series of replications. Successful replication allows researchers to form a consensus on a target problem (or set of problems) and scope that the research stream seeks to solve (Freese, 1980). (The readers should refer to Appendix A for detailed guides on the methods for expanding theory).

A series of early TAM studies replicated the original TAM study (Davis, 1989) and, thereby, established the validity and reliability of perceived usefulness (PU) and perceived ease of use (PEOU) instruments; they also reproduced the original findings. Adams, Nelson, and Todd (1992) ascertained validity and reliability of the two scales, and Hendrickson and Collins (1996) and Hendrick, Massey, and Cronan (1993) established test-retest reliability. Davis and Venkatesh (1996) compared original grouped items with intermixed items and found that item grouping did not generate bias. Segars and Grover (1993) challenged the unidimensionality of PU instruments, and this challenge generated both support (Barki & Hartwick, 1994) and objections (Chin & Todd, 1995). Some studies (Davis, 1993; Subramanian, 1994; Szajna, 1994) also showed that the original results were reproducible with minor variations and demonstrable predictive validity. Overall, the findings of replicating studies provided evidence that the instruments were valid and reliable and the original results were reproducible, which, thus, seeded the ground for empirical generalization and theoretical extension.

5.1.2 Quadrant II: Empirical Generalization (*UTOS)

Empirical generalization seeks to extend a stream of research by introducing variations into the U, T, O, or S while keeping the original theory. An extension along the U-element (i.e., *U) requires including more diverse samples, whereas that with *T is made by applying the treatment at different levels. Researchers can extend with *O by diversifying the outcome metrics or by introducing heterogeneous measurement methods. Extension with *S tests the consistency of cause-effect relationships across multi-settings. Overall, the domain *UTOS may subsume the original UTOS or stay outside of it (Cronbach et al., 1980).

Practically, after a theory's inception, its readers will be keenly interested in eliminating uncertainties (e.g., doubts or challenges) with respect to *UTOS in which its practicalities are widely discussed and evaluated (Cronbach et al., 1980). They typically approach this with "Will the theory work with *U, *T, *O, or *S?". Researchers can address *UTOS concerns by formulating an extended theory that reflects on the original data or conclusion on utos/UTOS or after explicitly recognizing the differences between UTOS and *UTOS.

Theoretically, empirical generalization is quite important in refining original theoretical structures (Johns, 2006; Wagner & Berger, 1985) in such a way that it uncovers internal conflicts with or boundaries of the original theory. The extended theory is close to the original expression and has the same nomological structure and the same focus of explanation. Eventually, one variation of the theory may prevail over others in all circumstances or each variation may hold under certain conditions (Wagner & Berger, 1985).

A host of researchers went on to incorporate *UTOS elements in their TAM studies. Researchers investigated the *U-element through variations of user groups (Chau & Hu, 2002a), individual differences (e.g., education and experiences) (Agarwal & Prasad, 1999; Davis, Bagozzi, & Warshaw, 1989; Szajna, 1996), and gender (Gefen & Straub, 1997; Venkatesh & Morris, 2000). Sample variants in the S-element include culture (Straub, 1994; Straub, Keil, & Brenner, 1997), small firms (Igbaria, Zinatelli, Cragg, & Cavaye, 1997), tasks (Gefen & Straub, 2000; Moon & Kim, 2001), technologies (Karahanna & Limayem, 2000; Ridings & Gefen, 2000), and time (Karahanna, Straub, & Chervany, 1999).

One notable observation is that interest in *UTOS elements has persisted from the outset of TAM research. Also, studies involving *UTOS element often have contained elements of both empirical generalization and theoretical extension. That is, researchers who tested *UTOS elements often did so via a theoretical extension of TAM. For example, some studies included a *UTOS element and extended the theory by including subjective norm or social influence (Davis et al., 1989; Karahanna & Limayem, 2000; Karahanna et al., 1999; Venkatesh & Morris, 2000).

5.1.3 Quadrant III: Theoretical Extensions (UTOS+)

Theoretical extensions are concerned with expanding the original theory's nomological network by incorporating changes into the U, T, O, or S. One expands the original theory by adding or subtracting treatment (or independent) and outcome (or dependent) variables (i.e., T+, O+) or by introducing new units and settings (i.e., U+, S+). The changes by U+, T+, O+, or S+ occur beyond the theoretical framework of the original theory and lead to a reconstruction of the relationships among the existing and new variables. One can accomplish an extension along T+ by identifying new determinants (or independent variable) and interventions, whereas one can accomplish one along O+ by expanding the dependent variable for predictive validity (Venkatesh, Davis, & Morris, 2007) or by adding a new dependent variable. Researchers often reconceptualize or refine existing constructs for an extension. An extension along U+ and S+ occurs when researchers introduce totally new contingencies such as time and a new setting. When researchers decide to include variables, they have to consider whether any relevant variables are missing (i.e., they employ a comprehensiveness criterion) and whether some variables should be eliminated due to little added explanatory power (i.e., parsimony) (Whetten, 1989).

During theoretical extensions, researchers tackle instrumental problems and expand on or constrain the original scope (Freese, 1980). After theoretical extension, the expanded theory should extend the original theory's scope (i.e., boundaries), rigor, precision (i.e., the nature of the relationship), or empirical support (Wagner & Berger, 1985). Thus, the findings of the new theory explain more by being more comprehensive or more precise or by being better supported empirically than the original theory's findings. Theoretical structure and domain of explanation get larger after each extension, and theoretical structures are finally integrated at the theoretical generalization stage (Wagner, 1984).

TAM examples of theoretical extension come in several sorts. The first is where TAM is compared with other competing theories. Competing theories include: 1) the theory of reasoned action (TRA) (Davis et al., 1989); 2) the theory of planned behavior (TPB) (Chau & Hu, 2002b; Hubona & Cheney, 1994; Mathieson, 1991); 3) the decomposed TPB (Taylor & Todd, 1995); 4) innovation diffusion theory (Plouffe, Hulland, & Vandenbosch, 2001); and 5) the combined TAM and TPB model of PC utilization and social cognitive theory (Venkatesh et al., 2003). Such comparisons occurred in various stages of TAM's development. Earlier tests focused on whether more complicated theories could add explained variance without sacrificing parsimony. However, researchers used latter tests to determine core determinants of system use intentions and actual system use based on model comparisons (e.g., Venkatesh et al., 2003), and we believe these latter attempts have contributed more to extending TAM research.

A second group of researchers have sought to integrate TAM with related theories such as: 1) innovation diffusion theory (Agarwal & Prasad, 1997; Agarwal & Prasad, 1998; Chen, Gillenson, & Sherrell, 2002; Karahanna et al., 1999; Wu & Yuan, 2003); 2) innovation diffusion theory considered along with social cognitive theory (Agarwal & Karahanna, 2000; Lewis, Agarwal, & Sambamurthy, 2003); 3) TPB (Riemenschneider, Harrison, & Mykytyn, 2003); 4) TPB combined with innovation diffusion theory (Yi et al., 2006); 5) theories of communications media choice and use (Karahanna & Limayem, 2000); 6) and task-technology fit (Dishaw & Strong, 1999). These attempts at integration emerged mostly in the latter periods of theory development.

The third area, which includes extensions of TAM via constructs from other theory bases, does not show any clear patterns. Some constructs from other theory bases include, for example, trust (Gefen, 2004; Gefen et al., 2003), risk (Featherman & Pavlou, 2003; Pavlou, 2003) and subjective norms (Hardgrave, Davis, & Riemenschneider, 2003; Venkatesh & Davis, 2000). Some studies have systematically extended TAM elements by proposing antecedents of PEOU (Venkatesh, 2000) and by identifying social influence processes and cognitive instrumental processes (Venkatesh & Davis, 2000). Other studies have applied the theory to unique problems or engaged in construct refinement and alternative mechanisms (Venkatesh et al., 2007).

5.1.4 Quadrant IV: Theoretical Generalization (*UTOS+)

One accomplishes theoretical generalization when the theory brings the highest predictive power with minimal scope restrictions (Freese, 1980). The generalized theory resolves the target problems by being able to accurately predict the problems that the theory encompasses. The transition from theoretical extensions to theoretical generalization includes variations in the UTOS+ (i.e., *UTOS+) in the extended theory. A generalized theory should present elements of its predecessors in an integrated manner

(Wagner & Berger, 1985). The findings from this generalized theory sometimes contain new insights that are not available in earlier theories.

One can accomplish theoretical generalization via single studies or meta-analyses (Shadish et al., 2002). Single study-based generalization involves integrating ideas in prior models into a coherent generalized theory. It is generally difficult to specify the content of major prior models in a single unifying theory. This approach is effective only after instrumentation problems have been properly investigated and, thus, uncertainties, ambiguities, or doubts in a theory have been successfully resolved. Single study-based generalization without going through empirical generalization and theoretical extensions will generate a theory that does not gain the status of common knowledge but rather is full of uncertainties and limited usefulness and impact. Historically, three to five alternative models have contended for this status at a specific time for a given problem (Collins, 1998).

With the statistical meta-analysis, one synthesizes knowledge that comes from multiple studies by using statistical techniques. Researchers need to identify related studies that try to solve the same problems and that have consistent structures in regard to U, T, O, and S. Then, they calculate the effect size from each study to consolidate them across the studies (Shadish et al., 2002). The meta-analysis has several advantages over single studies in accomplishing theoretical generalization (Shadish et al., 2002). First, it relies on studies with different backgrounds with respect to units, treatments, outcomes, settings, and methodologies. Such diversity enables richer testing of causal inference and provides more highly credible results. Second, the summaries from multiple studies can provide more accurate estimates on the causal relationships and better explain theoretical boundaries and the changes in causal relationships over variations. Nearly all the major fields in the administrative sciences use the meta-analysis to advance their field by determining the most profitable lines of investigation for future research. In the IS field, meta-analysis has been an essential tool for research synthesis and further development (e.g., Wu & Lederer, 2009; Joseph, Ng, Koh, & Ang, 2007).

One can also perform competent meta-analyses by using qualitative approaches via simpler statistics; for example, Lacity, Khan, Yan, and Willcocks (2010) analyzed the IS outsourcing research stream in this way.

In TAM research, a single study by Venkatesh et al. (2003) sought theoretical generalization. After synthesizing eight related models, Venkatesh et al. constructed a single formulation called the unified theory of acceptance and use of technology (UTAUT) that has additional constructs of social influence and facilitating conditions to the base PU and PEOU. The authors show UTAUT to be superior to the eight other competing models with respective to its predictive power, and the moderators bring additional insights by properly delimiting the effects of core relationships. Attempts to partially integrate TAM research into TAM have occurred during theoretical extensions, but UTAUT is more comprehensive and has stronger predictive power than earlier partially integrated models.

Further, a handful of researchers have sought theoretical generalization via meta-analyses. King and He (2006) focused on the nature of the relationship of the original theory, while Gefen and Straub (2000), Schepers and Wetzels (2007), and Deng, Doll, Hendrickson, and Scazzero (2005) investigated moderators. PEOU received exclusive attention in Gefen and Straub's (2000) study.

5.2 Research Objective 2, Part II: Knowledge Accumulation Pathways

5.2.1 Four Types of Paths

Among many possibilities, we suggest that researchers select among paths 1, 2, 3, and 4 (see Figure 1 above) to create the most successful streams of research. Researchers should be mindful of a research stream's discovery goals when they follow a given pathway to advance the theory. The underlying common goal of all pathways is to solve the target problem(s) (Kuhn, 1970) while maintaining the parsimony of scientific investigation—not just to linearly accumulate theoretical knowledge.

We do not maintain that there cannot be other paths to theoretical generalization. For example, there is a feasible overall path from quadrant 1 to quadrant III, from there to quadrant II, and from there to quadrant IV. We interpret the thrust of the external validity literature as that it is highly desirable to begin a research stream by generalizing on UTOS elements before adding nomological variants. Therefore, we do not depict this feasible path in BoKA.

Other possible paths include a leap directly from quadrant I to quadrant IV. This path runs counter to the entire argument we make for careful and thoughtful incrementalization, so, whereas this path is within the realm of possibility, we do not think there is any reason to recommend it.

In short, the paths depicted here represent the IS field's optimal movement as a whole toward the goal of theoretical generalization.

Paths 1 and 4 are concerned with generalizing an original or its extended theory by introducing variations in the UTOS/UTOS+. Since the original or the extended theory has high novelty, the goals of these pathways should be to reduce uncertainties associated with novelty or resolving discrepancies surrounding the UTOS/UTOS+. While incorporating *UTOS/*UTOS+ element into the theory, researchers should go beyond merely contextualizing research to context-theorizing (Bamberger, 2008). Context-theorizing "specifies how surrounding phenomena or temporal conditions directly influence lower-level phenomena, condition relations between one more variables at different levels of analysis, or are influenced by the phenomena nested within them" (Bamberger, 2008, p. 841). Context-theory is beneficial because it allows one to identify discrepancies or destabilization in a theory by generating a restriction of range, the incidence of behaviors, causal directionality, recursiveness, curvilinearity, and inverting relationships (Johns, 2006).

One can accomplish mere contextualization by acknowledging the influence of *UTOS/*UTOS+ elements, identifying boundaries of research, or being sensitized to such issues. However, this approach can lead to "a post hoc and largely speculative exercise" (Bamberger, 2008, p. 840) and postpones theory development to a later stage; that is, until sufficient information about the boundary conditions of a theory are aggregated. It is also not likely that such an ad hoc approach drives the specification of a model with consistent content and research design so that theory generalization is accomplished in a meaningful way at later stages of theory development.

Path 2 focuses on extending the theory by considering new UTOS elements (i.e., UTOS+). Since the original theory is characterized by a broad scope, abstraction, and ambiguity (McKinley, Mone, & moon, 1999), the researcher's primary goal should be to address these concerns by probing adjacent problems, confirming/disconfirming assumptions, and/or providing detailed or accurate representation (Weick, 1989) beyond the original. In order to extend the theory further, researchers should generate "a greater number of diverse conjectures" over "a smaller number of homogeneous conjectures" (Weick, 1989, p. 522). Heterogeneity and independence among conjectures enable the research stream to cover the solution space more comprehensively. Once the extended theory is debuted, we should evaluate its contribution and selection for long-term survival based not on validation but on the importance of relationships it adds to the existing theory and the quality of added insights to the original. Specifically, we need to apply the following multiple selection criteria consistently and simultaneously to evaluate the importance of an extension: interest, obviousness in unexpected ways, connectedness, believableness, beauty, and reality (Weick, 1989).

Path 3 is where empirical generalization prompts theoretical extensions, which can occur in two ways. First, the discrepancies found during empirical generalization are substantially resolved and, thus, the uncertainties regarding the boundaries and scope of the original are mitigated. This establishment of the original's validity will allow researchers to move beyond the original. Second, the discrepancies associated with *UTOS still exist and require one to further explore the theory. The discrepancies may be attributed to the added *UTOS or to the original constructs and their relationships. Researchers may attempt to resolve these by exploring the theory further by incorporating new UTOS (i.e., UTOS+). In both occasions, theoretical attempts for empirical generalization should become great assets in improving the theory at the stage of theoretical extensions. Researchers' goals should the same as the ones along path 2, but it is conceivable that some of their concerns have been resolved during empirical generalization.

5.2.2 Recommended Path Sequences

After combining the four paths explained earlier, we surmise that two recommended pathways or path sequences toward theoretical generalization in our BoKA methodology exist[4]. The first pathway is

[4] Before a theory can be claimed to be its universal, researchers should address instrumentation problems via empirical generalization or theoretical extensions after near replication of the original theory. By solving instrumentation problems, researchers can make the theory less ambiguous and broader in scope; thus, this becomes the basis of solving a target problem and providing adequate prediction (Freese, 1980). A jump of a single theory from near replication to theoretical generalization is likely to generate a

following paths 1 → 3 → 4 to achieve near replication, empirical generalization, theoretical extensions, and, lastly, theoretical generalization. The next is adopting paths 2 → 4 to pursue near replication, theoretical extensions, and, finally, theoretical generalization. The major difference between the two is that the first attempts to accomplish external validity at an earlier stage of theory development, whereas the second seeks to examine external validity at a later stage after first undertaking theoretical extensions. The advantage of adopting the first pathway is that, by addressing discrepancies or destabilization in a theory early on, researchers can confirm which constructs and which linkages in a theory are accurate and which need further work. Done in an early time frame, context-theorizing will, therefore, prevent further discrepancies from arising. We should, however, acknowledge that this pathway requires substantial amounts of time and resources at an early stage.

While following the pathways, we should not be under an illusion with a sense of knowledge accumulation by a sheer number of conjectures when, in fact, it is a mere lateral accumulation in which "the addition to the literature of new facts and principles…sum to nonintegrated nondiscoveries" (Freese, 1980, p. 61). Lateral accumulation occurs when problem formulation and associated findings do not add to the systematic building of the research stream and, therefore, contribute less to solving the target problems (Freese, 1980). Such a situation will fragment the research stream and slow down a field's advancement.

5.2.3 Application of BoKA to TAM, ISM, and RBV

To illustrate how one can apply our BoKA methodology to the IS field, we use the cases of the TAM, DeLone and McLean IS success model (ISM), and resourced-based view (RBV) research streams (see Appendices D and E for the ISM and RBV analyses). TAM research displays all four types of knowledge and paths toward theoretical generalization (Table 6). The vulnerability of TAM research along paths 2 and 3 can be summarized as a greater *number of homogeneous conjectures* to use Weick's terminology. As a result, research with a high degree of dependence and conformity that has led to a lateral accumulation of knowledge without substantially enhancing our understanding about the phenomenon tends to occur (Benbasat & Barki, 2007). For example, the antecedents of the base constructs (i.e., PU and PEOU) and the consequences of technology adoption have not been systematically expanded. Many theory extension attempts, adding antecedents (another belief system) to PU and PEOU (the base belief system), have not always elucidated our understanding of the determinants of IT's usefulness and the relationships among them (Benbasat & Barki, 2007).

Table 6. The Application of BoKA to TAM Research

Dev. stage	Development characteristics and major studies
Model timeline	• Model inception: Davis (1989)
Stage 1: near replication	• Validity and reliability of PU, PEOU scales: Adams et al. (1992), Segars & Grover (1993) • Test-retest reliability: Hendrickson & Collins (1996), Hendrickson et al. (1993) • Predictive validity: Davis (1993), Subramanian (1994), Szajna (1994)
Stage 2: empirical generalization	• Variations of units: user groups (Chau & Hu, 2002a), individual differences (Agarwal & Prasad, 1999; Davis et al., 1989; Szajna, 1996), gender (Gefen & Straub, 1997; Venkatesh & Morris, 2000) • Variations of settings: culture (Straub, 1994; Straub et al., 1997), small firms (Igbaria et al., 1997), tasks (Gefen & Straub, 2000; Moon & Kim, 2001), technologies (Karahanna & Limayem, 2000; Ridings & Gefen, 2000), time (Karahanna et al., 1999)

theory that does not gain the status of common knowledge but rather is knowledge full of uncertainties, which means, in essence, it holds limited predictability.

Table 6. The Application of BoKA to TAM Research

Stage 3: theoretical extensions	• Model comparison with competing theories: TRA (Davis et al., 1989), TPB (Chau & Hu, 2002b; Hubona & Cheney, 1994; Mathieson, 1991), the decomposed TPB (Taylor & Todd, 1995), and innovation diffusion theory (Plouffe et al., 2001) • Integration with related theories: innovation diffusion theory (Agarwal & Prasad, 1997; Agarwal & Prasad, 1998; Chen et al., 2002; Karahanna et al., 1999; Wu & Yuan, 2003), innovation diffusion theory and social cognitive theory (Agarwal & Karahanna, 2000; Lewis et al., 2003), TPB (Riemenschneider et al., 2003), TPB and innovation diffusion theory (Yi, Jackson, Park, & Probst, 2006), theories of communications media choice and use (Karahanna & Limayem, 2000), task-technology fit (Dishaw & Strong, 1999) • Extensions with additional constructs: trust (Gefen, 2004; Gefen et al., 2003), risk (Featherman & Pavlou, 2003; Pavlou, 2003), subjective norms (Hardgrave et al., 2003; Venkatesh & Davis, 2000), antecedents of PEOU (Venkatesh, 2000), and social influence processes and cognitive instrumental processes (Venkatesh & Davis, 2000)
Stage 4: theoretical generalization	• Single study: Venkatesh et al. (2003) • Meta-analyses: King & He (2006), Gefen & Straub (2000), Schepers & Wetzels (2007), and Deng et al. (2005)

An evaluation along path 4 is that we still need additional unifying theories or an assembly of complementary models that consolidates TAM research effectively. Although UTAUT demonstrates theoretical generalization, it has come back to TPB in a sense (Benbasat & Barki, 2007) while lacking the original's parsimony (Straub & Burton-Jones, 2007). Moreover, it may have serious common method bias problems (Sharma, Yetton, & Crawford, 2009). Similarly, despite a host of meta-analyses, we still require a comprehensive meta-analysis to understand the research more fully with the components of key antecedents, moderators, and their relationships (Straub & Burton-Jones, 2007).

6 Conclusion

We summarize our contribution in three ways. First, we empirically assess the degree of cumulative tradition across the four elements of external validity. Extant research is not consistent in defining what best constitutes the "context" of research. Berthon et al. (2002) and Tsang and Kwan (1999) refer to units and settings, while Lee and Baskerville (2003) deal only with settings. Therefore, generalization's target is often limited to units and settings. This research overcomes the limitation of such studies by accommodating all four elements that Cronbach proposes. Our analysis also unfolds that research in the IS and management fields is characterized by some degree of external validity awareness but still has much room for improvement in testing external validity.

Second, as a guiding framework for further improvement, the BoKA methodology offers researchers a way to see their own position in their chosen stream of research. After applying Shadish et al.'s (2002) framework, we show that we can classify accumulated knowledge into four types. The research space we propose is comprehensive and encompasses elements that one can find in most prior frameworks. Using our classification, researchers can visualize the stage of their theory in the entire lifecycle of a research stream.

Last, we portray various pathways toward theoretical generalization and explicate how scholars can transition to the next knowledge accumulation with specific development goals in mind. Berthon et al.'s (2002) and Lee and Baskerville's (2003) frameworks describe research space and possible types of knowledge generation. We extend such frameworks by developing a usable methodology about how to actually reach different types of knowledge and build cumulative traditions effectively. This echoes a call made by Cohen (1989) two decades ago. Although Seddon and Scheepers (2012) have made strides on this front by suggesting the pathways for generalization, their methodology is narrowly focused on units and settings. Our methodology suggests the four types of paths for knowledge accumulation. Paths 1 and 4 pursue empirical generalization given the original or the extended theory. Path 2 seeks theoretical extensions by introducing novelty into the theory. Path 3 looks for theoretical extensions given empirical generalization. Given these four paths, we recommend the following two pathways toward theoretical generalization: 1 → 3 → 5 and 2 → 4. A major advantage of the former pathway is its contextualization (furthermore context-theorizing) of research and minimization of uncertainties in the theory at early stages.

This dynamic portrayal of theory development is unique in the scientometric literature, and our suggested development goals should help make business research more consistent and efficient in advancing theory.

The eventual goal of cumulative tradition is theoretical generalization. In the TAM research stream, researchers have primarily accomplished theoretical generalization via the UTAUT model and meta-analyses within 14 years of the theory's inception. We believe that our methodology, applied wisely and properly, can guide the field in achieving theoretical generalization in other research streams. The end result is early consensus and predictions with speed and accuracy on key IS phenomena and wise use of research resources. We also believe that researchers can use our method as a guide for building an IS body of knowledge (Hirschheim & Klein, 2003) through establishing clearer theoretical tenets (or agreements) first in IS subfields and then by facilitating communications and integration in the field. This establishment of a BoK based on strong cumulative traditions should, in the final analysis, enhance our impact on praxis.

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Appendix A: Knowledge Accumulation Methods

Table A1 provides modes and methods for theory expansion along four types of accumulated knowledge. The basic elements of column 2 draw on Berthon et al.'s (2002) three potential research spaces comprising context, method, and theory. We enlarge the scope of research context to the UTOS elements beyond the U- and S-element suggested in their framework. By combining these three elements, we obtained eight different modes of theoretical expansion. Column 3 suggests various techniques, approaches, and principles researchers can use while speculating about how to proceed to theory expansion given the extant findings.

Table A1. Mode and Method for Theory Expansion

Knowledge type	Mode for theory expansion	Methods for theory expansion
Near replication	• Near replication • Method-only extension	• Literal/operational replication (other than time of new study) • Good-enough replication
Empirical generalization	• UTOS-only extension • UTOS & method extension	• Qualitative studies • Process theory • Advanced data analysis techniques
Theoretical extensions	• Theory-only extension • Theory & method extension	• Qualitative studies • Process theory • Advanced data analysis techniques • Comprehensiveness vs. parsimony
Theoretical generalization	• Theory & UTOS extension • Theory & method extension • Theory & UTOS & method extension[a]	• Integration of theoretical structures • Meta-analysis

[a] Berthon et al. (2002) call this mode of extension as pure generation whose domain of explanation does not overlap with that of the original theory. In this paper, we use this mode as variations in all three dimensions but the domain subsumes most of the phenomena of earlier ones.

There are many different modes of theory expansion, and so, for greater clarity, we focus on near replication, method-only, UTOS-only, and theory-only extensions. In reality, researchers tend to mix extension modes at a certain stage of theory development as the table depicts (i.e., UTOS and method extension, theory and method extension, theory and UTOS extension, and theory and UTOS and method extension). One should conduct **near replication** at an early stage of theory development to validate the original findings. One can use replication research to resolve previous studies' conflicting findings or to clarify a controversial theory.

Method-only extensions involve expanding a research stream by employing different data collection and/or data analysis methods. A necessary precaution to take is that methodological expansion should be along the line of already acknowledged methodological recipes in the research stream (Freese, 1980). This practice will unify the language used in the stream, systematize knowledge extension processes, and enable researchers to compare/contrast/integrate discovered knowledge claims. At a minimal level, researchers can reanalyze published data to detect any errors in the data analysis. One can employ a different method for collecting and analyzing data to triangulate it with published findings or for extending the theory. One can use qualitative methods relying on ethnography, interviews, or unstructured observation and interviews during pre-hypothesis development stages to better understand the influence of UTOS-elements (Bamberger, 2008). Quantitative and qualitative methods sometimes generate findings that are inconsistent with each other, and these inconsistencies provide opportunities to scrutinize research designs using both methods. Researchers can use these inconsistencies to resolve the conflicts and theoretical breakthrough or leave these issues for further studies to resolve.

Researchers can also take advantage of advanced data analysis techniques during the stage of empirical generalization and theoretical extensions. Structural equation modeling is effective in handling measurement errors (errors in variables) and specification errors (errors in equations) in experimental and non-experimental research (Shadish et al., 2002), and these advantages enhance findings'

generalizability. Certain advanced techniques enable theoretical extensions in an unexpected way by revealing hidden configurations in the dataset. For example, polynomial regression allows one to investigate the impacts of fit between two variables on three-dimensional response surface (Edwards & Parry, 1993).

UTOS-only extensions may involve variations in multiple elements among U, T, O, and S. For an extension along the **U-element,** researchers determine the sampling unit (e.g., working professionals) for the variation and specify the target population (e.g., sub-U, *U) on which the researcher wants to make causal inferences. At this point, a researcher identifies typical characteristics (instances) of the U-element in the target population (for purposive sampling of typical instances). Typicality is easily definable using statistical centrality measures such as mean, median, or mode if the target can be clearly isolated or typicality requires expert opinions or qualitative judgment calls if it is not easily describable (Shadish et al., 2002). The next step is to define sampling frame on which the survey data are collected. Researchers sometimes have to restrict the sampling frame due to data access challenges. When the available sampling frame cannot provide the data that can meet the typicality criteria, the researcher should redefine the target population to accommodate the sampling reality or acknowledge potential coverage error (Groves et al., 2004). Studies in many situations do not clearly describe their target population, which makes it difficult to define the typicality in the survey population.

An extension along the **T-element** involves first addressing construct validity concerns of ensuring the proper operationalization of the construct according to its original intent. Such an extension also deals with ensuring externality validity by examining whether the causal inferences do vary according to different treatment levels (Shadish et al., 2002). To address these concerns, researchers first need to clearly conceptualize the construct and properly identify the scope of the treatment. To create appropriate levels for the treatment, researchers need to identify two extreme points that can reasonably yield variations in result. Then they should determine whether it is necessary to examine other points in between (intrapolation) or above the highest observed point or below the lowest observed point (extrapolation) (Shadish et al., 2002). In experimental IS research, the T-element has always been an important factor in estimating a system's effectiveness on the dependent variable. For example, many EBS researchers have recognized different levels of the treatment of electronic brainstorming (Dennis, Aronson, Heninger, & Walker, 1996), such variations as group size, task decomposition methods (all parts or subparts of the task presented), and time periods (one time period or several shorter ones).

One can accomplish variations along the **O-element** by diversifying the outcome metrics or by introducing heterogeneous measurement methods. One diversifies the outcome by probing the construct's other dimensions. A good example of this form of diversification can be found in Dennis and Reinicke's study (2004), a study that investigates the appropriateness of the number of ideas generated as a dominant metric for electronic brainstorming effectiveness. They conclude that non-task oriented outcomes (e.g., group/organization wellbeing and member support) should be incorporated into models to better understand the true usefulness of electronic brainstorming technology. Thus, their re-conceptualization of the outcome triggered a theoretical extension. One can introduce heterogeneous measurement methods when there are alternative data collection methods for the outcome. For example, one can measure organizational performance by subjective measures via participant self-reports and objective measures based on archival data.

Including different settings for an extension along the **S-element** is usually accompanied with a strong theoretical justification. This type of extension is most frequently recognized in IS (Table 3), but the actual execution is rare (Table 5) because it is costly or sometimes not feasible. When obtaining multiple settings is not feasible, researchers can creatively vary setting in a single large setting (Shadish et al., 2002). One can compare different departments in a single company instead of seeking out different companies. One also can assess the effect of relationship duration in interorganizational relationships by sampling randomly among the relationships and, thereby, avoiding a time- and labor-intensive longitudinal study. The exemplary settings that researchers can refer to in considering alternatives include (Porter & McLaughlin, 2006): culture/climate, goals, processes, state of organization, structure of groups/organization, and time.

One of the best known ways of building context-theory for **theory-only extensions** is employing multi-level analyses. Multi-level analyses can be built via two processes: top-down or bottom-up (Bamberger, 2008; Kozlowski & Klein, 2000). Top-down processes include (1) identifying the influence of higher-level variables (e.g., UTOS elements) on lower-level variables (i.e., cross-level direct-effect modeling), (2) assessing whether the relationship between two lower-level variables are moderated by a higher-level

variable (i.e., cross-level moderator modeling), and (3) measuring the relative influence of lower-level entity surrounded by a higher-level social context (cross-level frog-pond modeling). Bottom-up processes are concerned with determining how the phenomenon at a low level influences the emergence of properties at a higher level. These processes are less prevalent, but we may be interested in examining, for example, how individuals' use of IT affects organizational performance (Burton-Jones & Gallivan, 2007). Methodological barriers to context-theorizing are greatly reduced due to the development of statistical analysis techniques such as random coefficient modeling.

Appendix B: Extending to *UTOS

An important question here is “how can we extend a causal relationship to novel contexts?”. Cook uses “causal explanation” as the preferred method to describe knowledge transfer to new contexts. Causal explanations are contrasted with causal connections (Cook & Campbell, 1979; Mackie, 1974). Causal connections describe the nature of the link between a treatment and a response. Causal explanations identify how or why a causal connection occurs through uncovering causal properties and processes whereby social actions arise. Cook presumes that, once a causal explanation is given, “we can then identify the conditions that seem *necessary* and *sufficient* for the effect, permitting us to bring these conditions together in *novel* treatment configurations that are tailored to the specifics of particular local populations and local settings” (Cook, 1993, p. 78, emphasis added). Once the generative mechanism is known via investigating how or why, the causal relationship will hold with all kinds of people and in all kinds of settings (Cook, 2004).

Appendix C: An UTOS Example

This example illustrates how *UTOS*, *sub-UTOS*, *utos*, **UTOS* are played out in a specific research. Following Cronbach's (1982) framework, we based it on the UTOS elements in Tan et al.'s (2003) paper.

Table C1. UTOS Example

	Units	Treatments	Outcomes	Settings
Populations about which research conclusions are drawn (*UTOS*)	(*U*) The population of persons/ firms/ communities to be investigated. • *People who are involved in a software development project for a client organization, and play a role of a project leader.*	(*T*) The planned experimental intervention. • *Organizational climate to reporting bad news.* • *Information asymmetry.*	(*O*) A variable to be measured for events and reactions in experiments. The dependent variable in field studies. • *Predisposition to report bad news.*	(*S*) The large social context in which the study is influenced. • *Individualism-Collectivism.*
Subcategories of UTOS (*sub-UTOS*)	(*sub-U*) • *College students who have software development experience.* • *Black man involved in a software project.*	(*sub-T*) • *A treatment plan to measure certain aspects of organizational climate (e.g., democratic vs. authoritative).*	(*sub-O*) • *A set of items inquiring about predisposition to report bad news.*	(*sub-S*) • *Individualism: Eastern U.S.* • *Collectivism: Southeast Asia.*
Actual data of the evaluation (*utos*)	(*u*) Actual participant. • *A total of 354 subjects (162 citizens of the U.S. and 192 citizens of Singapore). They were working professionals who were attending graduate classes part-time in the evenings.*	(*t*) Realized interventions to any u. • *Organizational climate: conducive and not conducive.* • *Information asymmetry: sustainable and not sustainable.*	(*o*) The actual measure observed. • *A three-item measure.*	(*s*) Actual research setting. • *Colleges in the US and Singapore.*
Populations that have evidently different attributes from UTOS (**UTOS*)	(**U*) A unit not represented in U or a sub-U. • *People involved in a software project without a leader's position.*	(**T*) A treatment or program that is different from T or a sub-T. • *Different manipulations of organizational climate.*	(**O*) A different variable not included in the original study, or a different method of measurement. • *Expectation of project success.* • *Expectation of project quality.* • *Qualitative inquiries to ask about predisposition to report bad news.*	(**S*) A setting not represented in S or a sub-S. • *Individualism: Europe.* • *Collectivism: Eastern Asia.*

Appendix D: Illustration of BoKA Methodology to D&M IS Success Model

To demonstrate how our methodology functions in research practice, we also apply it to the DeLone and McLean (D&M) IS success model (DeLone & McLean, 1992) and, thereby, illustrate how one can develop a research program along the specified development pathways (Table D1). We consider the D&M model to be part of a larger IS effectiveness research stream, the overall research question of which is to investigate what factors explain information system's success. To systematize the process for IS success, DeLone and McLean identified six dimensions of IS success and developed a causal model. The original model comprises six constructs, including system quality, information quality, system use, user satisfaction, individual impact, and organizational impact. Their original model was revised a decade later to reflect on the development in research thus far and IS's changed roles in the organization.

Near replication: one fundamental issue with the D&M model at the time of its debut was a lack of measurement model and no guidelines for empirical research. These issues arose partly because their conceptual model was motivated to clarify the issues that had been accumulated from prior empirical studies and to pave the way for more streamlined development in the community. After its initial release, researchers did not replicate it because of the lack of an initial measurement model, and further development of the measurement model was left to individual researchers (Hunton & Flowers, 1997; Rai, Lang, & Welker, 2002; Roldan & Millan, 2000). In addition, few researchers tested the D&M model in its entirety right after its initial release.

Empirical generalization: A host of researchers looked at **variations via subcategories and irrelevancies**, variations including user type (Agarwal & Prasad, 1997), the type of information systems (Kositanurit, Ngwenyama, & Osei-Bryson, 2006; Molla & Licker, 2001; Wu & Wang, 2006), organizational size (Sedera, 2009), the maturity stage of information systems (Choe, 1996), industry (Skok, Kophamel, & Richardson, 2001), voluntariness of the system (Delone & McLean, 2003), culture (Vlahos & Ferratt, 1995), and time (Jurison, 1996), among others. When it comes to **variations via novel categories**, central issues include recognizing the multi-dimensional nature of each construct in the success model, clearly identifying the core set of measures for the constructs that can be applicable to various contexts, and properly operationalizing the measure that fits in the research context. Our overall evaluation on this type of variation is that 1) this type of variation is central to successfully establishing the model, and 2) more research is necessary to reach a consensus on the core measures of constructs (Delone & McLean, 2003). We conjecture that, after the two decades since its debut, lack of ongoing consensus on the measurement model is partly caused by the initial lack of the measurement model to guide later research and a lack of rigorous validation by the later researchers *before* tackling any other aspects of the model. With respect to **variations via multi-level analysis**, many researchers have already extended the model to the organizational level and have demonstrated its applicability. Some sample organizational contexts include data warehousing (Wixom & Watson, 2001), electronic data interchange (EDI) (Farhoomand & Drury, 1996), and mid-sized to large for-profit organizations (Bradley, Pridmore, & Byrd, 2006).

Theoretical extensions: many researchers have engaged in theoretical extensions at the early stages of the success model. First, Seddon and Kiew (1997, 1996) replaced use with perceived usefulness. Second, Seddon (1997), considering use to be a behavior resulting from perceived befits of system use, placed use outside the success model. Third, a breakthrough was made by Pitt, Watson, and Kavan (1995), who added service quality of the IS function into the original model. Fourth, there have been numerous attempts to extend and respecify the original model (Ballantine, Bonner, Levy, Martin, & Powell, 1996; Chen & Cheng, 2009; Myers, Kappelman, & Prybutok, 1997; Sabherwal, Jeyaraj, & Chowa, 2006; Wu & Wang, 2006). Last, DeLone & McLean (2003) proposed a revised success model after adding service quality and splitting use into intention to use and use and combining individual impact and organizational impact into net benefits.

Theoretical generalization: a handful of researchers have attempted theoretical generalization via meta-analyses. Sabherwal et al. (2006) investigated the original model (i.e., system quality, perceived usefulness, user satisfaction, and system use) along with the impacts of context-related constructs (top management support and facilitating conditions) and user-related constructs (user experience, user attitude, user training, and user participation) on the model. Petter and McLean (2009) focused on the nature of the relationship of the revised model at the individual and organizational levels. Bokhari et al. (2005) exclusively examined the relationship between system use and user satisfaction.

Table D1. IS Success Model Development

Development stage	Development characteristics and major studies
Major timeline of the model	• Original model: DeLone & McLean (1992) • Revised model: DeLone & McLean (2003)
Near replication	• No model testing and measurement model in the original model (DeLone & McLean, 1992) • Early empirical test: Seddon and Kiew (1994, 1996) • Full model test: Rai et al. (2002), McGill, Hobbs, & Klobas (2003), Sedera and Gable (2004)
Empirical generalization	**Subcategories and irrelevancies** • Subcategories and irrelevancies examined: User type (Agarwal & Prasad, 1997), type of information systems (Kositanurit et al., 2006; Molla & Licker, 2001; Wu & Wang, 2006), organizational size (Sedera, 2009), maturity stage of information systems (Choe, 1996), industry (Skok et al., 2001), voluntariness of the system (Delone & McLean, 2003), culture (Vlahos & Ferratt, 1995), and time (Jurison, 1996) **Novel categories** • Too simplified operationalization: Perceived Ease of Use for system quality (Agarwal & Prasad, 1997; Rai et al., 2002) • Richer conceptualization on System Quality (Gable, Sedera, & Chan, 2003; Rivard, Poirier, Raymond, & Bergeron, 1997) • More attention to Use (Collopy, 1996; Doll & Torkzadeh, 1998); Richer conceptualization on Use necessary (Burton-Jones & Straub, 2006) • Intention to Use as an alternative measure for Use (Delone & McLean, 2003) • Measurement model still evolving (Gable, Sedera, & Chan, 2008; Sedera & Gable, 2004) **Multi-level analysis** • Mostly focused on individual-level analysis (Agarwal & Prasad, 1997; Rai et al., 2002) • Sporadic organizational-level analyses: Data warehousing (Wixom & Watson, 2001), electronic data interchange (Farhoomand & Drury, 1996), mid to large for-profit organizations (Bradley et al., 2006) • More cross-level analysis necessary: Top management support, facilitating conditions (e.g., support by help desks or technical support teams) (Sun & Bhattacherjee, 2011; Thong, Yap, & Raman, 1996)
Theoretical extensions	• Replaced Use with Perceived Usefulness (Seddon, 1997; Seddon & Kiew, 1996); Use reinstated in the D&M's revised model (Delone & McLean, 2003) • Use placed outside the D&M model (Seddon, 1997); A better fit of the original model found (Rai et al., 2002) • Service Quality suggested (Pitt et al., 1995) and added in the revised D&M model • Additional attempts to extend and respecify the original model (Ballantine et al., 1996; Chen & Cheng, 2009; Myers et al., 1997; Sabherwal et al., 2006; Wu & Wang, 2006) • A revised model proposed (Delone & McLean, 2003): Service Quality added, split of Use into Intention to Use and Use, and integration of Individual Impact and Organizational Impact into Net Benefits; the revised one received empirical support (Wang, 2008)
Theoretical generalization	• The original model + use context + user (Sabherwal et al., 2006) • Focus on the nature of the relationship (individual, organizational) (Petter & McLean, 2009) • Focus on the relationship between system use and user satisfaction (Bokhari, 2005)

Appendix E: Illustration of BoKA Methodology to Resource-based View

To seek the general applicability of our framework to theories in business fields, we selected the resource-based view (RBV) (See Table E1). Its overall goal is to evaluate whether the specific resources and capabilities that a firm possesses contribute to its sustained competitive advantage. Resources refer to stocks of assets in a firm, which can be in tangible or intangible formats. Resources must be valuable, rare, inimitable, and non-substitutable (VRIN) to result in a firm's competitive advantage. Capabilities regard the capacity to integrate and deploy bundles of resources in organizational processes and routines (Amit & Schoemaker, 1993). Competitive advantage is obtained when a firm implements "a value creating strategy not simultaneously being implemented by any current or potential competitors" (Barney, 1991, p. 102).

Near replication: the 1991 Barney framework dealt with theoretical aspects alone and did not involve empirical testing. The initial contributors of the theory did not provide methodological guidelines and, thus, methodological issues have persisted over time without much improvement, which has created many challenges for latter empirical research (Armstrong & Shimizu, 2007; Barney, Ketchen, & Wright, 2011; Kraaijenbrink, Spender, & Groen, 2010). There have been many empirical studies since the initial empirical studies by Chandler and Hanks (1994) and Henderson and Cockburn (1994). However, replication research has been scant in the RBV literature.

Empirical generalization: variations via subcategories are the first crucial step for knowledge accumulation, but concerted efforts have not been made. First, the construct "resources" is defined at a very high level and subsumes many categories. Second, capabilities have been investigated more often than resources and have been found to have a stronger influence on competitive advantage (Newbert, 2007). However, it is hard to access and measure capabilities because they are built over time through complex interactions among resources in processes and routines (Amit & Schoemaker, 1993). Third, some researchers have operationalized resources using their VRIN characteristics. Each of these characteristics also has numerous possibilities. Last, the dependent variable has been operationalized in four different ways (i.e., performance, sustained performance, competitive advantage, and sustained competitive advantage) (Newbert, 2007). **Variations via novel categories** have occurred often since the formalization of RBV. Kogut and Zander (1992) added knowledge as a novel type of resource and incorporated it into the concept of combinative capabilities. This development led to the explicit recognition of capabilities in the theory (Barney, 1997). From this line of thinking, Teece and Pisano (1997) conceptualized dynamic capabilities and so enriched the theory by adding dynamic dimensions. As for the dependent variable, researchers have proposed process-level variables that can be better aligned with specific resources (Coff, 1999; Ray, Barney, & Muhanna, 2004). **Variations via multi-level analysis** have not received much attention in RBV. One multi-level application is the relational view (Dyer & Singh, 1998), which applied RBV to interfirm relationships. **Variations via cross-level analysis** have been made to some extent, but more efforts are probably necessary considering their importance. Greater attention has been paid to evaluating the influence of higher-level factors on the focal phenomenon. Industry has been identified as a major factor that facilitates the development and evolution of resources (Armstrong & Shimizu, 2007).

Theoretical extensions: theoretical extensions have been continuous and have contributed greatly to expanding the theory's coverage and applicability. Above all, the development of the knowledge-based (Grant, 1996) and relational views (Dyer & Singh, 1998) is remarkable. RBV has been further extended by a capability lifecycle (Helfat & Peteraf, 2003), a cooperative game theory framework (Lippman & Rumelt, 2003), and a property rights economics perspective (Foss & Foss, 2005).

Theoretical generalization: the attempt on its theoretical generalization has been infrequent. Three meta-analyses (Crook, Ketchen, Combs, & Todd, 2008; Crook, Todd, Combs, Woehr, & Ketchen, 2011; Liang, You, & Liu, 2010) and two literature reviews on empirical studies (Barney & Arikan, 2001; Newbert, 2007) are extant. In their meta-analysis with 125 studies, Crook et al. (2008) found that the effect size for the association of strategic resources and performance was 0.22. Crook et al. (2011) focused on one specific resource (i.e., human capital) and found an overall positive impact on performance (effect size = 0.17). Liang et al. (2010) found that IT resources explain firm performance better in the presence of organizational capabilities mediators.

Table E1. Resource-based View Development

Theory stage	Development characteristics and major studies
Major timeline	• Conceptualization (Penrose, 1959; Rumelt, 1984; Wernerfelt, 1984) • Formalization (Barney, 1991); Ten-year review (Barney, Wright, & Ketchen, 2001); Twenty-year review (Barney et al., 2011)
Near replication	• No model testing and measurement model in the formalization (Barney, 1991) • Early empirical studies on resources (Chandler & Hanks, 1994; Henderson & Cockburn, 1994) • Early empirical studies on (dynamic) capabilities (Bharadwaj, 2000; Hitt, Bierman, Shimizu, & Kochhar, 2001)
Empirical generalization	**Subcategories** • Split of the construct resources into resources and capabilities (Amit & Schoemaker, 1993) • Major resource types: financial, physical, human, technological, reputational, and organizational resources, and knowledge (Barney, 1991; Grant, 1991; Hofer & Schendel, 1978; Kogut & Zander, 1992) • Systematic variations of resources and capabilities via subcategories challenging (Molloy, Chadwick, Ployhaty, & Golden, 2011) • Variations of resources using the VRIN characteristics (Newbert, 2008) • Resources defined at the individual or collective level, or using proxies (Armstrong & Shimizu, 2007) • Competitive advantage manifested by performance (Newbert, 2007) **Novel categories** • Knowledge added as a resource; Combinative capabilities (Kogut & Zander, 1992); Capabilities added explicitly (Barney, 1997) • Dynamic capabilities (Eisenhardt & Martin, 2000; Teece & Pisano, 1997); Micro-foundations of dynamic capabilities (Teece, 2007) • Business process as an alternative measure for performance (Ray et al., 2004) • Stakeholder bargaining power in rent appropriation (Coff, 1999) **Multi-level analysis** • Cross-level: Mostly industry focused; Additional higher level influences include country settings (Wan, 2005), culture (national, organizational), network resources (Gulati, 1999; Gulati, Lavie, & Madhavan, 2011), external environments (Sirmon, Hitt, & Ireland, 2007), institutional forces (Oliver, 1997), and stakeholder influences; Lower level influence includes managers' role (Sirmon, Hitt, Ireland, & Gilbert, 2011) • Multi-level: Individuals, groups, interfirm networks (relational view), and countries
Theoretical extensions	• Knowledge-based view (Grant, 1996); Relational view (Dyer & Singh, 1998) • Dynamic resource-based view (Foss & Ishikawa, 2007; Helfat & Peteraf, 2003); Cooperative game theory (Lippman & Rumelt, 2003); Property rights economics (Foss & Foss, 2005) • Applied to different disciplines: Entrepreneurship (Ireland, Hitt, & Sirmon, 2003), HR (Wright, Dunford, & Snell, 2001), IS (Wade & Hulland, 2004), natural environment (Hart, 1995), interconnected firms (Lavie, 2006)
Theoretical generalization	• Meta-analysis: Strategic resources on performance (Crook et al., 2008); Human capital (Crook et al., 2011); IT (Liang et al., 2010) • Assessment of empirical studies (Barney & Arikan, 2001; Newbert, 2007)

Appendix F: Coding Scheme for Task Type and Industry

Task type

1. Planning-generating plans for action
2. Creativity-generating ideas
3. Intellective-solving problems with correct answers
4. Decision making-deciding issues with no right answers
5. Cognitive conflict-resolving conflicts of viewpoint
6. Mixed motive-resolving conflicts of interest
7. Competitive-resolving conflicts of power
8. Psychomotor-executing performance tasks

Industry

1. Utilities
2. Construction
3. Manufacturing
4. Wholesale trade
5. Retail trade
6. Transportation and warehousing
7. Information (incl. telecommunications)
8. Finance and insurance
9. Real estate and rental and leasing
10. Professional, scientific, and technical services
11. Educational services
12. Health care and social assistance
13. Arts, entertainment, and recreation
14. Accommodation and food services
15. Public administration
16. Nonprofits

Appendix G: Additional Tables

Table G1. Overview of Coded Papers

Field	No. of papers	Research setting			Research design		
		Lab + field experiment	Field studies	Archival	Cross-sectional	Longitudinal	Cross+ longit.
IS	65	21 (32%)	32 (49%)	12 (19%)	48 (74%)	15 (23%)	2 (3%)
Management	68	3 (4%)	21 (31%)	44 (65%)	27 (40%)	41 (60%)	-
Total	133						

Table G2. Industry Distribution

IS		Management	
Category	**Frequency**	**Category**	**Frequency**
Manufacturing	16 (24%) [a]	Manufacturing	23 (34%)
Retail trade	9 (13%)	Professional services	9 (13%)
Finance and insurance	8 (12%)	Finance and insurance	7 (10%)
Professional services	8 (12%)	Information (incl. telecom)	5 (7%)
Utilities	4 (6%)	Transportation and warehousing	5 (7%)
Wholesale trade	4 (6%)	Arts, entertainment, and recreation	5 (7%)
Public administration	4 (6%)	Educational services	3 (4%)
Transportation and warehousing	3 (4%)	Health care and social assistance	3 (4%)
Information (incl. telecom)	3 (4%)	Utilities	2 (3%)
Educational services	3 (4%)	Non-profits (e.g., charities)	2 (3%)
Health care and social assistance	2 (3%)	Retail trade	1 (1%)
Real estate and rental and leasing	1 (1%)	Accommodation and food services	1 (1%)
Arts, entertainment, and recreation	1 (1%)	Public administration	1 (1%)
Non-profits (e.g., charities)	1 (1%)	Construction	0 (0%)
Construction	0 (0%)	Wholesale trade	0 (0%)
Accommodation and food services	0 (0%)	Real estate and rental and leasing	0 (0%)
Total cases	*67*	**Total cases**	*67*
Total papers	*29*	**Total papers**	*53*

[a] We calculated the percentage based on total cases (67 for IS and 71 for management), which we observed across 29 and 53 papers in IS and management, respectively.

Table G3. Elaboration on Task and Culture/Climate

	IS			Management	
	Variables	**Frequency**		**Variables**	**Frequency**
Task	Task complexity Dual-task interference Job autonomy Modification task Online task goals Task ambiguity **No. of cases** **No. of papers**	2 1 1 1 1 1 **7** **7 (11%)[a]**		Task interdependence Task environment **No. of cases** **No. of papers**	1 1 **2** **2 (3%)**
Culture/ climate	Cultural orientation National cultural values Open source software norms **No. of cases** **No. of papers**	1 1 1 **3** **3 (5%)**		Collectivistic culture Cooperative exchange norms Norms for knowledge sharing Communication climate **No. of cases** **No. of papers**	1 1 1 1 **4** **3 (4%)**

[a] We calculated the percentage based on total number of papers (65 for IS and 68 for management).

Table G4. Elaboration on Variations of U, T, O, and S

Units:			
Field	**Authors**	**Category**	**Variables**
IS	Hong & Tam (2006)	Demographic characteristics	Age, gender
	Levina & Xin (2007)	Demographic characteristics	Age, gender, education, experience
	Moores & Chang (2006)	Demographic characteristics	Age, gender
	Park, Shin, & Sanders (2007)		IT-intensive economies & less IT-intensive economies
	Zhu, Kraemer, Gurbaxani, & Xu (2006)		EDI users & nonusers
	Stewart & Gosain (2006)		Team size
Management	Cho & Hambrick (2006)	Demographic characteristics	Demographic heterogeneity: Average industry tenure
	DiTomaso, Post, Smith, Farris, & Cordero (2007)	Demographic characteristics	Different demographic groups
	Lawrence (2006)	Demographic characteristics	Individuals' demographic attributes, demographic composition of the organizational reference group
	Westphal & Stern (2006)	Demographic characteristics	Top managers' ethnicity, gender
Treatments: No papers are identified.			
Settings:			
Field	**Authors**	**Category**	**Variables**
IS	Hong & Tam (2006)	IT Adoption	Multipurpose information appliance adoption decisions (between-study variation)
	Levina & Xin (2007)		Institutional environments: Country, institution size

Table G4. Elaboration on Variations of U, T, O, and S

	Mishra, Konana, & Barua (2007)		Internet use in two stages: The search stage and the order initiation and completion stage
	Venkatesh & Ramesh (2006)		Web versus wireless usability
Management	Chang, Chung, & Mahmood (2006)		Institutional environments: Country
Outcomes:			
Field	**Authors**	**Category**	**Variables**
IS	Banker, Bardhan, Chang, & Lin (2006)	Firm performance	Plant Performance: Product quality, time to market, plant efficiency
	Oh & Pinsonneault (2007)	Firm performance	Objective: Expense and revenue; Subjective: Perceived profitability
	Tanriverdi (2006)	Firm performance	Market-based: Tobin's q values, Treynor ratio; Accounting-based: Return on assets (ROA), return on sales (ROS)
	Kuechler & Vaishnavi (2006)	Decision quality	Recall, decision confidence, comprehension, solution count
	Nissen & Sengupta (2006)	Decision quality	Procurement economy, accuracy of purchase decisions
	Iivari & Huisman (2007)		Deployment of system development methodologies: Methodology support, methodology use, methodology impact
	Karahanna, Agarwal, & Angst (2006)		System usage: Usage intensity, usage scope
Management	Gomez-Meja, Haynes, Nunez-Nickel, Jacobson, & Moyano-Fuentes (2007)	Firm performance	Performance hazard: Historical target achievements, referent-target achievement, probability of failure
	Cote & Miners (2006)	Job performance	Task performance, organizational citizenship behavior
	DiTomaso et al. (2007)	Job performance	Favorable work experiences: Technical control, help from sponsors, mentors, and coaches; Performance evaluation: Innovation, promotability into management
	Xiao & Tsui (2007)	Career performance	Objective: Monthly salary and bonus; Subjective: Job satisfaction
	Hsu (2006)	Box office success	Audience reaction: Audience size, overall appeal
	Sorenson & Waguespack (2006)	Box office success	Budget, promotion, release timing
	Bercovitz, Jap, & Nickerson (2006)	Relationship performance	Exchange performance: Evaluation, satisfaction, future
	Briscoe (2007)		Personal flexibility: Weekly patient-related work hours, predictable work hours, organizational attention to physician work satisfaction
	Guler (2007)		Termination decisions: Hazard of success, hazard of termination
	Blader (2007)		Voting behavior: Support for unionization, actual vote cast

Appendix H: Papers Included in the Sample

IS Papers Coded

Ahuja, M. K., McKnight, D. H., Chudoba, K. M., George, J. F., & Kacmar, C. J. (2007). IT road warriors: Balancing work-family conflict, job autonomy, and work overload to mitigate turnover intentions. *MIS Quarterly, 31*(1), 1-17.

Allen, G. N., & March, S. T. (2006). The effects of state-based and event-based data representation on user performance in query formulation tasks. *MIS Quarterly, 30*(2), 269-290.

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