Potential Research Space in MIS: A Framework for Envisioning and Evaluating Research Replication, Extension, and Generation

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Replications are an important component of scientific method in that they convert tentative belief to accepted knowledge. Given the espoused importance of replications to the extraction of knowledge from research, there is surprisingly little evidence of its practice or discussion of its importance in the management information systems literature. In this article we develop a framework within which to systematize the conceptualization of replications; we review and illustrate how some key information systems research fits into the framework and examine the factors that influence the selection of a research strategy. Our framework includes a conceptualization of the relationship among replication, extension, and generation in IS research. The concept of "research space" is defined and a framework is developed that delineates eight possible research strategies. Finally, the benefits of our framework to salient stakeholders in the research process are outlined.
(*Research Issues*; *Research Methodology*; *Research Models*; *Research Status*; *Research*; *Theoretical Evaluation*)

Always look twice—differently.
Bonhiem

Introduction

Research is a methodic search for knowledge: an epistemological process. Just as epistemology presumes methodology, methodology presumes replicability.[1] Replication, from the Latin *replicare* to "fold back," is the process of going back, or "*re-searching*" an observation, investigation, or experimentation to compare findings. While much attention has been paid to methodological rigor and pluralism in MIS research, replication has received less attention. In our rush for new knowledge, generation rather than replication, "*search*" rather than "*re-search*" predominates. The purpose of this article is to build a bridge between generation and replication and offer a framework to aid the MIS community in putting the "*re*" back in "*research*."

But why is replication important? The Greeks felt that the primary role of science was to turn "*doxa*" into

[1]That is, a theory of knowledge presumes a method for the generation of knowledge, and a method for generating knowledge presumes replicability of itself (process) and, under isomorphic circumstances, the knowledge it produces (content), cf. Heidegger 1977.

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"*episteme*," that is to turn belief or opinion into knowledge. The generation of knowledge comprises three components: *injunction* (follow a method—a specific of sequence actions), *observation* (observe and interpret), and *verification* (check if observations are repeatable and interpretations commensurate). Each component can be thought of as one of three legs of a stool—If one leg is missing or weak, the stool of research becomes unstable. Without verification, information produced by injunction and observation grows rapidly, but we can never tell if it is *doxa* or *episteme*—opinion or knowledge.

We suggest that paucity of replications in management research is due to a number of problems: First, *confusion over terminology*—Terms such as replication and extension are employed in disparate ways and often remain undefined; second, the *lack of frameworks* to guide researchers in envisioning and evaluating replication research; third, the *lack of strong institutional support*—While the importance of replication is acknowledged, it is differentially rewarded.

The goals of this paper are to: (1) highlight the relative paucity of replication in MIS and issue a call for this to be ameliorated, (2) clarify terminology within and across disparate paradigms, (3) present a conceptual framework within which to envision (design) and evaluate replication research, and (4) explore how replication studies can be designed and conducted to maximize their usefulness to the various research stakeholders both inside and outside a particular research program.

The article is organized as follows. After briefly reviewing key literature related to replications in the MIS field, we offer the following contributions. First, starting at the level of meta-assumptions, we review how different paradigms view replication. Second, a precise conceptualization of the relationship between replication, extension, and generation is offered. Third, the concept of "research space" is defined and a framework is developed that delineates eight possible research strategies that can guide and structure research efforts aimed at replication, extension, and generation. These strategies are discussed in turn and illustrated with examples from the information systems literature. Finally, we conclude with a discussion of the factors that influence the selection of strategies directed at replication, extension, and generation and show how our framework of research space can guide the efforts of scholars and even, perhaps, of editors and reviewers.

The Rarity of Replication

Replications are not common in most areas of business and management research. As with many things, replication might be one of those things that everyone talks about, but almost no one does. A broad study of replications in management research (including accounting, economics, finance, management, and marketing; Hubbard and Vetter 1996) found that such research constitutes less than 10% in accounting, economics, and finance, and less than 5% in management and marketing. The area of management information systems is no exception. This is somewhat of a paradox given that Kane (1984) regards replicability as the touchstone of scientific research, and that Rosenthal and Rosnow (1984) argue that replicability is almost universally accepted as the most important criterion of genuine scientific knowledge. Their view is echoed generally in the social sciences (e.g., Collins 1985, Ehrenberg 1990).

The reasons for this are unclear, and are undoubtedly worthy of scholarly study: Is there a lack of outlets for this type of research? The message from editors of leading journals in the various management disciplines can be somewhat unclear. The editor of a leading marketing journal stated that replication was sought for and encouraged (Kinnear 1992). A past editor of a leading MIS journal stated quite categorically that pure replications of prior studies were not appropriate (Zmud 1996). His successor acknowledges that "the potential contribution of refuting or substantially extending an existing and well-known theory could be compelling and significant," but also concedes that "incremental studies and replications generally have much less appeal" to the stakeholders of academic research (Lee 1999, p. xxvii). While there is a perception that replication research is more likely to be published in lower tier journals, research in the areas of management and strategy (Hubbard et al. 1998) indicates that replication studies are as unlikely to find a home in lower tier publications as they are in the premier journals. Is replication research in MIS not rewarded? Are

there theoretical problems? Is it simply a case of neglect? Or is it possible that MIS researchers have lacked a framework to conceptualize, structure, and guide replication research efforts?

Replications: Research Paradigms and Programs

The role that replication plays in research depends on the meta-assumptions made about the nature of reality and how that reality might be known. Generally, researchers working implicitly or explicitly within the objectivist paradigm have stressed the need for replication and indeed its central role in "science." In this section, as a preamble to the core of our discussion on the replication, we briefly review two distinct paradigms, namely the objectivist and the subjectivist (cf. Burrell and Morgan 1979, Lee 1991, Morgan and Smircich 1980) and briefly examine the role the concept of replication plays in each.

Objectivist Paradigm

It can be argued that objectivism is an implicit assumption of scientific realism, whose axioms are: (1) the world exists independently of being; (2) the task of science is to develop true and accurate knowledge about the world, even though such knowledge is never likely to be entirely unequivocal; (3) all knowledge claims must be critically evaluated and tested to determine the extent to which they do, or do not, truly represent or correspond to the world.

Given the above assumptions, it is clear why researchers in the objectivist paradigm have stressed a particular view of replication. The generation of valid knowledge in this instance is building an ever-more accurate picture of reality, and replication is a key method whereby the accuracy of a particular representation may be assessed. Accuracy here has four components. First, it stresses *validity* (i.e., the truth, or correspondence, of a particular representation to reality), second, *reliability* (i.e., the constancy of a particular representation over repeated observations), third, *objectivity* (i.e., the extent to which findings are free from bias). Finally, extension is seen as a way of *generalizing* a particular representation across observations in different contexts.

Subjectivist Paradigm

Three major ideas lie behind subjectivism. First, scientific statements are not true or false descriptions of some external, independent reality, but rather are constructions or creations of the subject scientist. Second, that the criteria for acceptance or rejection of theory and fact are ultimately subjective, reflective of the subject's interests, aesthetics, etc. Third, truth or falsity of theories is essentially undetermined by empirical data; observation cannot provide an objective control for science. Subjectivist philosophies stress the dominant and critical role of the subject, and the perceived organized properties of a known object are quintessentially subject-, rather than object-, dependent.

In summary, subjectivism posits the existence of an ontologically primary subject. Knowledge results from the subject engaging in self-reflection. Knowledge is seen as an intrasubjective process: Concern revolves around the depth of feeling, empathy, and reflexivity. Knowledge is unique and subject-dependent. The subjectivist tradition also has a strong counterpart in the social sciences, where the subject is replaced by the intersubjective and the social group replaces the individual. Social subjectivists argue that meaning is intersubjectively created and has no correspondence in the empirical world. The social subjectivist camp encompasses the interpretivist schools of social phenomenology, hermeneutics, and ethnography.

Replication takes on a very different role in the subjectivist paradigm. The generation of valid knowledge in this instance focuses on the process of self-reflection. Replication thus is not concerned with accuracy (the building of an ever-more accurate representation of some external reality), but depth of understanding (building richness of phenomenological experience). In this context, validity is not about correspondence of a particular representation to reality, but rather about overcoming self-illusion, akin to overcoming "false consciousness;" it might be better termed self-honesty. Furthermore, reliability, the constancy of a particular representation over repeated observations, is replaced with insight: once again the deepening of understanding—i.e., not the same but different. As Gadamer (1975) argues, "to understand is to understand differently" (p. 138). Finally, extension may be better termed empathy—the placing of oneself in another's shoes.

Research Programs

The discussion of replication in this paper fits primarily into the objectivist paradigm, which accords replication a significant role in the research process. Indeed, Popper (1959) claimed that only through repetition and retesting can the observations of scientists be called scientific. "Only through repeated regularity and reproducibility do empirical observations establish the requisite intersubjective invariance of the phenomena under analysis" (Popper 1959, p. 45). Lindsay and Ehrenberg (1993) suggest that replication research is important for the development of research programs. The ultimate goal of replication studies is to promote the systematic accretion of valid knowledge through the creation of a *research program* from an isolated finding. Such an integrated series of replications promotes Popper's regularity and reproducibility and prevents journals from becoming the repositories of fragmented, creative, yet isolated, results. According to Lindsay and Ehrenberg, the creation of a research program can only be accomplished through deliberate, carefully designed, systematic replication research.

Definition of Terms

Replications and Extensions: A Question of Terminology

The first problem one faces when considering replication is one of terminology. The MIS literature provided a good example of some of the well-intentioned confusion and subsequent debate surrounding these issues in the exchanges between Hartwick and Barki (1994) and Robey (1994): Hartwick and Barki claimed to have *replicated* and *extended* the model of conflict during systems development reported by Robey and his colleagues (Robey and Farrow 1982; Robey et al. 1989, 1993) and emphasized the importance of replicating the findings of empirical studies so that more general support could be established for theoretical relationships. Robey (1994) countered that their work could more properly be considered an extension of his work, rather than a replication, because of differences in the approach to measurement and data analysis.

What is a replication? What is an extension? When does a replication become an extension? These issues are now addressed. In reviewing articles in this area, one is struck by two factors: First, many authors fail to explicitly define "replication" or "extension," and second, amongst authors who do offer definitions, there is a lack of consensus. For example, Cooper and Rosenthal (1980) define a replication as an additional test of an already-tested hypothesis, while an extension involves moving beyond the original hypothesis to contribute findings undetected in previous studies. In contrast, Bedeian et al. (1992), following Lykken (1968), make the distinction between *literal* or *exact* replications and *operational* replications. The former stresses exact duplication of procedures, while operational replications allow some deviation from a target study's procedures. Hubbard and Armstrong (1994) define a replication as a duplication of a previously published empirical study that is concerned with assessing whether similar findings can be obtained upon repeating the study. In contrast they define a "replication with extension" as a duplication of previously published empirical research that serves to investigate the generalizability of earlier research findings. The extension does not alter the conceptual relationships of the earlier study but instead tests them by making changes in some aspects of the design. Examples would include the modification of either exogenous or endogenous variables, the addition of a new variable(s), and drawing a new sample from a different population (cf. Hubbard and Armstrong 1994, Hubbard and Vetter 1996). Finally, Barwise (1995), following Ehrenberg (1990), argues that replication is the looking for "significant sameness" across many sets of data, preferably covering a wide range of conditions.

Replication, Generation, and Extension

To clarify and consolidate the various terminologies used in replication research, we offer the following definitions. Given two studies, an original "target" study and a new "focal" study:

- A *pure replication* study is defined as a duplication of a given target study. All key research parameters held constant between the target and focal studies.
- An *extension* study is defined as a duplication of a target study in which one or more key parameters are altered. Thus, certain parameters are held constant and certain parameters are changed between the target and focal studies.

• A *pure generation* study is defined as a focal study in which all key parameters are altered relative to the target study.

On the one hand research can be thought of as a problem-solving exercise (or indeed a phenomenon-exploring exercise), and on the other hand a knowledge generation process. Simply, problems or phenomena describe the focus of the research, and knowledge generation constitutes the process by which phenomena are solved or explored. Given a particular research problem or phenomenon, at any one time research can be replicative (in the sense of duplicating previous research parameters) and/or generative (in the sense of modifying the parameters of previous research). Cohen (1990), who contends that successful research makes some theoretical proposition more likely, rather than conclusively settling an issue, emphasizes this. Issues can only move toward resolution by means of successful future replications in the same and different settings, as might be found in meta-analysis. McGrath and Brinberg (1983) contend that both confirmations and disconfirmations can reduce uncertainty, a point substantiated by Raman (1994), who employs a Bayesian perspective to explicitly derive the probability of an additional confirmation of a theory, given a history of outcomes.

While many divisions and classifications of the research space exist, we believe the following to be a framework useful to the various stakeholders in the research production and consumption process. Any particular research study can be thought of as occupying a conceptual space bounded by generation and replication. Thus, these two elements define the region of *potential research space*. Ideally, a pure replication study is one in which problem, theory, methods, and context remain essentially the same between studies. In contrast, a pure generation study is one in which an entirely new problem is addressed and, by definition, new theory is developed, new methods are used to generate and evaluate data used to test the theory, and the theory is tested (by default) within a new context. However, from a practical perspective extension, falling in between pure replication and pure generation, will tend to dominate the space in most replicative research. Pure replication is obviously an ideal condition because at least one parameter must change between studies—time. Hubbard and Armstrong (1994), after making the distinction between replication and replication with extension, argue that the class replication with extension covers those studies that wish to assess the impact of time.

Depending on how much of a Heraclitean or Parmenidean[2] perspective one adopts, this presents more or less of a problem. Contexts in which the rates of change are sufficiently slow, relative to the interval between studies, might qualify as pure replicative studies. This is possibly why physical scientists are said to be more concerned with replicability than the social sciences (Chase 1970). Simply, the rate of change in the physical world is either slower than in the social world or more intrinsically predictable. However, the social world is not entirely fluid. As Tsoukas (1992) points out, *institutions* make the social world patterned, regular, and habitualized (e.g., Berger and Luckmann 1966), and thus amenable to rational investigation (cf. Cooper 1988).

On the other extreme, pure generation is a more immediately feasible research strategy. Given a specific research problem or phenomenon, it is feasible to change all major research parameters (relative to previous research) in the process of exploring the problem. The middle ground between the extremes of pure replication and pure generation is that of extension. Any one piece of research in this region is thus a combination of replication and generation.

Finally, it should also be pointed out that replication, generation, and extension are all *relative* terms in two senses. First, as argued above and as Bedeian et al. (1992) stress, time inevitably changes both researcher and subject. Thus pure replication is in an absolute sense an ideal. Second, the very terms replication, generation, and thus extension are always relative to some previous work. Thus, on the one hand one can replicate the problem, theory, method, and context of previous research, and on the other hand one can generate novelty in terms of the problem, theory, method, and context of previous research.

[2]Among the Greek philosophers, Heraclitus believed that everything was in a state of flux. Parmidies believed that change was an illusion.

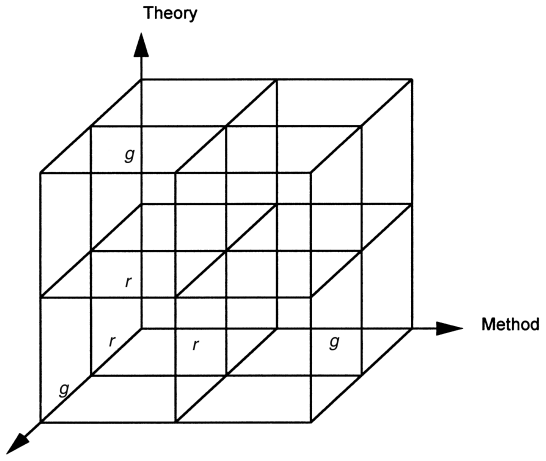
A Framework: Research Space

As outlined above, our perspective is that research is essentially a problem-solving or phenomenon-exploring exercise, and knowledge generation is the process by which the phenomenon is solved and/or explored. Thus research is an epistemological process that occupies a conceptual space defined by four primary parameters or dimensions: problem or phenomenon, theory, method, and context. The problem or phenomenon specifies and delimits the focus of the research—Simply it specifies *what* is being investigated. The theory answers questions as to *why* certain phenomena might occur; the method addresses the problem of *how* one might go about generating knowledge about the phenomena; and the context concerns the *who, what,* and *where*—the phenomenological context and content of the problem. Research space ($\Re$) can thus be defined as the following four-tuple and illustrated in Figure 1:

$$\Re \text{ (Research Space)} =_{\text{def}} \text{(Problem, Theory, Method, Context).}$$

Our conceptualization of a research space resonates to a certain extent with the validity network schema for the analysis of validity and the research process of Brinberg and McGrath (1982). The assumptions of such approaches are first, that research involves three analytically distinct but interrelated domains—namely, *conceptual*, *methodological,* and *substantive*. Second, that research involves *elements* and *relations* between elements, from each of these three domains. And third, that a complete research process involves the *identification*, *selection*, *combination*, and *use* of elements from the conceptual, methodological, and substantive domains. Our framework differs in that it specifically focuses on the roles (and their interrelationships) of replication, extension, and generation in the advancement of information systems knowledge.

Figure 1 Potential Research Space



Where r = parameter level replication, and g = parameter level generation. The problem dimension is held constant.

Obviously each dimension of research space can comprise subdimensions or levels. In Table 1 we provide one example of how each dimension can usefully be subdivided. This classification is obviously not exhaustive (i.e., one can identify further subdimensions) or definitive (other distinctions can be made); however, it illustrates the composite nature of each research-space dimension.

Thus, the problem dimension can be split into two related components—general (e.g., broad research questions) and focused (e.g., propositions and hypotheses). Theory can be split into the philosophical underpinning of the research (e.g., critical realism) and the specific theory(s) employed (e.g., contingency theory). Similarly, method would operationally include both method of data collection or generation (e.g., interviews) and method of data analysis (e.g., structural equation modeling). Finally, context can be split into investigative and interpretive contexts. In this illustration, Level 2 presupposes Level 1. Thus, a focused problem is a subset of a more general problem, while a specific theory presupposes a philosophical lens (i.e., a set of deep assumptions). In turn, data analysis presupposes data generation, and an interpretive context presupposes an investigative context. Table 1 delineates these distinctions in greater detail.

We now suggest a framework enumerating all possible instantiations of the potential research space available to the researcher when working in a particular research area or research stream. A research area or stream might be defined as a "family of research issues" related through an intellectual or practical "family resemblance" to one another (Wittgenstein 1953). For example, the research issues associated with

Table 1 Research Space and Levels

	Level 1	Level 2
Problem	*General problem* General managerial and research question(s)	*Focused problem* Focused research propositions and hypotheses[1]
Theory	*Philosophical lens* Meta theory, including ontological, epistemological, and methodological axioms	*Specific theory* Specific theories comprised of constructs and their relations, (i.e., nomological network), level of analysis (i.e., individual, group, organizational), etc.
Method	*Data generation* Methods of data production, including measurement issues, survey processes, interviews techniques, observational protocols, etc.	*Data analysis* Methods of data analysis, including textual analysis, statistical analysis, visual methods, etc.
Context	*Investigative context* The when, where, and from whom/what data is collected (i.e., population specification and variable delineation (e.g., country, culture, industry, etc), sample issues, etc.)	*Interpretive context* The when, where, and whom of data interpretation. This acknowledges that while data may be objective, its interpretation is contextual. This context is both social (a function of individual, organizational, and cultural values) and theoretical (dependent upon the body of literature within which the researcher is working).

[1]Obviously, a hypothesis is essentially a problem or question that the research seeks to address.

technology acceptance can be considered a research area or stream within the larger MIS research discipline; the research associated with IS success is an example of another research stream. Building on Figure 1, a framework which clearly explicates the possible research combinations of problem, theory, method, and context, is expanded in Table 2 and explained in subsequent paragraphs.

The usefulness of such a framework to working researchers, reviewers, editors, domain reviewers, and meta-analysis researchers is to provide a strategic or evaluative representation within which to locate a particular research effort. Through that location a set of requirements for the study and its subsequent representation in an article can be established. These criteria can be used to both plan and evaluate each research effort based on its position in the research space. For instance in a pure replication study, to what extent have the problem, theory, methods, and context been held constant? If any of the research conditions have changed, are the authors justified in calling the study a true replication? Our framework can assist in the

Table 2 Potential Research Space: Studies of Zero to Three Degrees of Freedom

Type of Study	df	Theory	Method	Context
Pure Replication	0		*r (Validation)*	
Context Extension	1	*r*	*r*	*g (Generalization)*
Method Extension	1	*r*	*g (Method Triangulation)*	*r*
Theory Extension	1	*g (Theoretical Extension)*	*r*	*r*
Theory/Method	2	*g (Theory/Method Extension)*		*r*
Method/Context	2	*r*	*g (Method/Context Extension)*	
Theory/Context	2	*g (Theory/*	*r*	*Context Extension)*
Pure Generation	3		*g (Generation)*	

meta-analysis process by providing a universal, a priori scheme for categorizing studies.

Zero Degrees of Freedom Research Strategy

Pure Replication. This strategy constrains all three dimensions of the research to be as close as possible to the original study or studies. That is, the same theoretical framework, the same methodology, and the same phenomenological context are employed. This pure replicative strategy is essentially an ideal case for the reasons outlined earlier. Pure replicative studies seem to be very rare in MIS, with literature reviews identifying no pure replicative studies in any of the major journals. As will be discussed later, the paucity of research in this area is somewhat surprising given the importance placed on replication within the scientific method.

One Degree of Freedom Research Strategies

Context-Only Extension. This strategy takes an existing theory and method and applies it in a different context. Examples are evident in the area of IS user satsfaction, and specifically the use of the SERVQUAL instrument (Parasuraman et al. 1988) in IS. A number of authors have attempted to test an existing instrument from the marketing literature in the same way that it is used in marketing (i.e., theory, and method, remain constant) in a different context, namely IS. Kettinger and Lee (1994) studied the link between perceived service quality and user satisfaction with the information services function. Similarly, Pitt et al. (1995) also considered service quality as a measure of information systems effectiveness.

Other research areas in which theory and method area frequently held constant, while context changes, are those of the comparative international arena and cross-cultural settings. It is of importance, as well as interest, to discover whether theories that predict well in one setting will be as effective in another, and whether methods that work in one environment will be as well applied in another. There is evidence that IS scholars are pursuing these research opportunities. For example, Dasgupta et al. (1999) describe their attempts to generalize work from developed countries in a developing country (India). They examined the determinants of process-based information technology adoption in the Indian manufacturing sector and found that while there were differences between developed and developing countries, factors that influence technology adoption were similar.

Method-Only Extension. This strategy takes an existing theory and context and links them through a different research method. There are a number of examples of this strategy in the MIS literature. One of these well illustrates not only the potential of the strategy to contribute to the literature, but also its value in stimulating productive academic debate. Van Dyke et al. (1997) extended the work of Pitt et al. (1995) who looked at the reliability of the difference scores in the "gaps" approach to measuring the service quality of the IS department. Whereas Pitt et al. (1995) used Cronbach's alpha (1951), a widely used method of estimating instrument reliability, to determine the reliability of the SERVQUAL instrument, Van Dyke et al. (1997) argued that this approach is inappropriate for difference scores, citing the work of Lord (1958), Cronbach and Furby (1970), Wall and Payne (1973), Johns (1981), Peter et al. (1993), and Edwards (1995). This is because the reliability of a difference score is dependent on the reliability of the component scores and the correlation between them. Relying primarily on the work of Johns (1981), Van Dyke et al. (1997) contend that as the correlation of the component scores increases, the reliability of the difference scores is decreased. In a rejoinder, however, Pitt et al. (1997) used the same data set as in their 1995 work (Pitt 1995) and the same underlying theory—the Parasuraman et al. (1985, 1988) "Gaps" model—but changed the method of analyzing the data (Van Dyke et al.'s 1997 recommendation to use the Johns 1981 approach) to take into account the use of difference scores. An interesting finding here was that the method did not have a significant effect on the reliability of difference scores, at least in the case of the use of the SERVQUAL instrument to measure IS service quality.

Another example of this strategy shows how the methods available to the researcher evolve over time,

and how using these new tools to address existing problems can offer new insights. Davis (1989) used Bandura's (1982) self-efficacy theory to explore how perceived usefulness and perceived ease of use impacted user acceptance of information technology. Adams et al. (1992) replicated Davis's work a few years later, using the same theory and Davis's instruments, in a very similar setting (IS users). However, Adams et al. used multiple-indicator structural equation modeling (LISREL), rather than multivariate regression of averaged scores, as the method of analysis.

Theory-Only Extension. This strategy takes an existing method and context but employs a new theory to explain the results. An example of this can be seen in Dishaw and Strong's (1998) attempt to explain information technology utilization behavior by integrating two existing models (theories), namely the Technology Acceptance Model (TAM) and the Task-Technology Fit Model (TTF), into a new model (theory). Their result is an extension of TAM to include TTF constructs, which is then tested using a commonly employed method in this field of research—path analysis, in a conventional setting, namely IS users.

Two Degrees of Freedom Research Strategies

Method/Context Extension. This strategy takes a new method and context, but employs an existing theory to explain the results. An instance of this strategy can be found in the area of IT-enabled change and specifically in the work of Manzoni and Angehrn (1997, 1998). Here, existing theory, regarding successful management of IT-enabled change, is extended. Specifically, there was a new method employed: The researchers used a new computer-based, multimedia simulation (EIS Simulation) that allows managers to experience the process of introducing an executive information system into a fictitious organization. Furthermore there was a change in context (from a typical real-world, IS setting to a simulated, fictitious one). The theoretical framework, as to why that successful management of IT-enabled change requires good management of the change process, remained unchanged.

Theory/Context Extension. This strategy takes an existing method, but applies it to a new context and employs a new theory to explain the results. In the area of software project management, the work of Keil et al. (2000) represents an example of this approach. Here, four alternative theories (generally new to information systems), namely self-justification theory, prospect theory, agency theory, and approach-avoidance theory, are offered as alternatives to simple escalation behavior, to understand the dynamics of commitment to software projects. Following other studies in information systems (e.g., Liberatore et al. 1989), a logistic regression methodology is employed to compare the explanatory power of the four theories for the commitment to a software project.

Theory/Method Extension. This strategy takes a new theory and method and applies them to an existing context. An instance of this type of research can be found in the work of Jackson et al. (1997). They expand on the Technology Acceptance Model (TAM) of Davis et al. (1989), in turn based on the Theory of Reasoned Action in investigating the behavioral intention to use an information system. On the theory side they extend TAM by including additional constructs and factors, including prior usage, argument for change, situational involvement, and intrinsic involvement (an incremental change), and in terms of methodology they utilize a confirmatory method of covariance analysis in a holistic framework, whereas Davis et al. used multiple regression (also an incremental change). Finally, on the context side they also used a sample of employees in various levels of organizations, representing no significant change on this dimension.

Three Degrees of Freedom Research Strategy

Pure Generation. In the pure generation strategy all three dimensions of the research are changed, making this by definition a three-dimensional strategy. That is, a new theoretical framework is employed; a new methodology and a new phenomenological context are used. The MIS literature abounds with this type of research. Arguably, Bailey and Pearson's user satisfaction instrument development study (1983)

might be an example of pure generation strategy in that it developed a new tool (UIS) to measure user satisfaction with information systems and sets the stage for the research stream resulting in other models such as the TTF Model (Goodhue and Thompson 1995). This pure generative strategy would seem to be the goal of many researchers and appears indeed to be the type of submission sought by editors of premier journals in the IS field (e.g., Zmud 1998). On the other hand, both researchers and journal editors alike can appreciate the challenges posed by this risky strategy and might prefer, at least on occasion, to resort to the more cautious alternatives suggested in the research-space framework.

Recommendations and Conclusions

In this paper we explore the issues of generation, extension, and replication in research. We have attempted to illustrate our discussion by referencing examples of the various types of research strategies in the information systems literature. The search for these examples was extensive and time consuming: Illustrations of the various strategies do exist in the IS literature, but they are few and far between. Indeed, it might also be argued that some of the examples are not exactly on-point as examples of the strategy they most closely represent. Our intention with these examples was merely to illustrate the properties of the research-space model, and to show that at least some replication was occurring in IS research. If the paucity of replications in information systems research may be partly attributed to the lack of a framework to conceptualize, structure, and guide replicative research efforts, we have attempted to address this by the provision of a structure for the delineation and identification of research strategies. This framework is outlined and the various strategies within it discussed. The use of such a framework and the decision as to which research strategy to pursue depends on a number of factors, first and foremost being the researcher's goal or purpose. This is typically specified by the research problem, which in turn is delineated by some person or group's vested interest. The second factor is the classic admonishment to "contribute to knowledge." The third is the degree of risk associated with a particular strategy.

The first factor that drives the selection of a research strategy—the research problem—simply revolves around selecting the strategy(s) that gives the greatest utility in addressing the particular problem at hand. The issue of "contribution to knowledge" is a simple one to address: All strategies outlined achieve this objective, from pure replication to pure generation. However, the value of the outcome of any one strategy can only be assessed a posteriori. By this we mean that it is often the case that only after the research is completed and the results known and assimilated can their real value be assessed. Finally, the factor of risk should be considered. Broadly speaking the greater the number of degrees of freedom of a research strategy, the greater the risk involved. Risk in this context is multifarious: risk of not being accepted by a peer group, risk of procedural error, and risk of conceptual integrative error. The latter concerns the risk that the whole project has not been thought through properly; for example, the assumptions that underpin the theory component are at odds with those on the methodological side.

The framework presented here will find application among a number of stakeholders within the broader information systems research community. These stakeholders may be broadly classified as producers, consumers, and stewards of MIS research.

For the researchers as producers of scholarly endeavors, the framework permits the planning of new research streams, the identification of opportunities, and the ensuing development of strategies and approaches to existing research streams. Moreover, the framework enables the researcher to gauge the nature and extent of a particular research contribution, and to position a piece of research for future publication. This in turn allows the researcher to identify future research opportunities. For the verifier or replicator, the framework makes the identification of research opportunities a more structured task. It also permits the determination of strategies by facilitating the direction that a piece of replicative research can take, by moving in one or more of the three directions in the framework.

For the consumers of scholarly output—researchers (from graduate students to senior academics) and managers (the implementers of MIS knowledge)—the framework can be used to place the research that they

make use of into perspective and to evaluate it effectively. The framework can help identify which streams of research have been effectively verified and which are more tentative.

Finally, the stewards of research—the journal editors—who serve as both authors and readers alike, can use the framework to take unequivocal positions on what they reject, accept, and publish to give research producers fair opportunities and meet the demands of their audience. The framework can help editors gauge the relative significance of a manuscript's contribution and help to identify an appropriate balance between the striving for new knowledge with the scientific requirement for confirmation of existing knowledge.

To avoid sending mixed messages to their constituents, editors need to avoid two undesirable positions. One would be where an editor proclaims the importance of replicative research, yet doesn't publish it. The other would be where replication is tacitly or explicitly censured, yet appears from time to time. Finally, a reconsideration of the roles of replication, extension, and generation in the discipline that the journal serves might even permit the editor to develop the journal further and enable innovation. For example, journals could devote separate sections to replications, particularly of well known or classic pieces of research, or to discussions of tools, techniques, and requirements for this type of research, much in the same way that some journals now have sections devoted to shorter research notes or book reviews. Finally, journal reviewers can utilize the framework to gain perspective on manuscripts submitted to them.

In conclusion, it has been our aim to encourage MIS stakeholders to reconsider the role that replication plays the production of IS knowledge and to facilitate them in reinstating replication as a critical component of research. We hope to have helped put the "re" back into research.

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