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RESEARCH NOTE

RECONCEPTUALIZING COMPATIBILITY BELIEFS IN TECHNOLOGY ACCEPTANCE RESEARCH[1]

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Abstract

Theoretical and empirical research in technology acceptance, while acknowledging the importance of individual beliefs about the compatibility of a technology, has produced equivocal results. This study focuses on further conceptual development of this important belief in technology acceptance. Unlike much prior research that has focused on only a limited aspect of compatibility, we provide a more comprehensive conceptual definition that disaggregates the content of compatibility into four distinct and separable constructs: compatibility with preferred work style, compatibility with existing work practices, compatibility with prior experience, and compatibility with values. We suggest that the form of the multidimensional compatibility construct is best modeled as a multivariate structural model. Based on their conceptual definitions, we develop operational measures for the four compatibility variables. We assess the nomological validity of our conceptualization by situating it within the technology acceptance model. In contrast to prior research, which has regarded beliefs of compatibility as an independent antecedent of technology acceptance outcomes, we posit causal linkages not only among the four compatibility beliefs, but also between compatibility beliefs and usefulness, and ease of use. We test our theoretical model with a field sample of 278 users of a customer relationship management system in the context of a large bank. Scale validation indicates that the operational measures of compatibility developed in this study have acceptable psychometric properties, which support the existence of four distinct constructs. Results largely support the theorized relationships.

Keywords: Technology acceptance model, TAM, compatibility, innovation diffusion, innovation characteristics

Introduction

In response to the pervasiveness of computing technology in all aspects of the organizational and personal lives of indi-

[1]Debbie Compeau was the accepting senior editor for this paper. James Thong was the associate editor. Darren Meister served as a reviewer. Two other reviewers chose to remain anonymous.

viduals, information technology acceptance and usage endure as central concerns in information systems research (Venkatesh et al. 2003). To better understand and predict key outcomes associated with technology acceptance, several theoretical models have been proposed (for a recent review, see Venkatesh et al. 2003). Of these, the technology acceptance model (TAM; Davis 1989) is widely recognized as a robust yet parsimonious conceptualization. Drawing upon the theory of reasoned action (TRA; Ajzen and Fishbein 1980) from social psychology, TAM argues that IT acceptance behaviors can be explained by individual beliefs about the usefulness and ease of use of the IT. Other work in technology acceptance, notably innovation diffusion studies, however, argues for a more comprehensive set of beliefs as predictors of both adoption as well as subsequent continued usage behaviors. Juxtaposing TAM with other findings (e.g., Moore and Benbasat 1996; Tornatzky and Klein 1982), we note that compatibility is an important belief recurrent in technology acceptance studies but missing from TAM. Compatibility assesses the extent of congruence between a new technology and various aspects of the individual and the situation in which the technology will be utilized. Although recent studies have tried to incorporate perceived compatibility, they have had limited success because of issues inherent with the conceptualization, which resulted in subsequent measurement problems.

In this research note, we focus on this important belief in technology acceptance. Specifically, unlike the majority of prior research, which has examined limited aspects of perceived compatibility, we provide a more comprehensive conceptual definition that views this belief as a multidimensional construct consisting of four distinct and separable dimensions. We describe the content (i.e., the dimensions) as well as the structural form of compatibility. We assess its nomological validity by situating it within TAM. In contrast to prior research in information systems, which has predominantly regarded beliefs about compatibility as an independent antecedent of technology acceptance outcomes, we posit causal linkages among the compatibility beliefs and other key beliefs of usefulness and ease of use. Based on the conceptual definitions of the dimensions, we develop and validate operational measures and test the theorized relationships with a field sample of 278 users of a customer relationship management (CRM) system in the context of a large bank. Scale validation indicates that the operational measures of compatibility developed in this study have acceptable psychometric properties, and partial least squares factor analysis supports the existence of four distinct constructs comprising compatibility.

Conceptual Background

TAM, proposed by Davis (1989),is based on constructs and relationships in the theory of reasoned action (Fishbein and Ajzen 1975). It posits that behavioral intentions to use an IT are determined by an individual's attitude toward using the IT, as well as beliefs the user holds about its perceived usefulness (PU). Attitude, in turn, is determined by PU and perceived ease-of-use (EOU). *PU* is defined as the degree to which a person believes that use of a system would improve his or her performance (Davis 1989), and thus taps into the instrumental outcomes a user associates with technology use. *EOU* refers to the degree to which a person believes that using a particular system would be effortless (Davis 1989). Even though both PU and EOU are significantly correlated with intentions, Davis' findings suggest that PU and attitude collectively mediate the effect of EOU on behavioral intentions. The model has been shown to have good predictive validity for both initial adoption as well as continued use of a variety of information technologies (Adams et al. 1992; Davis et al. 1989; Mathieson 1991; Szajna 1996).

Comparing TAM to research grounded in innovation diffusion theory, we find that empirical studies in the latter tradition have used a more complex set of beliefs to predict adoption. Based on studies of multiple innovations in various domains, Rogers (1983) proposed that adoption behavior is influenced by beliefs related to relative advantage, compatibility, complexity, trialability, and observability. Perceived usefulness in TAM is equivalent to Rogers' relative advantage while ease of use is equivalent to complexity (EOU suggests that low cognitive effort is required for using the innovation, whereas complexity connotes the opposite). Moore and Benbasat (1991) further refined the theoretical and operational definitions of these innovation beliefs into a set of seven conceptually distinct constructs. These were subsequently used by Moore and Benbasat (1996) to predict usage of personal workstations (PWS). Only perceptions of usefulness, ease of use, and compatibility were significantly related to usage. The importance of compatibility in predicting technology acceptance outcomes has also been consistently supported in other empirical IS studies (e.g., Agarwal and Prasad 1997; Brancheau and Wetherbe 1990; Chin and Gopal 1995; Hoffer and Alexander 1992; Karahanna et al. 1999; Taylor and Todd 1995). Furthermore, Tornatzky and Klein's (1982) meta analysis of over 100 innovation studies showed that of the 10 innovation attributes identified, only relative advantage (PU), compatibility, and complexity (EOU) were consistently related to adoption and/or utilization decisions. Finally, of the seven beliefs discussed in Moore and Benbasat (1991), recent work focused on integrating various streams of research in technology acceptance (Venkatesh et al. 2003) has retained

only beliefs about usefulness, ease of use, compatibility, and image. Thus, it is evident that compatibility is an important belief salient to technology acceptance behaviors.

Attempts so far to incorporate compatibility in models of technology acceptance have had limited success. Although compatibility and perceived usefulness have been regarded as conceptually distinct and although compatibility has been shown to have significant effects on attitude and/or intentions, with few exceptions (e.g., Chin and Gopal 1995, Taylor and Todd 1995), most studies have not been able to empirically discriminate between the two constructs (Karahanna et al. 1999; Moore and Benbasat 1991). In addition to the empirical confounding of the two constructs, there are two other shortcomings with the treatment of compatibility in prior work. First, for the most part, the operational definition of compatibility has generally been limited to compatibility with one's preferred work style and, to a more limited extent, compatibility with the existing situation, even though compatibility has a much broader connotation. Second, except for TAM, most innovation diffusion-based studies in information technology, while acknowledging that these innovation characteristics are correlated, do not explore any causal linkages among them.[2] A few exceptions from other disciplines that posit causal relationships among beliefs include the work of Holak and Lehmann (1990) and of Ettlie and Vellenga (1979). Holak and Lehmann developed a path model to explain purchase intentions for new products, where antecedents to purchase intentions included perceptions of communicability, complexity, divisibility, relative advantage, compatibility, and perceived risk. Compatibility was found to have a significant effect on communicability, relative advantage, perceived risk, and purchase intentions. However, they used single-item measures for these perceptions and, moreover, did not present any data to indicate whether their measure of compatibility was distinct from relative advantage. Ettlie and Vellenga examined the time lag in decision making over the adoption and implementation of transportation innovations. Their conceptualization of compatibility treated this construct as consistency with "existing values, past experiences, and present needs" (p. 435). Empirical results supported the existence of a significant effect of trialability on the perceived compatibility of an innovation.

Below we address two shortcomings of prior work in IT innovation adoption: the limited conceptualization and operationalization of compatibility, and the absence of theoretical linkages between compatibility and other important technology acceptance beliefs. First, consistent with its conceptual definition, we disaggregate the global compatibility construct into four distinct dimensions and develop operational measures for each. Second, we posit a set of causal linkages among the leading technology adoption beliefs of perceived usefulness, ease of use, and the four dimensions of compatibility.

Revisiting the Construct of Compatibility

We develop our specification of compatibility and its dimensions through a review of prior theoretical and empirical work that has conceptualized and measured this belief. Acknowledging that compatibility is multidimensional, we describe both the substantive content of the construct (the conceptual dimensions comprising it) and its structural form (the relationships among the dimensions).

The Content of Compatibility

One of the earliest treatments of compatibility was offered by Rogers (1962), who defined this belief as the degree to which using an innovation is perceived as consistent with the existing sociocultural values and beliefs, past and present experiences, and needs of potential adopters (pp. 126-127). Tornatzky and Klein (1982) elaborate on this definition and argue for the existence of two types of compatibility: normative or cognitive compatibility referring to compatibility with what people feel or think about an innovation, and practical or operational compatibility, referring to compatibility with what people do. Although Rogers' definition of compatibility is widely accepted and used—indeed, this definition was utilized by Moore and Benbasat (1991) as the starting point for their instrument development process—the latter part of the definition, which refers to compatibility with the needs of potential adopters, taps an aspect of relative advantage since an innovation cannot be viewed as advantageous if it does not meet users' needs (Moore and Benbasat 1991). Thus, it is possible that compatibility with the potential adopter's needs is a subdimension of relative advantage or perceived usefulness.[3] Therefore, because of the potential for confounding between the definitions of compatibility and perceived usefulness, as a starting point, we eliminate com-

[2]Research not specifically using DOI as the underlying theory, such as Venkatesh and Davis (2000), has tested relationships between beliefs related to result demonstrability, image, and perceived usefulness. However, no study in information systems that we are aware of has related compatibility to usefulness and ease of use beliefs.

[3]We are grateful to an anonymous reviewer for pointing this out.

patibility with needs from our conceptualization of this construct.

Based on Rogers' definition, we can isolate two distinct dimensions of compatibility: compatibility with values and compatibility with prior experience. The former dimension is subsumed in Tornatzky and Klein's normative or cognitive compatibility. However, except for the acknowledgement of compatibility with prior experience, Rogers' definition does not explicitly include operational compatibility, the second type of compatibility as defined by Tornatzky and Klein. Moreover, although Tornatzky and Klein suggested that an important aspect of compatibility is the extent to which the new artifact is consistent with what people do (operational compatibility), we believe that a finer-grained elaboration of this specific dimension is necessary. It is possible to further disaggregate operational compatibility into three distinct dimensions: compatibility with prior experience, compatibility with existing work practices, and compatibility with preferred work style. Indeed, an examination of the items used in prior research as potential measures of operational compatibility (e.g., Moore 1989) support such a disaggregation. The distinction here between preferred work style and existing work practices is subtle; while the former captures an individual's self-concept regarding the way they like to work, the latter describes the reality as it is currently experienced. Thus, compatibility in the latter category captures the degree of disruption and magnitude of change the individual is likely to experience when using a new technology. Although the two might be identical in certain situations, that is not always the case. For example, one might like to work in a highly organized fashion using an automated schedule, but available technology or the manner in which coworkers behave in their execution of work might impede the fulfillment of this desire. Existing work practices are often an outcome of institutional influences and organizational routines in a work setting, or environmental influences in a nonwork setting, whereas preferred work style is an explicit statement of the way an individual *likes* to work. This refined, nevertheless important, distinction has largely been ignored in extant conceptualizations of compatibility.

Table 1 summarizes empirical research in information systems that has examined compatibility beliefs. Several aspects of this table are noteworthy. First, it demonstrates that a majority of prior work on compatibility, with a few notable exceptions, has tended to use a definition of compatibility that confounds compatibility with preferred work style and compatibility with an existing situation (e.g., Agarwal and Prasad 1997; Chin and Gopal 1995; Karahanna et al. 1999; Moore and Benbasat 1991; Taylor and Todd 1995). In this work, surprisingly, compatibility was measured as a unidimensional construct, even though the conceptual definition of compatibility employed in these studies was much broader. This may have contributed to the inability of some of these studies to discriminate between perceived usefulness and compatibility and to the lack of clear insight into the role of compatibility in the technology acceptance process. Moreover, research in IT that has treated compatibility as comprising of more than one dimension appears to have confounded the dimensions of compatibility, either in the theoretical definition or in the operationalization. For example, as shown in Table 1, Ramiller (1994) attempted to extend the conceptualization of compatibility. Drawing upon research in a variety of domains, he theorized that perceived compatibility included seven distinct "elements" such as fundamental appropriateness to the work domain, adequacy of the innovation's current design, and fit to production infrastructure. Exploratory factor analysis on data related to the adoption of CASE technology did not support the existence of seven unique elements. Five factors emerged from the data and were related to the original seven elements through *post hoc* arguments. An analysis of the specific items constituting the factors points to considerable construct confound: Ramiller's definition of the different dimensions of compatibility includes elements of relative advantage, perceived behavioral control (Ajzen 1985), and image (Moore and Benbasat 1991).

Similar concerns exist with respect to the work reported by Harrington and Ruppel (1999). Examining compatibility in the context of telecommuting, the study acknowledges the existence of two dimensions: practical and value compatibility. The former dimension, which taps into the climate existing in the organization to support the innovation, has conceptual overlaps with perceived behavioral control or facilitating conditions (Taylor and Todd 1995) while the latter dimension is more consistent with Rogers' original conceptualization.

In summary, the discussion above reveals that much research in information systems innovation adoption has adopted a unidimensional perspective on compatibility. Even studies discussed above that acknowledge the existence of multiple dimensions exhibit certain methodological limitations. In an attempt to address such gaps, and drawing upon the findings in prior research, we suggest that compatibility comprises four distinct yet related constructs. We define the conceptual notion of compatibility as the *perceived cognitive distance between an innovation and precursor methods for accomplishing tasks*. In essence, it assesses the congruence between a new way of doing work enabled and instigated by a technology and the former methods, which are driven by various aspects of an individual's cognitive make-up that have been

Table 1. Views of Compatibility in Prior Research: Conceptual and Operational Definitions

Study/Conceptual Definition	Compatibility				Other Constructs		
	Values	Past Experience	Current Practices	Preferred Practices	PU	Image	PBC
Hardgrave, Davis, and Riemenschneider (2003) Compatibility with preexisting software development process			✓ X				
Cazier (2003); Cazier and Gill (2003); Cazier, Shao, and St. Louis (2002) How closely an individual's personal values and the perceived values of an organization overlap	✓						
Cho and Kim (2001-2002) Consistent with existing values, experiences, and needs of adopter	✓	✓ X		✓	✓		
Harrington and Ruppel (1999) ***Practical Compatibility*** Climate for the innovation's implementation ***Value Compatibility*** Fit of an innovation to the targeted users' values at the organizational and group level	✓ X						✓
Karahanna et al. (1999) Consistent with existing values, needs, and experiences of potential adopters	✓	✓	✓ X	✓ X	✓		
Parthasarathy and Bhattacherjee (1998) Consistent with the adopters values, experiences, and needs	✓	✓ X	✓ X	✓	✓		
Agarwal and Prasad (1997) Consistent with existing values, needs, and experiences of potential adopters	✓	✓	✓ X	✓ X	✓		
Chin and Gopal (1995) Consistent with existing values, needs, and past experiences of potential adopters	✓	✓	✓ X	✓ X	✓		
Taylor and Todd (1995) Degree to which the innovation fits with the potential adopter's existing values, previous experiences, and current needs	✓	✓	✓ X		✓		

Table 1. Views of Compatibility in Prior Research: Conceptual and Operational Definitions (Continued)

	Compatibility				Other Constructs		
Study/Conceptual Definition	**Values**	**Past Experience**	**Current Practices**	**Preferred Practices**	**PU**	**Image**	**PBC**
Ramiller (1994)							
Theoretical Definition							
Appropriateness to work domain			✓		✓		
Fit with tasks				✓			
Readiness to accommodate innovation			✓				✓
Technical transitional support							
Knowledge gap of adopter		✓			✓		
Impact on performance evaluation and reward						✓	
Congruence with value system.	✓						
					X		
Empirically Derived Dimensions		X			X		
Efficacy of the technology			X		X		X
Knowledge and control						X	
Experience of work and professionalism					X		
Management impact and response			X				
Technical transitional support							
Moore and Benbasat (1991)							
Consistent with existing values, needs, and past experiences of potential adopters	✓	✓	✓ X	✓ X	✓		
Rogers (1983)							
Compatibility with:							
Sociocultural values and beliefs	✓						
Past and present experiences		✓					
Needs of potential adopters			✓		✓		
Tornatzky and Klein (1982)							
Cognitive/Normative							
Compatibility with what people feel or think about an innovation	✓						
Operational/Practical							
Compatibility with what people do			✓				

✓ Represents dimensions included in the conceptual definition of compatibility
X Represents dimensions used in the operationalization of compatibility

influenced not only by the target technology's precursors, but also by prior beliefs and experiences. We suggest that four dimensions reflect this definition: (1) compatibility with existing work practices, measuring the extent to which a technology "fits" with a user's current work process; (2) compatibility with preferred work style, capturing the possibility offered by the technology of being consistent with a desired work style; (3) compatibility with prior experience, reflecting a fit between the target technology and a variety of users' past encounters with technology; and (4) compatibility with values, epitomizing the match between the possibilities offered by the technology and the user's dominant value system.

Our perspective on compatibility builds upon and extends the definitions offered by Rogers (1983) and by Tornatzky and Klein. As illustrated in Table 1, Rogers' definition encompasses compatibility with values, past experiences, and existing practices. Tornatzky and Klein's definition includes compatibility with values and existing practices. We noted earlier that it is important to distinguish between existing practices and preferences for how work should be accomplished, reflected in compatibility with work practices. Thus, we include a fourth dimension to explicitly capture this distinction.

The Structural Form of Compatibility

Scholars have suggested that there are multiple ways to conceptually model a multidimensional construct (Edwards 2001; Law et al. 1998). Law et al. identify three distinct models: latent, profile, and aggregate. A latent model is one in which the global construct does not exist at the same level as its dimensions but rather is reflected by the dimensions. In both the profile and aggregate models, the construct is "derived" through an appropriate manipulation of the constituent dimensions. With aggregate models, dimensions are combined using an additive or multiplicative approach, while in the profile model, theoretical archetypes or profiles are identified as combinations of specific levels of the various dimensions. In an alternate, but nonetheless similar taxonomy of multidimensional constructs, Edwards distinguishes between *superordinate* and *aggregate* approaches to modeling. A superordinate construct is reflected by its dimensions and is similar to Law et al.'s description of a latent construct, while an aggregate construct is "formed" by some algebraic combination of dimensions, and includes both profile and aggregate models from the Law et al. classification.

An alternative approach to modeling a multidimensional construct is to theoretically acknowledge that multiple dimensions collectively provide insight into the global construct (i.e., they are conceptually related), but are distinct enough to comprise separable constructs. Edwards points out (and demonstrates through empirical illustrations) that some constructs are best modeled as multivariate structural models where the dimensions are treated as separate yet related constructs. He notes that "a multidimensional construct can be represented directly using a multidimensional construct model, or indirectly using a multivariate structural model" (p. 185).

In determining the structural form for the compatibility construct, we choose the multivariate structural model with separable dimensions as the preferred modeling approach that is consistent with our theoretical conceptualization of compatibility. Viewing the four dimensions as reflective of a global compatibility construct is problematic in that there is no *a priori* reason to believe that the dimensions would be positively correlated in all instances, as is the requirement for reflective factors (Chin 1998a). Thus, for example, it is feasible that a particular technology might be highly compatible with existing work practices but quite incompatible with preferred work style, prior experiences, and dominant values. An alternative option, that of treating compatibility as an aggregate multidimensional construct formed by some algebraic combination of its underlying dimensions, is also problematic for several reasons. Positing the existence of a single conceptual construct, regardless of whether it is uni- or multidimensional, implies that it is possible to theoretically state consistent relationships to other variables as predictors or outcomes (Johns 1998). However, as is discussed subsequently, the theorized effects of the four dimensions of compatibility on outcomes are different. Furthermore, Law et al. note that "multidimensional constructs under the aggregate model can have dimensions that are totally uncorrelated" (p. 751). Therefore, knowledge about any single dimension would be insufficient to determine an individual's overall measure of compatibility. Although one would expect that high scores on all four compatibility dimensions would contribute to enhancing global compatibility, the potential attenuation in this value due to a low score on a specific dimension would be difficult to predict.

Finally, we could not theoretically identify and derive archetypes or profiles of compatibility based on combinations of the four dimensions. Given the absence of strong theoretical grounding for different compatibility profiles, we attempted to empirically derive compatibility profiles using the taxonomic approach that Becker and Billings (1993) employed to identify the various profiles of commitment. Although three profiles were identified, these were not theoretically meaningful. Thus, we could not find theoretical or empirical support for a profile approach to modeling the compatibility construct. Therefore, we believe it is appropriate to regard the four dimensions of compatibility as

distinct, while simultaneously acknowledging that collectively they represent facets of the same abstract concept. Such a multivariate modeling approach allows for a rich set of relationships to be specified among the dimensions themselves and between the dimensions and the outcomes of compatibility. As knowledge and empirical evidence about compatibility accumulates, following the recommendation of Edwards, future work might consider alternative approaches to modeling and argue for a different structural form based on the relative fit of various models.

Theoretical Model

Figure 1 presents a nomological net, which situates the proposed dimensions of compatibility (henceforth, compatibility beliefs) within TAM. As discussed above, the relationships between PU, EOU, and use derive directly from TAM. Although the original specification of TAM (Davis 1989) included attitude as mediating between beliefs and intentions, subsequent work yielding a refined TAM2 (Venkatesh and Davis 2000) relates beliefs directly to usage intentions and excludes attitude from its theoretical arguments. Additionally, beliefs have been related to both use intentions (e.g., Davis et al. 1989) and use behaviors (Moore and Benbasat 1991). We focus here on use as the outcome of interest. We extend TAM to include the four compatibility beliefs that are posited to influence actual use behaviors both directly and mediated by usefulness and ease of use beliefs. The theoretical rationale for these relationships follows.

Ease of use represents the perceived cognitive burden induced by a technology. Two of the four compatibility beliefs (compatibility with prior experience and compatibility with existing work practices) are likely to exhibit positive effects on ease of use beliefs. Compatibility with prior experience implies that one has the cognitive schemas in place to utilize the technology, which in turn results in a lower cognitive burden. Compatibility with existing work practices suggests that use of the new technology does not require substantial change in one's work, again resulting in less effort to utilize the technology. Additional support for these arguments may also be found in the learning literature. In the human associative view of learning, the law of proactive inhibition or interference (McGeoch and Irion 1952) argues that individuals' prior knowledge and experiences interfere with their ability to learn new concepts. The fundamental notion underlying this law is the extent of similarity or dissimilarity between an individual's prior experiences and knowledge and a new target behavior. Greater consistency with prior experiences should facilitate the learning process, thereby rendering a new technology easier to use. By contrast, when the new technology is significantly different from experiences the user has had, prior experiences constrain rather than facilitate learning about it. We therefore test the following hypotheses:

H1a: Beliefs about the compatibility of a technology with prior experience positively influence beliefs about its ease of use.

H1b: Beliefs about the compatibility of a technology with existing work practices positively influence beliefs about its ease of use.

Perceived usefulness refers to the instrumental value derived from use of a technology. Moore and Benbasat (1991) allude to a possible relationship between compatibility and perceived usefulness and a temporal ordering of beliefs in their work on innovation characteristics: "it is unlikely that respondents would perceive the various advantages of using a PWS [personal work station], if its use were in fact not compatible with the respondent's experience or work style" (p. 208). Thus, we suggest that all four compatibility beliefs are likely to influence perceived usefulness: compatibility with values, compatibility with prior experience, compatibility with existing work practices, and compatibility with one's preferred work style. Technologies that are consistent with one's value system are likely to be perceived as helping foster and promote such values, thereby contributing to enhanced perceptions of instrumentality. Moreover, as observed in prior research, the more experience one has in the innovation domain, the easier it is to recognize the worth of the innovation[4] (Hirschman 1980; Moore 1989). Finally, perceptions of usefulness of the innovation are a function of the fit between the innovation, one's existing practices, and one's preferred work style. Furthermore, as established in prior research (e.g., Davis 1989; Venkatesh et al. 2003), ease of use perceptions also influence perceptions of usefulness of the innovation. These expectations are summarized in the following hypotheses:

H2a: Beliefs about the compatibility of a technology with values positively influence beliefs about its usefulness.

H2b: Beliefs about the compatibility of a technology with prior experience positively influence beliefs about its usefulness.

[4]An assumption implicit in this statement, consistent with prior research in innovation adoption (e.g., Kwon and Zmud 1987), is that the innovation possesses some intrinsic, positive value for potential adopters (Rogers 1995).

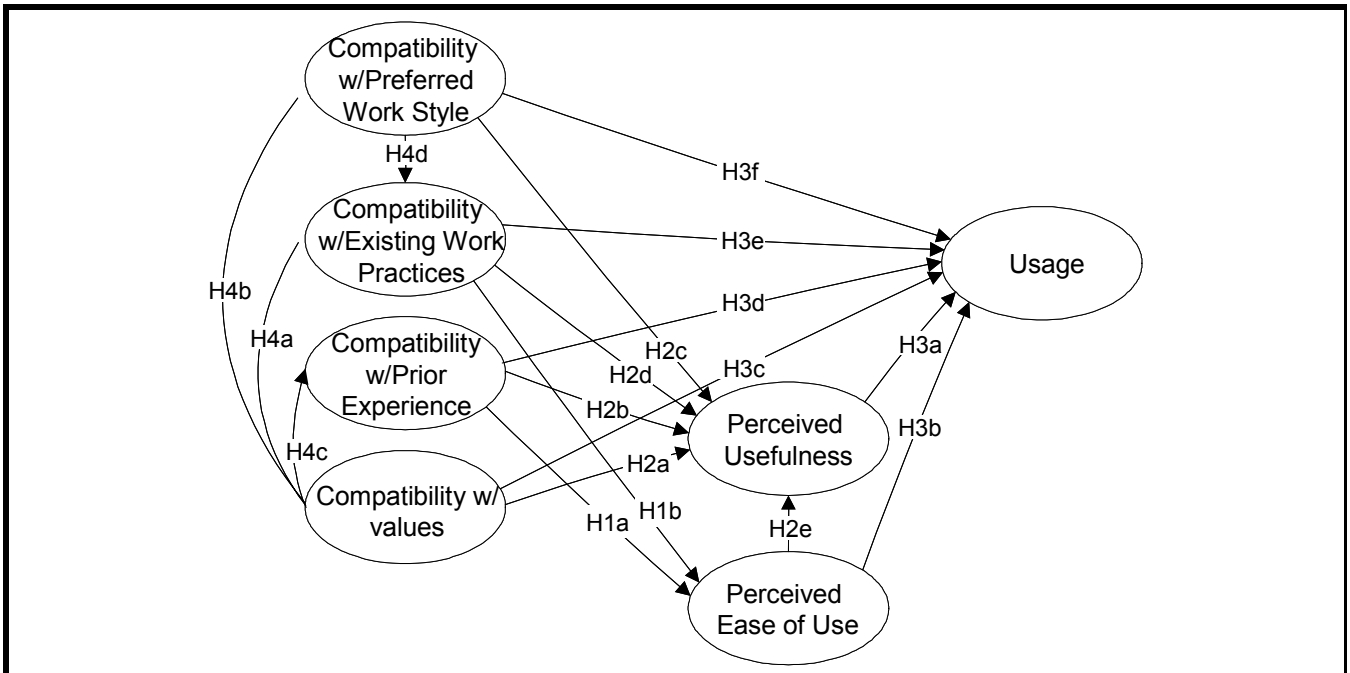

Figure 1. Theoretical Model

H2c: Beliefs about the compatibility of a technology with preferred work style positively influence beliefs about its usefulness.

H2d: Beliefs about the compatibility of a technology with existing work practices positively influence beliefs about its usefulness.

H2e: Beliefs about ease of use of a technology positively influence beliefs about its usefulness.

TAM posits a direct link between perceived usefulness, ease of use, and use behavior, with ease of use additionally exhibiting a positive relationship to perceived usefulness. In contrast, innovation diffusion theory suggests that all beliefs, including compatibility, have a direct effect on technology acceptance outcomes such as intentions to adopt or use the technology (Moore and Benbasat 1991; Rogers 1995; Tornatzky and Klein 1982). Szajna (1996) found that ease of use beliefs directly influenced usage intentions prior to implementation, but only had a mediated effect through perceived usefulness beliefs post-implementation. In TAM, ease of use does not have a direct influence on usage, whereas perceived usefulness does. One could argue that several empirical tests of TAM have not specifically included a direct effect of ease of use on intentions, therefore, it is difficult to state whether such an effect truly does not exist or does not exist because it has not been specifically tested. On the other hand, as noted above, this direct effect has been observed in other work (e.g., Venkatesh and Davis 2000). Given that there is no compelling theoretical rationale for assuming that beliefs exhibit differential effects on use and drawing upon innovation diffusion theory and TAM, we posit that all salient beliefs will have a significant effect on use.

Ease of use influences use behaviors through the theoretical mechanism of self efficacy (Bandura 1977). *Ceteris paribus*, easier to perform behaviors heighten self-efficacy (Bandura 1977) and personal control, thereby yielding greater use. Likewise, perceived usefulness affects use because of the performance expectancies embedded in the definition of usefulness (Venkatesh et al. 2003). Performance expectancies provide the extrinsic motivation (Vallerand 1997) that is key to inducing use behaviors. The effects of compatibility beliefs on intentions and use derive from a similar theoretical logic. Compatibility with values and preferred work style represent intrinsic motivators (Vallerand 1997) in that they help the user attain consistency with an internal belief system and overt actions, thereby reducing cognitive dissonance (Festinger 1957). Simply put, if a user believes that a technology helps promote deeply held values and helps achieve the self-concept of the way one would like to work, the more likely the user is to develop positive use behaviors. Finally, compatibility with existing work practices and prior experience, assuming that the technology has intrinsic, positive value for adopters, again provides the extrinsic motivation to

engage in greater use. These expectations are summarized in the following hypotheses:

H3a: Beliefs about the usefulness of a technology positively influence use of the technology.

H3b: Beliefs about the ease of use of a technology positively influence use of the technology.

H3c: Beliefs about the compatibility of a technology with values positively influence use of the technology.

H3d: Beliefs about the compatibility of a technology with prior experience positively influence use of the technology.

H3e: Beliefs about the compatibility of a technology with existing work practices positively influence use of the technology.

H3f: Beliefs about the compatibility of a technology with preferred work style positively influence use of the technology.

It is noteworthy that although not explicitly acknowledged in the formal statement of hypotheses 3c through 3f, in essence we are suggesting that the effects of compatibility beliefs on use are *not* fully mediated by PU and EOU. The issue of full versus partial mediation has been raised in prior work (Agarwal and Prasad 1999), although the question there was whether beliefs mediated the effects of external variables on attitude. Nevertheless, understanding whether other beliefs fully mediate the relationship between compatibility beliefs and use is important because it enhances our understanding of the network of relationships that lead to acceptance of technology.

In keeping with our conceptualization of compatibility as a multivariate structural model and consistent with prior research that has argued for the existence of relationships among beliefs about a technology, we posit relationships among the four dimensions of compatibility. In conceptualizing these linkages, we draw upon the dominance of compatibility with values as the enduring and deeply held beliefs that motivate and drive individuals (Feather 1992). Feather identifies values as strong motivators that provide an overall framework for regulating behavioral choices and compel individuals to act in certain ways. Thus, values determine how individuals structure their behavior (i.e., current practices), and they predict individuals' preferences with regard to work practices. When a technology is compatible with values, all else being equal, it will also be compatible with the prior experiences the individual has had, relative to the extent that stable and enduring values determine past choices regarding the experiences in which one will engage. These expectations lead us to test the following hypotheses:

H4a: Beliefs about the compatibility of a technology with values positively influence beliefs about compatibility with existing practices.

H4b: Beliefs about the compatibility of a technology with values positively influence beliefs about compatibility with preferred work style.

H4c: Beliefs about the compatibility of a technology with values positively influence beliefs about compatibility with prior experience.

Finally, when a behavior has a significant element of volition associated with it, in an attempt to achieve internal consistency and reduce cognitive dissonance (Festinger 1957), individuals seek to align their actual behavior with preferences that reflect their self-concept. Thus, when a technology is congruent with the way an individual likes to work, because existing work practices have likely been modified to be consistent with such preferences, it will also be congruent with the existing practice. It is important to underscore the theorized causality here: we are arguing that preferences are the driving force for behaviors under one's own control, and therefore compatibility with the former will yield compatibility with the latter. Therefore, we propose

H4d: Beliefs about the compatibility of a technology with preferred work style positively influence beliefs about compatibility with existing practices.

Methodology

Study Context and Sample

We tested the research hypotheses with a field study using a survey methodology for data collection. Initially we conducted a pilot study by collecting data from student subjects enrolled at a large state university, with the World Wide Web as the target technology and shopping on the web as the target behavior. The pilot study included 216 subjects and provided initial evidence for validating the psychometric properties of the scales.[5] The setting for the main study was a wealth advisory regional bank (hereafter, bank) in the northeast region of the United States. Two specific divisions within the bank—the high-net-worth wealth management group and the

[5]Due to space limitations, full details of the pilot are not reported.

commercial lending group—were the focus of our study. These two groups consist of 437 people who have been trained and given access to the contact opportunity management module of the bank's customer relationship management (CRM) system. The CRM system is a joint database that is used to manage client information such as address, account information, personal information, and investments. In addition, the system is used to send mass mailings, generate a sales pipeline, and coordinate events, just to name a few of its features. Use of the CRM system was greatly encouraged by the top management team as evident by several reminders sent to potential users of the system. Even with strong top management support, 41 of 278 respondents (14.7 percent) never used the system.

A web survey was administered to the respondents approximately 6 months after CRM training, allowing them sufficient time to get acquainted with the CRM system (the average amount of experience using the CRM was 9.5 months). Of the potential 437 subjects, 278 usable responses (63.6 percent response rate) were received. Demographic information on the respondents is provided in Table 2.

The web-based questionnaire was developed with the assistance of senior management and IT professionals at the bank. The survey was subsequently pretested on three managers and two support staff at the bank and several minor changes were made. Twenty interviews were also conducted with various people at different organizational levels from the wealth management and commercial lending groups. These interviews were conducted to assess the effectiveness of the survey and also to collect qualitative data related to perceptions and usage behaviors. Finally, three top officers within the bank created a joint memo explaining the importance of participation and sent it via e-mail to all potential respondents 1 week before the launch of the survey. Two follow-up e-mails were sent to nonrespondents approximately 1 week and 2 weeks after the initial survey URL was e-mailed to the respondents. T-tests on early and late responders for all research variables showed no significant differences. In addition, our detailed interviews with 20 employees included both respondents and nonrespondents to the survey and we have no reason to believe that systematic biases exist in those who complied and those who did not. Hence, we concluded that nonresponse bias was not a threat to our findings.

Operationalization of Research Variables

All research variables were measured using multi-item scales (see the appendix). Scales for perceived usefulness and ease of use were adapted from those developed and rigorously validated by Davis (1989), while various different measures of usage were used tapping into both breadth and depth of use. Specifically, usage was measured through two constructs: one tapping into use intensity and consisting of frequency of use and amount of time spent on the system per day, and one tapping into use scope and consisting of percent of system features used regularly by the respondent, and percent of client interactions managed through the system. The latter measure was designed to account for variations in respondents' job that would require more or less usage of the system. For instance, depending on the amount of client interaction involved in one's job, it is possible for a person to be using the system for two hours per day and account for 100 percent of their client interactions and for another person to be using the system for 4 hours but only using it for 60 percent of their client interactions.

Scales for the four compatibility dimensions were constructed following the conceptual definition of the dimensions and drawing upon the work of Moore (1989), who reviewed empirical studies that used the compatibility construct and compiled a comprehensive pool of items (for an extensive discussion, see Moore 1989). This consisted of items culled from the empirical studies reviewed as well as new ones created by Moore. Prior research items were drawn from Bolton (1981), Hurt and Hubbard (1987), Licker et al. (1986), and Ostlund (1969). In this study, to the extent possible, we used items from the pool compiled by Moore. In addition, we constructed new items in cases where no items or an insufficient number of items existed to measure a particular dimension and where the wording of items was problematic.

As a starting point, the four-item compatibility scale employed by Moore (1989) and by Moore and Benbasat (1991) was examined: "Using a PWS is compatible with all aspects of my work," "Using a PWS is completely compatible with my current situation," "Using a PWS fits well with the way I like to work," and "Using a PWS fits into my work style." A closer look at these items revealed that while the first two items tap into compatibility with existing work practices, the latter two items refer to compatibility with one's preferred work style. Therefore, compatibility with preferred style was assessed using these two items (contextualized to the current behavior) as well as two new items. The word *preferred* was inserted in the wording to clearly distinguish these items from compatibility with existing practices (CPREF; see the appendix for all items; see Table 3 for items used). The two remaining items from the Moore and Benbasat compatibility scale were used as the starting point for compatibility with existing practices. However, the item referring to "complete compatibility with one's current situation" was dropped since the term *current situation* could be interpreted to encompass not only current work practices, but also values and prior ex-

Table 2. Sample Characteristics

	Mean	Standard Deviation	Missing
PC Experience (Years)	15.31	4.98	21
CRM Experience (Months)	9.53	7.72	35
Gender	Male	44.6%	
	Female	55.4%	
Job Title	Administrative Assistant	29.1%	6
	Commercial Banker	16.7%	
	Private Client Advisor	8.7%	
	Trust Expert	6.9%	
	Investment Expert	6.9%	
	Manager/Director	5.8%	
	Tax Expert	5.5%	
	Corporate Client Advisor	2.9%	
	Sales Assistant	1.8%	
	Senior Private Client Advisor	1.1%	
	Other	14.5%	
Minutes of Use/Day (minuse)	0	27.0%	1
	1–20	34.2%	
	20–60	21.9%	
	60–120	6.8%	
	120–180	5.8%	
	over 180	4.0%	
Percent of Features Used (featreg)	less than 10%	44.2%	13
	10%–24%	25.2%	
	25%–49%	11.5%	
	50%–74%	10.4%	
	75%–94%	2.9%	
	95% and above	1.1%	

periences (CEXIST; see the appendix for all items; see Table 3 for items used). Note the subtle distinction between preferred method of conducting one's job and existing method of conducting one's job: while the former captures an individual's self-concept regarding the way they like to work, the latter describes the reality as it is currently experienced. Although the two might be identical in certain situations, this may not always be the case. Items comprising the compatibility with prior experience (CEXP) and compatibility with values (CVAL) are shown in the appendix and Table 3.

Results

We used PLS to assess the psychometric properties of the scales and to test the research model and hypotheses. PLS is a latent structural equations modeling technique that utilizes a component-based approach to estimation (Jöreskog and Sörbom 1993). Because of this, it places minimal demands on sample size and residual distributions (Chin 1998a, 1998b; Fornell and Bookstein 1982; Lohmoller 1989). The psychometric properties of all scales were first assessed within the context of the structural model by assessing discriminant validity and reliability. The nomological validity of the construct was then tested through the structural model of the study.

Measurement Model

Descriptive statistics for the research constructs are shown in Tables 3 and 4. The psychometric properties of the scales are assessed in terms of item loadings, discriminant validity, and internal consistency. Item loadings and internal consistencies greater than .70 are considered acceptable (Fornell and Larcker 1981). PLS factor analysis showed that 5 of the 21 compatibility items loaded poorly on their corresponding factors (CEXIST1, CEXIST2, CEXIST3, CVAL1, CEXP1, and CEXP2). These items were subsequently removed from

Table 3. PLS Factor Analysis Results

	Use Intensity	Use Scope	PU	EOU	CPREF	CEXP	CEXIST	CVA L
Minuse: During a typical day, how many minutes would you spend using the CRM system?	**0.92**	0.64	0.40	0.32	0.45	0.17	0.26	0.22
Frequse: How frequently do you access the CRM system?	**0.94**	0.64	0.43	0.31	0.45	0.18	0.19	0.23
Featreg: Of all features and functions available in the CRM system, what percentage would you estimate that you use on a fairly regular basis?	0.60	**0.85**	0.43	0.45	0.51	0.09	0.31	0.13
Clinterac: Approximately, what percentage of all your client interactions are managed using the CRM system?	0.67	**0.92**	0.49	0.44	0.52	0.13	0.37	0.13
PU1: Using the CRM system in my job will increase my productivity	0.42	0.50	**0.94**	0.55	0.80	-0.01	0.48	0.25
PU2: Using CRM system will enhance my effectiveness on the job	0.45	0.49	**0.94**	0.56	0.78	0.04	0.44	0.28
PU3: Using the CRM system will make it easier to do my job	0.42	0.48	**0.94**	0.56	0.80	0.02	0.47	0.25
PU4: Using CRM system will improve my job performance	0.38	0.43	**0.90**	0.56	0.77	0.00	0.42	0.28
EOU1: Learning to operate the CRM system is easy for me	0.32	0.44	0.42	**0.84**	0.56	0.27	0.48	0.19
EOU2: I find it easy to get the CRM system to do what I want it to do	0.23	0.36	0.57	**0.85**	0.68	0.00	0.48	0.11
EOU3: I find the CRM system easy to use	0.26	0.40	0.52	**0.92**	0.67	0.14	0.47	0.16
EOU4: I find the CRM system to be flexible to interact with	0.21	0.35	0.56	**0.85**	0.66	0.00	0.55	0.12
EOU5: My interaction with the CRM system is clear and understandable	0.38	0.50	0.58	**0.89**	0.72	0.14	0.52	0.22
EOU6: It is easy for me to become skillful at using the CRM system	0.35	0.47	0.44	**0.84**	0.62	0.18	0.46	0.23
CPREF1: Using the CRM system fits my preferred routine for conducting my job	0.49	0.56	0.81	0.68	**0.90**	0.05	0.56	0.25
CPREF2: The CRM system enables me to work in the way I prefer	0.38	0.50	0.75	0.78	**0.92**	0.08	0.59	0.27
CPREF3: Using the CRM system fits well with the way I like to work	0.45	0.52	0.81	0.68	**0.95**	0.08	0.57	0.36
CPREF4: Using the CRM system fits my preferred method for doing my job	0.45	0.51	0.76	0.66	**0.91**	0.10	0.61	0.33
CEXP3R: Using the CRM system is a new experience for me	0.19	0.14	-0.06	-0.03	-0.03	**0.68**	0.04	0.11

Table 3. PLS Factor Analysis Results (Continued)

	Use Intensity	Use Scope	PU	EOU	CPREF	CEXP	CEXIST	CVA L
CEXP4R: Using the CRM system is not similar to anything that I've done before	0.14	0.10	0.07	0.20	0.15	**0.88**	0.14	0.38
CEXP5R: Using the CRM system is different from other experiences I have had	0.07	0.05	-0.01	0.15	0.04	**0.85**	0.03	0.24
CEXP6R: Using the CRM system is a new business experience for me	0.24	0.14	0.00	0.08	0.05	**0.83**	0.01	0.23
CEXIST4: To use the CRM system, I don't have to change anything I currently do	0.15	0.27	0.41	0.48	0.55	0.04	**0.89**	0.09
CEXIST5: Using the CRM system does not require significant changes in my existing work routine	0.27	0.41	0.47	0.56	0.59	0.10	**0.93**	0.15
CVAL2R: Using the CRM system runs counter to my own values	0.16	0.05	0.15	0.07	0.14	0.19	0.02	**0.72**
CVAL3R: Using the CRM system does not fit the way I view the world	0.25	0.19	0.33	0.26	0.40	0.34	0.22	**0.86**
CVAL4R: Using the CRM system goes against what I believe computers should be used for	0.22	0.10	0.21	0.13	0.20	0.20	0.04	**0.74**
CVAL5R: Using the CRM system is not appropriate for a person with my values regarding the role of computers	0.07	0.05	0.14	0.08	0.14	0.19	0.05	**0.66**
CVAL6R: Using the CRM system runs counter to my values about how to conduct my job	0.17	0.08	0.15	0.11	0.20	0.24	0.08	**0.82**

Notes: PU = perceived usefulness, EOU = ease of use, CPREF = compatibility with preferred work style, CEXP = compatibility with prior experience, CEXIST= compatibility with existing work practices, CVAL = compatibility with values

Table 4. Descriptive Statistics

Construct	Mean	S.D.
Percent of Client Interactions via System	31.40	35.30
Frequency of Use	3.72	1.63
Perceived Usefulness	4.23	1.40
Ease of Use	4.37	1.27
Compatibility – Prior Experience	4.12	1.24
Compatibility – Existing Practice	3.74	1.27
Compatibility – Preferred Style	4.08	1.34
Compatibility – Values	4.93	1.10

Percent of Client Interactions was measured on a scale of 0-100%
Frequency of use was measured on a scale of 1 to 6 (1 = never; 2 = a few times a year; 3 = monthly; 4 = weekly; 5 = daily; 6 = Nearly all the time)
All other constructs were measured on a scale of 1 (strongly disagree) to 7 (strongly agree)

analysis. Examining the compatibility with prior experience items, it becomes clear that while items 1 and 2 refer to compatibility with past computer experiences, the rest of the items on the scale refer to compatibility with past experiences in general or past business experiences. It is possible that compatibility with past experiences is a multidimensional construct that consists of compatibility with computer experience as one dimension and compatibility with business experience as a second dimension. The poor loading of CEXIST2 is likely attributed to the fact that while the other items of the scale were worded as "requiring (or not) a change in the way I currently conduct my job," CEXIST2 was worded as "compatibility with most aspects of the way I typically conduct my job." The fact that both CEXIST1and CEXIST3 are reverse-coded items may have contributed to the reason why they did not load well on their corresponding factor (Weems et al. 2003). Finally, in terms of the value item, a close examination of the scale reveals that all items represent different facets of compatibility with values (e.g., values with respect to how business should be conducted, values with respect to the role of computers) and this may have contributed to the lower item loading. The factor analysis was then rerun with the remaining items. As evidenced by the PLS factor analysis results in Table 4 and composite reliability scores (Werts et al. 1974) in Table 5, the final scales essentially meet the .70 guidelines for internal consistencies and item loadings. All items, except for one item in compatibility with values (CVAL5r) and one item in compatibility with experience (CEXP3r), exhibit high loadings (greater than .70) on their respective constructs with CVAL5r and CEXP3r approximating the .70 guideline with loading of .66 and .68. All constructs in the model exhibit good internal consistency as evidenced by their composite reliability scores, ranging from 0.87 to 0.96.

To assess discriminant validity (Chin 1998b), indicators should load more strongly on their corresponding construct than on other constructs in the model (i.e., loadings should be higher than cross-loadings), and the square root of the average variance extracted (AVE) should be larger than the inter-construct correlations (i.e., the average variance shared between the construct and its indicators should be larger than the variance shared between the construct and other constructs). As shown in Table 4, all indicators load more highly on their own construct than on other constructs. However, the items comprising compatibility with preferred work style, besides loading quite highly on their corresponding factor, also cross-load on perceived usefulness. Furthermore, examination of the inter-construct correlations and square root of AVE (shaded leading diagonal) in Table 5 reveals that all constructs share considerably more variance with their indicators than with other constructs. Both compatibility with preferred style and perceived usefulness share more variance with their items (.92 and .93 respectively) than with each other (.84) and their items load more highly on their corresponding construct than cross-load. However, given the high inter-construct correlation and the high cross-loadings of the perceived usefulness items on compatibility with preferred style, we took the conservative approach of removing compatibility with preferred style from the analysis. This is consistent with prior studies (e.g., Karahanna et al. 1999; Moore and Benbasat 1991) that also showed problems of discriminant validity between perceived usefulness and compatibility with preferred style. Thus, with the exception of compatibility with preferred style, these results point to the convergent and discriminant validity of the compatibility constructs.

The Structural Model

To establish the nomological validity of compatibility, we tested the research model shown in Figure 1. The path coefficients and explained variances for the model using a bootstrapping procedure are shown in Figure 2. All constructs were modeled as reflective and included in the model using multiple indicators, rather than summated scales. The outer model loadings of all items on their respective constructs are shown in Table 6.

The three compatibility beliefs, perceived usefulness, and perceived ease of use together explain 32.5 percent of the variance in self-reported usage scope and 24.3 percent of the variance in self-reported usage intensity, while 43 percent of the variance in perceived usefulness is accounted for by perceived ease of use and the three compatibility beliefs. Finally, the two compatibility beliefs explain 33 percent of the variance in perceived ease of use.

As is evident from Figure 2, PLS results provide strong support for the effect of compatibility on perceived usefulness and perceived ease of use that further underscores the importance of including causal relationships among these beliefs in theories of technology acceptance. Specifically, all but one hypothesis linking compatibility beliefs to perceived usefulness and perceived ease of use were supported (the hypothesis involving the relationship between compatibility with preferred work style and usage—H3f—could not be tested). More specifically, three compatibility beliefs have significant effects on perceived usefulness (supporting hypotheses H2a, H2c,[6] and H2d) and compatibility with existing practices and compatibility with prior experience have significant effects on

[6]Although compatibility with preferred work style was not included in the model, its strong significant correlation with perceived usefulness (.84) coupled with the lack of conceptual overlap between the constructs provide support for H2c.

Table 5. Inter-Construct Correlations

	Composite Reliability	Use Intensity	Use Scope	PU	EOU	CPREF	CEXP	CEXIST	CVAL
Use Intensity	0.93	**0.93**							
Use Scope	0.85	0.69	**0.86**						
PU	0.96	0.45	0.51	**0.93**					
EOU	0.94	0.34	0.49	0.59	**0.86**				
CPREF	0.95	0.48	0.57	0.84	0.75	**0.92**			
CEXP	0.88	0.19	0.13	0.01	0.14	0.09	**0.81**		
CEXIST	0.91	0.24	0.38	0.48	0.57	0.63	0.08	**0.91**	
CVAL	0.87	0.24	0.14	0.28	0.20	0.32	0.32	0.14	**0.76**

Composite Reliability = $r_c = (Sl_i)2 / [(Sl_i)2 + S_i var(e_i)]$ where λ_i is the component loading to an indicator and $var(e_i) = 1-\lambda_i^2$.

The shaded numbers on the leading diagonal are the square root of the variance shared between the constructs and their measures. Off diagonal elements are the correlations among constructs. For discriminant validity, diagonal elements should be larger than off-diagonal elements.

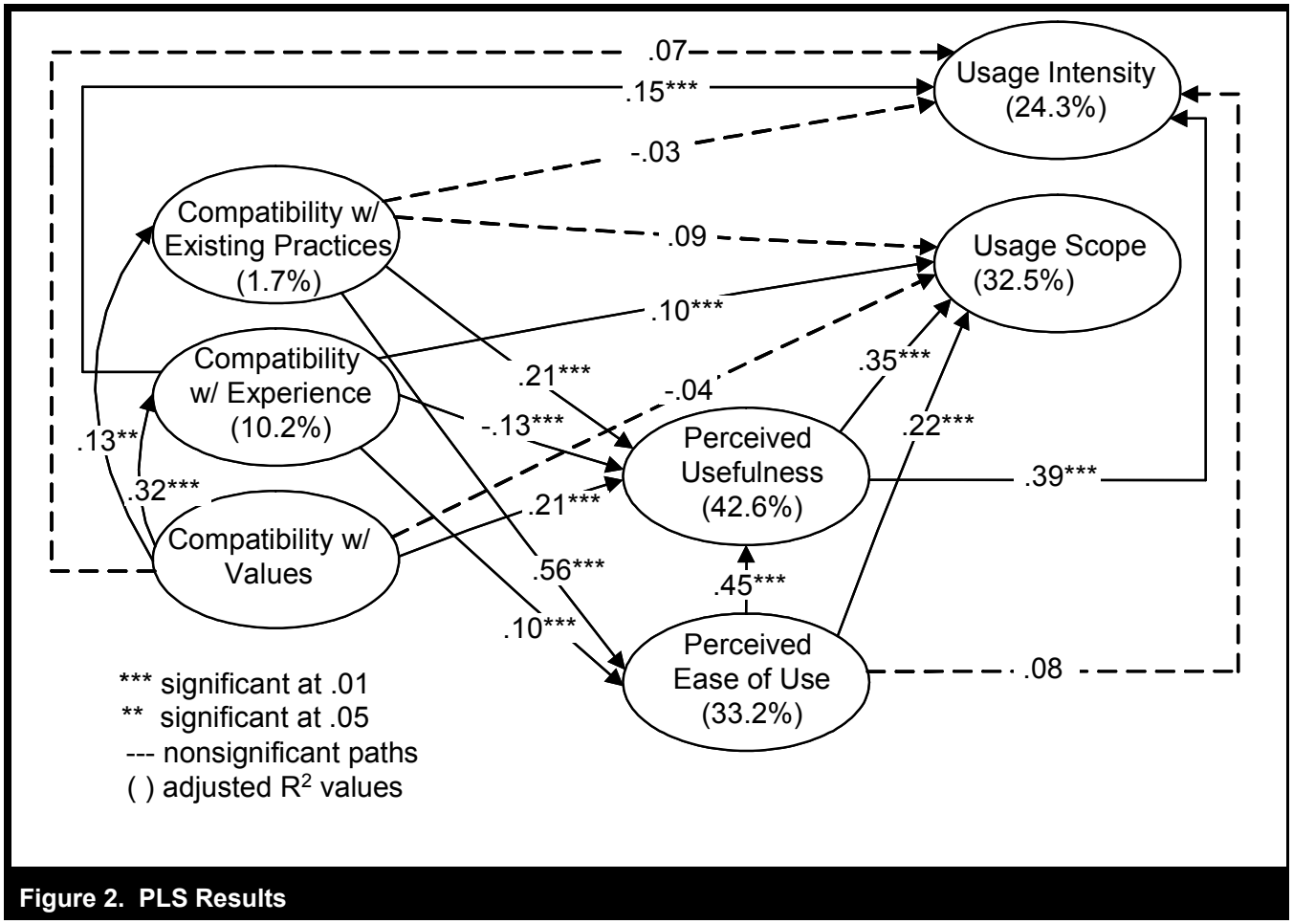

Figure 2. PLS Results

Table 6. PLS Outer Model Loadings

Construct	PLS Outer Model Loading
Compatibility with Experience	
CEXP3R: Using the CRM system is a new experience for me	.67
CEXP4R: Using the CRM system is not similar to anything that I've done before	.88
CEXP5R: Using the CRM system is different from other experiences I have had	.84
CEXP6R: Using the CRM system is a new business experience for me	.83
Compatibility with Existing Work Practices	
CEXIST4: To use the CRM system, I don't have to change anything I currently do	.89
CEXIST5: Using the CRM system does not require significant changes in my existing work routine	.93
Compatibility with Values	
CVAL2R: Using the CRM system runs counter to my own values	.74
CVAL3R: Using the CRM system does not fit the way I view the world	.85
CVAL4R: Using the CRM system goes against what I believe computers should be used for	.74
CVAL5R: Using the CRM system is not appropriate for a person with my values regarding the role of computers	.66
CVAL6R: Using the CRM system runs counter to my values about how to conduct my job	.81
Perceived Ease of Use	
EOU1: Learning to operate the CRM system is easy for me	.84
EOU2: I find it easy to get the CRM system to do what I want it to do	.84
EOU3: I find the CRM system easy to use	.91
EOU4: I find the CRM system to be flexible to interact with	.84
EOU5: My interaction with the CRM system is clear and understandable	.89
EOU6: It is easy for me to become skillful at using the CRM system	.84
Perceived Usefulness	
PU1: Using the CRM system in my job will increase my productivity	.93
PU2: Using CRM system will enhance my effectiveness on the job	.94
PU3: Using the CRM system will make it easier to do my job	.94
PU4: Using CRM system will improve my job performance	.90
Usage Intensity	
Minuse: During a typical day, how many minutes would you spend using the CRM system?	.90
Frequse: How frequently do you access the CRM system?	.90
Usage Scope	
Featreg: Of all features and functions available in the CRM system, what percentage would you estimate that you use on a fairly regular basis?	.82
Clinterac: Approximately, what percentage of all your client interactions are managed using the CRM system?	.89

Note: All loadings are significant at .001

perceived ease of use (supporting hypotheses H1a and H1b). The relationship between compatibility with prior experience and perceived usefulness, although significant, is negative. Thus, hypothesis H2b is not supported. Furthermore, examination of the significance of the path coefficients reveals that the relationship between compatibility with experience and usage (both use intensity and use scope) is not fully mediated by beliefs about perceptions of usefulness and ease of use (supporting hypothesis H3d), but that these beliefs fully mediate the effect of compatibility with values and compatibility with existing practices with usage (not supporting hypotheses H3c and H3e). Thus, in general, the impact of the compatibility beliefs on technology acceptance behaviors appears to be primarily via perceptions of usefulness and ease of use. Results also provide support for relationships among the compatibility dimensions. Specifically, beliefs about com-

patibility with values influence beliefs about compatibility with existing practices (H4a) as well as compatibility with experiences (H4c).

As *post hoc* analysis, and to assess the role of compatibility with preferred work style, we removed perceived usefulness from the model and included compatibility with preferred work style. As hypothesized (H3f), compatibility with preferred work style has a significant effect on usage intensity (t-statistic = 7.32; path coefficient = .56; explained variance in usage intensity = 26.5 percent) and on usage scope (t-statistic = 6.86; path coefficient = .48; explained variance in usage scope= 33.9 percent). This indicates the importance of this aspect of compatibility in technology acceptance, albeit its role and relationship vis-à-vis perceived usefulness is still an open question. In this analysis, compatibility with preferred work style had significant relationships with compatibility with existing practices (t-statistic = 12.21; path coefficient = .65) and compatibility with values (t-statistic = 4.95; path coefficient = .32), providing support for hypotheses H4d and H4b respectively.

Discussion

In general, the empirical results are encouraging and provide support for the two main objectives of the study. One major objective was related to the development of a fresh perspective on the notion of compatibility both in terms of dimensionality as well as structure of the construct. Based on the theoretical definition of compatibility, we proposed four distinct aspects of compatibility: compatibility with prior experience, compatibility with preferred work style, compatibility with existing work practices, and compatibility with values. Empirical validation of operational measures of these constructs suggested that the definition of compatibility as explicated in prior work (i.e., compatibility with preferred work style) exhibited discriminant validity concerns with perceived usefulness. This is consistent with prior empirical work utilizing these two constructs (e.g., Karahanna et al. 1999; Moore and Benbasat 1991). Elimination of this aspect of compatibility from our nomological network resulted in three compatibility constructs with good psychometric properties. Further, we posit compatibility as a multivariate construct and represent it in the nomological network as four distinct dimensions. Although this is the structural form that matched our conceptualization of compatibility, we would encourage researchers to consider and explore other possible forms for the construct such as a profile conceptualization.

Compatibility with preferred work style refers to a fit with an individual's *preferred* work style while perceived usefulness refers to the extent to which the system improves one's job performance. Empirical evidence in the literature on whether the two constructs are distinct is mixed. While, for example, in some studies (e.g., Karahanna et al. 1999; Moore and Benbasat 1991) the two constructs loaded together, in other studies they were empirically distinct (e.g., Taylor and Todd 1995; Venkatesh et al. 2003). In cases where the two constructs did not exhibit discriminant validity, it has been argued that it may be unlikely that individuals would view a specific system as useful if it is not compatible with the manner in which they prefer to work (Moore and Benbasat 1991). Thus, task-centered beliefs that focus on the ability of the technology to facilitate one's job (i.e., perceived usefulness and compatibility with preferred work style) may be inextricably linked in the user's mind (Karahanna et al. 1999). While it is evident that conceptually the two constructs are distinct, whether compatibility with preferred work style and perceived usefulness are indeed empirically distinct for some respondents or technologies is an issue that merits further attention. Further, while we believe that compatibility with preferred work style is an important aspect of the compatibility construct, the question remains as to whether this dimension in its current form should be retained as part of the compatibility construct. Developing a set of different measures for this aspect of compatibility may be a fruitful direction for future research. Nonetheless, the possibility exists that, despite best measurement efforts, the amount of overlap between this dimension and perceived usefulness may result in elimination of this aspect of compatibility.

A second major objective of this study was to find empirical support for the theorized consequents of compatibility beliefs. With one exception, the posited theoretical relationships between compatibility beliefs and perceptions of usefulness and ease of use were supported. Although clearly a cross-sectional study cannot establish causality, our theoretical development and empirical evidence provide support to the idea raised in prior work (Agarwal and Prasad 1997; Moore and Benbasat 1991) that there is a temporal ordering or a hierarchical structure to beliefs. Moreover, while the effects of compatibility with existing practices and compatibility with values on usage (both scope and intensity) were fully mediated by perceived usefulness in the case of usage intensity and perceived usefulness and perceived ease of use in the case of usage scope, these two beliefs did not fully mediate the effects of compatibility with experience. Together these findings suggest, as has been echoed by Tornatzky and Klein (1982), that compatibility beliefs are critical in technology acceptance and should be included in models that attempt to explain and predict this phenomenon.

The hypothesis that was not supported related compatibility with prior experience to perceived usefulness. The relationship between compatibility with past experience and

perceived usefulness, while significant, was negative and in the opposite direction than hypothesized. We had hypothesized that the more compatible a system was with one's prior experiences the more useful it was likely to be perceived. Our results show that the less compatible the system with prior experiences (e.g., using the system is not similar to anything that I've done before) the more useful it was perceived. Thus, it may be that individuals who have used similar systems before or who have used systems that embodied similar types of functionality are not as impressed as individuals who encounter such a system for the first time. Further research is required to examine whether the negative relationship generalizes to other contexts.

Finally, in our theoretical development, we hypothesized that compatibility with existing practices would positively relate to perceptions of usefulness and ease of use. Our results support these hypothesized relationships and to the extent that individuals are resistant to change and are satisfied with the status quo, these relationships should hold. However, one can envision that existing practices may be so inefficient and ineffective that compatibility of a new system with such practices may be viewed negatively and indeed have a negative effect on perceived usefulness.

We also examined relationships among the various aspects of compatibility. Compatibility with values had strong effects on all other compatibility dimensions. Values are enduring beliefs that a specific mode of conduct or end-state of existence is personally or socially preferable to an opposite or converse mode of conduct or end-state of existence (Rokeach 1960). As such, values are persistent and less likely to change in the short term whereas experiences and existing practices are malleable and changeable. There has been little research on the nature of IS values. In our conceptualization, we examined compatibility with values regarding the role of computers in work practices. Given the strong effect of compatibility with values in the model, we encourage future research to identify additional IT values that are salient in individual technology acceptance decisions and to expand the compatibility with values construct to include these.

Prior to discussing the implications of our work, some limitations of the study must be acknowledged. With respect to the external validity of this study, data were collected from users within a single organization. Even though there is no reason to believe that the sample is atypical of a more general population of organizational IT users, the possibility exists and results should be interpreted with this caveat in mind. Further, conclusions drawn in this study are based on a single technology, and, to the extent that the CRM system is a distinctive technology, they may not generalize across a wide set of technologies and tasks. We believe, however, that the CRM system is not exceptional in that it embodies a trend toward more flexible and malleable information systems in contemporary IT environments. Nonetheless, additional validation of the compatibility beliefs, of the psychometric properties of their operational definitions, and of the nomological network across a variety of settings and technologies would provide further evidence in support of the validity of the scales and the role of compatibility in technology acceptance.

Measures of compatibility, perceived usefulness, perceived ease of use, and usage were gathered at the same point in time using the same instrument and, consequently, the potential for common method variance exists. However, results from Harman's one factor test demonstrated that common method variance was not a threat to our findings given that a principal components factor analysis, (1) identified five factors explaining 71.6 percent of the variance; (2) the first factor did not account for all of the variance (39.3 percent); and (3) there was no general factor in the unrotated factor structure (Podsakoff and Organ 1986). Even though our measures of usage were comprehensive and tapped at various aspects of usage, they were all self-reported measures. Thus, they may not accurately reflect actual usage (Straub et al. 1995). Finally, due to the cross-sectional nature of the study, causality and temporal sequencing cannot be inferred from the results. Any statements about the temporal ordering and hierarchical structure of beliefs as well as causality are made based on theoretical grounds rather than empirical evidence of the study.

Implications and Conclusions

In this paper, we argued for the need to revisit the compatibility construct. Empirical results supported a new view of compatibility as a multifaceted construct consisting of four distinct constructs as well as causal linkages to perceived usefulness, perceived ease of use, and usage. Thus, a major contribution of this work is the development of scales to operationalize the four compatibility constructs. Confirmation of the effects that compatibility beliefs have on key technology acceptance beliefs and outcomes such as perceived usefulness, perceived ease of use, and, to some extent, usage further underscore the importance of this belief.

Several implications for future research and theoretical development emerge from our findings. First, future research should investigate the hierarchical structure of beliefs affecting intentions and usage. As technology users gather and synthesize information to evaluate technologies, it might

be the case that certain beliefs are formed earlier than others and, in essence, become the basis for additional, subsequent beliefs. In fact, even though compatibility beliefs had significant effects on both beliefs of usefulness and ease of use as well as on key outcomes, they explained more variance in perceived usefulness and perceived ease of use than in usage. One interpretation of this result is that compatibility beliefs are more important as precursors of key beliefs in technology acceptance rather than of usage. However, to be conclusive, this finding needs to be replicated in other research. The effect of compatibility beliefs on perceived usefulness and perceived ease of use and as an antecedent of intentions and usage suggests that models like the TAM should be extended to include the compatibility construct. In fact, process research may be a useful method of examining the temporal sequencing, formation, and interplay among the various technology acceptance beliefs (see Langley 1999).

From the perspective of practice, since compatibility beliefs are instrumental in shaping beliefs about usefulness and ease of use, and they also influence usage directly, managers responsible for implementing new technologies need to pay careful attention to their formation. Positive beliefs about the compatibility of a new technology can be developed in many ways: by highlighting the similarities between workflow enabled by the technology and the individual's current and preferred work styles, by underscoring how the technology embodies prevalent values, and by emphasizing the fit between the technology and the mental models created through prior experiences.

An interesting question of theoretical and pragmatic value relates to the comparative salience of the four compatibility beliefs. It is not entirely infeasible that as knowledge work technologies become increasingly malleable and easy to use, and as society in general becomes more comfortable with information technology, beliefs about compatibility with existing work practices and with prior experiences might diminish in importance. In contrast, compatibility with values might assume increasing significance in technology adoption decisions. In organizational settings where IT can potentially influence work practices, work and social relationships, power distribution and influence, and relationships with clients, one's value system could become a major driver of behaviors. It is a matter worthy of managerial attention that technology today has the potential to radically alter relationships in the workplace as well as the way work is conducted. For example, electronic mail is widely recognized in reducing face-to-face communication. Electronic commerce may alter the way in which employees interact with customers and suppliers. Data warehousing and data mining technologies raise privacy issues. Therefore, compatibility with values might well assume primacy in the minds of potential adopters. This is an issue worthy of further investigation.

Further, future research should investigate conditions that influence the relative salience and relationships among compatibility beliefs. For instance, while compatibility with existing practices refers to compatibility with one's *current* work processes, compatibility with preferred work style refers to a fit with an individual's *preferred* work style. To the degree that behaviors are voluntary, one's current work style may indeed be the same as one's preferred work style. This, however, need not always be the case, particularly in cases where behavior is mandated. Current work practices may be dictated by organizational policies and procedures as well as the available technology. These work practices may well deviate from an individual's preferred work style. Thus, even though the two dimensions of compatibility are conceptually distinct, it is possible that they are empirically distinct only in cases where behavior is mandated to some extent.

Finally, how compatibility beliefs are formed and shaped is worthy of investigation. Compatibility with values is a particularly intriguing belief in this regard, as there exists a rich theoretical and empirical literature on the formation of values (e.g., Feather 1992; 1994; Grube et al. 1994; Kohlberg 1981). Although a complete discussion of the value formation process is beyond the scope of this paper, one avenue for future research may be the relationship between compatibility with values and social norms, as well as factors determining the emergence of compatibility with values. For instance, Kohlberg's (1981) theory of moral reasoning suggests that an individual's values with respect to a course of action might be influenced by a variety of factors including the beliefs of salient referent groups, a desire to "abide with the law," and to gain the approval of others. Likewise, Grube et al. (1994) observe that values reflect individual needs and desires as well as societal demands. Thus, in addition to one's value system, social norms or the desire to comply may play an important role in shaping compatibility with values.[7]

Future research could also draw upon other work such as that of Navarez and Rest (1995) to probe further into the process underlying the emergence and modification of values. As observed earlier, although the dominant conceptualization of values is that they are *relatively* stable dispositions, scholars have also noted that values are not completely immune to change. For instance, Grube et al. discuss the process of value "self-confrontation" where individuals are presented with feedback and interpretations of the value they and impor-

[7]We are grateful to an anonymous reviewer for pointing this out.

tant referents hold. They suggest that the process of self-confrontation can induce a change in the dominant value system of an individual. Similarly, Feather (1992) notes that values are not immutable across one's life span. Therefore, to the extent that values can be modified under certain circumstances, identifying appropriate interventions that can change values such that a technology is perceived to be more compatible with them would be a useful direction for further study.

The current research has provided a conceptualization and operational measures of compatibility beliefs and has situated them in TAM. Future research is needed to further validate this conceptualization and examine the effects of compatibility within more extended models of technology acceptance (e.g., Venkatesh and Davis 2000; Venkatesh et al. 2003) that take into account the effect of the social context and moderating effects of age, gender, experience, and voluntariness.

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Appendix

Scales and Items

Perceived Usefulness
PU1: Using the CRM system in my job will increase my productivity.
PU2: Using the CRM system will enhance my effectiveness on the job.
PU3: Using the CRM system will make it easier to do my job.
PU4: Using the CRM system will improve my job performance.

Ease of Use
EOU1: Learning to operate the CRM system is easy for me.
EOU2: I find it easy to get the CRM system to do what I want it to do.
EOU3: I find the CRM system easy to use.
EOU4: I find the CRM system to be flexible to interact with.
EOU5: My interaction with the CRM system is clear and understandable.
EOU6: It is easy for me to become skillful at using the CRM system.

Compatibility with Preferred Work Style[8]
CPREF1: Using the CRM system fits my preferred routine for conducting my job.
CPREF2: The CRM system enables me to work in the way I prefer.

[8]Compatibility items not footnoted were developed by the authors.

CPREF3: Using the CRM system fits well with the way I like to work.
CPREF4: Using the CRM system fits my preferred method for doing my job.

Compatibility with Existing Practices
CEXIST1r: Using the CRM system requires a change in the way that I currently conduct my job.[9]
CEXIST2: Using the CRM system is compatible with most aspects of the way I typically conduct my job.[10]
CEXIST3r: Using the CRM system would force me to change my existing method of conducting my job.[11]
CEXIST4: To use the CRM system, I don't have to change anything I currently do.[12]
CEXIST5: Using the CRM system does not require significant changes in my existing work routine.

Compatibility with Prior Experience
CEXP1: Using the CRM system is compatible with my past computer experience.[13]
CEXP2r: Using the CRM system is different from using other software I have used in the past.[14]
CEXP3r: Using the CRM system is a new experience for me.
CEXP4r: Using the CRM system is not similar to anything that I've done before.
CEXP5r: Using the CRM system is different from other experiences I have had.
CEXP6r: Using the CRM system is a new business experience for me.

Compatibility with Values
CVAL1: Use of the CRM system is consistent with the way I think business should be conducted.[15]
CVAL2r: Using the CRM system runs counter to my own values.
CVAL3r: Using the CRM system does not fit the way I view the world.
CVAL4r: Using the CRM system goes against what I believe computers should be used for.[16]
CVAL5r: Using the CRM system is not appropriate for a person with my values regarding the role of computers.[17]
CVAL6r: Using the CRM system runs counter to my values about how to conduct my job.

Usage Intensity
Minuse: During a typical day, how many minutes would you spend using the CRM system?
_____0 _____1–20 _____20–60 _____60–120 _____120–180 _____> 180

Frequse: How frequently do you access the CRM system?
_____ Never _____A few times a year _____Monthly _____Weekly _____Daily _____ Nearly all the time

Usage Scope
Featreg: Of all features and functions available in the CRM system, what percentage would you estimate that you use on a fairly regular basis?
_____ < 10% _____10–24% _____25–49% _____50–74% _____75–94% _____95% +

Clintera: Approximately, what percentage of all your client interactions are managed using the CRM system? _____%

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[9]Dropped from the final analysis due to low loadings or high cross-loadings in the PLS factor analysis for the main data collection. Adapted from Moore (1989).

[10]Dropped from the final analysis due to low loadings or high cross-loadings in the PLS factor analysis for the main data collection. Adapted from Moore and Benbasat (1991).

[11]Dropped from the final analysis due to low loadings or high cross-loadings in the PLS factor analysis for the main data collection. Adapted from Moore and Benbasat (1991).

[12]Adapted from Ostlund (1969).

[13]Dropped from the final analysis due to low loadings or high cross-loadings in the PLS factor analysis for the main data collection.

[14]Dropped from the final analysis due to low loadings or high cross-loadings in the PLS factor analysis for the main data collection.

[15]Dropped from the final analysis due to low loadings or high cross-loadings in the PLS factor analysis for the main data collection.

[16]Adapted from Moore and Benbasat (1991).

[17]Adapted from Ostlund (1969).