A Theoretical Extension of the Technology Acceptance Model: Four Longitudinal Field Studies

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The present research develops and tests a theoretical extension of the Technology Acceptance Model (TAM) that explains perceived usefulness and usage intentions in terms of social influence and cognitive instrumental processes. The extended model, referred to as TAM2, was tested using longitudinal data collected regarding four different systems at four organizations ($N = 156$), two involving voluntary usage and two involving mandatory usage. Model constructs were measured at three points in time at each organization: preimplementation, one month postimplementation, and three months postimplementation. The extended model was strongly supported for all four organizations at all three points of measurement, accounting for 40%–60% of the variance in usefulness perceptions and 34%–52% of the variance in usage intentions. Both social influence processes (subjective norm, voluntariness, and image) and cognitive instrumental processes (job relevance, output quality, result demonstrability, and perceived ease of use) significantly influenced user acceptance. These findings advance theory and contribute to the foundation for future research aimed at improving our understanding of user adoption behavior.
(*Adoption of Information Technology; Technology Acceptance Model; Social Influence; Perceived Usefulness*)

Introduction

Information technology adoption and use in the workplace remains a central concern of information systems research and practice. Despite impressive advances in hardware and software capabilities, the troubling problem of underutilized systems continue. Low usage of installed systems has been identified as a major factor underlying the "productivity paradox" surrounding lackluster returns from organizational investments in information technology (Sichel 1997). Understanding and creating the conditions under which information systems will be embraced by the human organization remains a high-priority research issue.

Significant progress has been made over the last decade in explaining and predicting user acceptance of information technology at work. In particular, substantial theoretical and empirical support has accumulated in favor of the Technology Acceptance Model (TAM) (Davis 1989, Davis et al. 1989). Numerous empirical studies have found that TAM consistently explains a substantial proportion of the variance (typically about 40%) in usage intentions and behavior, and that TAM compares favorably with alternative models such as the Theory of Reasoned Action (TRA) and the Theory of Planned Behavior (TPB) (see Venkatesh 1999 for recent review). TAM theorizes that an individual's behav-

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ioral intention to use a system is determined by two beliefs: perceived usefulness, defined as the extent to which a person believes that using the system will enhance his or her job performance, and perceived ease of use, defined as the extent to which a person believes that using the system will be free of effort. TAM theorizes that the effects of external variables (e.g., system characteristics, development process, training) on intention to use are mediated by perceived usefulness and perceived ease of use. According to TAM, perceived usefulness is also influenced by perceived ease of use because, other things being equal, the easier the system is to use the more useful it can be. As of January 2000, the Institute for Scientific Information's *Social Science Citation Index®* listed 424 journal citations to the two journal articles that introduced TAM (i.e., Davis 1989, Davis et al. 1989). In 10 years, TAM has become well-established as a robust, powerful, and parsimonious model for predicting user acceptance.

Across the many empirical tests of TAM, perceived usefulness has consistently been a strong determinant of usage intentions, with standardized regression coefficients typically around 0.6. Since perceived usefulness is such a fundamental driver of usage intentions, it is important to understand the determinants of this construct and how their influence changes over time with increasing experience using the system. Perceived ease of use, TAM's other direct determinant of intention, has exhibited a less consistent effect on intention across studies. Whereas some research has been done to model the determinants of perceived ease of use (Venkatesh and Davis 1996), the determinants of perceived usefulness have been relatively overlooked. A better understanding of the determinants of perceived usefulness would enable us to design organizational interventions that would increase user acceptance and usage of new systems. Therefore, the goal of the present research is to extend TAM to include additional key determinants of TAM's perceived usefulness and usage intention constructs, and to understand how the effects of these determinants change with increasing user experience over time with the target system.

Theory and Hypotheses

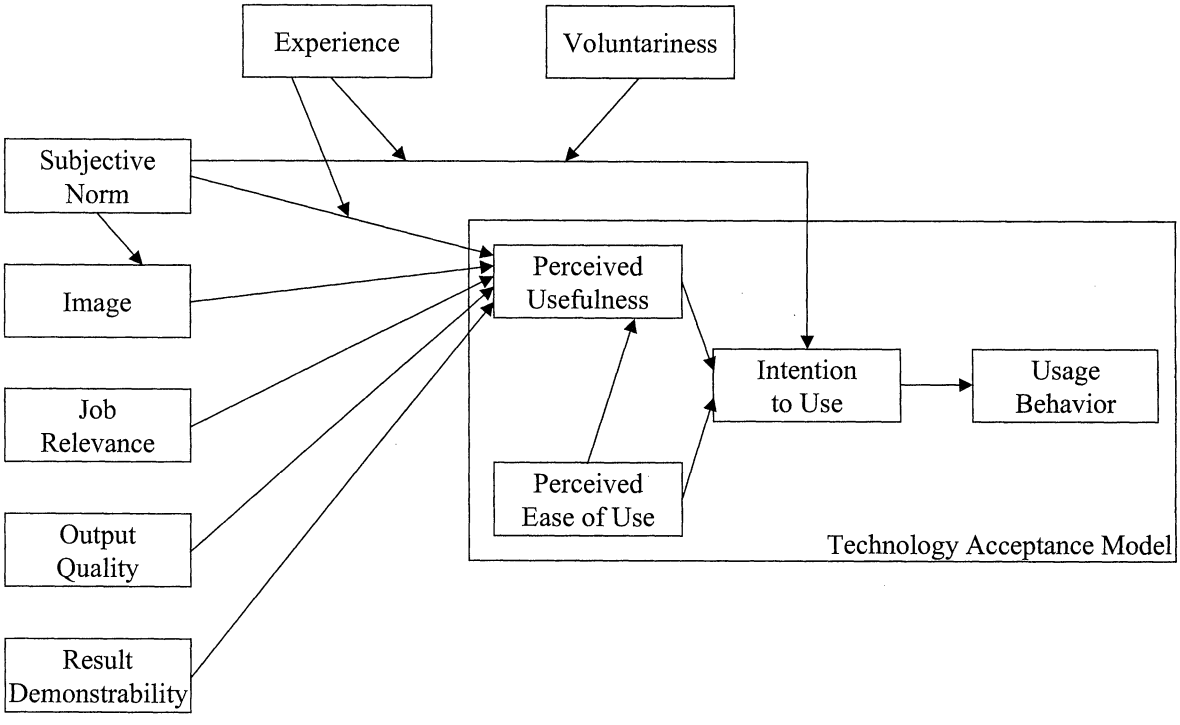
Figure 1 shows the proposed model, referred to as TAM2. Using TAM as the starting point, TAM2 incorporates additional theoretical constructs spanning social influence processes (subjective norm, voluntariness, and image) and cognitive instrumental processes (job relevance, output quality, result demonstrability, and perceived ease of use). Below we define each of these constructs and develop the theoretical rationale for the causal relationships of the model.

Social Influence Processes

TAM2 reflects the impacts of three interrelated social forces impinging on an individual facing the opportunity to adopt or reject a new system: subjective norm, voluntariness, and image.

Subjective Norm. Consistent with TRA, which was a key theoretical underpinning for the original development of TAM, we tap into social influences via *subjective norm*, defined as a "person's perception that most people who are important to him think he should or should not perform the behavior in question" (Fishbein and Ajzen 1975, p. 302). Subjective norm is included as a direct determinant of behavioral intention in TRA (Fishbein and Ajzen 1975) and the subsequent TPB (Ajzen 1991). The rationale for a direct effect of subjective norm on intention is that people may choose to perform a behavior, even if they are not themselves favorable toward the behavior or its consequences, if they believe one or more important referents think they should, and they are sufficiently motivated to comply with the referents. User acceptance research examining the direct effect of subjective norm on intention has yielded mixed results. Mathieson (1991) found no significant effect of subjective norm on intention, whereas Taylor and Todd (1995) did find a significant effect. In their empirical comparison of TAM and TRA, Davis et al. (1989) found that subjective norm had no significant effect on intentions over and above perceived usefulness and ease of use, and they omitted it from the original TAM, but they did acknowledge the need for additional research to "investigate the conditions and mechanisms governing the impact of social influences on usage behavior" (p. 999).

Figure 1 Proposed TAM2—Extension of the Technology Acceptance Model



Voluntariness and Compliance with Social Influence. A contingency underlying the mixed findings regarding subjective norm was identified by Hartwick and Barki (1994): After separating their respondents into mandatory and voluntary usage contexts, they found that subjective norm had a significant effect on intention in mandatory settings but not in voluntary settings. We refer to the causal mechanism underlying this effect as compliance. In general, the direct compliance effect of subjective norm on intention is theorized to operate whenever an individual perceives that a social actor wants him or her to perform a specific behavior, and the social actor has the ability to reward the behavior or punish nonbehavior (French and Raven 1959, Kelman 1958, Warshaw 1980). TAM2 theorizes that, in a computer usage context, the direct compliance-based effect of subjective norm on intention over and above perceived usefulness and perceived ease of use will occur in mandatory, but not voluntary, system usage settings. To distinguish between mandatory and voluntary usage settings, our model posits *voluntariness* as a moderating variable, defined as "the extent to which potential adopters perceive the adoption decision to be non-mandatory" (Agarwal and Prasad 1997, Hartwick and Barki 1994, Moore and Benbasat 1991). As Hartwick and Barki (1994) found, even when users perceive system use to be organizationally mandated, usage intentions vary because some users are unwilling to comply with such mandates.

HYPOTHESIS 1a. *Subjective norm will have a positive direct effect on intention to use when system use is perceived to be mandatory.*

HYPOTHESIS 1b. *Subjective norm will have no significant direct effect on intention to use when system use is perceived to be voluntary.*

HYPOTHESIS 1c. *Voluntariness will moderate the effect of subjective norm on intention to use.*

Internalization of Social Influence. Whereas the direct relationship between subjective norm and intention in TRA and TPB is based on compliance, TAM2 encompasses two additional theoretical mechanisms

by which subjective norm can influence intention indirectly through perceived usefulness: internalization and identification. Internalization (Kelman 1958, Warshaw 1980) refers to the process by which, when one perceives that an important referent thinks one should use a system, one incorporates the referent's belief into one's own belief structure. Internalization is equivalent to what Deutsch and Gerard (1955) refer to as informational (in contrast to normative) social influences, defined as "influence to accept information from another as evidence about reality" (p. 629). In the present context, if a superior or co-worker suggests that a particular system might be useful, a person may come to believe that it actually is useful, and in turn form an intention to use it. In French and Raven's (1959) taxonomy, the basis of internalization is expert power, where the target individual attributes expertise and credibility to the influencing agent (Kelman 1958). In the case of internalization, subjective norm has an indirect effect on intention through perceived usefulness, as opposed to a direct compliance effect on intention. Research based on Salancik and Pfeffer's (1978) social information processing model is consistent with the proposed internalization effect (e.g., Fulk et al. 1987, Rice and Aydin 1991). TAM2 theorizes that internalization, unlike compliance, will occur whether the context of system use is voluntary or mandatory. That is, even when system use is organizationally mandated, users' perceptions about usefulness may still increase in response to persuasive social information.

HYPOTHESIS 2. *Subjective norm will have a positive direct effect on perceived usefulness.*

Image and Social Influence. Individuals often respond to social normative influences to establish or maintain a favorable *image* within a reference group (Kelman 1958). Drawing from research on diffusion of innovations, Moore and Benbasat (1991, p. 195) define image as "the degree to which use of an innovation is perceived to enhance one's . . . status in one's social system." TAM2 theorizes that subjective norm will positively influence image because, if important members of a person's social group at work believe that he or she should perform a behavior (e.g., using a system), then performing it will tend to elevate his or her standing within the group (Blau 1964, Kiesler and Kiesler 1969, Pfeffer 1982). Kelman (1958) refers to this source of social influence as identification and distinguishes it from compliance and internalization. Viewed from the perspective of French and Raven's (1959) taxonomy, the basis of identification is referent power. In the typical work environment, with a high degree of interdependence with other social actors in carrying out one's duties, increased status within the group is a basis of power and influence via processes such as social exchange, coalition formation, and resource allocation (Blau 1964, Pfeffer 1981, 1982). As Pfeffer (1982, p. 85) argues, by performing behaviors that are consistent with group norms, an individual "achieves membership and the social support that such membership affords as well as possible goal attainment which can occur only through group action or group membership." The increased power and influence resulting from elevated status provides a general basis for greater productivity. An individual may thus perceive that using a system will lead to improvements in his or her job performance (which is the definition of perceived usefulness) indirectly due to image enhancement, over and above any performance benefits directly attributable to system use. This identification effect is captured in TAM2 by the effect of subjective norm on image, coupled with the effect of image on perceived usefulness. TAM2 theorizes that identification, like internalization but unlike compliance, will occur whether the context of system use is voluntary or mandatory.

HYPOTHESIS 3a. *Subjective norm will have a positive effect on image.*

HYPOTHESIS 3b. *Image will have a positive effect on perceived usefulness.*

Changes in Social Influence with Experience. How might the effects of these social influence processes change with increasing *experience* using a target system? There is theory and evidence to suggest that the direct effect of subjective norm on intentions may subside over time with increased system experience. Hartwick and Barki (1994) found that, although subjective norm had a significant effect on intentions prior

to system development, the effect became nonsignificant three months after system implementation. Their interpretation of this pattern is that, before a system is developed, users' knowledge and beliefs about a system are "vague and ill-formed," and they must therefore rely more on the opinions of others as a basis for their intentions (Hartwick and Barki 1994, pp. 458–459). After implementation, when more about the system's strengths and weaknesses are known through direct experience, the normative influence subsides. A similar pattern of results was obtained by Agarwal and Prasad (1997), who found that "mandating the use of a system can increase initial system utilization," enabling users to "overcome the hurdle of first-time use," but that such pressure seems to erode over time (p. 575). Research outside the domain of information systems also indicates that normative pressure attenuates over time (Ram and Jung 1991). Therefore, TAM2 theorizes that the direct effect of subjective norm on intentions for mandatory usage contexts will be strong prior to implementation and during early usage, but will weaken over time as increasing direct experience with a system provides a growing basis for intentions toward ongoing use. Similarly, we expect the effect of subjective norm on perceived usefulness (internalization) to weaken over time, since greater direct experience will furnish concrete sensory information (Doll and Ajzen 1992, Fazio and Zanna 1981, Tybout and Scott 1983), supplanting reliance on social cues as a basis for usefulness perceptions. In contrast, we do not expect the influence of image on perceived usefulness (identification) to weaken over time since status gains from system use will continue as long as group norms continue to favor usage of the target system.

HYPOTHESIS 4a. *The positive direct effect of subjective norm on intention for mandatory systems will attenuate with increased experience.*

HYPOTHESIS 4b. *The positive direct effect of subjective norm on perceived usefulness will attenuate with increased experience for both mandatory and voluntary systems.*

Cognitive Instrumental Processes

Beyond the social influence processes affecting perceived usefulness and usage intention discussed above, we theorize four cognitive instrumental determinants of perceived usefulness: job relevance, output quality, result demonstrability, and perceived ease of use. As we argue below, people form perceived usefulness judgments in part by cognitively comparing what a system is capable of doing with what they need to get done in their job. To develop the theoretical basis for these instrumental determinants, we draw from recent developments in the reference paradigms upon which TAM's perceived usefulness construct was originally formulated. These theoretical underpinnings come from three main areas: work motivation theory (e.g., Vroom 1964), action theory from social psychology (e.g., Fishbein and Ajzen 1975), and task-contingent decision making from behavioral decision theory (e.g., Beach and Mitchell 1978). Recent work in these areas has converged on a view of behavior being driven by a mental representation that links higher-level goals to specific actions that are instrumental for achieving those goals.

Within work motivation theory, Locke and Latham (1990) discuss task-specific plans, which are cognitive mechanisms by which acts are selected, combined, and sequenced in order to achieve goals. Task-specific plans guide behavior through a conception-matching process (see also Bandura 1986) linking instrumental acts to goals. Within social psychology, action identification theory (Vallacher and Wegner 1987, p. 4) posits an organized cognitive representation of action, called the identity structure, which links lower-level identities regarding specific actions to higher-level identities indicating why the action is done or what its effects or implications are. This identity structure is seen as a fundamental mechanism by which people cognitively regulate their behaviors in the furtherance of higher-level goals (Vallacher and Kaufman 1996). Within behavioral decision theory, recent work in image theory (Beach and Mitchell 1996, 1998) has embraced the concepts of a trajectory image, which is a mental representation of adopted goals and the ideal future state, and a strategic image, which is a mental representation of possible action sequences that can guide behavior toward the goal states of the trajectory image. When deciding among alternative instrumental action sequences (called the adoption decision),

image theory posits two distinct decision stages. In the first stage, a compatibility test is used to screen from further consideration any options that are incompatible with one's decision standards. In the second stage, a profitability test is performed to compare the acceptable options directly with one another to determine the best option. For example, in searching for and hiring a new employee, an employer would first eliminate any candidates whose attributes violate more than a threshold number of standards. If more than one acceptable candidate remains in the choice set after the compatibility test, then the profitability test is used to select the best candidate on a compensatory basis. Although different with respect to the pattern of information processing required, both the compatibility and profitability tests are based on cognitively assessing the match between the characteristics of the trajectory image and the perceived consequences of alternative action plans.

These recent theoretical developments cutting across action theory, work motivation theory, and behavioral decision theory share the view that the impetus for engaging in specific behaviors stems from a mental representation linking instrumental behaviors to higher-level goals or purposes. Following this line of reasoning, TAM2 theorizes that people use a mental representation for assessing the match between important work goals and the consequences of performing the act of using a system as a basis for forming judgments about the use-performance contingency (i.e., perceived usefulness).

Job Relevance. One key component of the matching process discussed above is a potential user's judgment of *job relevance*, which we define as an individual's perception regarding the degree to which the target system is applicable to his or her job. In other words, job relevance is a function of the importance within one's job of the set of tasks the system is capable of supporting. Research in human-computer interaction (Black et al. 1987, Norman 1987) has postulated similar goal-hierarchy models, though operating at more micro levels of analysis wherein higher-level goals include tasks such as writing a document, and lower-level actions are at the level of keystrokes and mouse clicks. Kieras and Polson (1985) and Polson (1987) argued that users possess distinct knowledge about their job situation, which they can use as a basis for determining what tasks can be performed with a given system. The existence of well-defined knowledge structures regarding important job goals is supported by research from personnel psychology (e.g., Roberson 1989). We regard job relevance as a cognitive judgment that exerts a direct effect on perceived usefulness, distinct from social influence processes. Empirically, user acceptance has been linked in other research to variables similar to job relevance, including job-determined importance (Leonard-Barton and Deschamps 1988), involvement (defined by Hartwick and Barki (1994) as personal importance and relevance), task-technology fit (Goodhue 1995), and cognitive fit (Vessey 1991). We conceptualize perceptions of job relevance to be part of a compatibility test within the context of Beach and Mitchell's (1996, 1998) image theory since systems below a minimal threshold value of perceived job relevance would be screened from further adoption consideration.

HYPOTHESIS 5. *Job relevance will have a positive effect on perceived usefulness.*

Output Quality. TAM2 posits that, over and above considerations of what tasks a system is capable of performing and the degree to which those tasks match their job goals (job relevance), people will take into consideration how well the system performs those tasks, which we refer to as perceptions of *output quality*. Empirically, the relationship between perceived output quality and perceived usefulness has been shown before (Davis et al. 1992). We expect output quality to be empirically distinct from, and to explain significant unique variance in, perceived usefulness over and above job relevance because a different underlying judgmental process is involved. In the context of image theory (Beach and Mitchell 1996, 1998), judgments of job relevance are more apt to take the form of a compatibility test whereby systems that are judged not to be job-relevant are eliminated from one's choice set for further consideration. Judgments of output quality, in contrast, are less likely to be used for excluding options from consideration. Instead, they are more apt to take the form of a profitability test

in which, given a choice set containing multiple relevant systems, one would be inclined to choose a system that delivers the highest output quality.

HYPOTHESIS 6. *Output quality will have a positive effect on perceived usefulness.*

Result Demonstrability. Even effective systems can fail to garner user acceptance if people have difficulty attributing gains in their job performance specifically to their use of the system. Therefore, TAM2 theorizes that *result demonstrability*, defined by Moore and Benbasat (1991, p. 203) as the "tangibility of the results of using the innovation," will directly influence perceived usefulness. This implies that individuals can be expected to form more positive perceptions of the usefulness of a system if the covariation between usage and positive results is readily discernable. Conversely, if a system produces effective job-relevant results desired by a user, but does so in an obscure fashion, users of the system are unlikely to understand how useful such a system really is. Empirically, Agarwal and Prasad (1997) found a significant correlation between usage intentions and result demonstrability. The relationship between result demonstrability and perceived usefulness is also consistent with the job characteristics model, which emphasizes knowledge of the actual results of work activities as a key psychological state underlying work motivation (Hackman and Oldham 1976, Loher et al. 1985).

HYPOTHESIS 7. *Result demonstrability will have a positive effect on perceived usefulness.*

Perceived Ease of Use. TAM2 retains *perceived ease of use* from TAM as a direct determinant of perceived usefulness (Davis et al. 1989), since, all else being equal, the less effortful a system is to use, the more using it can increase job performance. There is extensive empirical evidence accumulated over a decade that perceived ease of use is significantly linked to intention, both directly and indirectly via its impact on perceived usefulness (e.g., Davis et al. 1989, Venkatesh 1999). Although beyond the scope of the present extension of TAM, other research has begun to model the antecedents of perceived ease of use. For example, Venkatesh and Davis (1996) model perceived ease of use as being anchored on one's general computer self-efficacy and adjusted to account for a system's objective usability via direct behavioral experience using the target system. We note that the mechanisms by which ease of use perceptions are theorized to form and evolve are conceptually distinct from, and complementary with, the social influence and cognitive instrumental processes within TAM2.

HYPOTHESIS 8. *Perceived ease of use will have a positive effect on perceived usefulness.*

Changes in Cognitive Instrumental Influences with Experience. Consistent with the theories of mental representation discussed above, we expect that, even over time, people will continue to rely on the match between their job goals and the consequences of system usage (job relevance) as a basis for their ongoing usefulness perceptions. Just as the role of what a system does remains influential, we expect that how well a system does what it does (output quality) will remain a significant determinant of perceived usefulness over time. Similarly, we have no basis to expect the effect of result demonstrability on perceived usefulness to become either stronger or weaker over time. Although there is no theoretical account of such temporal shifts, the effect of perceived ease of use on perceived usefulness has sometimes been found to increase over time (e.g., Davis et al. 1989, Venkatesh and Davis 1996), whereas the direct effect of perceived ease of use on usage intention has been observed in some research to decrease over time (e.g., Davis et al. 1989), and in other research to increase over time (e.g., Venkatesh and Davis 1996). Presently, we lack sufficient theoretical rationale to hypothesize specific temporal shifts in the strength of any of the effects of cognitive instrumental determinants (job relevance, output quality, result demonstrability, or ease of use) on either perceived usefulness or intention to use.

In summary, the proposed TAM2 encompasses social influence processes (subjective norm, voluntariness, and image) and cognitive instrumental processes (job relevance, output quality, result demonstrability, and perceived ease of use) as determinants of perceived usefulness and usage intentions. We also hy-

pothesize a decrease in the strength with which social influence processes affect perceived usefulness and intention to use with increasing experience over time.

Method

Four longitudinal field studies were conducted to test TAM2. In the interest of ecological validity, we sought naturalistic research sites that closely mirrored the target situation to which we would like our results to generalize: where a new system is about to be introduced in the workplace. The four field sites spanned a range of industries, organizational contexts, functional areas, and types of system being introduced. We chose two sites where usage of the system was voluntary, and two where usage was mandatory to explicitly examine the theorized moderating role of voluntariness. To assess whether system use was mandatory or voluntary, the researchers initially interviewed senior managers in each of the organizations prior to the actual system introduction. In the actual questionnaire we measured user perceptions of voluntariness using a three-item scale (discussed below) since, although we expected these measures to coincide with senior manager reports, our theoretical model posits perceived rather than actual voluntariness as a moderator of the subjective norm-intention relationship. Questionnaires were administered to potential users at three points in time: after initial training (T1), one month after implementation (T2), and three months after implementation (T3). Self-reported usage behavior was measured at T2 and T3, and also five months after implementation (T4).

Data Sample

Study 1. Subjects were 48 floor supervisors in a medium-sized manufacturing firm who were being introduced to a proprietary system for their day-to-day activities, which included floor and machine scheduling and personnel assignment. Before the introduction of the system, most floor supervisors used a manual system, though there was software on multiple stand-alone Macintosh machines. Use of the new system was voluntary, and none of the subjects had any prior knowledge of the system. The subjects received two days of training, including one day of on-the-job training, to familiarize them with the use of the system. Thirty-eight subjects completed the study and provided usable responses at all points of measurement.

Study 2. Subjects were 50 members of the personal financial services department of a large financial services firm, representing various levels of the organizational hierarchy. The specific system project was to move all current mainframe operations to a Windows-based environment. Given the magnitude of the change, subjects were also given continued access to the old system and the discretion to use either system, thus rendering use of the new system to be voluntary. A one-and-a-half-day on-site training program was conducted to educate the users on the new environment. Thirty-nine subjects provided usable responses at all points of measurement.

Study 3. Subjects were 51 employees from various levels of the organizational hierarchy of a small accounting services firm. The subjects performed various activities related to customer accounts and telephone customer service. The new system introduced was a Windows-based customer account management system, which replaced a combination of a paper-based and a DOS-based system. A one-day on-site training program was conducted to educate all employees on the use of the new system and software environment. Unlike the first two studies, where use was voluntary, the old system was phased out over a one-week period, so use of the new system became mandatory. Forty-three subjects provided usable responses at all points of measurement.

Study 4. Subjects were 51 employees of a small international investment banking firm. The subjects, who represented various levels of the organization, performed a variety of functions related to domestic and international stock management. The new system introduced was designed to assist in analyzing and creating financially sound international stock portfolios. Compared with the existing system, the new system introduced new functionality such as the ability to quantitatively weight and incorporate subjective information (e.g., political stability) into risk assessment. The new system (a custom-built DOS-based

system) was developed by a different vendor and had a very different look and feel from the current system (which was also DOS-based). The subjects participated in a four-hour training program on the new system. Similar to Study 3, system use was mandatory, as the old system was immediately phased out. Thirty-six subjects provided usable responses at all points of measurement.

Measurement Scales

Theoretical constructs were operationalized using validated items from prior research (see Appendix 1). The TAM scales of perceived usefulness, perceived ease of use, and behavioral intention were measured using items adapted from Davis (1989) and Davis et al. (1989). The measurement of subjective norm was adapted from Taylor and Todd (1995). Measures of result demonstrability and image were adapted from Moore and Benbasat (1991). Measures of job relevance and output quality were adapted from Davis et al. (1992). Following Davis (1989), we measured usage behavior by asking subjects: "On average, how much time do you spend on the system every day? _ hours and _ minutes." Though some research suggests that self-reported usage measures are biased (e.g., Straub et al. 1995), other research suggests that self-report usage measures correlate well with actual usage measures (e.g., Taylor and Todd 1995). Our design avoided a major limitation associated with self-reported usage: common-method variance resulting from measuring both self-reported usage and its determinants (intention, perceived usefulness, etc.) on a single questionnaire. We examined the relationship between intention and other usage determinants measured at one point in time with self-reported usage measured at the subsequent time period, such that the measurement of usage and its determinants were separated by one month (T1–T2), three months (T2–T3), and two months (T3–T4), respectively. A three-item scale of voluntariness developed by Moore and Benbasat (1991) was included. To ensure that the measurement scales were adapted appropriately to the current context, we conducted a focus group pretest with five business professionals. Minor suggested wording changes were performed.

Procedure

Although the specific initial training in each organization was different, the process of questionnaire administration followed was very similar. Following the training (T1), the subjects filled out a questionnaire with the above measurement scales regarding the new system for which they just received training. The questionnaire was administered online and each subject's log-in ID was captured and used to create a barcode (for subsequent administrations in T2, T3, and T4) to help track individual responses over time. To preserve privacy and confidentiality, only the researchers had access to specific respondent information and only summarized responses were shared with the organization. One of the authors observed the process of questionnaire administration at T1 to ensure no biases were introduced. At T2 and T3, in addition to user reactions, self-reported usage was also measured. In each of these cases, a paper version of the questionnaire was delivered to subjects' mailboxes with a request that it be returned directly to the researchers within a one-week time window. At T4, only self-reported usage was measured using a procedure similar to T2 and T3. Intention measured in T1 was used to predict usage in T2, intention measured in T2 was used to predict usage in T3, and intention measured in T3 was used to predict usage in T4, respectively.

Results

Psychometric Properties of Measures

The measurement scales exhibited strong psychometric properties. All measurement scales showed high reliability, with Cronbach alpha coefficients for all four studies and three time periods exceeding 0.80 (see Appendix 1). Construct validity was strongly supported both by principal components analysis with direct oblimin rotation (Appendix 2), in which all cross-loadings were lower than 0.30, and by an analysis of the multitrait-multimethod matrix. This pattern of high reliability and validity is consistent with much prior research (e.g., Davis 1989, Davis and Venkatesh 1996, Mathieson 1991, Taylor and Todd 1995). Appendix 3 presents cross-sectional correlations among these constructs at each of the three points of measurement.

Based on measures of voluntariness (where 1 = *mandatory* and 7 = *voluntary*), we confirmed that employees in Studies 1 and 2 perceived system use to be voluntary (across companies and time periods, mean voluntariness ratings ranged from 6.2 to 6.7, and standard deviations ranged from 0.4 to 0.6), whereas employees in Studies 3 and 4 perceived system use to be mandatory (across companies and time periods, mean voluntariness ratings ranged from 1.2 to 1.5, and standard deviations ranged from 0.3 to 0.6). Further, correlations between measures of voluntariness across the three time periods exceeded 0.80 in all four studies.

Explaining Intention and Usage

Table 1 shows the effects of perceived usefulness, perceived ease of use, and subjective norm on intentions. Consistent with much prior research, perceived usefulness was a strong determinant of intention to use, and perceived ease of use was a significant secondary determinant. The effect of subjective norm on intention (compliance) was consistent with our expectations. That is, when usage was mandatory (Studies 3 and 4), subjective norm did have a direct effect on intention at T1 and T2 (supporting Hypothesis 1a), and this effect weakened to the point of nonsignificance by T3 (supporting Hypothesis 4a). In contrast, in cases where usage was voluntary (Studies 1 and 2), subjective norm had no direct effect on intention over and above what was explained by perceived usefulness and perceived ease of use (consistent with Hypothesis 1b). Unlike subjective norm, perceived usefulness and perceived ease of use remained consistent significant determinants of intention across all time periods in all four studies. TAM2 thus explained between 37% and 52% of the variance in usage intentions. The correlations between intention and usage behavior were found to be in the range of 0.44 to 0.57 for all studies at all points of measurement. For all studies and time periods, intention fully mediated the effects of perceived usefulness, perceived ease of use, and subjective norm on usage behavior.

Explaining Perceived Usefulness

TAM2 theorizes main effects for all determinants of perceived usefulness but does not explicitly posit any interactions. To address the possibility that some of the constructs combined multiplicatively rather than additively in their effect on perceived usefulness, we

Table 1 TAM2 Regression Results Explaining Intention to Use

	Voluntary Settings				Mandatory Settings			
	Study 1 (n = 38)		Study 2 (n = 39)		Study 3 (n = 43)		Study 4 (n = 36)	
Time of Measurement	R^2	β	R^2	β	R^2	β	R^2	β
Preimplementation (T1)	0.39		0.37		0.44		0.52	
Perceived Usefulness		0.58***		0.51***		0.48***		0.52***
Perceived Ease of Use		0.18*		0.27**		0.13*		0.18*
Subjective Norm		0.11		0.10		0.31**		0.28**
One month postimpl. (T2)	0.44		0.34		0.47		0.42	
Perceived Usefulness		0.55***		0.50***		0.54***		0.44***
Perceived Ease of Use		0.17*		0.21*		0.15*		0.11*
Subjective Norm		0.06		0.08		0.26**		0.24**
Three month postimpl. (T3)	0.42		0.42		0.39		0.39	
Perceived Usefulness		0.63***		0.64***		0.57***		0.50***
Perceived Ease of Use		0.14*		0.16*		0.17*		0.22*
Subjective Norm		0.11		0.02		0.10		0.08

*$p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. Adjusted R^2s are shown. β: standardized regression coefficients.

Table 2 TAM2 Regression Results Explaining Perceived Usefulness

	Voluntary Settings				Mandatory Settings			
	Study 1		Study 2		Study 3		Study 4	
Time of Measurement	R^2	β	R^2	β	R^2	β	R^2	β
Preimplementation (T1)	0.60		0.60		0.51		0.50	
Subjective Norm		0.50***		0.47***		0.38***		0.31**
Image		0.19*		0.21*		0.31**		0.36***
Job Relev. × Quality		0.40***		0.38***		0.32**		0.33**
Result Demonstrability		0.27**		0.30**		0.30**		0.22**
Perceived Ease of Use		0.23**		0.24**		0.23**		0.20**
One month postimpl. (T2)	0.48		0.55		0.51		0.46	
Subjective Norm		0.39***		0.34***		0.27**		0.21*
Image		0.22*		0.18*		0.28**		0.27**
Job Relev. × Quality		0.32**		0.38***		0.30**		0.33***
Result Demonstrability		0.24*		0.26**		0.30**		0.30**
Perceived Ease of Use		0.26**		0.35***		0.38***		0.29**
Three month postimpl. (T3)	0.44		0.40		0.43		0.40	
Subjective Norm		0.20*		0.08		0.16*		0.10
Image		0.17*		0.19*		0.27**		0.25**
Job Relev. × Quality		0.38***		0.36***		0.36***		0.32**
Result Demonstrability		0.34**		0.26**		0.21*		0.30**
Perceived Ease of Use		0.28**		0.34***		0.35***		0.35***

Note: Main effects of task importance and output quality were included in regressions but omitted from table due to noninterpretability in the presence of the interaction term.

* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$. Adjusted R^2s are shown. β: standardized regression coefficients.

conducted stepwise regression analyses. Specifically, following the test of the main-effects model, we used stepwise regression to enter into the model any significant two-way interactions. The only two-way interaction term that was significant was between job relevance and output quality. Moreover, this interaction was significant at $p < 0.01$ or $p < 0.001$ for all four studies at all three points of measurement. We presume this interaction effect to be robust, since the possibility of it occurring across four independent samples by chance, under the null hypothesis of no significant effect (type I error), is less than 0.00001. Therefore, we added this interaction term to the model and reestimated all parameters.

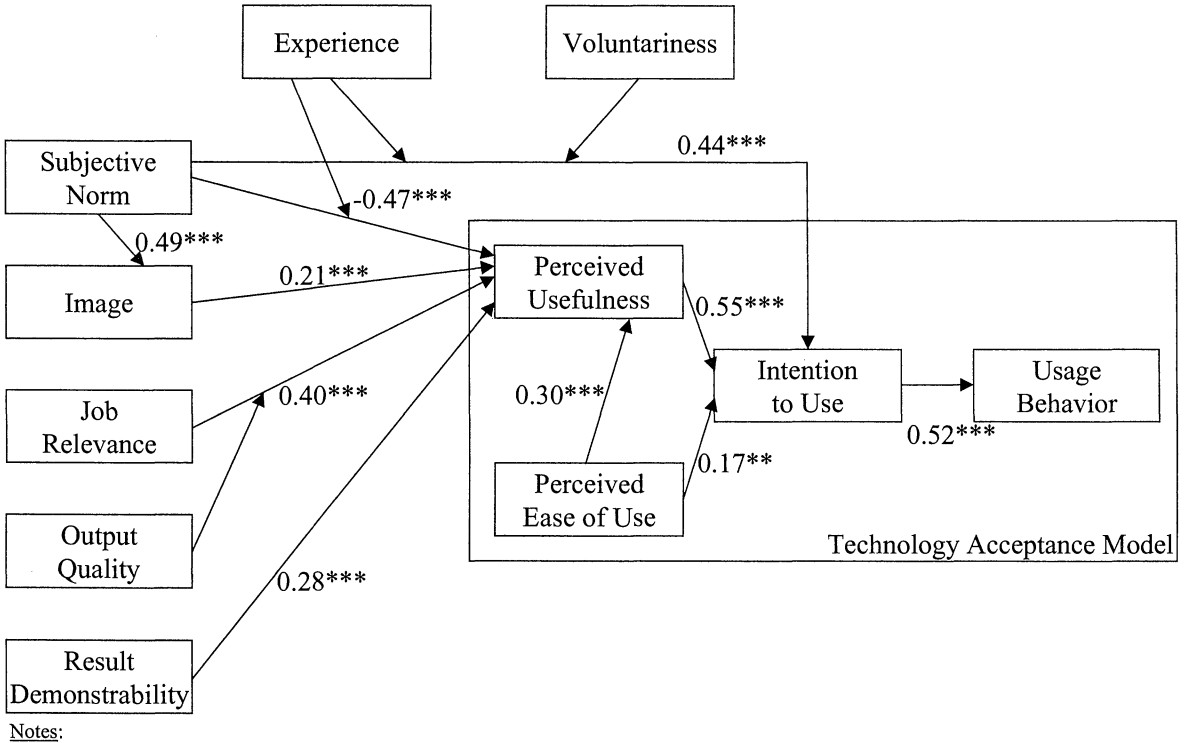
As Table 2 shows, TAM2 explained up to 60% of the variance in perceived usefulness. The effect of subjective norm on perceived usefulness (internalization) was significant at T1 and T2 (supporting Hypothesis 2), but weakened by T3 (supporting Hypothesis 4b). The influence of image on perceived usefulness (identification) was significant at all three points of measurement (supporting Hypothesis 3a). Also, as hypothesized, the effect of subjective norm on image was significant at all points of measurement (supporting Hypothesis 3b). As discussed earlier, the interaction of job relevance and output quality was significant in all four studies at all points of measurement (supporting Hypotheses 5 and 6, respectively). Note that the main effects of job relevance and output quality were found to be significant before the interaction term was introduced into the regression model. After the interaction term was included, the main effects were included in the model for parameter estimation, but they were omitted from Table 2 because main effects should not be interpreted in the presence of the interaction term under interval scale measurement. As theorized, result demonstrability and perceived ease of use were significant across all four studies and three time peri-

ods (supporting Hypotheses 7 and 8, respectively). To further substantiate the assertion that perceived usefulness fully mediates the effects of these determinants on intention, we performed hierarchical regression analyses with intention as the dependent variable and all the other variables as possible predictors. As theorized, perceived usefulness fully mediated the effects of all of its determinants on usage intentions, except for the expected direct effects of perceived ease of use in all studies and subjective norm for the mandatory usage studies (3 and 4).

Summary of Results Pooled Across Studies and Time Periods

Figure 2 provides a summary presentation of the results for TAM2 when data are pooled across studies and time periods. Pooling across the four studies yielded a sample of 156 per time period. Pooling across the three time periods yielded a sample of 468, which was used to estimate the summary model. Voluntariness was coded as a dummy variable with values of 0 for voluntary use (Studies 1 and 2) and 1 for mandatory use (Studies 3 and 4). Experience was coded as an indicator variable with values of 0 for T1, 1 for T2, and 2 for T3. Regression analyses with tests for moderation and mediation were done to test the summary model, which yielded results that were highly consistent with the 12 individual model tests for each combination of four organizations and three time periods (Tables 1 and 2). Consistent with theory, the basic TAM relationships (i.e., intention-usage, usefulness-intention, ease of use-intention, and ease of use-usefulness) were well supported, with full mediation by intention and no moderation by either voluntariness or experience. As theorized, the subjective norm-intention relationship was significantly moderated by both experience (supporting Hypothesis 4a)

Figure 2 **TAM2 Results Pooled Across Studies and Time Periods** (n = 468)



Notes:
1. Adjusted-R^2 for perceived usefulness is 0.51; Adjusted-R^2 for behavioral intention is 0.49.
2. ** p<0.01; *** p<0.001.
3. In cases of moderation, two- or three-way interaction terms are reported, with main effects partialed out.

and voluntariness (supporting Hypothesis 1c), mirroring the more detailed findings reported in Table 1 that subjective norm significantly affects intention directly only when usage is mandatory and experience is in the early stages. Also consistent with TAM2, the subjective norm-usefulness relationship (internalization) was significantly moderated by experience (supporting Hypothesis 4b), whereas the image-usefulness relationship (identification) was not. Consistent with Table 2, the effect of job relevance and output quality on perceived usefulness was interactive. Thus, all hypotheses were supported by all studies at all points of measurement.

Cross-Temporal Correlations of Intention Determinants

In a post hoc analysis performed to better understand how preimplementation user evaluations of a system relate to postimplementation evaluations, we examined the cross-temporal correlations of usage intention and its direct determinants, perceived usefulness, perceived ease of use, and subjective norm (Table 3). Perceived usefulness was the most stable of the three determinants, with correlations ranging from 0.56 to 0.79. Similarly, the stability correlations for subjective norm were relatively high (0.51–0.65). In contrast, the stability correlations were systematically lower for perceived ease of use (0.12–0.37). Reflecting the comparatively strong effect of perceived usefulness on intentions, as found in the present studies (see Table 2) as well as in previous studies, intention exhibited cross-temporal stability correlations comparable to those of usefulness, ranging from 0.63 to 0.82. Using distributed lag models, we confirmed that intentions fully mediated the effects of perceived usefulness, perceived ease of use, and subjective norm measured in one time period (T1 or T2) on intention measured in a later time period (T2 or T3).

Table 3 **Cross-Temporal Stability Correlations for Perceived Usefulness, Perceived Ease of Use, Subjective Norm, and Intention to Use**

	Voluntary Settings		Mandatory Settings	
Time Span	Study 1	Study 2	Study 3	Study 4
Time 1—Time 2 (1 month)				
Perceived Usefulness	0.68***	0.56***	0.76***	0.60***
Perceived Ease of Use	0.26*	0.23*	0.12	0.28*
Subjective Norm	0.56***	0.54***	0.59***	0.50***
Intention to Use	0.68***	0.78***	0.70***	0.66***
Time 2—Time 3 (2 months)				
Perceived Usefulness	0.71***	0.66***	0.79***	0.62***
Perceived Ease of Use	0.30*	0.17	0.26*	0.37**
Subjective Norm	0.61***	0.60***	0.57***	0.65***
Intention to Use	0.76***	0.82***	0.71***	0.61***
Time 1—Time 3 (3 months)				
Perceived Usefulness	0.66***	0.62***	0.71***	0.69***
Perceived Ease of Use	0.14	0.19	0.28*	0.36***
Subjective Norm	0.58***	0.57***	0.51***	0.52***
Intention to Use	0.69***	0.71***	0.63***	0.68***

* $p < 0.05$. ** $p < 0.01$. *** $p < 0.001$.

Discussion

TAM2 was strongly supported across four organizations and three points of measurement (preimplementation, one month postimplementation, and three months postimplementation). Encompassing both social influence processes (subjective norm, voluntariness, and image) and cognitive instrumental processes (job relevance, output quality, result demonstrability, and perceived ease of use), TAM2 provides a detailed account of the key forces underlying judgments of perceived usefulness, explaining up to 60% of the variance in this important driver of usage intentions. Moreover, TAM2 extends TAM by showing that subjective norm exerts a significant direct effect on usage intentions over and above perceived usefulness and perceived ease of use for mandatory (but not voluntary) systems.

The effects of social influence processes were consistent with TAM2. Subjective norm significantly influenced perceived usefulness via both internalization, in which people incorporate social influences into their own usefulness perceptions, and identification, in which people use a system to gain status and influence within the work group and thereby improve their job performance. Beyond these two indirect effects via perceived usefulness, subjective norm had a direct effect on intentions for mandatory, but not voluntary, usage contexts. This may explain previous research that found a nonsignificant role for social

influences in voluntary contexts (e.g., Davis et al. 1989, Mathieson 1991). We found that as individuals gained direct experience with a system over time, they relied less on social information in forming perceived usefulness and intention but continued to judge a system's usefulness on the basis of potential status benefits resulting from use.

The effects of cognitive instrumental processes were also consistent with TAM2. An important and interesting finding that emerged was the interactive effect between job relevance and output quality in determining perceived usefulness. This implies that judgments about a system's usefulness are affected by an individual's cognitive matching of their job goals with the consequences of system use (job relevance), and that output quality takes on greater importance in proportion to a system's job relevance. Although the interaction was not explicitly hypothesized, similar interaction effects between task characteristics and technology characteristics have been observed in other research (Davis et al. 1992, Goodhue 1995). As hypothesized, user perceptions of result demonstrability and ease of use were significant. Unlike social influence processes, the effects of cognitive instrumental processes remained significant over time.

Limitations

The present research has several limitations that should be noted. First, the sample sizes were less than 50 for each of the four longitudinal samples, which could reduce the power of significance tests. Fortunately, few of the findings were nonsignificant, and the small sample sizes give assurance that the significance we did observe indicates meaningful effect sizes. The consistency of the findings across studies further reduces the likelihood that the major findings are spurious. Second, several of the constructs were measured with only two items. The two-item scales exhibited adequate reliability (Cronbach alpha was over 0.80 in all cases) and factorial validity, mitigating concerns about measure reliability or validity. Also, the data analysis did not use structural equation modeling, in which two-item scales in a measurement model can introduce problems of underidentification resulting in instability of parameter estimates. Third, the field studies were longitudinal observational designs and hence did not involve experimental manipulation of theoretical constructs. Experimental replication of these findings would enhance causal interpretations of key relationships. Fourth, we employed self-reported as opposed to objectively measured usage. Since self-reported usage was measured in the wave of measurement subsequent to that in which intentions were measured (at minimum of one month later), common-method variance was minimized. Nevertheless, the interchangeability of self-report and objective usage measures remains a controversial point in IS research (Straub et al. 1995). Fifth, although we employed a longitudinal design spanning five months in each organization, we employed a variance theory approach. Additional insights into the underlying dynamics of the causal mechanisms addressed by the model might emerge by using a process approach that analyzes the detailed events and action sequences that unfold over time.

Contributions and Implications

There are several practical implications of our findings. Mandatory, compliance-based approaches to introducing new systems appear to be less effective over time than the use of social influence to target positive changes in perceived usefulness. Practical alternatives to usage mandates based on social information should be developed and tested, such as increasing the source credibility of social information to increase internalization or designing communication campaigns that raise the prestige associated with system use to increase identification. On the instrumental side, in addition to designing systems to better match job-relevant needs, improving the quality of their output, or making them easier to use, our research suggests that practical interventions for increasing result demonstrability, such as empirically demonstrating to users the comparative effectiveness of a new system relative to the status quo (e.g., Davis and Kottemann 1995), may provide important leverage for increasing user acceptance.

The current research represents an important contribution to theory by extending TAM to address causal antecedents of one of its two belief constructs,

perceived usefulness. Other research has begun to model the determinants of TAM's other major belief, perceived ease of use (Venkatesh and Davis 1996). Further research on TAM, in addition to refining the models of the determinants of perceived usefulness and perceived ease of use, should address the role of other direct determinants of usage intentions and behavior and continue to map out the major contingency factors moderating the effects of perceived usefulness, perceived ease of use, subjective norm, and other constructs on intention.

Another important avenue for future research concerns the temporal dynamics of the determinants of user acceptance. The present research found that TAM2 held up well at three points of measurement spanning from preimplementation to three months postimplementation. Perceived usefulness, subjective norm, and intention were quite stable over this three-month horizon. Perceived ease of use, in contrast, was less stable over time, which we attribute to the known role of direct hands-on experience in forming this belief (Venkatesh and Davis 1996). Future research might profitably seek to establish how early in a system development process, for example, even before a working prototype is built, we can measure key user reactions, such as perceived usefulness and intention, and still rely on them as indicators of postimplementation success of the system concept.

Additional research is needed to elucidate the processes involved in cognitively matching important job goals to the consequences of system use. Beach and Mitchell's (1996, 1998) compatibility and profitability tests offer theoretical structure that might be brought to bear for fleshing out this important process. Progress might also come from adapting profile-comparison processes from research on person-job fit (Caldwell and O'Reilly 1990) to the assessment of system-job fit. In any case, understanding this matching process is a vital research direction since it explicitly links the functional design characteristics of a system to perceived usefulness and ultimately user acceptance.

More broadly, future research should seek to further extend models of technology acceptance to encompass other important theoretical constructs, such as the choice sets of available alternative technologies, learning and training (e.g., Venkatesh and Speier 1999), misperceptions of usefulness or ease of use and how to correct them (e.g., Davis and Kottemann 1995), changes in work content or job goals, and changing social environments. Future research should compare our findings regarding the role of subjective norm with other recent findings (e.g., Venkatesh and Morris 2000). Of particular interest would be a comparison of TAM2 with recent approaches from the media choice paradigm that attempt to integrate normative and utilitarian determinants (e.g., Kraut et al. 1998, Webster and Trevino 1995). The continuing trend in organizations away from hierarchical, command-and-control structures toward networks of empowered, autonomous teams underscores our finding regarding the limits of organizational mandate as a lever for increasing usage. To adapt user acceptance theory to this trend, the conceptualization of perceived usefulness will need to be expanded from its current focus on expected individual-level performance gains to encompass team-based structures and incentives. As the adoption decision becomes more of a team- rather than individual-level decision, the nature and role of social influence processes (both within teams and across teams) will need to be elaborated beyond TAM2.

In conclusion, user acceptance of information technology in the workplace remains a complex, elusive, yet extremely important phenomenon. Research over the past decade has made significant progress toward unraveling some of its mysteries. The development and test of TAM2 reported here advances theory and research on this important issue.[1]

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Appendix 1. TAM2 Measurement Scales and Reliabilities

Intention to Use	(Cronbach's α ranged from 0.82 to 0.97 across studies and time periods)
Assuming I have access to the system, I intend to use it.	
Given that I have access to the system, I predict that I would use it.	
Perceived Usefulness	(Cronbach's α ranged from 0.87 to 0.98 across studies and time periods)
Using the system improves my performance in my job.	
Using the system in my job increases my productivity.	
Using the system enhances my effectiveness in my job.	
I find the system to be useful in my job.	
Perceived Ease of Use	(Cronbach's α ranged from 0.86 to 0.98 across studies and time periods)
My interaction with the system is clear and understandable.	
Interacting with the system does not require a lot of my mental effort.	
I find the system to be easy to use.	
I find it easy to get the system to do what I want it to do.	
Subjective Norm	(Cronbach's α ranged from 0.81 to 0.94 across studies and time periods)
People who influence my behavior think that I should use the system.	
People who are important to me think that I should use the system.	
Voluntariness	(Cronbach's α ranged from 0.82 to 0.91 across studies and time periods)
My use of the system is voluntary.	
My supervisor does not require me to use the system.	
Although it might be helpful, using the system is certainly not compulsory in my job.	
Image	(Cronbach's α ranged from 0.80 to 0.93 across studies and time periods)
People in my organization who use the system have more prestige than those who do not.	
People in my organization who use the system have a high profile.	
Having the system is a status symbol in my organization.	
Job Relevance	(Cronbach's α ranged from 0.80 to 0.95 across studies and time periods)
In my job, usage of the system is important.	
In my job, usage of the system is relevant.	
Output Quality	(Cronbach's α ranged from 0.82 to 0.98 across studies and time periods)
The quality of the output I get from the system is high.	
I have no problem with the quality of the system's output.	
Result Demonstrability	(Cronbach's α ranged from 0.80 to 0.97 across studies and time periods)
I have no difficulty telling others about the results of using the system.	
I believe I could communicate to others the consequences of using the system.	
The results of using the system are apparent to me.	
I would have difficulty explaining why using the system may or may not be beneficial.	

Note. All items were measured on a 7-point Likert scale, where 1 = *strongly disagree*, 2 = *moderately disagree*, 3 = *somewhat disagree*, 4 = *neutral* (neither disagree nor agree), 5 = *somewhat agree*, 6 = *moderately agree*, and 7 = *strongly agree.*

Appendix 2. Principal Components Analysis with Oblimin Rotation: Pooled Across Studies and Time Periods (n = 468)

	Construct Loadings							
Item	Intent to Use	Perc Usef	Perc EOU	Subj Norm	Image	Reslt Demon	Output Qual	Job Rel
Intention to Use 1	**0.91**	0.03	0.09	0.04	0.03	0.03	0.03	0.11
Intention to Use 2	**0.93**	0.06	0.12	0.28	0.07	0.05	0.01	0.02
Perc. Usefulness 1	0.11	**0.89**	0.07	0.09	0.01	0.00	0.06	0.06
Perc. Usefulness 2	0.13	**0.88**	0.02	0.22	0.04	0.18	0.22	0.02
Perc. Usefulness 3	0.05	**0.93**	0.11	0.04	0.01	0.12	0.03	0.05
Perc. Usefulness 4	0.22	**0.91**	0.04	0.00	0.11	0.06	0.08	0.12
Perc. Ease of Use 1	0.10	0.09	**0.91**	0.03	0.08	0.03	0.11	0.12
Perc. Ease of Use 2	0.11	0.11	**0.93**	0.11	0.19	0.09	0.17	0.05
Perc. Ease of Use 3	0.15	0.09	**0.96**	0.12	0.12	0.02	0.10	0.07
Perc. Ease of Use 4	0.09	0.04	**0.82**	0.02	0.17	0.08	0.02	0.02
Subjective Norm 1	0.27	0.03	0.11	**0.90**	0.09	0.00	0.05	0.07
Subjective Norm 2	0.22	0.20	0.18	**0.91**	0.06	0.04	0.08	0.02
Image 1	0.14	0.05	0.21	0.02	**0.86**	0.09	0.08	0.21
Image 2	0.04	0.06	0.13	0.04	**0.89**	0.11	0.13	0.17
Image 3	0.11	0.11	0.10	0.01	**0.91**	0.16	0.21	0.12
Result Demonst. 1	0.01	0.15	0.08	0.00	0.05	**0.90**	0.07	0.05
Result Demonst. 2	0.10	0.17	0.16	0.11	0.02	**0.91**	0.18	0.12
Result Demonst. 3	0.16	0.09	0.11	0.14	0.08	**0.88**	0.00	0.17
Result Demonst. 4	0.12	0.01	0.10	0.19	0.09	**0.84**	0.12	0.12
Output Quality 1	0.19	0.00	0.06	0.00	0.13	0.13	**0.88**	0.09
Output Quality 2	0.02	0.03	0.05	0.01	0.14	0.12	**0.85**	0.14
Job Relevance 1	0.13	0.04	0.12	0.07	0.16	0.11	0.07	**0.91**
Job Relevance 2	0.15	0.13	0.17	0.08	0.12	0.04	0.02	**0.92**
Cronbach's α	0.91	0.93	0.93	0.90	0.91	0.89	0.88	0.90

Note. The same simple factor structure was found within each time period in each of the four studies and when data were separately pooled across time and across mandatory versus voluntary settings.

Appendix 3. Cross-Sectional Correlation Matrices of TAM2 Constructs

Voluntary Setting (Studies 1 & 2 Pooled)

(a) Preimplementation (T1)

	U	EOU	SN	IMG	JR	QUAL	RD	BI
U								
EOU	0.27***							
SN	0.21*	0.12						
IMG	0.26**	0.13	0.45***					
JR	0.30***	0.21*	0.27**	0.11				
QUAL	0.28***	0.22**	0.12	0.20*	0.31***			
RD	0.28**	0.13	0.22*	0.13	0.16*	0.24**		
BI	0.45***	0.25**	0.13	0.24**	0.27***	0.21**	0.20*	

Mandatory Setting (Studies 3 & 4 Pooled)

(b) Preimplementation (T1)

	U	EOU	SN	IMG	JR	QUAL	RD	BI
U								
EOU	0.28***							
SN	0.40***	0.21*						
IMG	0.25**	0.16	0.43***					
JR	0.32***	0.23*	0.20*	0.14				
QUAL	0.29**	0.25**	0.19*	0.19*	0.29**			
RD	0.30***	0.18	0.28***	0.20**	0.15	0.30***		
BI	0.47***	0.23**	0.20*	0.27***	0.25**	0.31***	0.29***	

Appendix 3 (Continued)

(c) One month postimplementation (T2)

	U	EOU	SN	IMG	JR	QUAL	RD	BI
U								
EOU	0.27***							
SN	0.16*	0.15						
IMG	0.30**	0.11	0.40***					
JR	0.29***	0.20*	0.11	0.13				
QUAL	0.22*	0.21*	0.13	0.22*	0.30***			
RD	0.29**	0.11	0.23**	0.04	0.12	0.22*		
BI	0.50***	0.25**	0.09	0.26**	0.20*	0.23**	0.21*	

(d) One month postimplementation (T2)

	U	EOU	SN	IMG	JR	QUAL	RD	BI
U								
EOU	0.30***							
SN	0.33***	0.15						
IMG	0.26**	0.19*	0.40***					
JR	0.28***	0.20*	0.22*	0.19*				
QUAL	0.24**	0.29**	0.21*	0.22**	0.22*			
RD	0.33***	0.9	0.22*	0.16	0.13	0.28***		
BI	0.44***	0.20*	0.13	0.23*	0.26***	0.21*	0.24**	

(e) Three month postimplementation (T3)

	U	EOU	SN	IMG	JR	QUAL	RD	BI
U								
EOU	0.31***							
SN	0.19*	0.23*						
IMG	0.27***	0.13	0.40***					
JR	0.30***	0.20*	0.12	0.13				
QUAL	0.21*	0.23**	0.21*	0.14	0.33***			
RD	0.23*	0.14	0.12	0.19*	0.06	0.23*		
BI	0.46***	0.20*	0.18*	0.31***	0.20*	0.23**	0.20*	

(f) Three month postimplementation (T3)

	U	EOU	SN	IMG	JR	QUAL	RD	BI
U								
EOU	0.33***							
SN	0.27**	0.15						
IMG	0.21**	0.19*	0.40***					
JR	0.31***	0.20*	0.22*	0.19*				
QUAL	0.29***	0.29**	0.21*	0.22**	0.22*			
RD	0.36***	0.9	0.22*	0.16	0.13	0.28***		
BI	0.48***	0.28**	0.07	0.26**	0.21*	0.22*	0.24***	

Note. U = perceived usefulness; EOU = perceived ease of use; SN = subjective norm; IMG = image; JR = job relevance; QUAL = output quality; RD = result demonstrability; BI = behavioral intention to use; * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

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