Proposing a Comprehensive Meta-model for Technology Acceptance

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***Abstract*--**New technologies appear constantly, offering the promise of greater efficiency and effectiveness for work processes in all types of organizations. However, not all reach their full potential, either because of employee rejection or less-than optimal implementation. Studies that examine Information Technology (IT) adoption in business have often used the Technology Acceptance Model (TAM) to predict IT adoption in a business environment. However, the TAM fails to explain much of the variance in technology usage. This article examines technology acceptance processes in the light of theories of technology readiness, technology acceptance, and diffusion of innovation and proposes a comprehensive meta-model to integrate and expand existing models to explain technology acceptance in a wide range of contexts. With regard to future research, the paper also recommends attention to a greater breadth of contexts, cultures, and questions related to issues and recommendations for promoting technology acceptance.

Keywords: *technology acceptance, Technology Acceptance Model, diffusion of innovation, technology readiness, Technology Readiness Index*

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Introduction

New technologies appear constantly, offering the promise of greater efficiency and effectiveness for organizational work processes. However, not all technologies reach their full potential, either because of employee rejection or less-than optimal implementation (Burton-Jones & Hubona 2006). The potential for financial loss and employee dissatisfaction is high (Venkatesh 2000); therefore, it is important to fully explain and manage the factors facilitating new technology adoption.

Much information and communication technology research has worked to identify determinants of technology use, resulting in a number of explanatory theories (Kin &He 2006). Porter &Donthu (2006) identify two broad research paradigms to explain technology adoption and acceptance. One focuses on how an individual's perception of a technology is affected by its attributes; perception in turn affects the individual's use of the specific technology. One of the most widely used models within this paradigm is the Technology Acceptance Model (TAM), which focuses on the attributes of *perceived usefulness* and *perceived ease of use* (Davis, Barozzi & Warshaw 1989, Kin & He

2006,Porter & Donthu 2006). While the TAM has proved an enduring and popular explanatory model, it only explains about 40% of the variance in computer usage, suggesting that additional factors may help explain IT acceptance(Legris, Ingham & Collerette 2003,Venkatesh & Davis 2000).

In contrast, other models use a paradigm that focuses on an individual's personality to explain technology adoption (Porter &Donthu 2006). One example is the Technology Readiness Index (TRI) (Parasuraman 2000), in which technology readiness can be viewed as resulting from four personality dimensions (optimism, innovativeness, discomfort, and insecurity)that affect people's tendency to use new technologies. The first two dimensions enable technology adoption, while the last two are inhibitors.

Technology adoption has not been systematically studied in some environments, for example, Hayes (2012) notes thatrelatively few studies examine information technology (IT) adoption in small businesses. Smaller firms far outnumber larger ones and contribute significantly to the economy.and they encounter unique technology issues including reliance on external IT expertise (Thong, Yap & Raman 1996). Studies that have examined IT adoption in small firms all imply that an attitude toward the technology is important determinant of its successful adoption(Caldeira & Ward 2003,Murchandani & Motwani 2001,Riemenschneider, Harrison & Mykytyn 2003).

The purpose of this paper is twofold. One goal is to improve upon our understanding of technology adoption by proposing a revised model that incorporates elements from multiple models and from the emerging TA literature. Most importantly, however, the goal is to offer a model that ultimately better explains IT adoption in a broad range of environments, including small business, education, and other types of organizations.

Literature Review

Technology Acceptance

Teo(2011, p. 1) defines technology acceptance as "a user's willingness to employ technology for the tasks it is designed to support."Much research has been done to understand individual-level technology awareness, acceptance, and use (Sia, Lee, Teo & Wei 2001) in various contexts, such as digital libraries (Hong 2002), and collaboration systems (Choon-Ling, Hock-Hai, Tan & Kwok-Kee 2004,Sia, Tan & Wei 2002). In fact, technology acceptance research is one of the most, if not the most, mature streams in IS research (Sun & Zhang 2006,Venkatesh, Morris, Davis & Davis 2003). In most of the acceptance studies, researchers have sought to identify and understand the forces that shape users' acceptance so as to influence the design and implementation process in ways to avoid or minimize resistance or rejection when users interact with technology. This has given rise to the identification of core technological and psychological variables underlying acceptance. From these, acceptance models have emerged, some extending the theories from psychology with a focus on the attitude-intention paradigm in explaining technology usage, and allowing researchers to predict user acceptance of potential emerging technology applications.

Ball (2008) provides a useful review of the technology acceptance literature, highlighting themes common to multiple models. Sun & Zhang (2006) identify through systematic analysis three main factors and 10 moderating factors associated with technology acceptance models in the literature and develop an integrative model and propositions associated with each of the factors. According to Sun & Zhang(summarized in Ball 2008), it appears thatdespite their considerable empirical validation and confirmation, technology acceptance models have room for improvement. Moreover, research studies report inconsistent results, leading to a need for further research in different environments(Legris et al. 2003,Sun & Zhang 2006).

Hu, Clark & Ma (2003) suggest that job relevance is important for technology acceptance. They argue that while a number of factors influence initial acceptance of technology, fundamental determinants play a greater role in continued acceptance. According to Thompson, Compeau&Higgins (2006), although existing models have served the technology adoption stream well, they may lead to a narrow understanding of technology acceptance and might not serve modern technologies effectively. Wong,Teo& Sharon (2012) argue that it is crucial to look further into the contribution of external variables. In this vein, recent studies have found significant effects fromperceived enjoyment (Teo & Noyes 2011), facilitating conditions (Terzis & Economides 2011), social influence (Moran, Hawkes & El Gayar 2010,Terzis & Economides 2011), and self-efficacy (Chen 2010,Moran et al. 2010).

Theories of Technology Acceptance

The following sections review existing IT acceptance models in detail as a foundation for a proposed meta-model.

Theory of Reasoned Action. In their Theory of Reasoned Action,Fishbein & Ajzen (1975) describe how attitudes are formed by asserting that understanding human behaviors requires separate evaluation of (1) beliefs, (2) attitudes, (3) intentions, and (4) behaviors (p. 10). They stress the importance of experiences to formation of attitudes as well as belief systems, knowledge, and intention, contributing to

how individuals accept or reject innovations.They find that past events, beliefs and experiences all affect the elements that form attitudes that lead to behaviors. When those attitudes are understood, behaviors can be predicted in one or more ways, and when an individual's predisposition is established, it is expected that they will or will not perform the behavior in question (Fishbein & Ajzen 1975, p. 9). The authors assert that contributors to predispositions and attitudes are measured in multiple ways; one method of determining attitudes is through single-question interviews and surveys that measure likes and dislikes.

The TRA has been successful in predicting and explaining behaviour in general (Yi & Hwang 2003), and perceived usefulness and perceived ease of use have proven to be reliable and valid cognitive dimensions in a range of contexts (Burton-Jones & Hubona 2006,King & He 2006).

Technology Acceptance Model (TAM). A modification of the TRA,the Technology Acceptance Model(Davis 1989, 1993; Davis et al. 1989)regards an individual's behavioral intention to use information technology as jointly determined by the perceived usefulness (PU) of the information technology and the individual's attitude toward using it, primarily reflected in perceived ease of use (PEU).PU refers to "the degree to which a person believes that using a particular system would enhance his or her job performance" (Davis 1989, p. 320); and PEU refers to "the degree to which a person believes that using a particular system would be free of effort" (Davis 1989, p. 320).

Davis' studies specify the causal relationships between system design features, perceived usefulness, perceived ease of use, attitude toward using, and actual usage behavior (Davis 1993). His findings indicated that, although indirectly affecting attitude through its effect on usefulness, perceived ease of use has a "fairly small direct effect on attitude" (Davis 1993, p. 482). Perceived usefulness, however, has a very strong effect on actual use through attitude. Venkatesh and colleagues have also studied TAM extensively and evaluated its use as a predictor of user behavior (Davis & Venkatesh 1996,Venkatesh 1999,Venkatesh & Morris 2000,Venkatesh et al. 2003,Venkatesh, Speier & Morris2002).

TAM is linked to Social Cognitive Theory by its two key constructs, PU and PEU (Davis & Wiedenbeck 2001). It is notable in TAM that PEU is used as a measure of process expectations, while PU is a measure of outcome expectations after actions. The TAM has been proven as promising theoretical model among the various models developed to examine users' intentions to use computer and communication technology (Gefen & Straub 1997,Moon & Kim 2001,Taylor & Todd 1995,Venkatesh 1999,Venkatesh & Davis 1996).

Although research on TAM has provided insights into technology usage, it has focused on PEU and PU as the determinants of usage rather than on other factors affecting users' determinants. In addition, TAM suggests that users will use computer technology if they believe it will result in positive outcomes. The TAM does not explicitly consider how users' capabilities influence their perceived behaviors. The TAM excludes the social norm (SN) construct from the TRA because the direct effects of the SN component are difficult to disentangle from its indirect effects through attitude (Davis et al. 1989).

Davis et al. (1989) posit that behavioral intention (BI) may be directly affected not only by attitude, but also by PU. That is, their model suggests a direct link between the user's perceived usefulness of the system and his/her intention to use the system. Third, they include external variables in their model, items that directly affect PU and PEU. System features, training, user support consultants, and documentation are all examples of external variables in the TAM. Finally, the TAM's PU and PEU are expected to generalize across other systems and users. TAM has been used to explain or predict user's behavioral intentions on a variety of emerging technologies such as electronic commerce (Çelik & Veysel 2011,Ha & Stoel 2009), wireless internet (Kim & Garrison 2009), intranet (Horton, Buck, Waterson & Clegg 2001), telemedicine technology (Hu, Chau, Sheng & Tam 1999,Kowitlawakul 2011), internet-based course management systems(Dasgupta, Granger & McGarry 2002; Hashim 2008, Landry, Griffeth & Hartman 2006), learning management systems(Al-Busaidi & Al-Shihi 2012,Kamla Ali & Hafedh 2010), smart phones(Sek, Lau, Teoh, Law & Parumo2010), internet banking (Lai & Li 2005,Pikkarainen, Pikkarainen, Karjalutot & Pahnila2004) and digital library systems(Park, Roman, Lee & Chung 2009).

TAM has been found to explain between 30% and 40% of system usage (Burton-Jones & Hubona 2006,Legris et al. 2003), with perceived usefulness often the strongest determinant in the model (Burton-Jones & Hubona 2006,King & He, 2006,Legris et al. 2003). Godoe and Johansen (2012) note that since the original TAM was introduced, the model has undergone numerous adjustments, with some versions including only perceived usefulness, perceived ease of use, and actual use of a particular system (e.g., Adams, Nelson & Todd 1992,Burton-Jones & Hubona 2006,Davis 1989).

Although the TAM has been tested and validated in many Western cultures; further validations in different cultures would further enhance our understanding of the efficiency and parsimony of the TAM and strengthen the cultural validity of the TAM (Ball 2008;Teo 2009, 2010; Teo, Ursavaş & Bahçekapili 2011). Also, several researchers have recommended further research into the generalizability of factors associated with technology acceptance and refinement of acceptance models (Ball 2008,Sun & Zhang 2006,Teo et al. 2011,Thompson et al. 2006). Igbaria (1994) utilizes both TAM and TRA to study of microcomputer technology acceptance. Her research concludes that both individual attitudes and situation variables impact whether an individual will accept a new technology (Igbaria 1994,Igbaria, Guimaraes & Davis 1995).

Based on an extensive investigation on technology acceptance factors identified in information system (IS) studies, Legris et al. (2003) suggest that TAM should be integrated into a broader model that identifies additional variables that influence technology acceptance. Davis et al. (2003) suggest that a model comprised of elements from both TAM and TRA might provide a more complete view of the determinants of user acceptance. In an empirical assessment of the model, Davis et al. find that the combined model predicted intention better than either model by itself.

Theory of Planned Behavior. Some researchers believe that technology acceptance is more complex and have investigated other variables that influence acceptance (Taylor & Todd 1995,Thompson et al. 2006). TRA and TAM have strong behavioral elements and predict intention well, but they are limited in explanatory power and do not account for other factors that may influence technology acceptance (Sun & Zhang 2006,Thompson et al. 2006,Venkatesh & Davis 1996). Ajzen (1991) extended the TRA and developed the Theory of Planned Behavior (TPB) by empirically investigating the influence of perceived behavioral control, attitude, and subjective norms on technology acceptance(Ajzen 1991,Fishbein & Ajzen 1975,Schifter & Ajzen 1985). The sTPBis a well-researched model that is widely used in predicting and explaining human behavior across a variety of settings while also considering the roles of individual and social systems in the process (Ajzen 1991). TPB identifies three attitudinal antecedents of behavioral intention. Two reflect the perceived desirability of performing the behavior: attitude toward outcomes of the behavior and subjective norm. Perceived behavioral control also reflects perceptions that the behavior is personally controllable (Ajzen 1987, 1991). Ajzen found that the TPB is highly accurate in its predictions of user's behavioral intentions, and that people generally behave in accordance with their intentions.

Taylor and Todd (1995) test a decomposed TPB model that in some cases provides a better understanding of relationships than TAM. They use this model to examine specific antecedents to attitude, subjective norm, and perceived behavioral control in attempting to make TPB consistent and generalizable across different settings. There is evidence that the TPB is a valid model to explain pre-service teachers' acceptance of technology, specifically in terms of their behavioral intention to use technology (Teo & Tan 2012).

As researchers have used the TAM in their studies, they have added other factors from the TPB. In their review,Venkatesh et al. (2003) identify studies linking the two theories in a separate category. Davis, Bagozzi &Warshaw (1992) believe that usefulness and enjoyment mediate the perceived usefulness and ease of use of the participants. Lim (2003) uses a combination of the TAM and TPB to study the adoption of negotiation support systems and finds it to be valid. Combining the TAM and the TPB, Chau & Hu (2002) do not find that these theories are effective for studying technology acceptance by individual professionals in the healthcare setting. But the integration of TAM and TPB confirms its robustness in predicting user' intention to use new technology (Yang, Liu& Zhou 2012,Yang & Zhou 2011).

Model Combining the Technology Acceptance Model and Theory of Planned Behavior. To further investigate the complex relationships between technology acceptance variables, Taylor & Todd (1995) develop an extension to TPB, the Decomposed Theory of Planned Behavior (DTPB), and identify eight additional components to explain some of the antecedents to the original TPB variables more fully. DTPB provides a more complete understanding of BI and provides a better predictive power relative to TAM and TPB.

Thompson et al. (2006) believe that technology adoption needs to be approached in a more holistic fashion, and propose an integrative model that extends DTPB. Thompson et al. reveal strong influences of personal innovativeness and self-efficacy. In another study that integrates TAM and TPB, Chen, Fan &Farn (2007) show that the overall explanatory power of their research model is high and that it explains a high proportion of the variance in BI. Chen et al. suggest that integrating TPB with TAM might provide a more complete understanding of BI, and recommend further research into possible moderating factors that may contribute to BI.

Motivational Model. The effect of motivation on user acceptance has developed into a separate model. Both extrinsic and intrinsic motivations have been found to impact new technology adoption (Malhotra, Galletta & Kirsch 2008,Shroff & Vogel 2009,Zhang, Zhao & Tan 2008).

Model of PC Utilization. The Model of PC Utilization (MPCU) is based primarily on Triandis' Theory of Human Behavior (Triandis 1977). The constructs for the model include social factors and long-term consequences. Thompson, Higgins &Howell (1991) modify and develop Triandis' model for information system contexts and use the model to predict PC utilization, working to predict usage behavior rather than intention. Bagchi, Hart, and Peterson (2004) address one of these constructs in their research on the impact of national culture on Information Technology (IT) adoption. Their results show that even after controlling for national economic and social differences, national cultural dimensions significantly predict most IT product adoptions.

Cheung, Chang, & Lai (2000) utilize the MPCU in a study of World Wide Web users. Their study confirms that facilitating conditions and social factors should be part of an acceptance theory. A study of a groupware application by Li, Lou, Day &Coombs (2004) use the attachment theory to research individual motivation and intention to use a technology. The attachment theory seems to be subset of the MPCU.

Theory of Diffusion of Innovations. Change is measured and assessed by a method known as diffusion (Banks, 2002). According to Rogers (2003, p. 10), "diffusion is a process through which a new innovation is communicated through specific channels over a period of time, among the members of a social system."Essentially, diffusion theory describes how and when new ideas are either adopted or rejected, and how rapidly they are spread through society. The theory of diffusion of innovations in adoption of technology includes four main elements that apply to social systems, organizations, or individuals: (1) innovation, (2) communication channels, (3) time, and (4) social system.

Diffusion theory has been used for years to determine the acceptance and spread of any new technology within an organization, and it is the most relevant in describing the evaluation, selection, and adoption of any new technology (Banks 2002,Powell 2008). Rogers' Innovation Decision Process theory states that an innovation's diffusion is a process that occurs over time through five stages: Knowledge, Persuasion, Decision, Implementation and Confirmation. Accordingly, "the innovation-decision process is the process through which an individual (or other decision-making unit) passes from first knowledge of an innovation to forming an attitude toward the innovation to a decision to adopt or reject to implementation of the new idea, and to confirmation of this decision" (Rogers 2003, p. 168).

According to Rogers (2003), who uses the terms innovation and technology interchangeably, people's attitudes toward a new technology are a key element in its diffusion. Albirini (2006) reviews studies on technology diffusion in education, noting that they have often focused on the first three phases of the innovation decision process. In cases where technology has been recently introduced into an educational system, studies have mainly focused on the first two stages, that is, on knowledge of an innovation and attitudes about it (Albirini 2006).

Straub (2009) reviews technology adoption and diffusion models and concludes that adoption theory focuses not on the whole but rather the pieces that make up the whole. In contrast, diffusion theory describes how an innovation spreads through a population, considering factors such as time and social pressures.Adoption theory takes a micro-view, while diffusion theory takes a macro-perspective on the spread of an innovation across time(Straub 2009).

Adoption and diffusion of new technology have been studied in many different areas such asmedical and healthcare (Hikmet, Banerjee& Burns 2012,Sanson-Fisher 2004), sociology (Deffuant, Huet & Amblard 2005,Rogers 2003), education (Hall & Loucks 1978,Pennington 2004), and computer science (Venkatesh et al. 2003). The results of adoption theory are measured in terms of behavioral change, and the predictors of that behavioral change can be understood through contextual, cognitive, and affective factors (Straub 2009).

The Theory of Diffusion of Innovations was developed to study any innovation, not only technological ones (Venkatesh et al. 2003). Chen, Gillenson &Sherrell (2002)combine the Innovation Diffusion Theory (IDT) with the TAM to study consumers and online virtual stores and find that they are valid theories.

Social Cognitive Theory.Social Cognitive Theory (SCT) addresses constructs such as self-efficacy, affect, and anxiety in determining usage behavior (Bandura 1986,Bandura, Adams& Beyer 1977,Venkatesh et al. 2003). In a study of the relationship between the enjoyment users get from software and perceived usefulness and ease of use, Agarwal & Karahanna (2000) find that that the amount of

"playfulness" in the software or skill being studied can positively influence perceived usefulness and ease of use.

SCT has been used in various studies, including a study supporting the significance of self-efficacy and outcome expectations (Compeau, Higgins&Huff1999); research supporting the impact of computer playfulness and computer anxiety (Hackbarth, Grover & Yi2003); and research performed by Yi & Hwang (2003) on internet use that utilized students and combined SCT and TAM to determine that enjoyment, learning goal orientation, and application-specific self-efficacy positively affect use.

Unified Theory of Acceptance and Use of Technology. Some researchers have worked to integrate constructs from various models into a single model with the goal of providing one comprehensive model that would predict intention more accurately(Sun & Zhang 2006,Venkatesh et al. 2003). Venkatesh et al.'s (2003, p. 425) Unified Theory of Acceptance and Use of Technology model (UTAUT) integrates elements from eight different technology acceptance models–The Technology Acceptance Model, the Theory of Planned Behavior, the model combining the Technology Acceptance Model and the Theory of Planned Behavior, the Theory of Reasoned Action, the Motivational Model, the Model of PC Utilization, the Innovation Diffusion Theory, and the Social Cognitive Theory. They find that the eight models individually explain between 17 and 53 percent of the variance in user intentions. The UTAUT investigates four main variables and four moderating variables to determine their influence on technology acceptance. Tests using UTAUT produce higher percentages than the other models, indicating that it may be a more accurate model for predicting technology acceptance. Venkatesh et al. (2003) recommend further research to identify additional constructs that will improve the ability to predict user's intention and behavior.

Technology Readiness. Based on the literature and extensive qualitative research on customer reactions to technology, Parasuraman (2000) proposes the construct of technology readiness (TR). Attitude formation and characteristics of adopters are intrinsic components of TR (Rogers 2003). There are also measurable traits of TR among individuals that serve as indicators regarding how they adopt innovations and their rate and methods of adoption (Rogers 2003). Parasuraman & Colby (2001) describe the term Technology Readiness (TR) as individual beliefs and behaviors that transpire when new technologies are introduced in the workplace, school, or home. In other words, TR is the "people's propensity to embrace and use new technologies for accomplishing goals in home life and at work" (Parasuraman & Colby 2001, p. 18). These characteristics apply to all individuals engaged with technologies of all types. Parasuraman&Colby identified four primary elements of TR that should be considered when introducing new technologies to consumers. Those elements are optimism, innovativeness, insecurity, and discomfort. TR refers to the decision-making process that individuals engaged in regarding use of technology that is unique and different from the decision process used for non-technology decisions. The TR theory is relevant to understanding the decision-making process of individuals—including business professionals, educators and learners, who are confronted with responding positively or negatively to new technologies (Myers 2010).

Parasuraman & Colby (2001) find in qualitative analysis that there are positive and negative feelings expressed in response to technology. They find that TR is more complex than the categories outlined by Rogers (2003) of innovator, early adopter, early majority, majority and laggard; and that the concept of TR included a range of feelings and emotions of high, medium and low readiness. Parasuraman&Colby describe emotional reactions to technology as experiences, attitudes, beliefs and question whether most individuals actually seek technology or instead need coaxing to accept technologies being introduced by outside sources. They produce a continuum to illustrate their analysis of high, medium and low levels of TR that can be measured on a scale where resistance to technology is low and receptivity to technology is high (Parasuraman & Colby 2001).

In addition to measuring responses as high, medium, and low, Parasuraman & Colby (2001) classify TR into four distinct domains: optimism, innovativeness, insecurity and discomfort. They believe that optimism and innovativeness contribute to an individual's TR, while discomfort and insecurity inhibit TR. They refer to contributors and inhibitors as "drivers" of behaviors (Parasuraman & Colby, 2001).Parasuraman (2000)presents a 36-item technology readiness index (TRI) scale that measures an individual's propensity to embrace and use new technologies.

Parasuraman &Colby (2001)argue that there are five groups of individuals who reacted to technology in positive and negative ways. The descriptions used to describe the personalities are explorers, pioneers, skeptics, paranoids and laggards, and each personality type required different types of interventions for promotion of their TR. The categories are similar to categories of technology adopters listed by Rogers (2003), but vary somewhat in the characteristics described. Both sets of researchers include laggards as the slowest group to accept technology.

Extended Technology Acceptance Model (TAM 2 and TAM 3). Venkatesh & Davis (2000) propose an extension of TAM—TAM2—by identifying and theorizing about the general determinants of perceived usefulness—that is, subjective norm, image, job relevance, output quality, result demonstrability, and perceived ease of use—and two moderators—that is, experience and voluntariness. The first two determinants fall into the category of social influence and the remaining determinants are system characteristics. TAM2 presents two theoretical processes—social influence and cognitive instrumental processes—to explain the effects of the various determinants on perceived usefulness and behavioral intention. In TAM2, subjective norm and image are the two determinants of perceived usefulness that represent the social influence processes. 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 (Venkatesh & Davis 2000). In addition, TAM2 theorizes that three social influence mechanisms—compliance, internalization, and identification—play a role in understanding the social influence processes (Venkatesh & Bala 2008).

In TAM 3, Venkatesh &Bala (2008) identify disparities between large investments in IT and the potential for non-use or low acceptance levels among employees. They determine that there is some relevance among employees at companies regarding perceived usefulness, job relevance, output equality, results and perceived ease of use, however when those factors are not present employees may not engage the technology and IT investments could be wasted (Venkatesh & Bala 2008). In other words, Venkatesh & Bala (2008)find that major capital investments in technology could be lost if there is sufficient attention to ease of use and perceived usefulness. Venkatesh &Bala (2008)find that individual experience with technology and a feeling of voluntariness rather than compulsory requirements are factors that influenced employee acceptance of new technologies. Findings by Venkatesh&Bala could be useful for administrator introducing new technologies who need to determine if non-use or low-use among user could result in costly delays or rejectionof technologies.

Findings in TAM 3 indicate that low adoption and underutilization of technology are in conflict with large investments in IT and expected increases in productivity. Venkatesh & Bala (2008) suggest that managers need assistance with determining the elements of perceived usefulness and ease of use that addressed individual differences, system characteristics, social influences and facilitating conditions.

This literature review builds upon and contributes toknowledge about what motivates people to accept technology in general, based largely on the Technology Acceptance Model and models of technology readiness and diffusion of innovation. The application domains for TAM and its many extensions and refinements have broadened out in several directions. The influence of key constructs identified in the technology acceptance literaturehas been presented. However, comprehensive understanding of technology acceptance among individuals still remains an issue.

Additional Elements Affecting Technology Acceptance

Recent studies have continued to use the TAM to study IT adoption in a business setting (Chatzoglou, Vraimaki, Diamantidis & Sarigiannidis 2010,Dembla, Palvia & Krishnan 2007).) For example, in their study of web-enabled transaction processing by small businesses,Dembla et al. (2007) find that consistent with the TAM, perceived usefulness is a major determinant of adoption. Further, in their study of small and medium-sized businesses in Greece, Chatzoglou et al. (2010) find that perceived usefulness as well as perceived ease of use are important determinants of computer acceptance. However, despite its potential, the TAM still only explains at most about 40% of the variance in computer usage, suggesting that the current model does not include significant factors (Legris et al., 2003). Thus, in the spirit of developing our ability to explain technology adoption in a society, it makes sense to consider additional constructs.

Additional Elements: Technology Readiness. Parasuraman & Colby (2001) believe that TR varies from individual to individual; a person's method of adoption will depend on their nature and personality. The authors also believe that TR is multifaceted and a blend of different beliefs, customs and culture. TR is more than just the tendency to be an innovator or early adopter—it describes a person referred to by Rogers (2003) as venturesome (Parasuraman & Colby 2001). TR can also predict consumer behavior, the adoption rate of new technologies and explain the manner in which the technology is used, including association of a degree of satisfaction with technology and the kind of support required (Parasuraman & Colby 2001). In contrast, as a combined measure technology readiness does not predict intention or behaviour, but merely provides a measure of how ready a market is to adopt technologies (Rose & Fogarty 2010).

Wejnert (2002) finds that there are consequences when technologies are introduced without proper planning.Wejnert observes that there is insufficient research

that cross-connects information and analyzes the impact of innovation on interactions among professionals, organizations and government. In addition to the public and private impact of innovations, Wejnert expresses concerns that diffusion of innovations can affect societies and governments and result in historic transformations. She indicates that little regard is provided to conducting costs benefit analysis regarding the impact of introducing innovations in the public sector. Her concerns are relevant to the planning process of the introduction of new technologies into the public and business sectors. Wejnert suggests there are differencesbetween diffusing innovations in the private sector and in the public sector. She argues that when innovations are spread to society and new ideas or tools are spread throughout the society, new philosophies or ways of thinking can change entire cultures (Wejnert 2002).

Additional Elements: Technology Acceptance. Fishbein &Ajzen's (1975) research is applied to the predictability of attitude formation in general and not just attitudes regarding TA. In contrast, Mick &Fournier (1998) analyze attitudes towards technology and determine that there are conflicting attitudes about technology that can co-exist simultaneously. They argue that there are technology paradoxes in many situations that describe co-existing attraction and avoidance responses to technology. They conclude that thereare significant apprehensions and concerns about technology and ownership of technological products that foster complex and conflicting feelings in individuals, sometimes resulting in negative reactions to innovation. These paradoxes are described in Table 1.

Table 1.The eight paradoxes (Mick & Fournier 1998, p. 126)

Paradoxes	Description
Control/Chaos	Technology can facilitate regulation or order, and technology can lead to upheaval or disorder
Freedom/enslavement	Technology can facilitate independence or fewer restrictions, and technology can lead to dependence or more restrictions
New/obsolete	New technologies provide the user with the most recently developed benefits of scientific knowledge or new technologies that are already or soon to be outmoded as they reach the marketplace
Competence/incompetence	Technology can facilitate feelings of intelligence or efficacy and technology can lead to feelings of ignorance or ineptitude
Efficiency/inefficiency	Technology can facilitate less effort or time spent in certain activities and technology can lead to more effort or time in other activities
Fulfills/creates needs	Technology can facilitate the fulfillment of needs and technology can create new needs
Assimilation/isolation	Technology can facilitate human togetherness and technology can lead to human separation
Engaging/disengaging	Technology can facilitate involvement, flow or activity and technology can lead to disconnection, disruption or passivity

Mick & Fournier's (1998) examples show how potential users/consumers react with conflicting emotions about technological household and office products, generating tension between fulfilling needs and creating new needs by new technologies. Consumers and users of technology use a range of strategic behaviors to cope with these technology paradoxes, including "avoidance of technology; delays of use of new technologies; becoming acquainted with new technologies through other individuals; making extra efforts to understand and use technologies through partnering; and thoroughly learning new technology operations, strengths and weaknesses" (Mick & Fournier 1998, p. 140). They also determine that coping mechanisms are moderated by product, situation, and person factors over time and those mediators and moderators affect coping strategies. Based on their analysis, individuals are acutely aware of the presence of technologies in their lives and of the need to deal with them in their homes and workplaces, but they do not automatically accept technologies as ubiquitous and essential to their lives. Mick & Fournier (1998) recognize

that paradoxes in TA contributed to the complexity of adoption of technology in societies.

Additional Elements: Diffusion of Innovations. There are a number of key elements in Roger's (2003) diffusion theory, beginning with an idea and its perceived desirability (Rogers 2003). The three main types of innovation decisions are: (1) optional innovation decisions, where individuals make a decision to adopt or reject a new idea independent of others members of their social system, (2) collective innovation decisions where consensus is reached among members of a social system to adopt or reject an innovation or new idea, and (3) authority innovation decisions where individuals with power, status or technical expertise decide to adopt or reject an idea or innovation (Rogers 2003). Rogers also includes a fourth category, "contingent innovation-decisions" where choices to adopt or reject are reconsidered after an initial decision to not adopt. Whether or not an idea is adopted at a fast or slow rate in a particular group is contingent upon decision-innovation options and the outcome of each option results in consequences for individuals, units, or social system (Rogers 2003, p. 38).

or undesirability and followed by the idea being communicated by the media, interpersonal channels, or other vehicles (Rogers 2003). Next, there is a time element required for the idea to move around to key opinion leaders and finally the idea will be accepted by a social structure, leaders or society

There are four key elements in the diffusion of innovations. First, there is innovation—an idea or practice that is new to an individual or organization. There may be favorable or unfavorable responses to the innovative idea and the desirability of the idea is based on the relative advantage to the group, its compatibility, complexity, trialability, and observability (Table 2). The second key element in diffusing new ideas is communication channel—the role of mass media and how effective it is in communication of knowledge about new ideas. Interpersonal peer channels are influential in this the role of media and whether or not individuals accept or reject new ideas. Other significant factors are the qualities between two or more individuals and how they respond to the communications about the new idea.

Table 2. Intrinsic Characteristics to Adopt or Reject an Innovation (Rogers 2003)

Factor	Definition
Relative Advantage	The improvement of an innovation over the previous generation.
Compatibility	The level of compatibility that an innovation has to be assimilated into an individual's life.
Complexity or Simplicity	If the innovation is perceived as complicated or difficult to use, an individual is unlikely to adopt it.
Trialability	How easily an innovation may be experimented. If a user is able to test an innovation, the individual will be more likely to adopt it.
Observability	The extent that an innovation is visible to others. An innovation that is more visible will drive communication among the individual's peers and personal networks and will in turn create more positive or negative reactions.

The third element identified by (Rogers 2003)is time—a key part of the innovation decision process because of the time it takes for a new idea to come to an individual or other unit. It also takes time for knowledge to convey from one person to another, time for decisions to be made to either adopt or reject new ideas, and time to implement and confirm decisions about the innovation. Finally, social systems are important and the structure of those systems can facilitate or impede diffusions of innovations. Rogers (2003) notes various types of opinion leaders and change agents operated in social structures where they influenced the attitudes of others. The professional change agents are focused on producing desired outcomes and tried to influence client behavior, but may not have been as successful as their peers in the social structure.

Rogers (2003, p. 267)makes the observation that "individuals in a social system do not all adopt an innovation at the same time". He classifies individuals in "adopter categories" based on when they first began using

an idea and identifies five adopter categories called "ideal types" based on "abstractions from empirical investigations" (Rogers 2003, p. 282). Based on Rogers' analysis, it should be possible to understand the ideal types among professionals and to design approaches for each type in order to establish frameworks that increase knowledgeregarding TA.Rogers defines five stages of the adoption process categories (Table 2).

Table 3. Five Stages of the Adoption Process (Rogers 2003)

Stage	Definition
Knowledge	The individual is first exposed to an innovation but lacks information about the innovation. During this stage of the process the individual has not been inspired to find more information about the innovation.
Persuasion	The individual is interested in the innovation and actively seeks information/detail about the innovation.
Decision	The individual takes the concept of the change and weighs the advantages/disadvantages of using the innovation and decides whether to adopt or reject the innovation. Due to the individualistic nature of this stage Rogers notes that it is the most difficult stage to acquire empirical evidence.
Implementation	The individual employs the innovation to a varying degree depending on the situation. During this stage the individual determines the usefulness of the innovation and may search for further information about it.
Confirmation	The person finalises his/her decision to continue using the innovation. This stage is both intrapersonal and interpersonal; confirmation the group has made the right decision.

These definitions are significant when determining how to prepare individuals and communities for new ideas in the form of technologies and innovations. Rogers believes ideas and innovations are diffused by organizations and social systems through opinion leaders and change agents with defined roles who support or block adoption of the new ideas (Rogers 2003). He observes that innovators who are the most technologically ready are often not connected to social networks, but early adopters and the early majority are connected.

In discussing the role of opinion leaders in the adoption of new ideas, Rogers indicates that new ideas are adopted by social units or social systems where leaders perform key roles in introducing new ideas. He shows that opinion leaders function in "diffusion networks" that are systems of communications and dictate "the degree to which an individual is able informally to influence other individuals' attitudes or overt behavior in a desired way with relative frequency" (Rogers 2003, p. 300). Rogers underlines the importance of understanding how to overcome the barriers of getting new ideas adopted and how the absence of local input can delay adoption of innovations. He emphasizes that authority figures, followers, and change agents promote change through spontaneous or the planned spread of new ideas. Rogers views are summarized in his observation, "Getting a new idea adopted, even when it has obvious advantages, is difficult" (Rogers 2003, p. 1).

There are many characteristics cited by Rogers (2003) that are important for explaining how ideas spread through cultures. Opinion leadership is a significant category in diffusion theory where opinion leaders have access to external communications and as a result of travel have access to mass media, exposure to change agents and interface with different groups of professionals. The opinion leaders are accessible to interpersonal networks where they participate socially and have higher economic status than do followers. Opinion leaders will generally adopt new ideas before followers and are innovative even if they are not innovators. The opinion leaders will reflect the norms of their social systems and will be part of organizations used to diffuse innovations (Rogers 2003).

The characteristics for opinion leaders are relevant to professionals who incorporate the characteristics of well-traveled cosmopolites with exposure to mass media and access to external communications. Opinion leaders are individuals who are part of networks that can diffuse innovations and ideas rapidly. Rogers' diffusion theory should have significant application to diffusion of new technologies among traditional business professional groups and new and emerging technology-related occupations.

A New Integrated Model: Readiness-Acceptance-Diffusion (RAD)

TAM theorizes that the effects of external variables 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 (Venkatesh & Davis 2000). 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 &Davis 1996), the determinants of perceived usefulness have been relatively overlooked. A better understanding of the determinants of perceived usefulness would enable us to redesign organizational interventions that would increase user acceptance and usage of a new technology. Therefore, this study proposes a model that extends TAM to include additional key determinants of TAM's perceived usefulness and usage intention constructs, and to add a combination of determinants into this model that could be benefit to the model.

The technology acceptance models used to create the alternative integrated model are summarized in Table 4 below.

Table 2. The Technology Acceptance Theories Used to Create the RAD Model

Name of Model	Level of Analysis	Dependent Variables	Independent Variables	Authors
Innovation Diffusion Theory (IDT)	Group, Firm, Industry, Society	Implementation Success or Technology Adoption	Relative advantage, ease of use, visibility, result provability, image and compatibility	(Rogers 2003)
Technology Readiness (TR)	Individual	Technology-related attitudes and behaviors	Optimism, Innovativeness, Discomfort, Insecurity	(Parasuraman 2000, Parasuraman & Colby 2001)
Unified Theory of Acceptance and Use of Technology (UTAUT)	Individual	Behavioral Intention, Use Behavior	Performance expectancy, Effort Expectancy, Social Influence, Facilitating Condition, Gender, Age, Experience, Voluntariness of Use	(Venkatesh et al. 2003)

The present study set out to integrate the fragmented theory and research on individual acceptance of information technology into a integrated theoretical model that captures the essential elements of previously established models. First, we identify and discuss the previous specific models of the determinants of intention and usage of technology. Second, these models are compared. Third, conceptual and empirical similarities across models (Table 4) are used to formulate the Readiness-Acceptance-Diffusion (RAD) model (Figure 1).

RAD is a alternative model that synthesizes what is known and provides a foundation to guide future research in this area. By encompassing the combined explanatory power of the individual models and key moderating influences, RAD advances cumulative theory while retaining a parsimonious structure. From a theoretical perspective, RAD also provides a refined view of how the determinants of intention and behavior evolve over time. It is important to emphasize that most of the key relationships in the model are moderated.According to Lam, Chiang & Parasuraman (2008), the four TR constructs have distinct effects on technology acceptance, suggesting that it may be suboptimal to use the sum of the four constructs' scores (the TRI) for behavioral prediction or explanatory purposes or treat them as reflective indicators of a second-order construct.

RAD underscores this point and highlights the importance of contextual analysis in developing strategies for technology implementation within organizations. While each of the existing models in the domain is quite successful in predicting technology usage behavior, it is only when one considers the complex range of potential moderating influences that a more complete picture of the dynamic

nature of individual perceptions about technology begins to emerge. Despite the ability of the previous models to predict intention and usage, theoretical perspectives on individual acceptance are notably weak in providing prescriptive guidance to designers (Venkatesh et al. 2003).

Although the RAD model has not been empirically tested to date, the models on which it is based provide strong theoretical support for RAD, which posits determinants of intention to use technology. Moderating influences are confirmed as integrated features of the RAD model.

While the variance explained by RAD is quite high for behavioral research, further work should attempt to identify and test additional boundary conditions of the model in an attempt to provide an even richer understanding of technology adoption and usage behavior. This might take the form of additional theoretically motivated moderating influences, different technologies, different user groups, or other organizational contexts. Results from such studies will have the important benefit of enhancing the overall generalizability of RAD and/or extending the existing work to account for additional variance in behavior. Specifically, given the extensive moderating influences examined here, a research study should examine the generalizability of these findings with significant representation in each determinant.

One of the most important directions for future research is to tie this mature stream of research into other established streams of work. The integrated model presented here might inform further inquiry into the short- and long-term effects of information technology acceptance on job-related outcomes such as productivity, job satisfaction, organizational commitment, and other performance-oriented constructs. Future research should study the degree to which systems perceived as successful from a technology adoption perspective are considered a success from an organizational perspective.

CONCLUSION

Technology acceptance models generally focus on the specific characteristics of the context, the individual, and the innovation to predict future use. Whereas much research has been done in the past 35 years about the processes individuals go through to adopt and adapt to an innovation, the constant bombardment of new information technologies makes understanding the hows and whys of user technology adoption a particularly pressing issue now and in the future.

In the study of informationtechnology implementations in organizations, there has been a proliferationof competing explanatorymodels of individualacceptance of informationtechnology. Comparisons and contrasts of theories of technology acceptance of scholars are presented to identify major areas of agreement and areas of differences.The present study advances individual acceptance research by integrating theoretical perspectives common in the literatureand incorporatingmoderators to account for dynamic influences including contributor and inhibitor determinants, organizational context,user experience, and demographic characteristics.

Technology and innovations could change or alter cultures and society for better or worse, depending on the management of their introduction to society. This should encourage business professionals, educators, and policymakers to take great care with introducing innovations and technologies into societies and cultures in order to promote or avoid consequences that could last for generations.

Future research on technology acceptance may examine the consequences of technology to create a holistic understanding of how technological changes influence the organization and the individual. Whereas technology acceptance may be viewed in terms of ramp-up time, or how much time is lost in the learning of technology, researchers should also be looking at how technologicalchanges modify individuals' views of technology. Finally, thejoint modeling method that we use in this study could be useful for other studies that involve bothadoption and usage of a technology.

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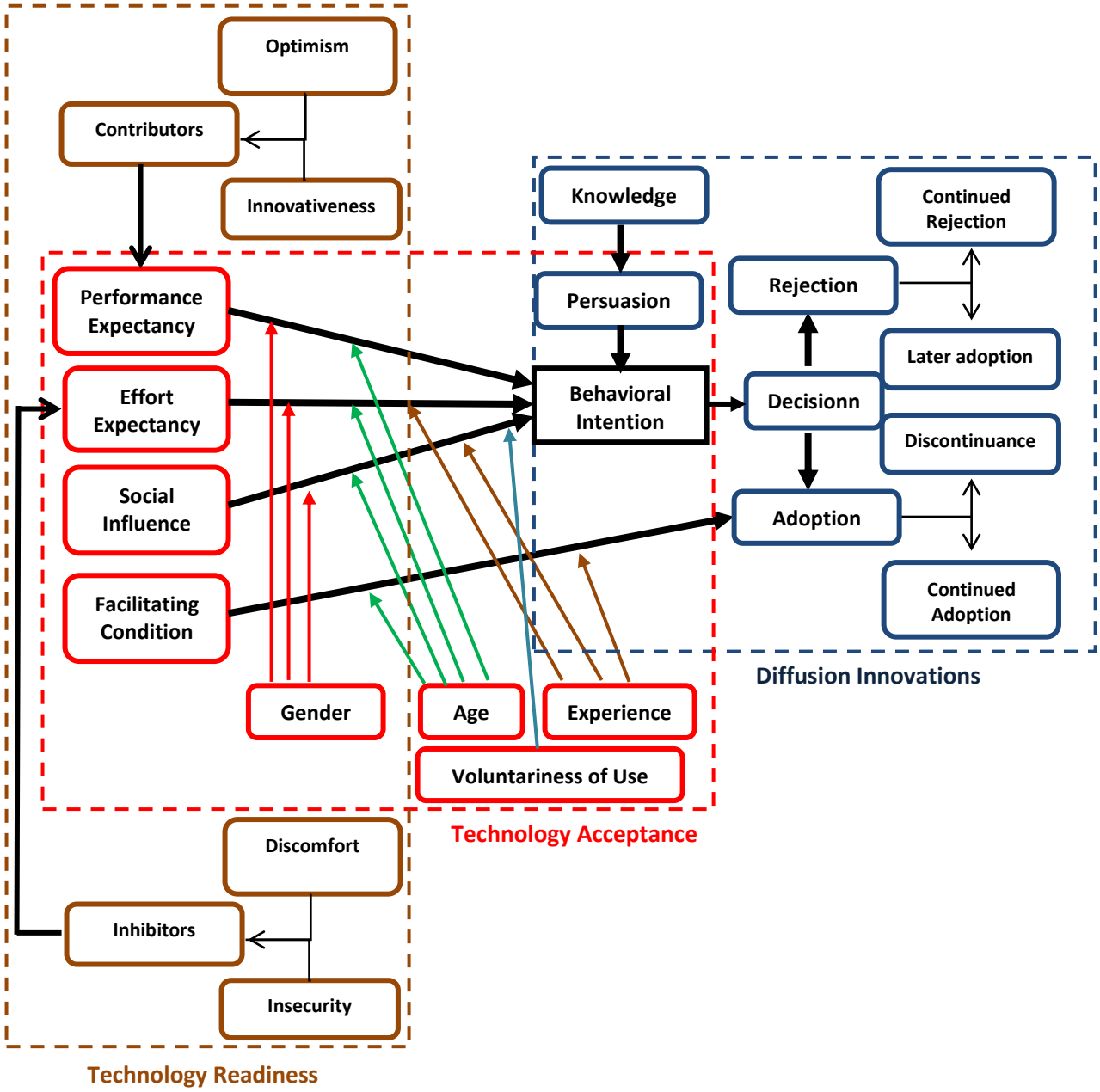

Figure 1. The Estimation of Alternative Integrated Technology Acceptance Model (Readiness-Acceptance and Diffusion/RAD Model)

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