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An Empirical Study on User Acceptance of Simulation Techniques for Business Process

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Abstract

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MA, University of Manitoba, 1979

BA, University of Ibadan, 1975

Dissertation Submitted in Partial Fulfillment

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Management

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Abstract

Non acceptance of technology may result in serious damages to organizations. For example, non acceptance of simulation technology cost Merrill Lynch Bank over $50 billion in 2008, while statistics in 2 separate studies showed that non acceptance of technology was responsible for a 57% decrease in performance level for physicians practicing in public tertiary hospitals in Hong Kong, and a 39% decrease in productivity for hotel workers in Seoul, Korea. The problem addressed in this research was non acceptance of simulation technology by project managers. This research investigated the correlation among personal innovativeness, organizational innovativeness, perceived usefulness, perceived ease of use, and intention to use simulation techniques by members of the Project Management Institute (PMI). The theory of reasoned action (TRA) and the extended technology acceptance model (TAM) served as the theoretical foundations for the study. In this quantitative, correlational survey study, data were obtained from a random sample of the PMI membership. Simple regression analysis was used to address research questions. Results indicate significant correlations of moderate strength among usefulness, innovativeness, ease of use, and intention to use simulation technology. The study contributes to positive social change by identifying factors that help companies to improve their business processes, generate more profits, create jobs, and make positive contributions to the communities in which they are located.

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Dedication

I dedicate this work to the loving memory of my late papa, Chief James Nathaniel Olaolu Ladeinde. You provided the inspiration, and encouraged me to reach for the highest level in education, the doctoral degree. Your expectation was that I would get my PhD in your lifetime, but you were not disappointed when I quit the program in 1981 before completing my dissertation. You did not query, but respected my decision and continued to show love and support, always believing in my ability to achieve this goal until the day you departed.

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To the memory of my siblings Funmilayo, Dotun, Biola, Lanre, Tokunbo, and Kola Ladeinde who are departed but never forgotten.

Finally, I dedicate this to my loving wife, Bose. Your prayers, words of encouragement, and high expectations for me not only contributed to my pursuit of a doctoral degree but also were instrumental to my success. I thank God for you, and I really love you.

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Chapter 1: Introduction

Background to the Study

Innovations in information systems technology during the last 2 decades have had major impact on organizational development and business process reengineering (BPR). In the 1990s, major changes occurred in the way business is conducted, including: increase in automation of many business processes, increased use of electronic data exchange and storage, video conferencing between main and branch offices, and use of virtual private networks (VPN) which enable employees of a company to work from home or other remote locations away from the main office.

In BPR projects, there is a growing acceptance and use of simulation software programs by companies as a decision support tool for predicting possible consequences associated with making choices between options, thereby mitigating risks of project failure. Benefits of simulation techniques are widely reported in projects involving scheduling (Duran et al., 2007; Kroon et al., 2009; Sud et al., 2009), optimization (Pajunas et al., 2007; Romo et al., 2009; Sampson, 2008), and improving liquidity risk management for revolving credit lines (Duffy et al., 2005).

However, in spite of the highly publicized successes of projects by companies that embrace use of simulation in projects, there is a serious lack of empirically based research to support a widespread acceptance of simulation by company executives and information technology (IT) professionals who work for these companies. Critics of simulation techniques such as Rochet and Rice (2009), have cautioned against use of the

simulation approach because of its paradoxical features. Rochet and Rice argued that stochastic modeling of uncertainty, as is usually the case with the simulation approach in BPR, is paradoxical because it implies knowing more than deterministic approaches regarding adequate distribution of a quantity. However, the arguments by Rochet and Rice were not designed to offer explanation or to predict user acceptance or rejection of simulation in company projects. More rational explanations for user acceptance or rejection of computer technological innovations are provided by researchers who borrowed models from social psychologists.

Researchers in social psychology have developed theories and models that validate claims of correlation between an individual's beliefs, attitudes, and behavioral intentions in the last 3 decades. The research findings in social psychology are now widely used to explain and predict user acceptance of computer technology. In this quantitative correlational study, I applied a model that was originally developed to explain why users choose to use computers, to explain behavioral intention of IT professionals to use simulation software in business projects. I focused on two main constructs:

1. Personal innovativeness.

2. Organizational innovativeness.

I investigated any relationships that may exist among personal innovativeness, organizational innovativeness, and intention to use simulation by utilizing the theory of reasoned action (TRA; Fishbein & Ajzen, 1975), and the technology acceptance model

(TAM; Davis, 1989), which provided a framework for understanding how users adopt and use technology. In developing the TAM, Davis (1989) examined the factors that influenced the decision to accept new technology, based on user *beliefs* and *attitudes* towards technology, and used the correlation between these factors to predict user *behavior*. Davis postulated that perceived usefulness of a technology and perceived ease of use of that technology combine to create an attitude about the technology that influences decisions of whether to accept and adopt the technology (Davis et al., 1989; Jaeger & Matteson, 2009). There is further discussion on Davis's hypotheses on TAM in the Theoretical Framework section.

The framework originally proposed by Davis (1989) for TAM has been used extensively to predict user acceptance of technology in different areas of specialization. Stone et al. (2007) for example, used the TAM in a quantitative research to investigate the impact of IT on individual and firm marketing performance. Jaeger and Matteson (2009) explored the relevance of the TAM for e-Government websites at the federal government level in the United States. Park (2009) and Lau and Woods (2009) utilized the TAM framework to conduct their studies on university students' behavioral intention to use e-learning.

Kwong and Park (2008) applied the TAM framework to their study on consumer intention and adoption of digital music services, while Varol and Tarcan (2009) chose to study the user acceptance of hotel information systems using the TAM framework. According to Venkatesh and Bala (2008), the use of TAM constructs for predicting user

intentions has its own benefits. A major benefit of the TAM lies in the motivation for researchers to develop a better understanding of the determinants of IT adoption and use, and the ability to devise intervention that can favorably influence these determinants such that managers can proactively implement it in their decision-making to effectively utilize a new technology.

The TAM model helped to explain individual acceptance of technology, while the extended version (TAM2) focused more on the effects of external variables on perceived usefulness and perceived ease of use. Personal innovativeness (PI), and organizational innovativeness (OI) are external variables that influence perceived usefulness and perceived ease of use, hence the acceptance of new technology by users and organizations. All the aforementioned studies point to the utility of the TAM framework in helping the audience to better understand user acceptance of a technological innovation in each case.

Problem Statement

There is a growing trend towards use of information technologies for business processes by companies that want to have a competitive edge in business (Spitler, 2005; Wright & Kaber, 2005). While recent studies show that companies benefit from use of IT for business (Alghalith, 2005; Au, 2008; Bartel et al., 2007; Kroon et al., 2009; Sirca & Choi, 2009), non acceptance of technology may constitute a problem resulting in serious damages to any organization (Fahmy, 2005; Goldstein, 2007). For example, non acceptance of simulation technology cost Merrill Lynch Bank over $50 billion (Duffy et

al., 2005; Labe, 2007). Also, statistics in two separate studies showed that non acceptance of technology was responsible for a 57% decrease in performance level for physicians practicing in public tertiary hospitals in Hong Kong (Chau & Hu, 2002) and a 39% decrease in productivity for hotel workers in Seoul, Korea (Ham et al., 2005).

Researchers in social psychology have developed tools that are used to quantitatively measure acceptance or non acceptance of technology by individuals and organizations (Davis et al., 1989; Fishbein & Ajzen, 1975; Venkatesh & Bala, 2008). Such tools have been employed in studies that sought to explain non acceptance of technology among different demographics, including administrative/clerical staff (Chau, 1996), students (Martinez-Torres et al., 2008), teachers (Yuen & Ma, 2008), healthcare professionals (Chau & Hu, 2002), online shoppers (Chen et al., 2002; Koufaris, 2002), and hotel workers (Varol & Tarcan, 2009).

However, there is a serious gap in scientific studies that sought to explain non acceptance of new technology among technology professionals, particularly project managers who oversee projects that could make or break a company depending on the outcome of a project. Finding the factors that affect decision making by these professionals could help lay the groundwork for future research and application of theories that would help companies grow and be more profitable.

Nature of the Study

Although simulation is central to the topic of this research, the focus is on user attitude toward acceptance or rejection of simulation technology in business projects.

Hence, this quantitative correlational study evaluated any differences that existed between (a) user attitudes in terms of perceived usefulness and perceived ease of use of simulation techniques, and (b) user acceptance of simulation technology for business projects. I investigated the overall attitude of users, represented by project managers from California, in determining acceptance and use of simulation as a technological innovation. According to Davis (1989), there is a correlation between user attitude and user acceptance of a technological innovation. Davis's argument is that user attitude is a function of two major beliefs: the perceived ease of use (PEOU) of a technology and the perceived usefulness (PU) or effectiveness of that technology.

Davis (1989) further hypothesized that current usage (CU) of a technology or future intention to use a technology is a demonstration of acceptance of that technology by the user. Varol and Tarcan (2009) successfully adapted the TAM to their empirical study on user acceptance of hotel information systems. Their research included a quantitative analysis of five hotels in Turkey, using innovativeness, usefulness and ease of use constructs to predict hotel workers' acceptance of computer technology.

Variables

The variables in this quantitative correlational research are personal innovativeness, organizational innovativeness, perceived usefulness, perceived ease of use, and intention to use technology. A conceptual definition of each variable is given below.

Personal Innovativeness

Personal innovativeness is defined as an individual's attitude to independently decide to experiment with new technologies (Schillewaert et al., 2005). It is a person's predisposition or attitude that reflects the person's tendency to experiment with and to adopt new information technologies independently of the communicated experience of others (Varol & Tarcan, 2009). Research by Karahanna, Ahuja, Srite, and Galvin (2002) on the effects of individual differences on usage of information systems found that personality traits play a significant role in technology acceptance process.

The implication of this finding is that an individual who has the propensity to take risks by trying out new innovations is more likely to be open-minded to the idea of accepting new technology. The definition of personal innovativeness by Karahanna et al. (2002) perceived innovativeness as receptivity to new ideas or readiness for change; that definition is in contrast to Rogers (1995), who defined innovativeness as the extent to which an individual adopts innovations earlier than other individuals. In the context of this research, the definition of personal innovativeness is in agreement with Karahanna et al. (2002) and Varol and Tarcan (2009); it is the propensity of an individual to take risks or the receptivity of an individual to new ideas and innovations.

Organizational Innovativeness

Organizational innovativeness is defined as a culture of openness to new ideas (Rogers, 1995) by company executives and employees such that decision to adopt new technology is welcome and implemented with enthusiasm (Robinson et al., 2005). It is

the propensity by an organization to be receptive and open to new ideas and innovations (Varol & Tarcan, 2009). Innovativeness, in this context, is the development of a corporate or firm culture of openness and predisposition toward new ideas and change (Karahanna et al., 2002). It plays a vital role in successful implementation of innovations introduced by the company.

According to Varol and Tarcan (2009), employees who work for an innovative organization are motivated to be more receptive and favorable to innovations in technology. Employees' cognitive behavioral perceptions of simulation techniques are directly correlated with pressures from company executives, managers, and supervisors to implement technology including simulation techniques in projects.

Perceived Usefulness

Perceived usefulness is defined as the degree to which an individual believes that using a particular system would enhance his or her job performance (Davis, 1989). According to Davis, organizations usually reward their employees for good job performance by pay raises, promotions, benefits, and other rewards. Hence, users are more likely to perceive new technology in terms of the usefulness of the technology to enhance their job performance and probability of rewards from their employers. This definition connotes value or reward in perceived usefulness.

Perceived Ease of Use

Perceived ease of use is defined as the degree to which a person believes that using a particular system would be free of effort. In contrast to the definition of perceived

usefulness, perceived ease of use is derived from an individual's desire for freedom from difficulty or great effort (Davis, 1989). The argument in this research is that an application that is perceived to be easier to use than another is more likely to be accepted by users. If simulation software is perceived to be difficult to use, there is a probability that users will not be motivated to accept or adopt the use of simulation in their projects.

Intention to Use

Intention to use is defined as self-reported indicants of system or technology use (Davis, 1989). The declared intention to use a system should not be confused with actual usage of the system. Researchers on TAM make assumption that self-declared intention to use a system often result in actual usage of the system in the future (Lee et al., 2006; Varol & Tarcan, 2009; Venkatesh & Bala, 2008).

Research Questions and Hypotheses

Legris, Ingham and Collerette (2003) showed that the TAM and its variations have been empirically proven as successful, up to 40% of cases, in predicting user intention to use technology in different contexts. There is a growing trend among corporations that adopt the use of simulation technology for business processes to report on the benefits that follow that choice. However, not all companies are persuaded to adopt simulation in their business projects. The research questions for this correlational study of randomly sampled project manager institute (PMI) members in California are

based on the following independent variables and the correlation with dependent variables on acceptance of simulation technology (Davis, 1989; Varol & Tarcan, 2009).

1. To what extent, if any, does personal innovativeness of the user relate to perceived usefulness of simulation?

2. To what extent, if any, does personal innovativeness of the user relate to perceived ease of use of simulation?

3. To what extent, if any, does organizational innovativeness relate to perceived usefulness of simulation?

4. To what extent, if any, does organizational innovativeness relate to perceived ease of use of simulation?

5. To what extent, if any, does perceived usefulness of simulation relate to the intention to use simulation?

6. To what extent, if any, does perceived ease of use of simulation relate to the intention to use simulation?

Based on the above research questions, a quantitative correlational approach was used in testing the following hypotheses.

$H1_0$: There is no relationship between personal innovativeness of the user and perceived usefulness of simulation.

$H1_A$: There is a relationship between personal innovativeness of the user and perceived usefulness of simulation.

$H2_0$: There is no relationship between personal innovativeness of the user and perceived ease of use of simulation.

$H2_A$: There is a relationship between personal innovativeness of the user and perceived ease of use of simulation.

$H3_0$: There is no relationship between organizational innovativeness and perceived usefulness of simulation.

$H3_A$: There is a relationship between organizational innovativeness and perceived usefulness of simulation.

$H4_0$: There is no relationship between organizational innovativeness and perceived ease of use of simulation.

$H4_A$: There is a relationship between organizational innovativeness and perceived ease of use of simulation.

$H5_0$: There is no relationship between perceived usefulness of simulation and intention to use simulation.

$H5_A$: There is a relationship between perceived usefulness of simulation and intention to use simulation.

$H6_0$: There is no relationship between perceived ease of use of simulation and intention to use simulation.

$H6_A$: There is a relationship between perceived ease of use of simulation and intention to use simulation.

Purpose of the Study

The purpose of this quantitative survey study was to examine the relationship between personal innovativeness and organizational innovativeness on perceived usefulness, perceived ease of use, and intention to use simulation technology. The outcome will help broaden the understanding of factors that impact the adoption and use of simulation techniques in projects, including personal innovativeness and organizational innovativeness, within the framework of the TAM.

Researchers of TAM including Venkatesh and Bala (2008) and Varol and Tarcan (2009), proposed that if researchers can develop a better understanding of the determinants of IT adoption and usage, and devise interventions that can favorably influence these determinants, managers can proactively decide on implementing the optimal interventions in order to minimize resistance and maximize effective utilization of IT. Findings in this research will have a positive effect on social change because they will enable companies to save on projects and provide more employment opportunities for the communities in which they are located. In this quantitative correlational study, I focused on the acceptance of simulation techniques from three perspectives:

1. User's perception of simulation as an effective tool in projects (perceived usefulness and perceived ease of use),
2. The organization's innovativeness in giving simulation methodologies a trial, and

3. The personal innovativeness of users in giving simulation a chance by supporting efforts by their organization to adopt simulation techniques.

There is ample literature on the benefits of simulation techniques when used to predict outcomes and mitigate risk of project failures. However, there is a gap in literature on empirical studies that examined correlation between innovativeness and perceived usefulness of simulation technology among professionals in California. This study is significant because it seeks to make a contribution to the literature on rationale for choice of simulation approach in business process projects.

Theoretical Framework

The theoretical framework for this quantitative survey research is based on the premise that innovativeness of users and organizations play a significant role in explaining behavioral intention of IT professionals to adopt and eventually use simulation techniques in business process projects. This framework is founded on the TRA and the TAM originally proposed by Davis (1989), and adapted by many researchers including Varol and Tarcan (2009), in empirical studies that examined and sought to predict users' behavioral intention to adopt and use technology.

In a research designed to predict user acceptance of computers, Davis (1989) presented two variables, perceived usefulness and perceived ease of use, as fundamental determinants of user acceptance of IT. Davis's TAM was grounded on the TRA (Fishbein & Ajzen, 1975). According to Venkatesh (2000), the TRA, which originated from social psychology, is one of the most fundamental and influential theories of human behavior.

According to Fishbein and Ajzen (1975), both the attitude towards a specific behavior and the subjective norm have an impact on behavioral intention which, in turn, determines actual behavior.

Davis (1989) argued that potential users of IT made their usage decisions based on psychological factors; their positive or negative evaluations of performing the target behavior. Davis suggested that personal attitude influences a user's behavioral intention to use technology, and the actual use of the technology. The major difference between the TRA proposed by Fishbein and Ajzen (1975) and TAM proposed by Davis (1989) is the exclusion of subjective norm in TAM as a factor that influences behavioral intention or action.

A theoretical extension of the technology acceptance model (TAM2) was developed by Venkatesh and Davis (2000). In TAM2, Venkatesh and Davis excluded the attitude component and focused directly on user perception of technology. They proposed that users of a system made their usage decisions based on their perception of how user-friendly it is, and the benefits to be derived from using the system. Further detail on the TRA and the TAM is discussed in the Literature Review section, chapter 2.

The TAM has been used widely by researchers to explain user attitude towards acceptance or usage of technology. Studies by Stone et al. (2007), Jaeger and Matteson (2009), Park (2009), Lau and Woods (2009), and Kwong and Park (2008), confirmed the usefulness and validity of applied TAM framework in helping the audience to better understand user acceptance of a technological innovation in each case. Hence, choice of

TAM is both rational and logical as the framework to use in this research to determine any relationships between personal innovativeness, organizational innovativeness and perceived usefulness, perceived ease of use and behavioral intention to use simulation technology by project managers in California.

Definition of Terms

The following is a list of terms and definitions used in this study:

Attitude: An individual's positive or negative feelings about performing a target behavior (Davies et al., 1989; Fishbein & Ajzen, 1975).

Beliefs: An individual's subjective probability that performing a target behavior will result in consequences (Davies et al., 1989).

Behavioral intention: This is a measure of one's intention to perform a specified behavior (Davis et al., 1989; Fishbein & Ajzen, 1975).

Innovation diffusion theory (IDT): Proposes that diffusion of new innovations is achieved through user adoption, which is the acceptance and continued use of the innovation by the user (Chen et al., 2002).

Motivation to comply: The drive to perform an activity.

Normative beliefs: Perceived expectations of specific referent individuals or groups (Davies et al., 1989).

Perceived behavioral control: An individual's perceptions of the presence or absence of requisite resources and opportunities (Ajzen & Madden, 1986; Mathieson, 1991).

Subjective norm: A person's perception that most people who are important to him or her think that he or she should or should not perform a behavior in question (Fishbein & Ajzen, 1975).

Technology acceptance model (TAM): Postulates two major beliefs, perceived usefulness and perceived ease of use, are of primary relevance for computer acceptance behaviors (Davis et al., 1989).

Theory of planned behavior (TPB): Postulates that a person's attitude toward a behavior is determined by his or her beliefs about consequences of performing the behavior and external controls that influence the individual (Ajzen, 1985).

Theory of reasoned action (TRA): Postulates that a person's attitude toward a behavior is determined by his or her salient beliefs about consequences of performing the behavior multiplied by the evaluation of those consequences (Davies et al., 1989).

Assumptions

Assumptions in this study included the belief that all participants were already exposed to, or have been faced with a choice to use or not use simulation in past projects. Also, participants were expected to answer the survey questions truthfully regarding their perception of simulation techniques when used in projects. There is an assumption that, because of the anonymous nature of this quantitative research survey, participants expressed their views about the organization they work for without fear of retaliation from their employers.

Limitations and Delimitations

The scope for this study was limited to project managers in California. Therefore, caution must be exercised in interpretation and generalizations made from the results of the research data. The survey instrument was administered to members of the project management institute (PMI) who agreed to take part in the study anonymously. Another limitation of the study included the fact that most survey questions were limited and closed ended, thus limiting the range of responses that could have come from respondents. The construction of survey questions could be regarded as another limiting factor because some factors that may be considered crucial to technology acceptance of simulation were omitted in the questions.

Social Change

This study is significant in many ways. First, it helps to fill the gap in literature on user acceptance of simulation as a technique in process change projects. The original TAM proposed by Davis (1989) was designed to measure user acceptance of computer technology. Subsequently, there have been variations in the application of the model to include other external variables including marketing (Stone et al., 2007), e-Government (Jaeger & Matteson, 2009), e-Learning (Park, 2009) and the hospitality industry (Varol & Tarcan, 2009). This quantitative correlational study adds to the literature on TAM by using simulation as an external variable when utilizing the TAM paradigm.

Secondly, the findings in this research, would contribute to the perceived value of simulation as a tool for risk mitigation in projects. The findings in this research, as

presented in chapter 4, did support the proposals that there is a correlation between personal innovativeness, organizational innovativeness and user perceptions of usefulness and intention to use simulation technology among project managers in California. Thus, it is rational to hypothesize further that there is a positive correlation between user and organizational acceptance of simulation and project success or risk mitigation in projects.

Finally, a major significance of this study is in researching the most efficient method for companies to reduce risk of project failure and to generate additional revenues which translate to more profit. Potential benefits include positive social change to society which manifests in more jobs, and reduced costs for consumer products because of the efficiency introduced by the optimization project utilizing simulation techniques.

Summary

Thus far, I have discussed the problem that inspired this study, and identified the purpose of the study, which was to find out any relationships that may exist between innovativeness of users and their perception of usefulness or ease of use of simulation technology for business projects. Also, I listed a series of hypotheses to test the relationship between user and organizational acceptance of simulation techniques in three different areas:

1. The correlation between personal innovativeness and perceived usefulness of simulation technology,

2. The correlation between organizational innovativeness and perceived usefulness of simulation technology, and
3. The correlation between perceived usefulness of simulation technology and intention to use the technology.

The theoretical framework that was used is the TAM (TAM) originally proposed by Davis (1989). Next, I discussed how this study used the adaptation of TAM proposed by Varol and Tarcan (2009) in their study of the hospitality industry. Assumptions were made in the study that presumed that participants were already exposed to simulation techniques or have used simulation in past projects. Limitations were discussed, including that the study was limited to project managers in the state of California.

In chapter 2, I explore in greater detail available peer-reviewed literature on TAM, upon which this study was anchored theoretically. Also, the TRA, which formed the basis for the development of the TAM is discussed in greater detail. A chronological approach is used to review the literature, starting with the TRA and TAM, then proceeding to the different modifications and adaptations of the TAM to different industries and specializations. In the discussion, alternate views and theories are examined and compared to TAM.

In chapter 3, I presented the research design and approach to this quantitative correlational study. In this chapter, I provided justification for the choice of approach, and related the chosen methodology to the problem statement. Next, I introduced the sampling frame, and the approach for data collection and analysis that was discussed.

This was followed by a description of the instrumentation or data collection tools that was used in the study. Chapter 3 closed with a discussion of measures taken to protect human participants in the study and a description of the plans for disseminating the findings of the study. In chapter 4, I presented the results of data analyses, and I made recommendations for further study in chapter 5.

Chapter 2: Literature Review

Introduction

In the past 3 decades, researchers have sought an adequate explanation for the behavioral decision-making process of individuals in adopting or rejecting usage of information systems technology (Ajzen & Madden, 1986; Jackson et al., 1997; Mathieson, 1991; Smith-McLellan & Fishbein, 2009). Theoretical models were devised to predict and provide explanations for users' intention to use or not use technology. The objective of this literature review is to discuss literature that is relevant to the theoretical framework of this research, i.e. acceptance and usage of technological innovations in information systems by individuals and organizations. In this chapter, I will discuss the basis upon which the technology acceptance model (TAM) was founded, i.e. the theory of reasoned action (TRA) proposed by Fishbein and Ajzen (1975), and the TAM originally developed by Davis (1989) including literature related to studies on the extension and replication of the model. Next, I will review variations of TAMs that have been proposed and tested by other researchers.

Theories on User Adoption of Information Technology

The theory of user acceptance of technology and its antecedent, the TRA, have their roots in theories of social psychology and the expectancy theory of behavior (Varol & Tarcan, 2009). The TAM, first proposed by Davis (1986) was grounded on the TRA proposed by Ajzen and Fishbein (1975) and the expectancy theory of behavior (Vroom, 1964). The evolution, adaptations, and relevance of these theories to the current study are

fully discussed later on in this chapter. TAM was specifically designed to predict utility of computer technology by measuring user acceptance variables. Since the theory's inception, research performed on various external variables that affect a user's attitude have consistently supported TAM's ability in explaining the correlation between individual's attitude of acceptance and actual usage of technology (Lau & Woods, 2009; Saade et al., 2008; Wang & Liao, 2008; Yuen & Ma, 2008).

The technology acceptance model (TAM; Davis, 1989; Davis et al., 1989) is most widely used in literature to predict user's behavioral intention to adopt computer usage, hence it was chosen as the primary model for this study. However, the TAM and other competing models drew their inspiration from the TRA.

Theory of Reasoned Action (TRA)

The TRA was developed under the assumption that an individual, has control over his or her behavior (Lee et al., 2006). Fishbein (1967) had proposed that the cognitive component of attitude be separated from the affective component. This separation gave rise to the concepts of beliefs, which represented the cognitive element, and attitude, which represented the affective element. This conceptualization formed the basis for the TRA (Ajzen & Fishbein, 1980; Fishbein & Ajzen, 1975). The TRA, which was grounded in social psychology, became a fundamental theory upon which subsequent theories of human behavior were constructed.

According to Fishbein and Ajzen (1975), an individual's attitude towards a specific behavior and the subjective norm of the individual both have a correlation to the

behavioral intention of the individual. Intention, in turn, determines actual behavior. Researchers use this relationship, as illustrated in Figure 1, to predict and understand human social behavior.

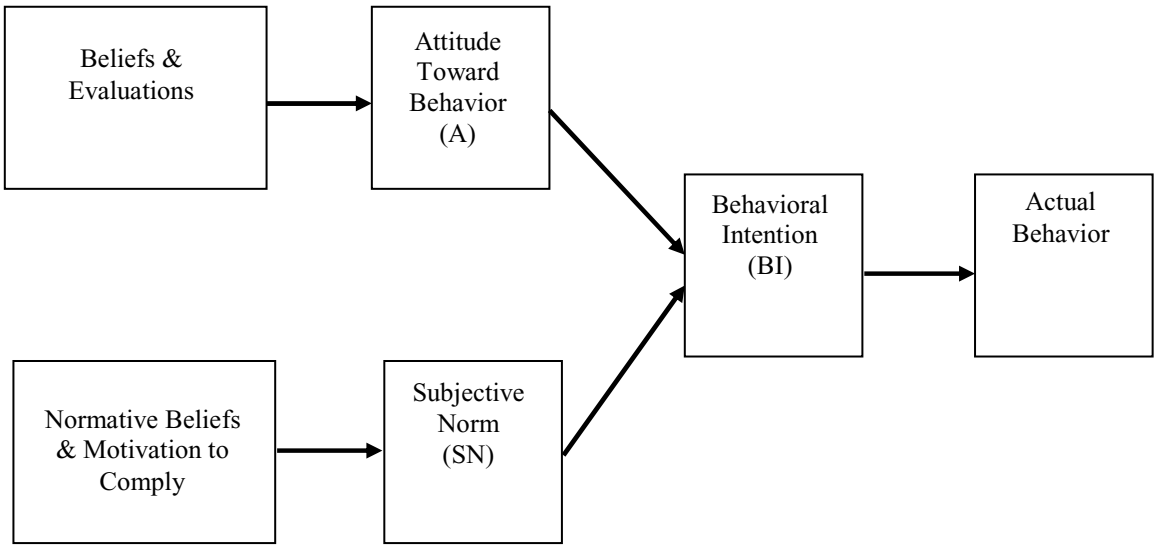

Figure 1. Theory of reasoned action model (Ajzen & Fishbein, 1980). From "User Acceptance of Computer Technology" by Davis et al., 1989, *Management Science, 39*(8), p. 984. Copyright 1989 by INFORMS. Figure adapted with permission.

A major assumption of this model is that intentions encapsulate the motivational factors that influence the behavior of an individual; thus the model indicates the extent to which people will make an effort to perform a behavior (Ajzen & Fishbein, 1980). Garg and Garg (2007) expressed the same concept in their study to measure course outcomes at the University of Botswana using TRA. They argued that the intention of a person to behave in a particular manner as a function of two determinants: the person's nature and the social influences on that person. Bulgurcu et al. (2010) researched the antecedents of

employee compliance with the information security policy (ISP) of an organization, based on the TRA. Their findings show a significant correlation between outcome beliefs about overall assessment of consequences by the employee, and the behavior of the employee to comply with the company policy.

The TRA is not limited to constructs of beliefs and attitudes of an individual, as Jeffres et al. (2008) reported in their research. They introduced communication as an external variable and predictor of an individual's behavioral intention. Drawing on data collected from a 2006 telephone survey that gauged the awareness of an organ donation campaign in Northeast Ohio, Jeffres et al. concluded that communication between individuals about organ donation increases the willingness towards favorable attitude about being an organ donor. In that context, communication was an antecedent variable to attitude toward behavior.

Findings by Jeffres et al. resonate with the view that for TRA, all factors that influence behavior do so indirectly through attitudes, subjective norms, or their relative weights (Varol & Tarcan, 2009). Peslak et al. (2010) utilized the TRA model as presented by Ajzen and Fishbein (1980) to predict user attitude toward instant messaging (IM) in business environment. Their findings show significant positive correlation between subjective norm as expressed by user attitude toward use of IM and intention to use IM. The TRA provided a sound foundation upon which Davis (1989) developed the TAM for predicting users' behavioral intention to use computer technology.

Technology Acceptance Model (TAM)

TAM, introduced by Davis (1989), is an adaptation of TRA and was specifically designed to explain computer usage behavior. In TRA, an individual's attitudes and subjective norms affect the individual's intentions, but in TAM, it is the individual's perceived ease of use and the perceived usefulness of a technology that affect intentions either directly or indirectly through attitudes (Burton-Jones & Hubona, 2005). TAM differs from TRA in that it excludes subjective norm as a factor that impacts behavior to accept or adopt technology (Mathieson, 1991; Varol & Tarcan, 2009). The goal of TAM was to provide an explanation of the determinants of computer acceptance that is general, capable of explaining user behavior across a broad range of end-user computing technologies and populations, but at the same time parsimonious and theoretically justified (Davis et al., 1989). For Davis, the TAM was meant to go beyond prediction of behavioral actions by providing explanations for those actions so that researchers and practitioners can identify reasons why a particular system may be unacceptable, and pursue appropriate corrective steps. TAM therefore provided a basis for tracing the impact of external factors on internal beliefs, attitudes and intentions (Stone et al., 2007).

Derived from TRA, Davis's original TAM posits that two independent variables, perceived ease-of-use and perceived usefulness, are of primary relevance to computer acceptance behaviors (Figure 2). It postulates that computer usage is determined by behavioral intention to use technology, but differs from TRA in that behavioral intention

is jointly determined by a person's attitude toward using the system, and the perceived usefulness of the system.

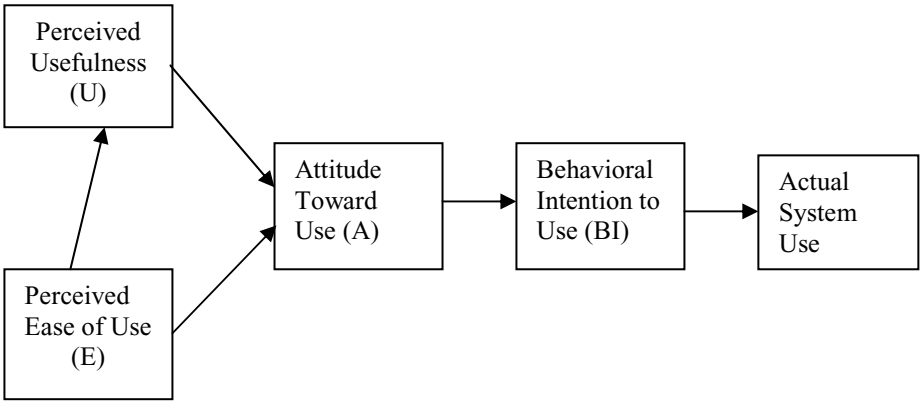

Figure 2. Technology acceptance model (TAM; Davis, 1989). From "User Acceptance of Computer Technology" by Davis et al., 1989, *Management Science, 39*(8), p. 985. Copyright 1989 by INFORMS. Figure adapted with permission.

The correlation between attitude (A) and behavioral intention (BI) is fundamental to TRA, TAM and related models presented by Triandis (1977) and Bagozzi (1981). In TAM, the individual's perceptions (E+U) of a computer system is encapsulated in the attitudes (A), positive or negative, toward the use of the system and the intention (BI) to actually use the system (Davis, 1989). The original TAM was developed to explain individual's acceptance of computer technology and the relationship to system usage. Davis developed and validated new scales for two specific variables: perceived usefulness and perceived ease of use of computer application programs. These two variables were used to develop scale items that were pretested for content validity, and

then tested for reliability in two studies involving 152 users and four application programs.

The results of these two studies showed significant correlation between perceived usefulness and current usage or self-predicted future usage, and significant correlation between perceived ease of use and current usage or self-predicted future usage (Davis, 1989). Although both studies showed a correlation between perceived usefulness, ease of use and usage or intention to use technology, perceived usefulness had a significantly greater correlation with usage behavior than perceived ease of use. This led Davis (1989) to hypothesize that perceived ease of use may actually be a causal antecedent to perceived usefulness rather than a direct determinant of technology usage.

However, it soon became obvious to the research community that other factors could be responsible for an individual's decision to use technology aside from behavioral factors that Davis (1989) already identified. An example is the notion that an employee's effort to comply with company mandates to use technology could be used as a valid explanation for acceptance and usage of technology. Davis et al. (1989), alluded to the concept of external variables influencing the original constructs in TAM while comparing the model with the TRA, a precursor to the development of the extended TAM versions (TAM2).

In the TAM, Davis (1989) focused on the effects of external variables on perceived usefulness (U) and perceived ease of use (E) in an individual's decision to adopt technology (Varol & Tarcan, 2009). Within organizational setting, the extended

TAM postulates that perception (U) by individuals within the organization may have direct effects on behavioral acceptance (BI) and use of a system, regardless of the attitude (positive or negative feelings) that may be evoked towards the system (Figure 3).

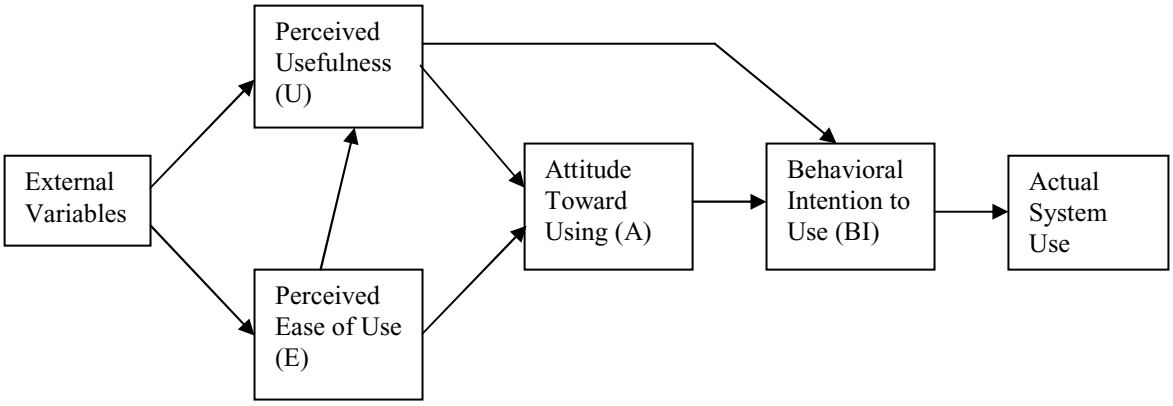

Figure 3. Extended technology acceptance model (Davis et al., 1989). From "User Acceptance of Computer Technology" by Davis et al., 1989, *Management Science, 39*(8), p. 985. Copyright 1989 by INFORMS. Figure adapted with permission.

Davis et al. (1989) conducted a longitudinal study of 107 users to assess how the TRA and the TAM predict and explain computer usage intentions in terms of attitudes, subjective norms, perceived usefulness, perceived ease of use, and related variables. In the study, user intentions to use a specific system were measured after a one hour introduction to the system. The data were then correlated with measurements of system use after 14 weeks. In presenting results for the study, Davis et al. revealed that perceived usefulness, in the form of cognitive affection by user to the design features of the system, significantly influenced intention to use. They also found that subjective norms had no

effect on intentions, as was confirmed by a later study conducted by Mathieson (1991). The significance to TAM, of findings in the study by Davis et al. (1989) was the shift to external variables as causal antecedents to perceived usefulness in explaining user acceptance of computer technology.

A comparison of the TAM to the TRA shows the idea of any direct relationship between perceptions (U) and behavioral intention (BI) runs counter to TRA. However, alternate models proposed by Triandis (1977), Brinberg (1979) and Bagozzi (1982), have provided theoretical justification and empirical evidence to buttress TAM's claim of a direct link between perception and behavioral intentions.

Vallacher and Wegner (1985) provided further insight into the rationale for theorizing such means-end behaviors in direct link between perception (U) and behavioral intention (BI) for people in organizational settings. They hypothesized that cognitive decision rules and reward system that organizations instituted, to improve work performance of their employees, act as motivational factors in overriding individual employee attitude towards personal goals and intentions. Hence, they explained the direct correlation between perceptions (U) and behavioral intention (BI) as an employee's performance to earn the rewards, pay raises and promotions promised by the company.

In Davis (1989), TAM excludes TRA's subjective norm (SN) as one of the variables that have direct effect on behavioral intentions. According to Davis et al. (1989), subjective norm may explain why employees use a system in order to comply with mandates from their superiors in a work setting. However, subjective norm is

complicated in that it does not differentiate between compliance (SN) with company rules, as represented in the study by Bulgurcu et al. (2010), and the perceptions (U) of an employee who chose to use a system because of personal benefits that was derived from the use of the system.

Extended Technology Acceptance Model (TAM2)

Venkatesh and Davis (2000) developed KAM2 (Figure 4) focusing on the link between external variables and perceived usefulness, and explaining the perceived usefulness and usage intentions in terms of social influence and cognitive instrumental process.

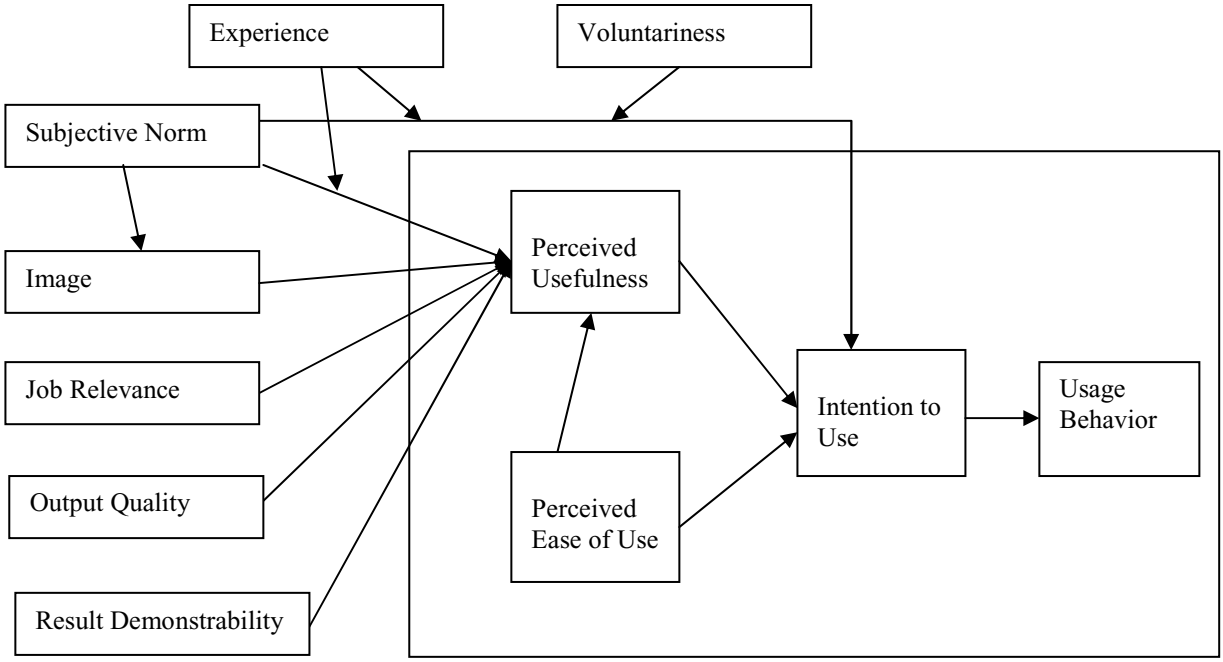

Figure 4. Extension of the technology acceptance model (Venkatesh & Davis, 2000). From "A Theoretical Extension of the Technology Acceptance Model: Four Longitudinal

Studies" by Venkatesh & Davis, 2000, *Management Science, 46*(2), p. 188.

In the study, Venkatesh and Davis (2000) examined the causal effects of mandatory versus voluntary usage of computer systems, which was theorized as compliance, on intention to use the system. The first two determinants of perceived usefulness in this model, i.e. subjective norm and image, represent social influence, while job relevance, output quality and result demonstrability represent system characteristics. Experience and voluntariness are two moderators that affect the system. This model postulates two theoretical processes, i.e. social influence and cognitive instrumental processes, to explain the effects of external variables on perceived usefulness and behavioral intention of individuals when making decisions to adopt use of computer technology.

The research involved four studies with data samples taken from employees and supervisors from a manufacturing firm, a large financial services firm, a small accounting services firm, and a small international investment banking firm. The research found that subjective norm had significant direct effect on compliance for mandatory usage contexts, but not for voluntary usage contexts. The results showed an interactive effect between job relevance and output quality in determining perceived usefulness. The relevance of these findings to computer usage behavior is that individual user's judgment about a system's usefulness is affected by the cognitive matching of the individual's job goals with the consequences of system use.

The TAM2 framework developed by Venkatesh and Davis (2000), has been widely tested over the years by researchers including Venkatesh & Brown (2001), Chen et al. (2002), Amoako-Gyampah and Salam (2004), Shang et al. (2005), Sun and Zhang (2008), and Lee et al. (2006). Their findings have validated a correlation between external variables and behavioral intentions to use technology as originally proposed by Venkatesh and Davis (2000).

In the extended TAM, organizations or companies that provide employment to users of technology were classified as external variables and causal antecedents in relationships between perceived usefulness and user's behavioral intention to use or adopt technology. Researchers who utilized TAM2 framework hypothesized a direct link between perception and behavioral intention to use technology. Correlation between the organization and behavioral intention of the individual to use technology was based on the idea that was first proposed by Vroom (1964), that within organizational settings, people form intentions (U) toward behaviors (BI) that they believe will enhance their job performance and be instrumental toward rewards in the form of pay increases and job promotions, regardless of any positive or negative attitude that may have existed towards the use of the system. In that study, Vroom hypothesized that a correlation exists between organizational innovativeness, perceived usefulness, and adoption of technology.

Notwithstanding its robustness at predicting user behavioral intention to use technology, TAM has its shortcomings; the most prominent according to Ahuja and Thatcher (2005), is the basic premise that a system user's technology acceptance

behavior can be predicted by using self-reported use-intention in the investigation. In their research, Saade et al. (2008) challenged the claims of earlier studies that validated TAM as an instrument to measure user's behavioral intention based solely on voluntary self-indicant data supplied by the user.

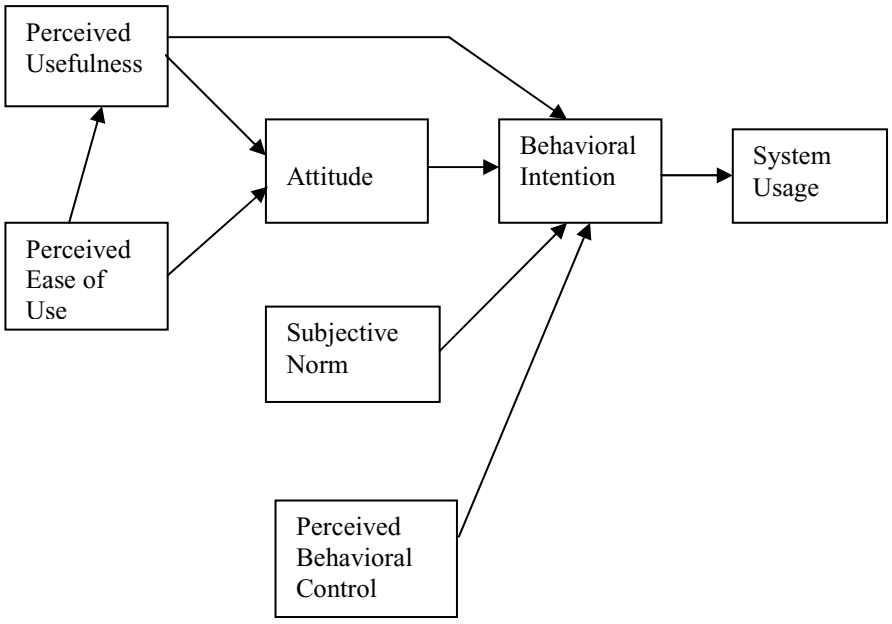

Figure 5. Integrated technology acceptance model (Saade et al., 2008). From "Is Usage Predictable Using Belief-Attitude-Intention Paradigm?" by Saade et al., 2008, *Issues in Informing Science and Information Technology, 5*, p. 593. Copyright 2008 by Issues in Informing Science and Information Technology. Figure adapted with permission.

The purpose of the study by Saade et al. (2008) was to empirically examine the validity of behavioral intention's prediction on actual system usage (Figure 5). Saade et al. queried the reliability of user-declared intention to use technology versus actual usage

action. They developed an integrated TAM with perceived usefulness and perceived ease of use, constructs from the original TAM, merged with new constructs of subjective norm and perceived behavioral control.

The research population in study by Saade et al. (2008) was approximately 306 online management information systems students from a large Canadian University, and the target system used was a multimedia entity relationship diagram (MMERD) learning tool. Saade et al. used questionnaire to gather system usage perceptions of students in the study, while at the same time setting up the e-learning system to record students' actual usage. Results showed that relationship between declared intention to use the system and actual usage of the system was very weak and insignificant.

Although the study by Saade et al. (2008) is empirical and valid, there are not enough studies to invalidate TAM's method of user-declared intention to use technology as a means of predicting actual usage. Another challenge to TAM's versatility as a universally accepted tool for predicting technology usage is demonstrated in Teo (2009) research of two variations of TAM. The first TAM model in the test had the original constructs of perceived usefulness, perceived ease of use, attitude toward use, and intention to use. The second TAM model excluded attitude as a construct, based on the findings of Davis et al. (1989) and another by Venkatesh and Davis (2000), that attitude was not significantly linked to technology usage. The findings in Teo's research confirmed earlier research findings and validated extended TAM postulates that attitude

was not significant in predicting technology usage, hence the exclusion of the construct from the extended TAM.

Theory of Planned Behavior (TPB)

I have discussed the TRA and the TAM, including extensions to TAM in order to accommodate external constructs that researchers believe have significant relationship with the original TAM constructs of perceived usefulness, perceived ease of use and intention to use technology. However, there are other competing models that researchers use to explain users behavioral intention to adopt use of technology; the most prominent of these is the theory of planned behavior (TPB). The TPB was discussed in this section only in relation to the extended TAM; the goal being to draw attention to the similarities and differences in the two approaches.

The TPB was first proposed by Ajzen (1985), and is widely used by researchers in recent studies to predict individual acceptance behavior of technologies (Cammock et al., 2009; Chen et al., 2009; Heerwegh & Loosveldt, 2009; Jung et al., 2010; Kwan et al., 2009; Pelling & White, 2009; Wang & Liao, 2008; Yao & Linz, 2008). Any discussion on the development of the TPB must start with an acknowledgement that the TPB is an offshoot of the TRA (Ajzen & Fishbein, 1980), just as the original TAM (Davis, 1989). Ajzen (1985), proposed the TPB as an extension of the TRA which he jointly developed with Fishbein in 1980. It is noteworthy that both TPB and TAM were originally centered on the attitude construct; Davis (1989) proposed that attitude was an intervening construct between the independent variables of perceived usefulness and perceived ease

of use and the dependent variable of intention to use technology. Ajzen's TPB theorized that intention to use technology could be predicted if the beliefs, attitudes, norms and control variables are known (Ajzen, 1989).

The theory of planned behavior (Figure 6) was tested in two experiments. In the first experiment, 169 undergraduates were tested for attendance of class lectures over a six week period. The second experiment utilized 90 undergraduate students. The behavioral goal for the subjects in both experiments was to get a grade of "A" in the course work. Attitudes, subjective norms, perceived behavioral control and intentions were assessed over the period of the experiments.

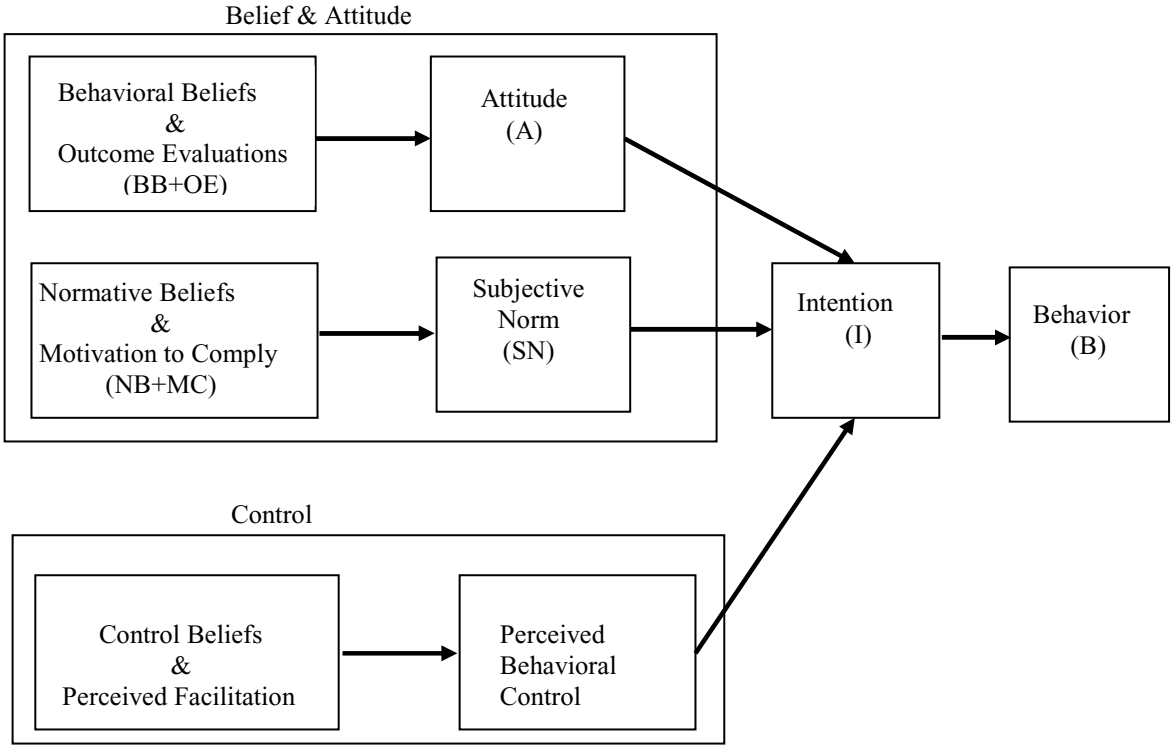

Figure 6. Theory of planned behavior model (Ajzen, 1985, 1989). From "Predicting user intentions: Comparing the technology acceptance model with the theory of planned

behavior" by Mathieson, 1991, *Information Systems Research, 2*(3), p. 175. Copyright 1991 by INFORMS. Figure adapted with permission.

Results of the experiments indicated that the theory of planned behavior permitted more accurate prediction of intentions and goal attainment than did the TRA. The results showed a correlation between behavioral control and intention to use technology; perceived behavioral control significantly impacted prediction of intentions (Ajzen & Madden, 1986). However, there was insufficient empirical evidence to support the hypothesis that a relationship existed between control, attitudes and subjective norms which constituted the other independent variables in the experiment.

A comparison of the TPB proposed by Ajzen (1989) to the TAM proposed by Davis (1989) shows that the TPB is very closely structured to the TRA as proposed by Ajzen and Fishbein (1980), while the TAM was a stripped down version of the TRA. Davis et al. (1989) found that subjective norms had no effect on intentions, as was confirmed by a later study conducted by Mathieson (1991). However, Ajzen (1989) and more recently, Saade et al. (2008) found empirical evidence of significant correlation between attitude, subjective norm, behavioral control and behavioral intention to use technology.

The theory of planned behavior is not obsolete, as evidenced by very recent studies conducted by White et al. (2008), Jing et al. (2009), Zhang et al. (2009), Wang (2009), Wong and Mullan (2009), and Yunhi and Heesup (2010), all utilizing the TPB to predict user behavioral intention to use a system. White et al. (2008) found that attitude

and perceived behavioral control were significant variables in predicting attendance at peer-assisted study sessions for undergraduate students in statistics. Jing et al. (2009) found significant correlation between the TPB variables and behavioral intention to use condoms during sex in a study of female injecting drug users who are sex workers in China.

Zhang et al. (2009) found that TPB is an appropriate theory for explaining the effect of psychosocial factors such as knowledge, attitudes, self-efficacy, subjective norms and intentions on infant feeding behaviors in China. Wang (2009) found that individual's intention to participate in physical activity was predicted by their utilitarian and self-esteem maintenance attitudes. Wong and Mullan (2009) found that TPB significantly predicted intentions and prospective behavior of breakfast consumption in a study of 96 undergraduate psychology students from an Australian University.

Finally, Yunhi and Heesup (2010) adopted a modified TPB to predict customers' intention to pay conventional hotel prices at a green hotel; they found that all TPB variables contributed significantly to customer decision-making to pay regular hotel prices at a green hotel, notwithstanding minor inconveniences such as reusing towels and using recycled products. Although some researchers who utilized the TPB decomposed the original constructs, as did Taylor and Todd (1995), Yunhi and Heesup were the first to attempt a modified version of TPB by incorporating three new constructs; environmental concerns, perceived customer effectiveness, and environmentally conscious behaviors, to the original TPB constructs proposed by Ajzen (1989). This is a

significant factor to consider in any comparison of TPB with TAM because TAM has been modified over the years with addition of new constructs as was demonstrated in discussions in the next section.

In view of the utility of the TPB as discussed above, it is rational to review a study that compared the TPB and TAM in order to determine which has an advantage over the other in predicting user intention to adopt and use a system. Two of the early researchers who attempted a comparison of TPB and TAM were Mathieson (1991), and Taylor and Todd (1995). It is important to note however, that there are no recent studies that compared the modified TAM, as would be discussed in the next section, to the TPB. Hence, both Mathieson's 1991 study and Taylor and Todd's 1995 study were discussed in this section in relation to the extended version of TAM as presented in Davis et al. (1989) and the TPB as proposed by Ajzen (1989).

Mathieson (1991) conducted a study to compare the two mostly utilized models for predicting an individual's intention to adopt technology: the theory of planned behavior (TPB) and the TAM. The goal of Mathieson's study was to find empirical evidence to support the hypothesis that one model predicts usage better than the other. Mathieson employed three criteria in the comparison:

1. the ability of each model to predict the user's intention to use technology,
2. the value of the information (i.e. prediction) provided by each model, and
3. how difficult the models are to apply.

Mathieson (1991) gathered data from 262 juniors and seniors enrolled in an introductory management course. The students used two computer programs developed by Mathieson. A total of 149 students used the TAM program while 113 students used the TPB program. In the results, Mathieson (1991) found that both TAM and TPB predicted user intention to use technology quite well. However, TAM had a slight empirical advantage over TPB in explaining the attitude of a user to adopt technology usage, and it was easier to apply, but it only supplied very general information on user's opinions about a system. In addition, Mathieson found that TPB provided more specific information on user's intention to adopt technology usage. According to Mathieson, TPB measured the system's performance on various outcomes, and identified factors that respondents feel might be barriers to system use. The TPB had an edge over the TAM in identifying groups which had the potential to influence potential users of a system. Mathieson found that TAM had an advantage in instrumentation, which was well developed compared to TPB where instrumentation had to be developed separately for each belief through pilot studies.

The utility of the theory of planned behavior is not only in its ability to explain and predict behavior, or as a competing model to the TAM, but the versatility in adapting component parts of the model to complement the TAM proposed by Davis (1986). Taylor and Todd (1995) demonstrated this in a research they conducted to compare TAM and two variations of the theory of planned behavior. The researchers used data collected from 786 students who were potential users of a resource center that provides high-end

computing and printing services. The research sample was divided into two groups: 430 experienced and 356 inexperienced users. Behavior data were based on monitoring 3,780 visits by the subjects to the resource center over a period of 12 weeks.

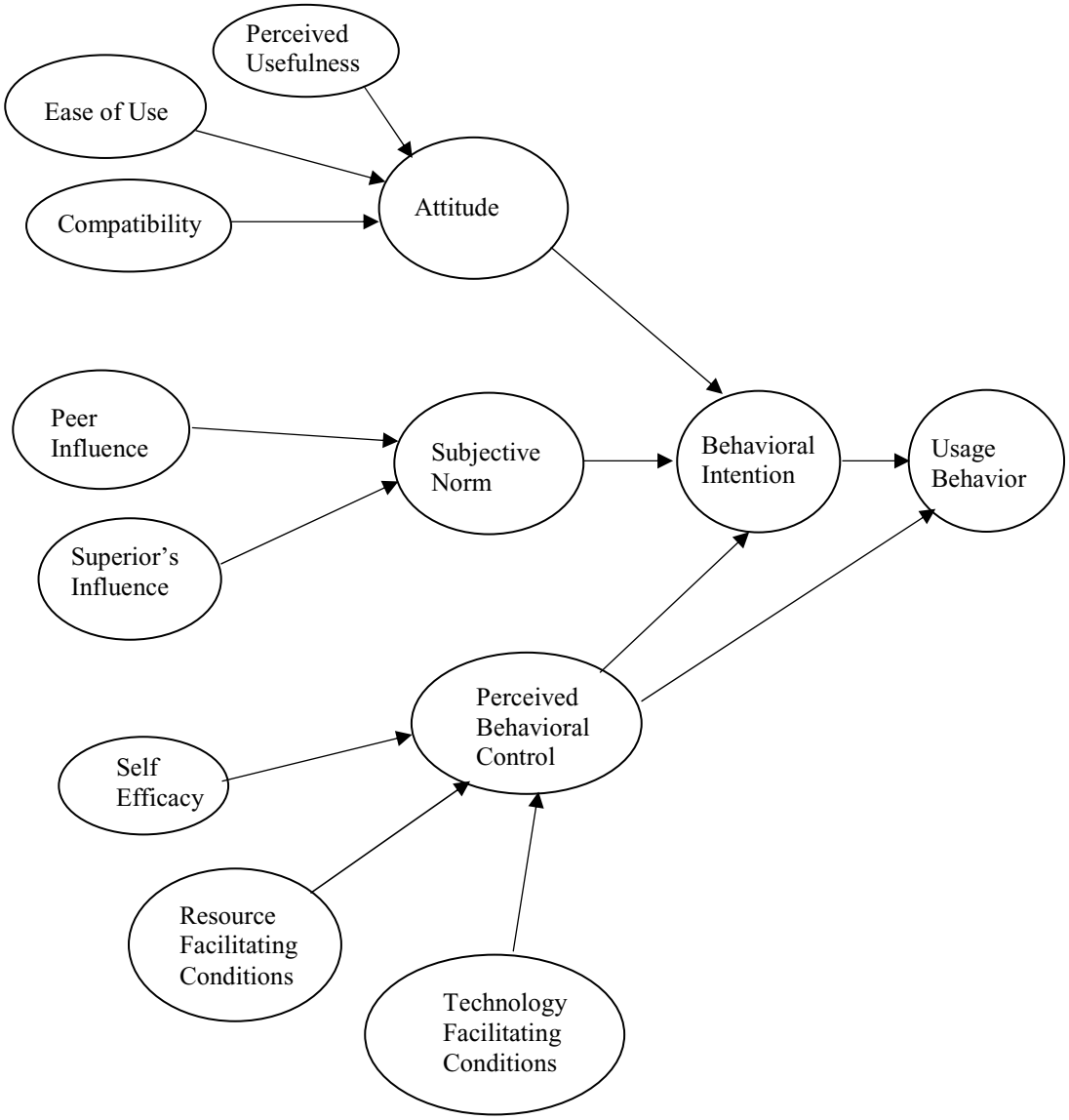

Figure 7. Decomposed theory of planned behavior model (Taylor & Todd, 1995). From "Understanding Information Technology Usage: A Test of Competing Models" by Taylor

& Todd, 1995, *Information Systems Research, 6*(2), p. 146. Copyright 1995 by INFORMS. Figure adapted with permission.

The purpose of Taylor and Todd's in this research was to assess which model best helps to understand usage of IT; the TAM, the theory of planned behavior, or the decomposed theory of planned behavior. Taylor and Todd (1995) decomposed the belief structures in the theory of planned behavior. Beliefs that influence attitude were decomposed into three; perceived usefulness, ease of use, and compatibility. Beliefs that influence subjective norms were decomposed into two; peer influence and superior's influence. Control beliefs were decomposed into three; self-efficacy, resource-facilitating conditions, and technology-facilitating conditions. Taylor and Todd (1995) found that decomposing the belief structures provided a moderate increase in the explanation of behavioral intention when compared to the TAM. Taylor and Todd were able to demonstrate that the decomposed theory of planned behavior provided a fuller understanding of behavioral intention because it focused more on factors that are likely to influence system usage.

Adaptations of Technology

The concept of decomposition that Taylor and Todd (1995) introduced into the TPB model became a motivating factor for researchers of TAM to produce variations to the TAM. Chau (1996), for example, followed the pattern introduced by Taylor and Todd (1995) by attempting to decompose perceived usefulness in the TAM. For most researchers of TAM however, the original constructs of usefulness, ease of use, and

intention to use technology, were already too simplified to be decomposed.

Rather, new constructs were introduced and incorporated into TAM from other models as researchers experimented with enhanced or augmented versions of the TAM in an effort to boost the predictive power. In this section, I discussed selected enhancements to the TAM in chronological order, and evaluated any contributions made to the TAM by each enhancement or augmentation.

Chau (1996) applied the strategy of decomposition to the TAM by decomposing usefulness into two separate constructs; near-term perceived usefulness and long-term perceived usefulness (Figure 8). Chau (1996) based his decomposed perceived usefulness constructs on expectancy theory which was first proposed by Vroom (1964), and further developed by Porter and Lawler (1968).

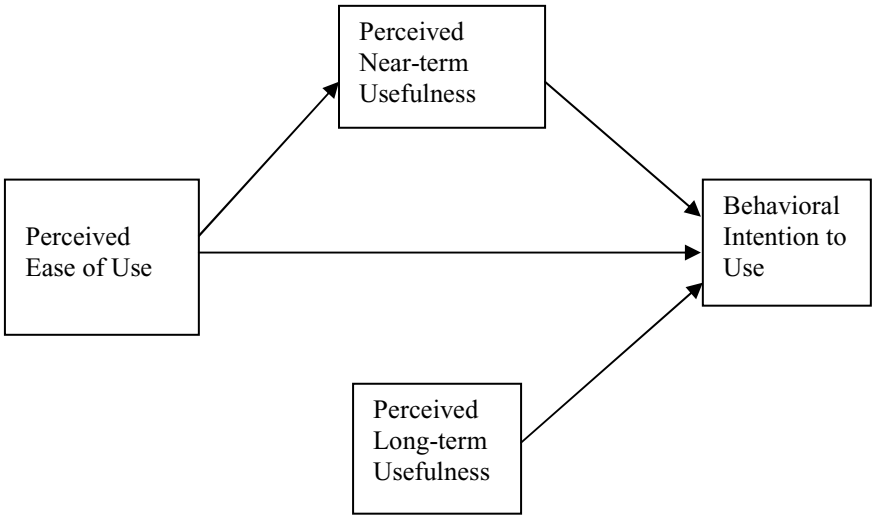

Figure 8. Modified technology acceptance model (Chau, 1996). From "An Empirical Assessment of a Modified Technology Acceptance Model" by Chau, 1996, *Journal of*

Management Information Systems, 13(2), p. 191. Copyright 1996 by M.E. Sharpe Inc. Figure adapted with permission.

In the expectancy theory, Vroom (1964) asserted that the perceived relative attractiveness of various options is related to people's beliefs about the consequences to which each option would lead, and their beliefs about the desirability of these consequences. Based on this theory, Chau (1996) proposed that perceived usefulness is a significant factor in an individual's evaluation of the consequences of their behavior, and a major determinant in the subsequent choice of usefulness and desirability of available options. Chau found inspiration in earlier empirical studies on expectancy theory (Burton et al., 1993; DeSanctis, 1983; Robey, 1979; Snead & Harrell, 1994).

According to Chau (1996), perceived long-term usefulness was hypothesized as the long-term job-related benefits of having knowledge of a particular technology such as opportunities for preferred future job assignments. In this research, Chau (1996) used empirical data collected from 285 administrative/clerical staff in a large organization. In the results to the study, Chau reported that although perceived near-term usefulness had the most significant influence on the behavioral intention to use a technology, perceived long-term usefulness had a positive correlation, although to a lesser extent, with behavioral intention to use technology. In addition, Chau found no significant relationship between ease of use and behavioral intention to use technology. The findings in Chau's study had significant implications on the strategy of decomposition for TAM; it

demonstrated that decomposition may not always add to the explanatory power of relationships between constructs.

Next, Chau and Hu (2002) changed their strategy for augmenting TAM. Since Chau (1996) did not find any significant correlation between decomposed TAM construct of usefulness and intention to use technology, Chau and Hu (2002) decided to incorporate new constructs into TAM in an enhanced model rather than decompose existing constructs. Their new design (Figure 9) featured a mix of constructs from Taylor and Todd (1995) and the original TAM constructs proposed by Davis (1989).

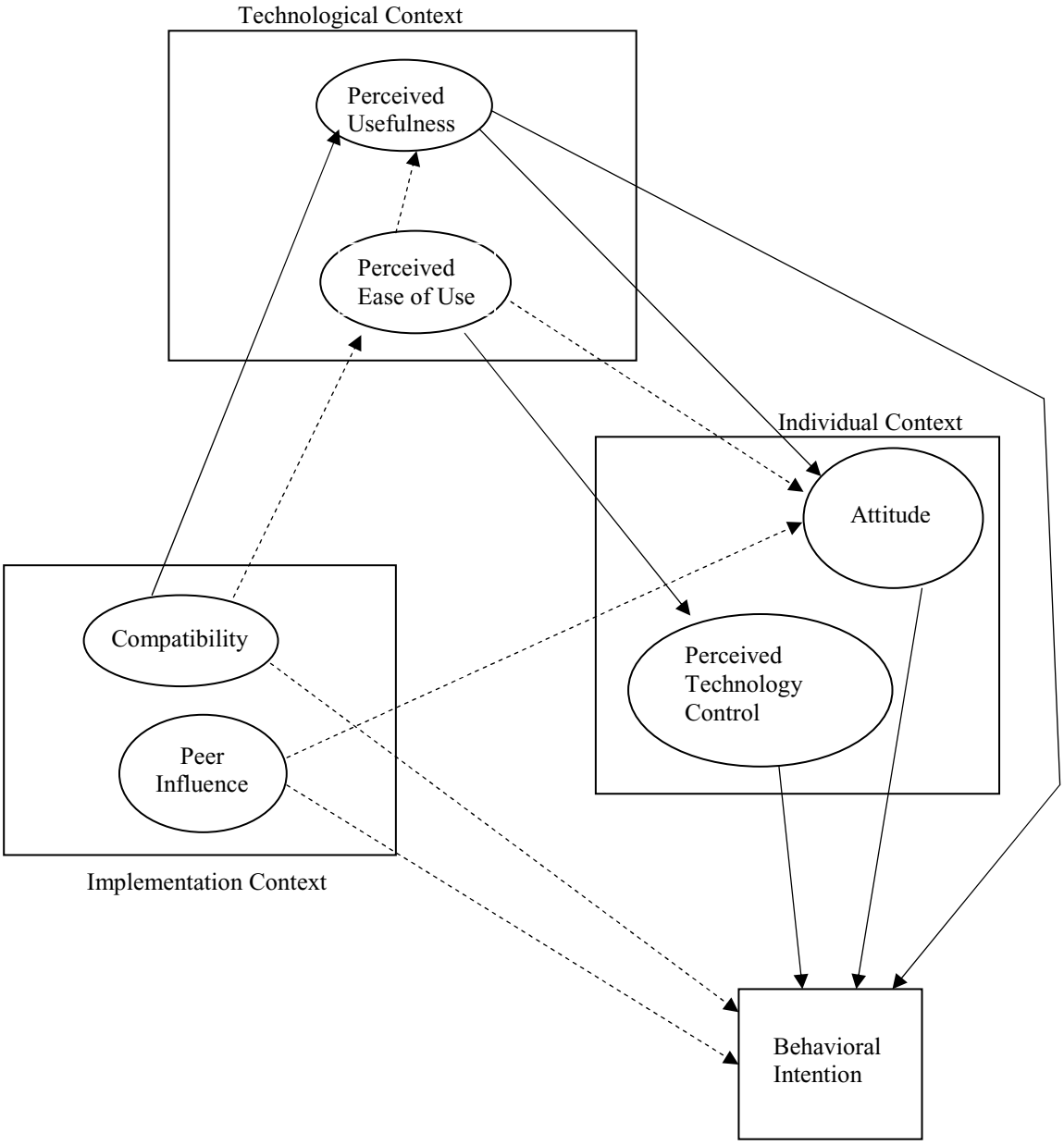

Figure 9. Decomposed-modified TAM model (Chau & Hu, 2002). From "Examining a Model of Information Technology Acceptance by Individual Professionals: An Exploratory Study" by Chau, 2002, *Journal of Management Information Systems, 18*(4), p. 198. Copyright 2002 by M.E. Sharpe Inc. Figure adapted with permission.

According to Chau and Hu (2002), the research model was based on a generic framework which the researchers developed specifically to test for telemedicine technology acceptance by physicians. The research model was then empirically evaluated using data collected from over 400 physicians practicing in public tertiary hospitals in Hong Kong. One of the objectives of this study was to find out if professionals, such as physicians, differ in their technology acceptance decision-making as compared with end-users and business managers in ordinary business settings.

Chau and Hu (2002) modified TAM by introducing compatibility, peer influence and perceived technology control; constructs that represent decomposed attitude, subjective norm and perceived behavioral control in Taylor and Todd (1995) decomposed TPB model. It could be reasonably argued that the effort by Chau and Hu (2002) to enhance the TAM with new external constructs was nothing more than a synthesis of the TRA, TPB and TAM. Chau and Hu (2002) alluded to this fact in the development of their modified TAM model.

Chau and Hu (2002) proposed that an individual professional's decision to accept a technology can be explained or predicted by factors in a hierarchical three-layer structure consisting of the individual context, the technological context, and the implementation context. The individual context focuses on essential characteristics of individual users and reasons why they accept technology use. The technological context concentrates on important characteristics of the technology under investigation. The analysis focus of the technological context includes identification of important perceived

technology attributes, together with assessments of their potential effects on individual technology acceptance.

The focus of the implementation context is on the specific professional environment where the investigated technology acceptance takes place. Analysis of the implementation context focuses on important characteristics of the underlying organizational and task-performance setting that may affect the professional's technology acceptance decision-making.

Chau and Hu (2002) measured individual professional's technology acceptance by evaluating decisions of over 400 of Hong Kong's physicians to accept telemedicine technology. In the individual context, attitude is hypothesized as a physician's positive or negative evaluative affect about using telemedicine technology. Perceived technology control refers to a physician's perceived ability to use telemedicine technology. In the technological context, the researchers evaluated telemedicine technology's usefulness and ease of use by the physicians who participated in the study. In the implementation context, compatibility refers to the degree to which the use of telemedicine technology is perceived by a physician to be consistent with their practice style or preference. Peer influence refers to a physician's perception of relevant colleagues' opinions on their use of telemedicine technology.

The new constructs of perceived technological control and compatibility in Chau and Hu (2002) is comparable to perceived ease of use in Venkatesh and Davis (2000), and compares to use of perceived relative advantage by Karahanna et al. (2002) in place

of perceived usefulness. While this may suggest decomposition of the constructs, it is important in adding that it provided an alternate strategy to TAM for predicting user intention to use a system.

Chau and Hu (2002) found that perceived usefulness was the single most significant determinant of physicians' acceptance of telemedicine technology. There was a high correlation between a physician's attitude and behavioral intention to use telemedicine technology. There was little empirical evidence to support a relationship between perceived ease of use and attitude. However, there was evidence to support a strong correlation between perceived ease of use and perceived technology control. Also, Chau and Hu (2002) reported that compatibility had a significant impact on perceived usefulness, but not on perceived ease of use or behavioral intention to use telemedicine technology by physicians in the study. Finally, Chau and Hu (2002) reported that peer influence had no significant effects on either attitude or intention to use telemedicine technology.

The significance of the findings by Chau and Hu (2002) was that professionals, such as physicians, appeared to be pragmatic in their decision-making on technology acceptance, largely anchoring their acceptance decisions more on the usefulness of the technology rather than in its ease of use. The physicians in the study expressed considerable concerns about the compatibility of the new technology with their practices, and placed less importance on controlling technology operations or peers' opinions about using the technology. The high level of skill that physicians already had as a result of

their professional training was offered as a possible explanation for choosing compatibility over ease of use in their decision-making to accept use of new technology. The researchers suggested that learning to use new technology should not pose any problems to professionals, as it did for ordinary users in earlier studies, because of their education and training. The results confirmed prior TAM research (Chau, 1996; Davis, 1989) that found that perceived usefulness was more significant in predicting intention to use technology than perceived ease of use.

Following after Chau and Hu (2002), compatibility started gaining focus as an independent construct that has significant relationship with perceived usefulness and predicting intention to use technology in TAM. Chen et al. (2002) were among early researchers who focused more on the relationship between perceived usefulness and compatibility in predicting behavioral intention of users to adopt technology. Other research studies that utilized compatibility as an independent construct in TAM include Chang and Tung (2008), Saeed and Muthitacharoen (2008), Ryu et al. (2009), Hernandez et al. (2010), and Koenig-Lewis et al. (2010). However, the study conducted by Chen et al. (2002) was chosen for further discussion in this section because it was a pioneer study that not only introduced compatibility as a new construct, but combines the TRA, the innovation diffusion theory, and the TAM, to propose a new hybrid TAM.

In a study designed to find out what enticed a consumer to shop online, Chen et al. (2002) confirmed that perceived usefulness and compatibility are significant constructs in predicting users' behavioral intentions to use technology. The researchers

conducted a survey of 253 online consumers, and utilized two well-established theories; the TAM and the innovation diffusion theory (IDT) to explain factors that determine a consumer's acceptance and use of virtual stores. Proponents of innovation diffusion theory argue that diffusion of new innovations is achieved through user adoption, which is the acceptance and continued use of the innovation by the user (Chang & Tung, 2008).

The model that Chen et al. (2002) developed to explain user acceptance of online stores was a synthesis of the TRA, the TAM and the innovation diffusion theory (IDT). Central to the model are constructs that originated with TAM; perceived usefulness, perceived ease of use, attitude, and behavioral intention to use technology. Chen et al. (2002) introduced compatibility as a construct that could be used to predict individual behavioral intention to accept and use technology. Unlike Taylor and Todd (1995) or Chau and Hu (2002), Chen et al. (2002) adopted a more simplified approach to enhance the TAM. In the study, Chen et al. (2002) hypothesized that there is a correlation between compatibility of a system and a consumer's attitude toward using a virtual store.

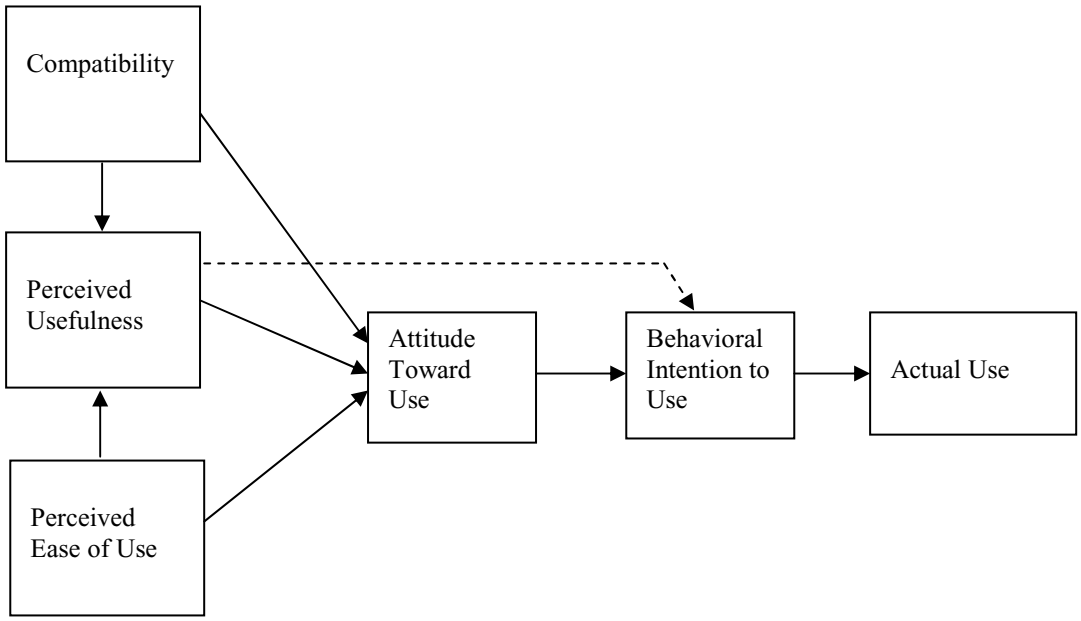

Figure 10. Modified TAM with compatibility as construct (Chen et al., 2002). From "Enticing Online Consumers: An Extended Technology Acceptance Model" by Chen et al., 2002, *Information & Management, 39*, p. 709. Copyright 2002 by Elsevier Science B.V. Figure adapted with permission.

Of the 1,865 web users who were invited to take the online survey for this research, only 253 responses were found to be complete and usable; a response rate of 13.6%. Results of the study confirmed prior research findings that TAM is useful in predicting user behaviors in the business-to-consumer electronic commerce context. Chen et al. (2002) found that compatibility, perceived usefulness and perceived ease of use are the primary determinants of consumer attitude towards using virtual stores. Both compatibility and perceived ease of use had significant influence on perceived usefulness, but the direct impact of perceived usefulness on behavioral intention to use technology was found to be insignificant. However, compatibility, perceived usefulness, and

perceived ease of use all had an indirect impact on behavioral intention to use technology through the attitude construct (Chen et al., 2002). This finding is inconsistent with findings of TAM researchers such as Venkatesh and Davis (2000), Kwon et al. (2007), Sun and Zhang (2008), and Varol and Tarcan (2009), who claimed that attitude was not significant in predicting behavioral intention to use a system.

The next study of interest in the review of hybrids to the TAM is by Koufaris (2002). Koufaris's research is important because it pioneered the introduction of multiple independent constructs into TAM (Figure 11).

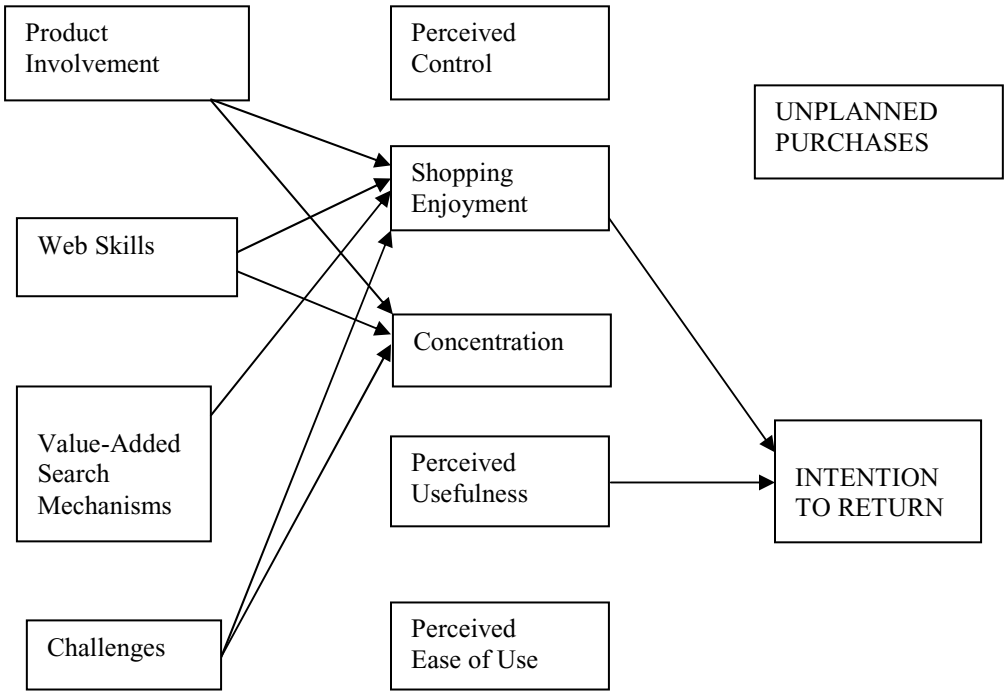

Figure 11. Extended TAM (Koufaris, 2002). From "Applying the Technology Acceptance Model and Flow Theory to Online Consumer Behavior" by Koufaris, 2002, *Information Systems Research, 13*(2), p. 213. Copyright 2002 by INFORMS. Figure adapted with permission.

Koufaris (2002) explored the effects of multiple variables on behavioral intention in his study of online consumer behavior. Koufaris' model shared one thing in common with Chen et al. (2002); it was a synthesis of the TAM and the innovation diffusion theory (IDT). Unlike Chen et al. (2002), Koufaris (2002) introduced more variables including shopping enjoyment and concentration, both elements of IDT and flow theory, into his extended TAM. Chen et al. (2002) had observed that IDT and flow theory, which focuses on the emotional and cognitive responses of individuals, were not suitable for measuring attitude and behavioral intention to use technology because the constructs are too broad to operationalize. That is a critical point that would be taken into consideration in the choice of which model to use for analysis in this quantitative research, as would be discussed in greater detail in chapter 3.

Koufaris (2002) hypothesized that online consumer's behavioral intention to return was same as intention to use technology. The introduction of emotional constructs, such as shopping enjoyment, is supported by earlier research on extended TAM including Davis et al. (1992), which explored the effects of extrinsic and intrinsic motivations to predict intention to use computer in the workplace. Results of the study found that both enjoyment and perceived usefulness had significant influence on intention to use computers.

In Koufaris (2002) study, shopping enjoyment was defined as a common measure of flow which is the level of intrinsic enjoyment of an activity, similar to the emotional

response of pleasure from environmental psychology. Koufaris (2002) examined the impact of shopping enjoyment on attitude and intention to return to an online shopping website. Results of the study by Koufaris (2002) showed that both enjoyment of the shopping experience and perceived usefulness of an online store's website had significant impact for a new customer's intention to return. The IDT flow variable of concentration showed no significant impact on intention to return. When tested alone without the IDT flow variables of shopping enjoyment and concentration, TAM's perceived usefulness explained 49% of variance of intention to return; a validation of the robustness of TAM in predicting user intention to use technology (Koufaris, 2002).

Recent Studies

In this section, I discussed more recent research studies that are significant in the evolution of hybrid TAM. In the review of selected literature, the focus of discussion was on the unique contribution that each contemporary research has made to the evolution of TAM, making the model more robust for predicting user intention to use technology. Also, the discussions provided a rationale for the choice of TAM model that was presented in chapter 3 for use in this quantitative research. Recent studies that were discussed in this section include Kwon et al. (2007), Sun and Zhang (2008), and Varol and Tarcan (2009).

The significance of Kwon et al. (2007) to the evolution of the TAM as a model for predicting intention to use technology is in the introduction of variables from

neuropsychology to the original model proposed by Davis (1989). Kwon et al. (2007) conducted a study to empirically examine user acceptance of context-aware services such as Global Positioning System (GPS) based telematics system and location-based commerce using self-efficacy, personal innovativeness and perceived sensitivity on contextual pressure as constructs in their amended TAM model (Figure 12).

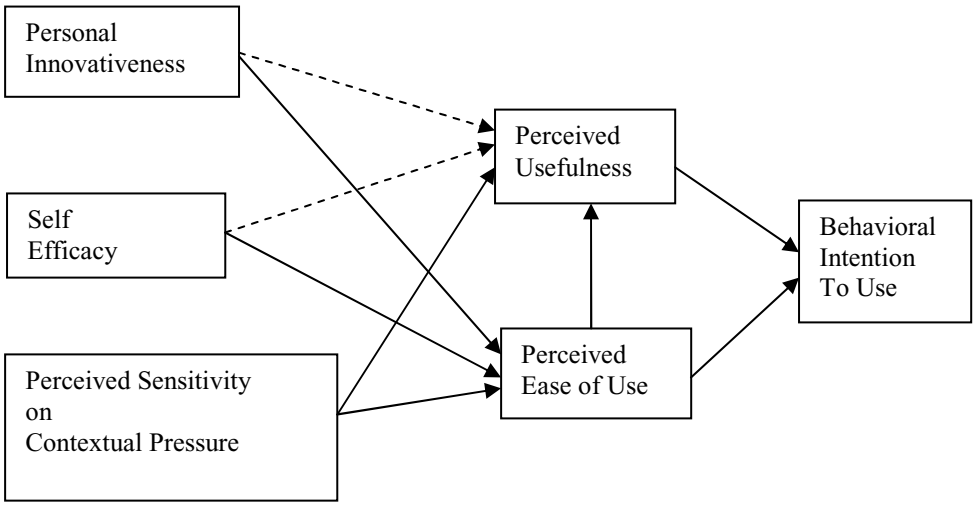

Figure 12. Amended TAM and construct from neuropsychology (Kwon et al., 2007). From "User Acceptance of Context-Aware Services: Self Efficacy, User Innovativeness and Perceived Sensitivity on Contextual Pressure" by Kwon et al., 2007, *Behaviour & Information Technology, 26*(6), p. 489. Copyright 2007 by Taylor & Francis. Permission granted for individual use.

This study is unique because it was the first study to introduce perceived sensitivity on contextual pressure (PSCP), a construct that is theoretically rooted in neuropsychology, into a modified TAM research model. The survey population for the study was selected from managers and information systems expert in Korean companies,

and business students at a major Korean University. Measurements for all variables were developed from instruments used by prior researchers, with slight modifications to fit the context of the context-aware service in this study.

Kwon et al. (2007) validated earlier research by psychologists on the PSCP construct. They found a strong correlation between a user's perceived sensitivity on contextual pressure (PSCP) and perceived usefulness; and a strong correlation between PSCP and perceived ease of use. Researchers in psychology traditionally view individuals with higher neuroticism as being more sensitive to stress. Based on this premise, Kwon et al. (2007) hypothesized that such individuals with higher neuroticism would be more sensitive to contextual pressure. Therefore, if a person has a higher PSCP, he or she would be more likely to perceive context-aware services very hard to use, and hence perceive a decreased usefulness for context-aware services.

In this study, Kwon et al. (2007) validated the findings of other researchers that TAM could be amended with addition of constructs from other disciplines in order to explain individuals' behavioral intention to adopt a system. The construct of sensitivity introduced by Kwon et al. (2007) is complex to measure, and this could pose a major problem to a research on TAM; Davis et al. (1989) and Bulgurcu et al. (2010) expressed similar concern about measurement for subjective norm in the TRA. However, Kwon et al. (2007) made a significant contribution to the evolution of hybrid TAM as a tool for predicting users' intention to use technology.

Another significant enhancement came in the introduction of two affect factors to the TAM by Sun and Zhang (2008). Affect is an umbrella concept for a set of more specific mental processes including emotions, moods and attitudes (Bagozzi et al., 1999). Affects, emotions, moods, and attitudes are complicated terms which have been used inconsistently in literature. According to Bagozzi et al. (1999), conceptual definition of affect factors is important, however the operationalization of the term provides the key to measurement of the construct; hence the true interpretation of the variable in the context that it was used.

Sun and Zhang (2008) introduced computer playfulness and perceived enjoyment as variables in their modified TAM model (Figure 15). The operational definition given for computer playfulness in the study was broad and vague, but the construct has been validated by earlier research studies on users' interactions with computers (Compeau & Higgins, 1995; Karahanna et al., 2002; Koufaris, 2002). Sun and Zhang (2008) defined computer playfulness as an enduring predisposition to respond to stimuli across situations; an individual characteristic representing a type of intellectual or cognitive playfulness, and imaginatively with microcomputers.

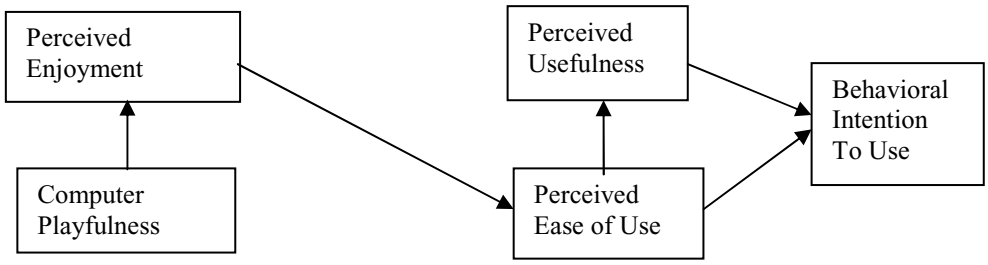

Figure 13. Amended TAM and affect factors (Sun & Zhang, 2008). From "An Exploration of Affect Factors and their Role in User Technology Acceptance: Mediation

and Causality" by Sun & Zhang, 2008, *Journal of the American Society for Information Science and Technology, 59*(8), p. 1254. Copyright 2008 by John Wiley & Sons, Inc. Permission granted for individual use.

Sun and Zhang (2008) designed four different models to empirically test for the relationships that may exist between computer playfulness, perceived enjoyment and perceived ease of use, in order to fully understand users' behavioral intention to adopt technology. Based on the results of the research, Sun and Zhang (2008) maintained that computer playfulness and perceived enjoyment are not independent antecedents of perceived ease of use; empirical evidence from the research shows that perceived enjoyment mediates computer playfulness' impact on perceived ease of use. Results of the research validated the hypothesis that no direct relationship exist between the affect factors and behavioral intention to use technology.

Sun and Zhang (2008) confirmed findings of prior researchers such as Davis et al. (1989), Mathieson (1991), Shih (2004), and Robinson et al. (2005) that a relationship exists between perceived ease of use, perceived usefulness and behavioral intention to use technology. The significance of the research by Sun and Zhang (2008) to hybrid TAM is in shifting focus to antecedent factors that play significant roles in predicting users' behavioral intention to use technology.

The next construct that would be reviewed is innovativeness, a construct that was developed under the innovation diffusion theory and utilized in relation to acceptance of IT by Agarwal and Prasad (1998), and Varol and Tarcan (2009). The research by Varol and Tarcan (2009) is relevant to this quantitative study because it is recent, and context-

specific; generalizing on innovativeness construct in relation to the hotel industry and behavioral intention of hotel employees in Turkey to adopt new technology.

Varol and Tarcan (2009) utilized a synthesis of the theories proposed in TAM2 (Venkatesh & Davis, 2000), and TAM3 (Venkatesh & Bala, 2008) in a study they conducted to empirically validate user acceptance of hotel information systems in Turkey. The researchers utilized an extended TAM with innovativeness as construct, to enhance their extended TAM.

In an earlier study, Rogers and Shoemaker (1971) and Rogers (1983) conceptualized innovativeness as a construct in the field of marketing, characterizing individuals as innovative if they are early to adopt innovation before others. The implication of their definition was that populations were categorized into innovators and non-innovators depending on the time of adoption of an innovation. Midgley and Dowling (1978), and subsequently Flynn and Goldsmith (1993) challenged this view arguing that innovation should be conceptualized at a higher level of abstraction, and the construct should be explicated from the observable behavior (Midgley & Dowling, 1978). Goldsmith and Hofacker (1991), and subsequently Flynn and Goldsmith (1993), proposed a measurement for innovativeness arguing that definition of the construct needs to be domain-specific, and should be measured directly through self-report in a manner similar to measurement of attitudes and other personality variables. Based on these arguments, Agarwal and Prasad (1998) adapted the construct of innovativeness to the domain of IT,

defining personal innovativeness as the willingness of an individual to try out any new IT.

Varol and Tarcan (2009) utilized the construct of personal innovativeness as defined in Agarwal and Prasad (1998) to develop a TAM research model that utilized two constructs; personal innovativeness and organizational innovativeness, to explain the behavioral intention of hotel employees to use new technology. Personal innovativeness was defined as a person's predisposition or attitude reflecting his/her tendency to experiment with and to adopt new information technologies independently of the communicated experience of others (Varol & Tarcan, 2009).

According to this definition, individuals who are innovative tend to take risks by exploring or trying out new innovations for the fun of doing it. Varol and Tarcan (2009) made a distinction between the construct of personal innovativeness as used in the study, and innovativeness as a construct used by Rogers (1983) in his innovation diffusion theory. Roger's definition of innovativeness is the extent to which an individual adopts innovation before other individuals; a behavioral act, rather than an attitude or openness to accept change as defined by Agarwal and Prasad (1998), Midgley and Dowling (1978), and Flynn and Goldsmith (1993).

Organizational innovativeness was defined in like manner; as the perception of openness to new ideas by employees of an organization, which eventually develops as an aspect of the organization's culture and forms the nucleus of organizational drive to successful implementation of innovations (Varol & Tarcan, 2009). It is a motivating

factor for the employee of an organization to be more receptive and have positive perception of technological innovations introduced by the organization. According to Varol and Tarcan (2009), organizational innovativeness may be explained as subjective norm; the perception of general social pressure by an employee to perform or not to perform a particular act. Hence, individuals are more likely to perform an act if they perceive the existence of social pressure from salient referents, including superiors and peers, to perform that act (Varol & Tarcan, 2009).

Varol and Tarcan (2009) decomposed organizational innovativeness construct into two for measurement; the first part measured supervisor support while the second part measured communication efficacy within the organization (Figure 14). Data were collected from 396 staff from 19 hotels using self-administered questionnaire. Likert-type scales were used for all constructs in the model, while Cronbach's alpha reliability measures were used to compute values for internal consistency.

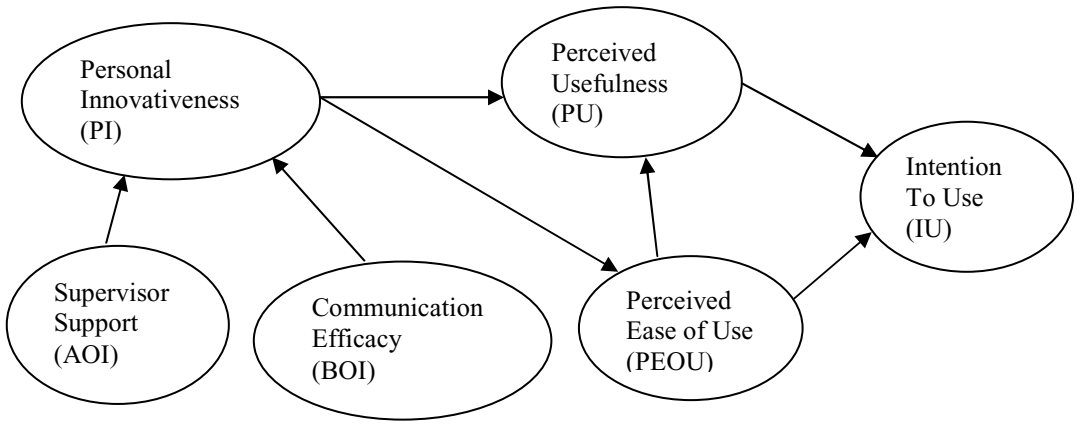

Figure 14. TAM with decomposed innovativeness constructs (Varol & Tarcan, 2009). From "An Empirical Study on the User Acceptance of Hotel Information Systems" by

Varol & Tarcan, 2009, *Tourism, 57*(2), p. 124. Copyright 2009 by Institut za Turizam. Figure adapted with permission.

Findings from the research conducted by Varol and Tarcan (2009) validated earlier findings by TAM researchers, that the constructs of perceived usefulness and perceived ease of use were perfect fit for predicting user's intention to adopt use of technology. The implication of this finding is that supervisor support and communication efficacy may impact individual's perception of usefulness or ease of use of a newly introduced technology only if the individuals have a predisposition to change and are willing to take risks in trying out new technology (Varol & Tarcan, 2009).

Other recent research studies on TAM include Shin (2009) who categorized the independent variables in TAM into intrinsic and extrinsic constructs, and Quan et al. (2010) who utilized trust construct of credibility and resource construct of perceived cost.

The significance of the research studies discussed thus far is that, for research in TAM, variations in the model and introduction of new constructs to the original TAM could actually be more advantageous to the study on acceptance of technology given certain circumstances. In view of the discussions in this chapter about research findings of researchers who validated the use of TAM constructs in predicting user intention to adopt and use technology, it is rational that I utilize the TAM method of user-declared intention to use simulation technology in this quantitative survey research.

Summary

In this chapter, I discussed existing literature on adoption of information systems technology by individual users. The TRA was reviewed as an antecedent to the TAM, which is the main focus for this study. The original TAM that was proposed by Davis (1986) was discussed with its basic constructs; perceived usefulness, perceived ease of use, and intention to use technology. Extensions to the original model was discussed with special focus on TAM2 (Venkatesh & Davis, 2000), with the increasing blend between TAM and the theory of planned behavior (TPB) first proposed by Ajzen (1985).

Further discussions on extended TAM focused on research studies by Chau (1996), Chau and Hu (2002), Chen et al. (2002), Koufaris (2002), Kwon et al. (2007), Sun and Zhang (2008), and Varol and Tarcan (2009). These studies utilized variations to explain the effects of independent constructs on mediating constructs and behavioral intention of an individual to adopt usage of computer or information systems technology.

In chapter 3, I will discuss in greater detail the research methodology used in the study; outlining the research design, sampling frame, methods of data collection and analysis, and the instrumentation or data collection tools.

Chapter 3: Research Method

Introduction

The literature reviewed in chapter 2 included a limited number of empirical research studies addressing the relationship between perceived usefulness and other independent variables on behavioral intention of an individual to use computer technology. Although empirical evidence were presented to substantiate claims of a causal relationship in many of the studies, the theoretical and empirical evidence that support the application of TAM to explain acceptance and usage of simulation techniques by professionals and organizations was almost nonexistent. The aim of this quantitative survey research was to examine empirically the connection between organizational innovativeness, individual innovativeness, and intention to use simulation technology.

Discussions in this chapter will focus on the rationale for and the design of a quantitative research that utilizes a Likert-type scale survey-based instrument, to address the research questions and related hypotheses in this study. Also, the chapter includes discussions on the sampling frame, the population from which the sample was drawn, the sampling method, sample size, eligibility criteria for study participants, and the characteristics of the selected sample.

Next, the methodology for data collection and analysis will be discussed. This will include the type of measurement that was used for each variable in the study, statement of hypothesis related to the research question, description of the analytical tools and data collection processes used in the study. That will be followed by a description of

instrumentation and materials used in the study. Finally, the chapter ends with description of measures taken to protect human participants in the study.

Research Design and Approach

Quantitative survey research was chosen as the most effective approach to this study. According to Smeyers (2008), in quantitative research, one typically looks for a distribution of variables such as the number of cases with specified characteristics, and for explanations which can be of a deductive-nomological kind incorporating universal laws. Explanations in quantitative research could be of an inductive nature which employs statistics (Smeyers, 2008, p. 692). Babbie (2001) defined quantitative analysis as the numerical representation and manipulation of observations for the purpose of describing and explaining the phenomena that those observations reflect. Advocates of quantitative methods usually appeal to the qualities of mathematics as a precise, unambiguous language that can extend ons's powers of deductive reasoning far beyond that of purely verbal methods (Sayer, 1992).

Singleton and Straits (2005) identified four major strategies for conducting social research: experiments, field research, surveys, and use of available data. Singleton and Straits pointed out that the nature of a research problem determines which research design or strategy to use, including the possibility of combining two or more strategies. When the major objective in a research is to investigate the causes of phenomena, then an experimental research design would be appropriate for the research. According to Singleton and Straits, experimental research involves systematic manipulation of

independent variable(s), followed by observation of the interactions to determine if there are correlations with the dependent variable (p.7). Experimental research would require collection of data at intervals over a long period of time. For this reason, experimental design was not the choice for this study.

Field research strategy requires that the researcher be immersed in a naturally occurring set of events in order to gain firsthand knowledge of the situation under study (Singleton & Straits, 2005, p.9). Given the nature of the research problem for this study, adopting this design would have required that the researcher be present in the companies to observe and report on changes in employee perceptions of usefulness and intention to use simulation in projects. That was not feasible for this study, given the obstacle posed by reluctance of companies not willing to grant permission to an outsider to observe or survey their employees, the time constraint to finish the study, and the high costs that would be needed to finish the research. In addition, company executives may not be persuaded to cooperate because it may expose company secrets to an outsider.

In a study conducted to find out perceptions of individuals who shop online, Koufaris (2002) expressed his frustration regarding companies that would not allow researchers to conduct surveys with their customers for fear that company secrets might be compromised. He observed that while non participation of companies being surveyed may pose a limitation to the study, it should not compromise the generalizability of the study provided the researcher found other unobtrusive ways to collect data. Restrictions to data collection, such as that mentioned in Koufaris's study, is common to other

researchers' experience when conducting a study that utilizes employees or customers as subjects. For these reasons, field research is not suitable for this study.

A research design using available data, involves use of existing data that have been generated for purposes other than those for which the researcher is using the data (Singleton & Straits, 2005, p.10). There are no existing data that would supply information required for analysis to explain the research questions raised in this study. The nature of this research requires that new data be collected to sample the self-reported behavioral attitude of professionals when faced with decision-making options to accept or not accept simulation technology for use in their projects; hence, survey research design is deemed appropriate for use in this study.

Survey research design allows for information to be gathered about the activities, beliefs, preferences and attitudes of subjects using a questionnaire which requires minimal time for participants to complete. Researchers have agreed that benefits of survey research include the uniqueness in making generalizations about an entire group from information that is collected from part of the population and the standardization of questionnaire instrument for use by other researchers in related studies (Babbie, 2001; Singleton & Straits, 2005).

The Research Model

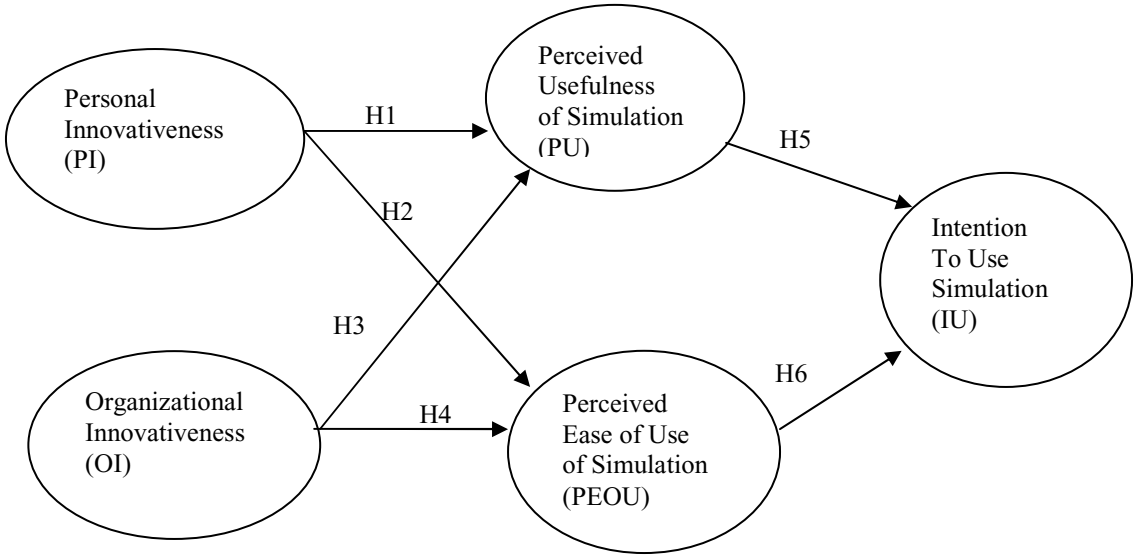

Figure 15. The research model with hypotheses.

Chen et al. (2002) had observed that care be taken in introduction of constructs from other theories to enhance the TAM. For example, the IDT and flow theory, which focuses on the emotional and cognitive responses of individuals, were not suitable for measuring attitude and behavioral intention to use technology because the constructs are too broad to operationalize. In this research, I utilized a modified TAM (Figure 15) that employed two external variables, personal innovativeness and organizational innovativeness, in addition to the original TAM constructs of perceived usefulness and perceived ease of use, to predict user's intention to use simulation technology. The design is akin to the modified TAM by Varol and Tarcan (2009) in their quantitative survey research of hotel employees' acceptance of technology in Turkey. The model consists of

six constructs; three of the constructs (perceived usefulness of simulation, perceived ease of use of simulation, and intention to use simulation) are part of the original constructs for TAM proposed by Davis (1989). These three constructs have been tested and validated by research studies on technology acceptance as already discussed in Chapter 2. The three new independent variables in the model; personal innovativeness, supervisor support and communication efficacy, were introduced by Varol and Tarcan (2009) to explain the probable impact of personal traits on acceptance of technology. This model is appropriate for this study and research questions and hypotheses for the study are developed around the model.

In this study, the questions that influenced the design of the research model are presented below:

1. To what extent, if any, does personal innovativeness of the user relate to perceived usefulness of simulation?

2. To what extent, if any, does personal innovativeness of the user relate to perceived ease of use of simulation?

3. To what extent, if any, does organizational innovativeness relate to perceived usefulness of simulation?

4. To what extent, if any, does organizational innovativeness relate to perceived ease of use of simulation?

5. To what extent, if any, does perceived usefulness of simulation relate to the intention to use simulation?

6. To what extent, if any, does perceived ease of use of simulation relate to the intention to use simulation?

Based on the above research questions, a quantitative correlational approach was used in testing the following hypotheses.

$H1_0$: There is no relationship between personal innovativeness of the user and perceived usefulness of simulation.

$H1_A$: There is a relationship between personal innovativeness of the user and perceived usefulness of simulation.

$H2_0$: There is no relationship between personal innovativeness of the user and perceived ease of use of simulation.

$H2_A$: There is a relationship between personal innovativeness of the user and perceived ease of use of simulation.

$H3_0$: There is no relationship between organizational innovativeness and perceived usefulness of simulation.

$H3_A$: There is a relationship between organizational innovativeness and perceived usefulness of simulation.

$H4_0$: There is no relationship between organizational innovativeness and perceived ease of use of simulation.

$H4_A$: There is a relationship between organizational innovativeness and perceived ease of use of simulation.

$H5_0$: There is no relationship between perceived usefulness of simulation and intention to use simulation.

$H5_A$: There is a relationship between perceived usefulness of simulation and intention to use simulation.

$H6_0$: There is no relationship between perceived ease of use of simulation and intention to use simulation.

$H6_A$: There is a relationship between perceived ease of use of simulation and intention to use simulation.

Operational Definition of Variables

Singleton and Straits (2005) described the operational definition of a variable as a counterpart to a conceptual definition; one that describes the research operations that will specify the value or category of a variable. This quantitative survey research was designed to find out the relationships between constructs as proposed in the model, i.e. personal innovativeness, organizational innovativeness, perceived usefulness, perceived ease of use, and behavioral intention to use technology. The operationalization of a variable requires that empirical representations or indicators be made for the variable, consisting of observable measures such as questionnaire items in a survey (Singleton & Straits, 2005). Hence, I discussed items that were used to measure each variable in this quantitative survey research.

In order to measure the constructs in this research, existing scales that were developed for TAM constructs were used (Appendix C). For all constructs, a 5-point

Likert-type scale is utilized with the following responses: (a) *strongly agree*, (b) *agree*, (c) *neither agree nor disagree or no opinion*, (d) *disagree*, and (e) *strongly disagree*. The combined responses for all items were averaged so that a single value for testing may be determined.

Personal Innovativeness

The indicators for personal innovativeness consist of the self-reported probability to take risk by trying out or experimenting with new technologies. The indicators that were used to measure this construct were already used in research by Argawal and Prasad (1998), and Varol and Tarcan (2009). There are four indicators as shown in Table 1.

Table 1.

Personal Innovativeness (PI)

Item	Indicators
PI1	Seeking to experiment with new technology.
PI2	Always first to try out new technology.
PI3	Hesitant to try out new technology.
PI4	Enjoy experimenting with new technology.

Sources: Argarwal & Prassad (1998), Varol & Tarcan (2009).

If the respondent was more eager to try out new technology or experiment with new technologies, the respondent would be categorized as more innovative. Likewise a respondent who indicate the likelihood of being more hesitant to take risks in trying out new technologies would be categorized as less or non-innovative.

Organizational Innovativeness

Indicators for organizational innovativeness consist of respondents' perception of their managers and supervisors. The construct items used to measure organizational innovativeness were used in research by Robinson et al. (2005) and Varol and Tarcan (2009). There are six indicators as shown in Table 2.

Table 2.

Organizational Innovativeness (OI)

Item	Indicators
OI1	Management has positive attitude toward change.
OI2	Supervisor has positive attitude toward change.
OI3	Power and control are concentrated in the hands of few individuals.
OI4	Employees possess high level of knowledge and expertise.
OI5	Rules and procedures are strictly enforced
OI6	Employees are networked

Sources: Robinson et al. (2005), Varol & Tarcan (2009).

If the employee's perception of the management's attitude to change is positive, then the organization is innovative. On the contrary, if the employee perceives the management as always resistant to change, and not willing to try out new innovations including newly released application software, then the organization is not innovative.

Perceived Usefulness

Indicators for perceived usefulness construct are based on respondents' self-reported view of benefits or rewards that would follow as a consequence of their adoption and usage of new technology. Construct items were used for measurement in research by Davis (1989), Chin and Todd (1995) and Varol and Tarcan (2009). There are five indicators as shown in Table 3.

Table 3.

Perceived Usefulness (PU)

Item	Indicators
PU1	Simulation increases productivity.
PU2	Simulation improves job performance.
PU3	Simulation enhances effectiveness on the job.
PU4	Using simulation makes it easier to do job.
PU5	Simulation technology is useful for job performance

Sources: Davis (1989), Chin & Todd (1995), Varol & Tarcan (2009).

A user who perceives new technology as useful would indicate the anticipated benefits from using such technology including, better job performance, pay raises and promotions.

Perceived Ease of Use

Indicators for perceived ease of use construct include self-reported ease or difficulties with learning a new technology. In order to ensure construct reliability, measurement items used by Davis (1989), Adams et al. (1992), and Varol and Tarcan

(2009) were adopted in this research to measure the perceived ease of use of technology. There are four indicators for this construct as shown in Table 4.

Table 4.

Perceived ease of use (PEOU)

Item	Indicators
PEOU1	Learning to use simulation software is easy.
PEOU2	It is easy to get the technology to perform job.
PEOU3	Interaction with simulation software is clear and understandable.
PEOU4	Find simulation easy to use.

Sources: Davis (1989), Adams et al. (1992), Varol & Tarcan (2009).

If simulation software is perceived to be difficult to use, there is a probability that users will not be motivated to accept or adopt the use of simulation in their projects.

Intention to Use

The indicator for intention to use technology is comprised of respondents' declared intention to use a technology whenever it becomes available to them at work, and frequently or just as needed. Researchers such as Ajzen and Fishbein (1980), Ajzen and Madden (1986) and Varol and Tarcan (2009) have developed and tested measurements for intention to use technology. Measurements used for this construct were adopted from these sources to ensure reliability. There are three indicators for this construct as shown in Table 5.

Table 5.

Intention to use (IU)

Item	Indicators
IU1	Seeking to experiment with new technology.
IU2	Always first to try out new technology.
IU3	Hesitant to try out new technology.

Sources: Ajzen & Fishbein (1980), Ajzen & Madden (1986), Varol & Tarcan (2009).

The constructs and their indicators are all listed in Appendix C. In terms of measurement, Singleton and Straits (2005) observed that interpretation of numerical results in social research is not always clear-cut and simple. While there are several ways to measure the indicators discussed above, for the purpose of this study, Likert-type scale would be utilized to measure survey participants' aggregated responses to each of the items listed for each construct.

Setting and Sample

Samples need to be representative of the population from which they are taken (Shields & Twycross, 2008). The project management institute (PMI) members who live in the San Francisco Bay Area are professionals who work with companies that are technologically oriented. The PMI members in the Silicon Valley chapter, for example, are highly skilled technologically because most are either employed by hi-tech companies such as Intel, Silicon graphics, IBM, Apple, HP, Cisco, Google, and Yahoo, or companies that are known to be open to innovations such as Safeway, Kaiser Permanente, Walmart, and Wells Fargo Bank.

It is significant that a study of this nature draw its sample from a population that has the probability of exposure to technology use, including use of simulation software for business purposes. In their study of health care professionals' acceptance of technology in Hong Kong, Chau and Hu (2002) validated their choice of sample frame primarily on the basis of accessibility and the likelihood of the respective specialist's involvement with telemedicine-enabled services as well as the probability of becoming technology adopters in the future.

In this quantitative correlative survey-based research, a systematic sampling technique was used to obtain responses from respondents who are members of three PMI chapters in the San Francisco Bay Area, California; the San Francisco Bay Area Chapter, the Silicon Valley Chapter, and the Wine Country Chapter. Systematic sampling, according to Singleton and Straits (2005), is a sampling technique in which the investigator starts with a randomly chosen case, and selects the sample cases from the population at a sampling interval that was pre-determined by the researcher.

The PMI rents out a direct mailing list of its membership for a fee, to qualifying individuals and organizations including current PMI members, Universities, Consultants and Technology companies. I qualify both as a member of PMI and a graduate student at Walden University to purchase such list for use in my research. Given the choice of sampling method chosen by the researcher for this research, there were two possible options for determining the desired sample size. The first option was to sample the entire population of individuals that could be reached using the direct mailing list obtained from

PMI. That option would invalidate the sampling method selected for this research, i.e. random systemic sampling. The other option, which was the preferred choice for this research, was for the researcher to determine an appropriate representative sample size, based on a pre-determined sampling interval. The three PMI chapters have a combined membership of over 5000 members with direct mail addresses in the San Francisco Bay Area.

A priori power analysis, a method used by behavioral scientists during the design stage to determine what is adequate sample size for a research and eliminate a type I error, was conducted using Raosoft power software (http://raosoft.com/samplesize.html; Cohen, 1989; Kraemer & Theimann, 1987; Murphy & Myors, 2003). Results of the power analysis showed that a minimum sample size of 72 would be required at 95% confidence level, a 5% margin of error, and an assumed 5% response rate because of the inherent nature of the target population which is averse to supplying information, citing privacy reasons.

A random systemic sample of 933 was drawn from the list provided by PMI using an interval of two. In order to boost the response rate, the researcher made efforts to get a top ranking officer of the PMI Silicon Valley Chapter, to write a note urging members to cooperate by responding to the survey request. However, this effort failed because the officer was afraid it would be misinterpreted as a PMI-sponsored survey. The national PMI office followed up by requesting that a sentence be inserted into the participant consent form which specifically says that this research is not PMI sponsored or funded.

PMI approval was conditional upon that statement which was in bold print in the participant consent form (see Appendix D).

Notwithstanding these drawbacks, the researcher decided to find other methods of boosting response rate to the survey. First, a decision was made to hand-write all 933 addresses to participants in the sample, rather than use computer-printed address labels. The rationale behind this decision was more common sense than science or statistics; that junk mails are more likely to be addressed with printed labels. By hand-addressing the request to participate in the research, the researcher hoped to get participants to open and read the mail. Secondly, a decision was made to give participants a choice in how to respond; they could access the survey online via a link which was inserted into the participant consent form, or they could fill out their responses in a paper survey that was included in the packet mailed to them. In addition, a stamped envelope that was pre-addressed to the researcher was included for use in mailing back the paper questionnaire if they chose to use that means. Respondents were specifically informed that the paper questionnaire was exactly the same questions as those posted online at surveymonkey.com, hence they must not complete both.

Finally, a short letter of invitation to participate in the research was inserted into the packet (see Appendix D). In the letter, the researcher identified himself to respondents as a fellow member of the PMI who needs their help by participating in the research. Although participation in the survey was voluntary, the selected sample population was encouraged to participate. Prospective participants were notified in the

consent form that survey was open for 14 days; and all responses must be completed online or received by mail by the deadline date of March 11, 2011. After this date, online access was shut down to all participants, and responses that arrived by mail were not counted as valid responses. The combination of these measures helped to boost response rate by 25% over the originally anticipated response rate of 5%. Of the 933 PMI members who were selected to participate in the research, a total of 289 or 30% responded by filling out the survey questionnaire online or on paper, while only 15 or less than 2% were returned by the postal services due to incorrect or no forwarding address.

In practical application of survey sampling, the probability of nonresponse is a reality that must be addressed by the researcher, especially because participation in the survey is totally voluntary. Aczel and Sounderpandian (2006) addressed the issue of nonresponse by suggesting callbacks; a method that entails returning to the non-respondents and reminding them of the importance and need to have their responses to the survey. Singleton and Straits (2005) suggested that response rate, i.e. the proportion of people in the sample from whom completed questionnaires are obtained, is highly correlated with the respondent's cognition of research objectives, and the design of the survey instrumentation. Respondents who perceive that a research would benefit them or the community to which they belong are more likely to participate in the research than those who do not see any significant benefit as a result of their participation (Singleton & Straits, 2005). In this survey research every effort was made to communicate the benefits

of the research to survey participants in order to get the opinions of all subjects in the sample.

Instrumentation and Materials

Data for this quantitative survey research were obtained through printed questionnaire and self-administered electronic survey instrument. As already stated in the operational definition of constructs, the survey instruments for this research were adopted directly from researchers who have developed and tested the instruments for validity and reliability, with some slight modifications, as described in this section, to suit the purpose of this research. The instrument, as laid out in Appendix C, depicts the items and sources for each construct. Assessment criteria for all items were standardized using an ordinal 5-point Likert-type scale to score responses from subjects.

The instruments used for personal innovativeness and organizational innovativeness as depicted in Appendix C, were adopted directly from Argawal and Prasad (1998) and Varol and Tarcan (2009), and Robinson et al. (2005) without any modifications. The only exception was the standardization of measurement scale from an ordinal 7-point Likert-scale used by Argawal and Prasad (1998) to a 5-point scale used by Varol and Tarcan (2009). Scores for individual respondents were computed by taking the average across all item statements for each construct.

However, the questions for perceived usefulness, perceived ease of use, and intention to use technology constructs, as indicated in Appendix C, were slightly modified to reflect the pertinent elements of this research topic; however this would not

have any significant effect on validity or reliability of the constructs since the survey is based on questionnaire format developed by Varol and Tarcan (2009). Also, a section was included in the instrument to gather demographic information to aid in the assessment and any follow-up activities. The demographic section, which was solely developed by the researcher for this study, had no direct effect on the computations or construct correlations.

Validity and Reliability

According to Marion (2004), a valid research is one that finds the truth, and the truth is determined by how representative the sample is of the population in the study. Marion identified the two components of validity; external validity which refers to the adequacy of the sample, and internal validity which refers to the adequacy of the study design. Singleton and Straits (2005) explained reliability as factors of measurement. Reliability is concerned with stability and consistency of the research. For example, the researcher needs a measuring instrument that is consistent and dependable. Measurement validity, according to Singleton and Straits (2005), refers to the congruence or *goodness of fit* between an operational definition and the concept it is purported to measure.

This study has adopted the instrument used in earlier studies, as indicated in Appendix C, that have been tested and considered fit for both reliability and validity. The instrument used in the original study of TAM (Davis, 1989) has repeatedly been used by other researchers and has demonstrated acceptable levels of validity and reliability. In the study, Davis used the Cronbach's alpha formula to validate the measurement scales for

the two constructs of perceived usefulness and perceived ease of use. A Cronbach's alpha reliability of 0.97 was obtained for perceived usefulness, and reliability of 0.91 for perceived ease of use (Davis, 1989). Cronbach's alpha reliability tests conducted by other researchers on the constructs of perceived usefulness and perceived ease of use obtained similar results in the range of 0.97 and 0.91 respectively, confirming the instruments as fit to use in research (Adams et al., 1992, Amoako-Gyampah & Salam, 2004; Bruner & Kumar, 2005; Lee et al., 2006; Quan et al., 2010; Shang et al., 2005). For intention to use technology construct, Varol and Tarcan (2009) obtained a reliability score of 0.86 on Cronbach's alpha; test results by Ajzen and Madden (1986), Kwon et al. (2007), and Sun and Zhang (2008) were in the same range for this construct. In regard to the innovativeness constructs, Cronbach's alpha test results were in the range of 0.73 for personal innovativeness, and 0.77 for organizational innovativeness (Argarwal and Prasad, 1998; Robinson et al., 2005; Varol and Tarcan, 2009). Similarly, the results of confirmatory factor analysis (CFA) conducted by Varol and Tarcan (2009) confirmed construct validity and showed high degree of reliability.

Data Collection and Analysis

The Survey Monkey online survey services were utilized for data collection. Pilot testing was deemed unnecessary because the instrumentation used corresponded with research previously cited (Ness, 2005). The Survey Monkey tool provides necessary means to construct a survey instrument that meets the needs of this study. Survey Monkey provides the option of viewing the survey results immediately after data

collection. In addition, Survey Monkey provides a public link that could be generated to the survey results, and results could be downloaded in raw format for statistical analysis.

Data were analyzed using Predictive Analytics Software (PASW) for Windows, originally known as Statistical Package for the Social Sciences (SPSS). Inferential correlational statistical analysis was performed in this study using the PASW/SPSS statistical feature for correlation and simple regression analysis. Correlation analysis tests for relationships between two variables. According to Aczel & Sounderpandian (2006), correlation is a measure of the linear relationship between two variables. Pearson *r* is a statistical test that is very effective for measuring linear correlation or dependence between two variables when the data is interval or ratio (Schweitzer & Schweitzer, 1971). However in this research, simple linear regression analysis was used to determine if a relationship exists between the independent and dependent variables, and what type of relationship, if any exists (Aczel & Sounderpandian, 2006; Schweitzer & Schweitzer, 1971). If the relationship is strong, prediction of the dependent variable can be relatively accurate, and conclusions drawn from the analysis may be given a high degree of confidence (Aczel & Sounderpandian, 2006). Further details of statistical tests utilized in this research would be presented in chapter 4.

Protection of Human Participants

In order to protest the interests of participants in the survey, respondents were assured of complete confidentiality. The researcher adhered to the four ethical principles

proposed by Singleton and Straits (2005) on the ethical treatment of human subjects when conducting a research. Participation in the study was voluntary, and the researcher was the sole data collector for the study. Adequate care was taken to protect participants from any known harm as a result of the survey conducted for this research. Respondents' opinions on issues regarding their employers or supervisors were kept highly confidential to avoid any harm resulting from each respondent's agreement to participate in this study. Subjects, who were randomly selected for participation in the study, were free to opt out of the study at any time without giving reasons, and were not forced to participate in any action against their will. All questions on the survey instrument were clearly defined and kept simple; there was no effort to lie or to mislead participants in this study. The researcher maintained confidentiality throughout the research and beyond, to protect the privacy of participants in the study. There were no names on questionnaires, and identities of respondents were kept anonymous. Questionnaires would be kept for a period of 5 years after publication of this study, and then securely destroyed.

Summary

Discussions in this chapter have focused on the rationale for, and the design of a quantitative research that utilizes a Likert-type scale survey-based instrument, to address the research questions and related hypotheses in this study. A model was presented; an enhanced TAM that was designed by Varol and Tarcan (2009), which was deemed appropriate and a perfect fit for the research framework, questions, and hypotheses as

presented in chapter 1 and validated with the review of literature in chapter 2.

The theoretical framework for this research postulates that innovativeness of users and organizations play a significant role in explaining behavioral intention of IT professionals to adopt and eventually use simulation techniques in process change projects. From the research model presented, six research questions were presented, and hypotheses were proposed for the study.

Next, there was an operational definition of the variables, with indicators on each variable that was measured. The background setting for the research was introduced; i.e. professional members of the Project Management Institute (PMI), Silicon Valley (SV) chapter in the San Francisco Bay Area. The primary rationale for selection of this group was location, accessibility and high probability of exposure to simulation software at work. Method of sampling the population was discussed as well as issues relating to validity and reliability of the research design and instrumentation.

Finally, there was discussion about what types of data were collected from participants in the survey, and how the data was analyzed for correlation using simple regression test. There was a discussion on steps that were taken to protect participants from any harm as a result of their voluntary participation in the research, and how the privacy of participants was protected by keeping responses confidential. Chapter 4 discussed the results of survey analysis, providing detailed description of the findings for each research question and hypothesis. Conclusions and recommendations for future research were discussed in chapter 5.

Chapter 4: Results

Introduction

The purpose of this quantitative survey study was to examine the possible relationship that may exist between personal innovativeness and organizational innovativeness on perceived usefulness, perceived ease of use and intention to use simulation technology. The outcome will help broaden the understanding of factors that impact the adoption and use of simulation techniques in projects, including personal innovativeness and organizational innovativeness, within the framework of the TAM.

The purpose of this chapter is to provide the data analysis findings that resulted from the data analysis, and therefore to address the research questions and hypotheses associated with the study. Specifically, the following research questions are addressed in this chapter:

1. To what extent, if any, does personal innovativeness of the user relate to perceived usefulness of simulation?

2. To what extent, if any, does personal innovativeness of the user relate to perceived ease of use of simulation?

3. To what extent, if any, does organizational innovativeness relate to perceived usefulness of simulation?

4. To what extent, if any, does organizational innovativeness relate to perceived ease of use of simulation?

5. To what extent, if any, does perceived usefulness of simulation relate to the intention to use simulation?

6. To what extent, if any, does perceived ease of use of simulation relate to the intention to use simulation?

Based on the above research questions, a quantitative correlational approach was used in testing the following hypotheses.

$H1_0$: There is no relationship between personal innovativeness of the user and perceived usefulness of simulation.

$H1_A$: There is a relationship between personal innovativeness of the user and perceived usefulness of simulation.

$H2_0$: There is no relationship between personal innovativeness of the user and perceived ease of use of simulation.

$H2_A$: There is a relationship between personal innovativeness of the user and perceived ease of use of simulation.

$H3_0$: There is no relationship between organizational innovativeness and perceived usefulness of simulation.

$H3_A$: There is a relationship between organizational innovativeness and perceived usefulness of simulation.

$H4_0$: There is no relationship between organizational innovativeness and perceived ease of use of simulation.

$H4_A$: There is a relationship between organizational innovativeness and perceived ease of use of simulation.

$H5_0$: There is no relationship between perceived usefulness of simulation and intention to use simulation.

$H5_A$: There is a relationship between perceived usefulness of simulation and intention to use simulation.

$H6_0$: There is no relationship between perceived ease of use of simulation and intention to use simulation.

$H6_A$: There is a relationship between perceived ease of use of simulation and intention to use simulation.

The remainder of this chapter is comprised of four sections, which include an overview of the data preparation and analysis procedures that were used to address the research questions and therefore test the research hypotheses, a descriptive summary of the research participants, a presentation of the data analysis findings addressing each research question and hypothesis, and an overall summary of the research findings.

Data Preparation and Analysis Procedures

The raw survey data were extracted via a Microsoft Excel (2007) spreadsheet directly from SurveyMonkey.com. The participants' survey responses were already numerically coded with responses of *strongly agree* receiving a weight of 5 and responses of *strongly disagree* receiving a weight of 1. However, because some of the items on the survey were reversal items (negatively phrased items), those items were

reverse coded prior to creating the overall dimension composite scores, which include personal innovativeness, organizational innovativeness, perceived usefulness of simulation, perceived ease of use of simulation, and intention to use simulation. The composite scores were computed by taking the average of all of the items that were linked to the same dimension on the survey.

In order to evaluate the reliability of the survey, Cronbach's alphas were computed for each dimension on the survey as well as the overall survey. Cronbach's alpha measures the degree of internal consistency or reliability of the survey items (Ponterotto & Ruckdeschel, 2007). The results of the reliability analysis are provided in Table 6. The results indicate that the reliability of the survey dimensions ranged from good to excellent, with the exception of the organizational innovativeness dimension, which yielded relatively poor reliability ($\alpha = .527$). However, the overall survey yielded excellent reliability ($\alpha = .912$).

Table 6.

Survey Dimension and Overall Survey Internal Reliability Coefficients

Dimension	Number of items	α
Personal innovativeness	4	0.792
Organizational innovativeness	6	0.527
Usefulness	5	0.946
Ease of use	4	0.842
Intention to use	3	0.921
Overall survey	22	0.912

The survey dimensions were descriptively analyzed by computing means and standard deviations, and by constructing box plots that illustrate the distributional characteristics of each dimension. The research questions and hypotheses were addressed by conducting simple linear regression. Since linear regression is based on the assumptions that the errors are normally distributed, the relationships are linear, and the error variance is constant (homoscedasticity), scatter plots of the standardized predicted values and the standardized residuals were constructed in order to assess the tenability of those statistical assumptions. Data points that scatter randomly indicate no violations (Field, 2009; Mertler & Vannatta, 2005). Statistical significance was determined by an alpha of .05.

Demographics

As already indicated in chapter 3, demographic data were gathered, but were not included in the analysis of data. The purpose of the demographics was to corroborate information about the distribution of the population and possibly use it to explain any non-response to the survey. It could also serve as valuable information for future research on the PMI.

The demographics of the sample population revealed that the sample was fairly representative of PMI membership in the San Francisco Bay Area. Of the 933 subjects surveyed, 174 or 60% were male while 114 or 40% were female. 116 or 40% of respondents were between the ages of 46 and 55; 84 or 29% of respondents were over the age of 55; 59 or 20% of respondents were between the ages of 36 and 45; and 28 or 9% of respondents were between the ages of 25 and 35. As expected, 216 or 75.5% of respondents were either project manager or project leader by profession; 172 or 62% of respondents work for technology companies, while 59 or 21% work for manufacturing companies.

There were no incomplete responses because respondents were given the option to skip any question they do not want to answer; that was an Institutional review Board (IRB) condition for granting approval to conduct this survey anonymously. Notwithstanding this provision, respondents gave answers to most questions on the questionnaire except for the demographic question that requested for the name of the

respondent's employer. 263 out of the 289 respondents, or 91% skipped this question; non-response to this question had no significance on the results.

Results of Analysis

This section of the chapter presents the data analysis findings and therefore addresses each research question and hypothesis. The descriptive statistics for the study variables are presented first followed by the simple linear regression data analysis findings for each predictive relationship tested. The strength of the predictive relationship, the direction of the relationship, the amount of variability explained, and the statistical significance of the predictive relationship are all presented. Significance values greater than .05 indicate that the null hypothesis cannot be rejected. Significance values of .05 or less indicate that the null hypothesis must be rejected.

Descriptive Statistics

The means and standard deviations for each of the survey dimensions are provided in Table 7. The results indicate that on average, participants agreed most with perceived usefulness (4.37) followed by personal innovativeness (4.22), ease of use (4.10), organizational innovativeness (3.83) and finally, intention to use (3.66). Therefore participants generally agree that simulation technology is useful and easy to use. Participants also generally agree that they exhibit personal innovativeness and therefore are likely to experiment with new technologies. However, participants reported less than complete agreement (e.g., they somewhat agreed) that their organization is innovative and that they (the participants) have an intention to use the technology simulation.

Finally, the dimension scores were all positively and statistically significantly inter-correlated, $p < .01$.

Table 7.

Survey Dimension Inter-correlations, Means and Standard Deviations

Measure	1	2	3	4	5	*M*	*SD*
1. Personal innovativeness	-	.48**	.53**	.66**	.57**	4.22	0.56
2. Organizational innovativeness	.48**	-	.44**	.41**	.41**	3.83	0.66
3. Usefulness	.53**	.44**	-	.64**	.69**	4.37	0.62
4. Ease of use	.66**	.41**	.64**	-	.63**	4.10	0.64
5. Intention to use	.57**	.41**	.69**	.63**	-	3.66	0.49

**$p < .01$.

Figure 16 shows the distributional characteristics for each of the five dimensions. Therefore the presence of extreme values or outliers can be detected, as well as skews in the responses. The circles reflect extreme values while the asterisks represent outliers. The box plots featured in Figure 16 indicate that there were some outliers and/or extreme values in each of the five distributions. Also, with the exception of organizational innovativeness, the distributions tended to have negative skews given the heavier tails on the lower end of the distribution and the greater number of extreme values or outliers on the lower end of the distribution. These results indicate that the majority of the scores were on the higher end of the scale (agree or strongly agree) for those four distributions, with relatively fewer scores falling at the lower end (disagree or strongly disagree).

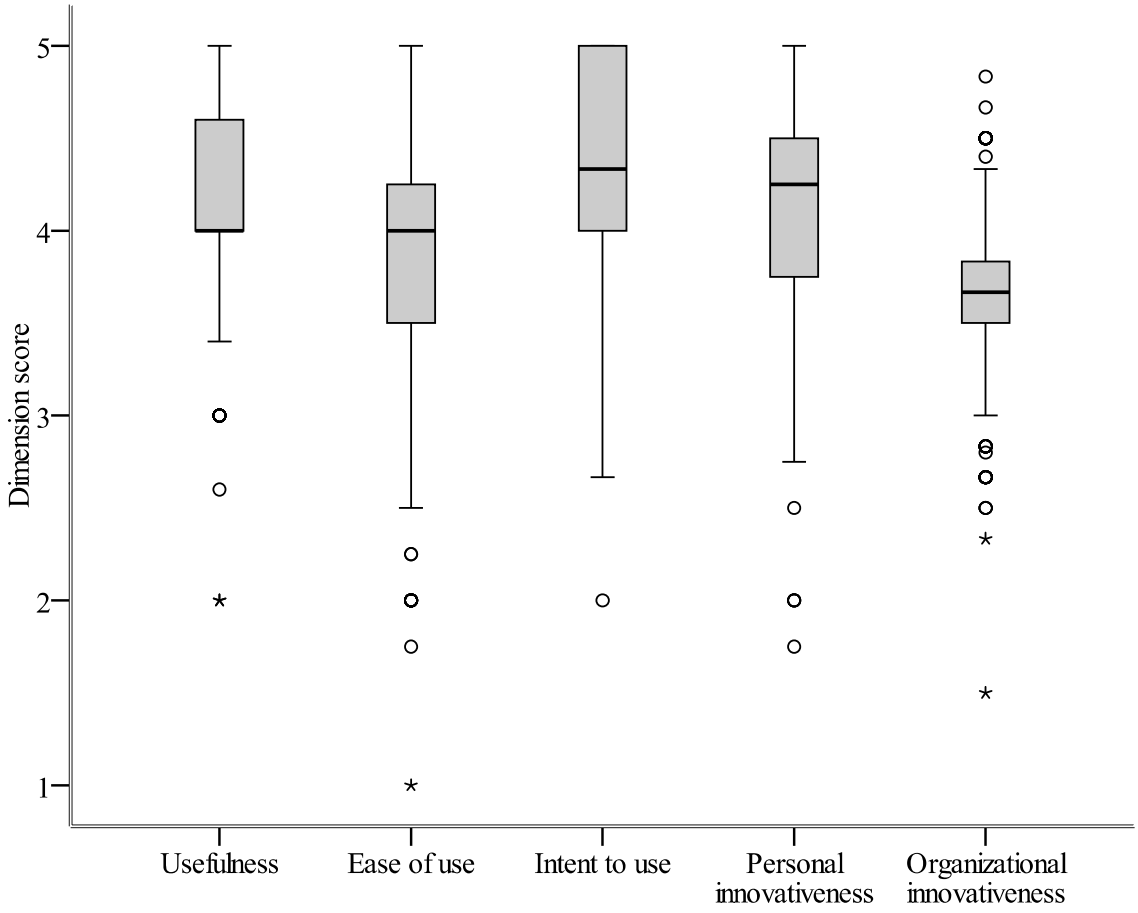

Figure 16. Box and whisker plot for outliers.

Research Question and Hypothesis 1

The first research question was, "To what extent, if any, does personal innovativeness of the user relate to perceived usefulness of simulation?" The research hypothesis states that there is a relationship between personal innovativeness of the user and perceived usefulness of simulation. The complementary null hypothesis states that there is no relationship between personal innovativeness of the user and perceived usefulness of simulation.

Figure 17 shows the relationship between the standardized predicted values and the standardized residuals. The results indicate that the pattern reflects linearity, and the data points are scattered throughout the center of the scatter plot. To elucidate further, there are no non-linear patterns in the data point, and the data points do not tightly cluster towards the top, bottom, left or right side of the scatter plot. Therefore the statistical assumptions of linearity, normality, and homoscedasticity are empirically supported.

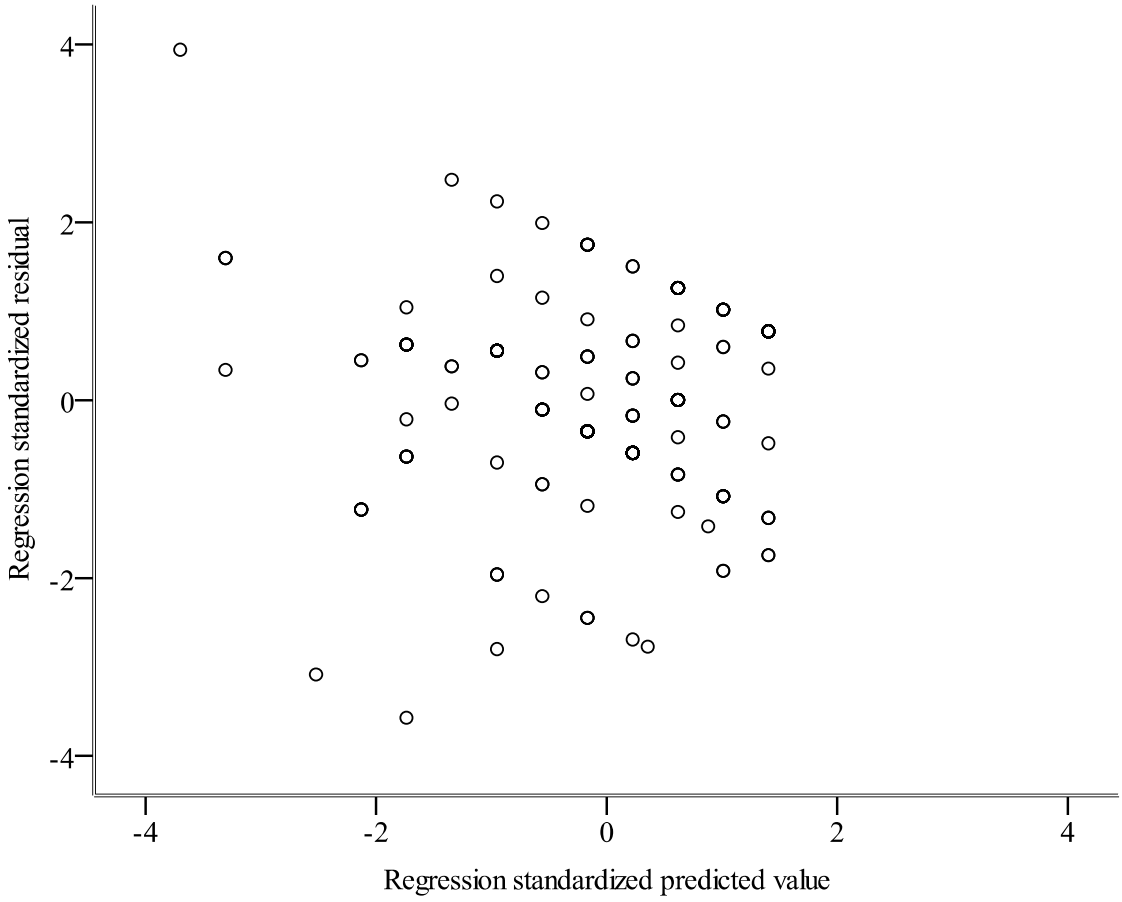

Figure 17. Scatter plot featuring the relationship between the standardized predicted values and the standardized residuals for personal innovativeness of user and perceived

usefulness of simulation.

The model summary results of the linear regression analysis are presented in Table 8. The results indicate that the predictive relationship between personal innovativeness of the user and perceived usefulness of simulation is positive, moderate to substantial in strength, and statistically significant, β = .53, $p < .01$. The amount of variability in perceived usefulness of simulation scores that is explained by the participants' personal innovativeness of the user scores is 28%. Therefore stronger agreement with personal innovativeness of the user is statistically significantly associated with stronger agreement with usefulness of simulation.

Table 8

Model Summary Results: Personal Innovativeness and Usefulness of Simulation

Variable	B	SE	β	95% CI
Constant	2.31	0.18		[1.95, 2.67]
Personal innovativeness	0.46	0.04	.53**	[0.38, 0.55]
R^2	0.28			
F	110.10**			

Note. $N = 287$. CI = confidence interval.
**$p < .01$.

The results for research question one and hypothesis one indicate that there is a positive and moderate to substantial relationship between personal innovativeness of the user and perceived usefulness of simulation. Therefore null hypothesis one is rejected.

Research Question and Hypothesis 2

The second research question was, “To what extent, if any, does personal innovativeness of the user relate to perceived ease of use of simulation?” The research hypothesis states that there is a relationship between personal innovativeness of the user and perceived ease of use of simulation. The complementary null hypothesis states that there is no relationship between personal innovativeness of the user and perceived ease of use of simulation.

The scatter plot featuring the relationship between the standardized predicted values and the standardized residuals is presented in Figure 18. The results indicate that no statistical assumption violations are detected.

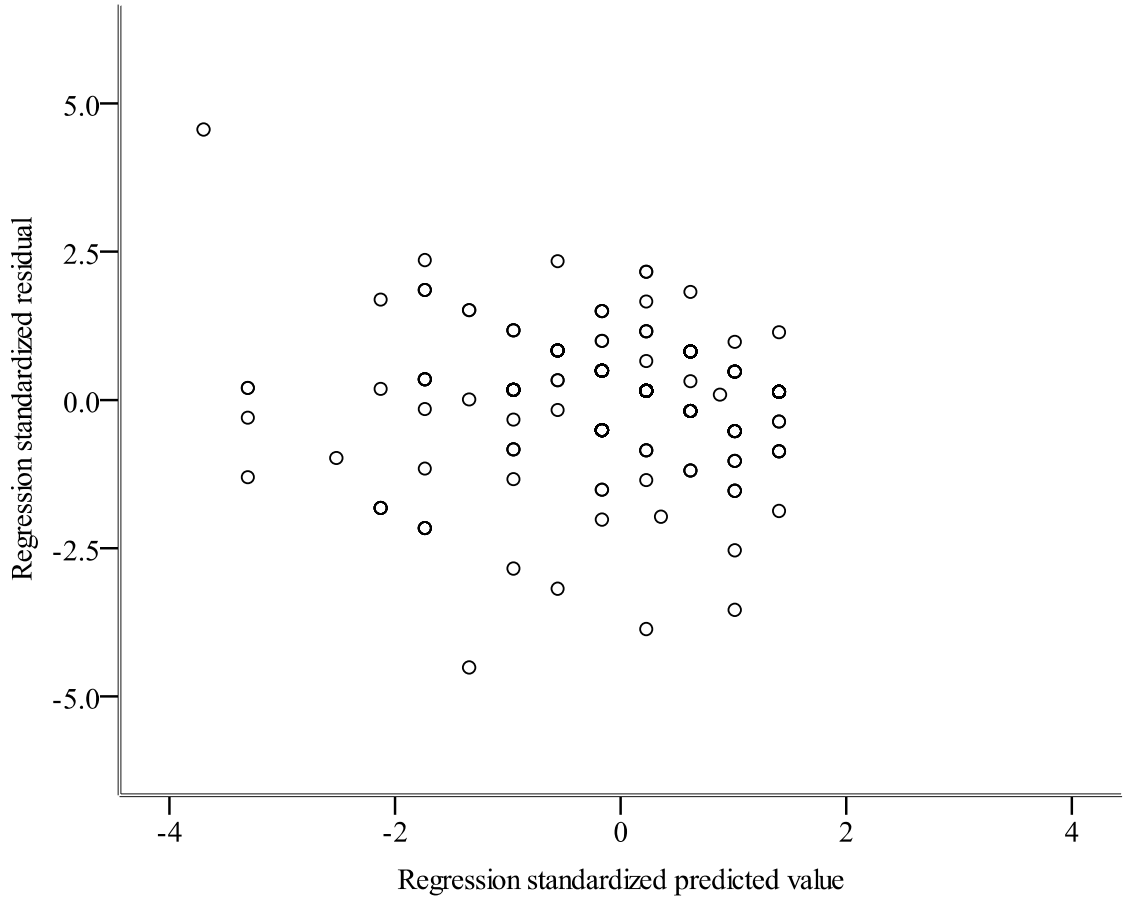

Figure 18. Scatter plot featuring the relationship between the standardized predicted values and the standardized residuals for personal innovativeness of user and perceived ease of use of simulation.

The model summary results in Table 9 indicate that the predictive relationship between personal innovativeness of the user and perceived ease of use of simulation is positive, substantial in strength, and statistically significant, $\beta = .66$, $p < .01$. The amount of variability in perceived ease of use of simulation scores that is explained by the participants' personal innovativeness of the user scores is 43%. Therefore stronger

agreement with personal innovativeness of the user is statistically significantly associated with stronger agreement with ease of use of simulation.

Table 9

Model Summary Results: Personal Innovativeness and Ease of Use of Simulation

Variable	B	SE	β	95% CI
Constant	1.04	0.19		[0.67, 1.42]
Personal innovativeness	0.68	0.05	0.66**	[0.59, 0.77]
R^2	0.43			
F	215.07**			

Note. $N = 287$. CI = confidence interval.
**$p < .01$.

The results for research question two and hypothesis two indicate that there is a positive and substantial relationship between personal innovativeness of the user and perceived ease of use of simulation. Therefore null hypothesis two is rejected.

Research Question and Hypothesis 3

The third research question was, "To what extent, if any, does organizational innovativeness relate to perceived usefulness of simulation?" The research hypothesis states that there is a relationship between organizational innovativeness and perceived usefulness of simulation. The complementary null hypothesis states that there is no relationship between organizational innovativeness and perceived usefulness of simulation.

The scatter plot illustrating the relationship between the standardized predicted values and the standardized residuals in Figure 19 indicates that no statistical assumption violations are detected.

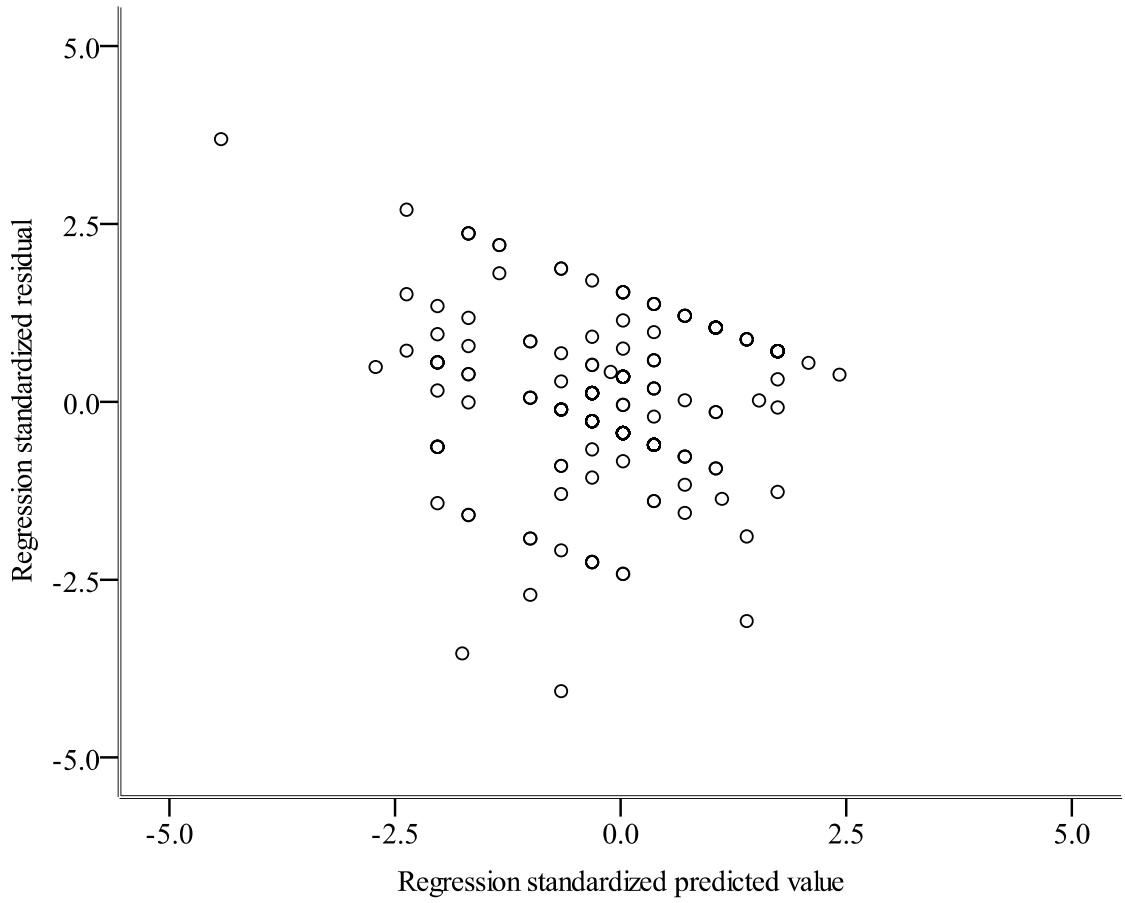

Figure 19. Scatter plot featuring the relationship between the standardized predicted values and the standardized residuals for organizational innovativeness and perceived usefulness of simulation.

Table 10 contains the model summary results of the linear regression analysis. The results indicate that the predictive relationship between organizational innovativeness and perceived usefulness of simulation is positive, moderate in strength,

and statistically significant, β = .44, $p < .01$. The amount of variability in perceived usefulness of simulation scores that is explained by the participants' organizational innovativeness scores is 19%. Therefore stronger agreement with organizational innovativeness is statistically significantly associated with stronger agreement with usefulness of simulation.

Table 10

Model Summary Results: Organizational Innovativeness and Usefulness of Simulation

Variable	B	SE	β	95% CI
Constant	2.38	0.23		[1.94, 2.83]
Organizational innovativeness	0.50	0.06	0.44**	[0.38, 0.62]
R^2	0.19			
F	66.76**			

Note. $N = 287$. CI = confidence interval.
**$p < .01$.

The results for research question three and hypothesis three indicate that there is a positive and moderate relationship between organizational innovativeness and perceived usefulness of simulation. Therefore null hypothesis three is rejected.

Research Question and Hypothesis 4

The fourth research question was, "To what extent, if any, does organizational innovativeness relate to perceived ease of use of simulation?" The research hypothesis states that there is a relationship between organizational innovativeness and perceived ease of use of simulation. The complementary null hypothesis states that there is no

relationship between organizational innovativeness and perceived ease of use of simulation.

Figure 20 presents the scatter plot featuring the relationship between the standardized predicted values and the standardized residuals. The results indicate that some heteroscedasticity is detected. Therefore the statistical assumption of homoscedasticity (constant error variance) is violated. This violation is based on the fact that the amount of scatter in the data points widens as the predicted values increase (Field, 2009; Mertler & Vannatta, 2005). To further elucidate, the prediction error increases as the predicted value increases resulting in non-constant error variance. Given this violation in combination with the fact the internal reliability of the organizational innovativeness dimension is low the results of this analysis should be interpreted with caution. Specifically, while the estimate of the predictive relationship between the variables may be reliable and valid, the ability to predict one's perceived ease of use (accuracy of prediction) based on his/her organizational innovativeness will depend on where he/she falls on the organizational innovativeness scale (Mertler & Vannatta, 2005).

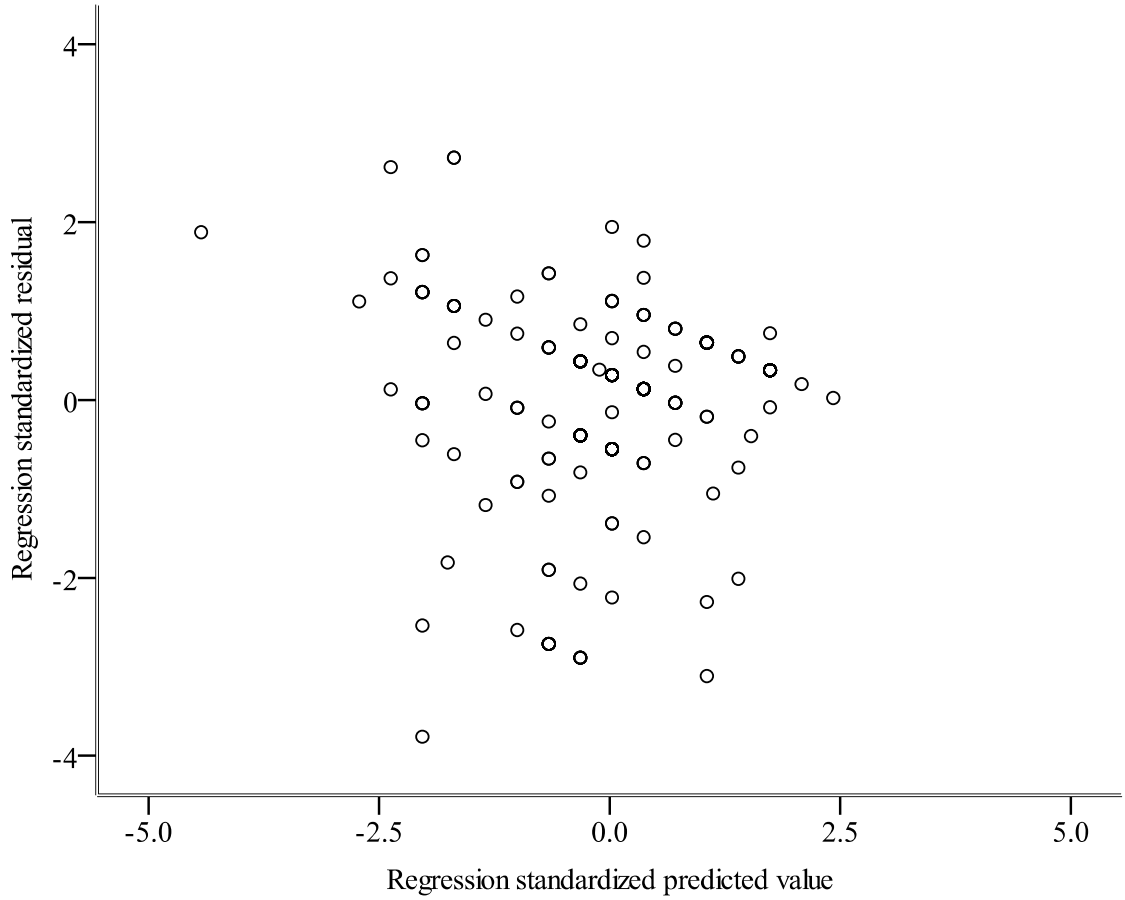

Figure 20. Scatter plot featuring the relationship between the standardized predicted values and the standardized residuals for organizational innovativeness and perceived ease of use of simulation.

The model summary results of the linear regression analysis are presented in Table 11. The results indicate that the predictive relationship between organizational innovativeness and perceived ease of use of simulation is positive, moderate in strength, and statistically significant, $\beta = .41$, $p < .01$. The amount of variability in perceived ease of use of simulation scores that is explained by the participants' organizational innovativeness scores is 17%. Therefore stronger agreement with organizational

innovativeness is statistically significantly associated with stronger agreement with ease of use of simulation.

Table 11

Model Summary Results: Organizational Innovativeness and Ease of Use of Simulation

Variable	B	SE	β	95% CI
Constant	1.78	0.27		[1.25, 2.31]
Organizational innovativeness	0.56	0.07	0.41**	[0.42, 0.70]
R^2	0.17			
F	59.03**			

Note. $N = 287$. CI = confidence interval.
**$p < .01$.

The results for research question four and hypothesis four indicate that there is a positive and moderate relationship between organizational innovativeness and perceived ease of use of simulation. Therefore null hypothesis four is rejected.

Research Question and Hypothesis 5

The fifth research question was, "To what extent, if any, does perceived usefulness of simulation relate to the intention to use simulation?" The research hypothesis states that there is a relationship between perceived usefulness of simulation and intention to use simulation. The null hypothesis states that there is no relationship between perceived usefulness of simulation and intention to use simulation.

The scatter plot depicting the relationship between the standardized predicted values and the standardized residuals is featured in Figure 21. The results indicate that no statistical assumption violations are detected.

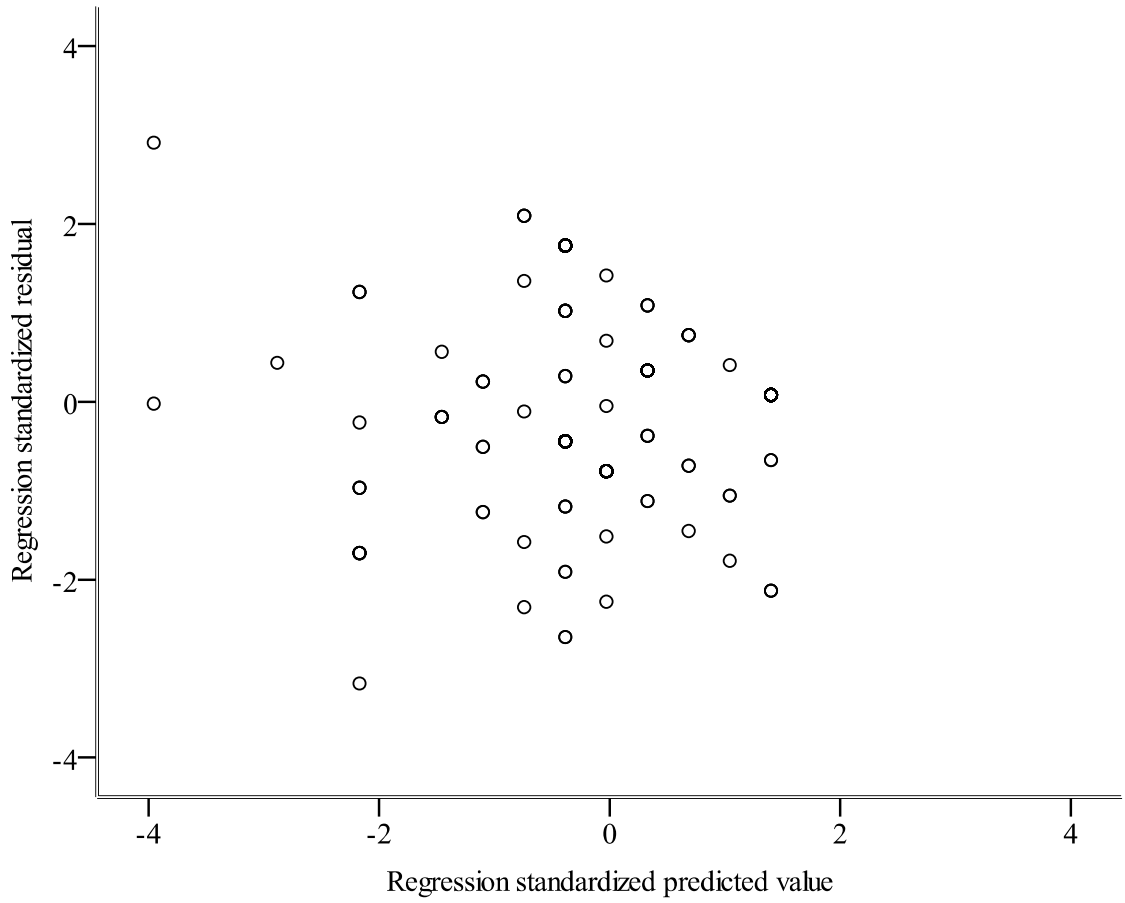

Figure 21. Scatter plot featuring the relationship between the standardized predicted values and the standardized residuals for perceived usefulness of simulation and intention to use simulation.

Table 12 presents the model summary results of the linear regression analysis. The results indicate that the predictive relationship between perceived usefulness of simulation and intention to use simulation is positive, substantial to strong, and

statistically significant, β = .69, $p < .01$. The amount of variability in intention to use simulation scores that is explained by the participants' perceived usefulness of simulation scores is 47%. Therefore stronger agreement with perceived usefulness of simulation is statistically significantly associated with stronger agreement with intention to use simulation.

Table 12

Model Summary Results: Usefulness of Simulation and Intention to Use Simulation

Variable	B	SE	β	95% CI
Constant	1.15	0.20		[0.75, 1.55]
Perceived usefulness	0.76	0.05	0.69**	[0.67, 0.86]
R^2	0.47			
F	253.11**			

Note. $N = 287$. CI = confidence interval.
**$p < .01$.

The results for research question five and hypothesis five indicate that there is a positive and substantial to strong relationship between perceived usefulness of simulation and intention to use simulation. Therefore null hypothesis five is rejected.

Research Question and Hypothesis 6

The sixth and final research question was, "To what extent, if any, does perceived ease of use of simulation relate to the intention to use simulation?" The research hypothesis states that there is a relationship between perceived ease of use of simulation

and intention to use simulation. The complementary null hypothesis states that there is no relationship between perceived ease of use of simulation and intention to use simulation.

Figure 22 provides the scatter plot of the standardized predicted values and the standardized residuals. The results indicate that no statistical assumption violations are detected.

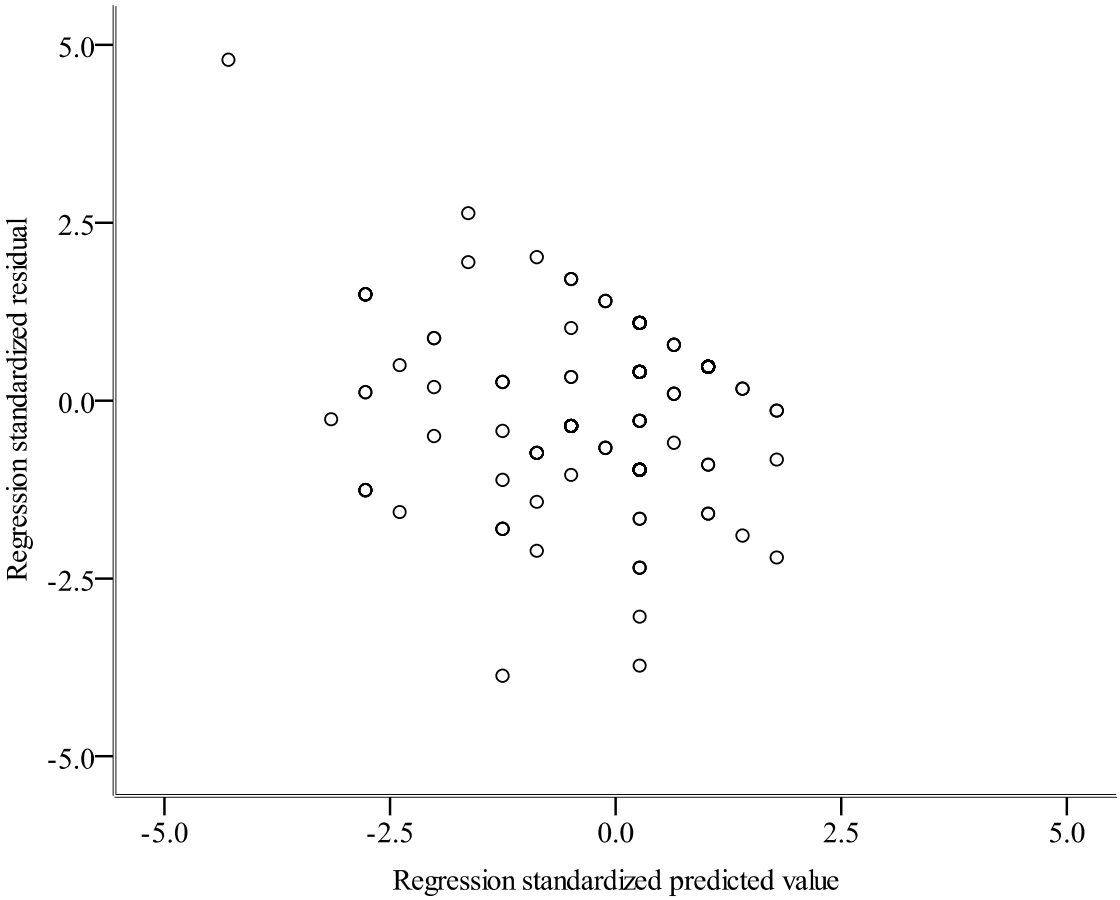

Figure 22. Scatter plot featuring the relationship between the standardized predicted values and the standardized residuals for perceived ease of use of simulation and intention to use simulation.

The model summary results of the linear regression analysis are featured in Table 13. The results indicate that the predictive relationship between perceived ease of use of simulation and intention to use simulation is positive, substantial in strength, and statistically significant, β = .63, $p < .01$. The amount of variability in intention to use simulation scores that is explained by the participants' perceived ease of use of simulation scores is 40%. Therefore stronger agreement with perceived ease of use of simulation is statistically significantly associated with stronger agreement with intention to use simulation.

Table 13

Model Summary Results: Ease of Use of Simulation and Intention to Use Simulation

Variable	B	SE	β	95% CI
Constant	2.08	0.17		[1.75, 2.41]
Perceived usefulness	0.60	0.04	0.63**	[0.51, 0.68]
R^2	0.40			
F	188.33**			

Note. $N = 287$. CI = confidence interval.
**$p < .01$.

The results for research question six and hypothesis six indicate that there is a positive and substantial relationship between perceived ease of use of simulation and intention to use simulation. Therefore null hypothesis six is rejected.

Summary

The purpose of this quantitative survey study was to examine the possible relationship that may exist between personal innovativeness and organizational innovativeness on perceived usefulness, perceived ease of use and intention to use simulation technology. The outcome will help broaden the understanding of factors that impact the adoption and use of simulation techniques in projects, including personal innovativeness and organizational innovativeness, within the framework of the TAM.

The results of this study indicate that all six research hypotheses were supported and therefore all six of the null hypotheses were rejected. Furthermore, in all cases the relationships were positive and moderate to substantial in strength. The strongest relationship was found between perceived usefulness of simulation and intention to use simulation ($\beta = .69$), followed by personal innovativeness of the user and perceived ease of use of simulation ($\beta = .66$), perceived ease of use of simulation and intention to use simulation ($\beta = .63$), personal innovativeness of the user and perceived usefulness of simulation ($\beta = .53$), organizational innovativeness and perceived usefulness of simulation ($\beta = .44$), and finally, organizational innovativeness and perceived ease of use of simulation ($\beta = .41$).

This chapter provided the data analysis results and addressed each of the six research questions and hypotheses associated with the study. Chapter 5 discussed an interpretation of these findings and a discussion of the implications of the findings. In

addition, chapter 5 outlines limitations of the current study and suggests recommendations for future research.

Chapter 5: Summary, Conclusions, and Recommendations

Introduction

In this chapter, I present a summary of the purpose of this quantitative correlational survey study, and discussed the interpretations of results presented in chapter 4. In addition, the implications of the result for social change is discussed with recommendations for action and further study. The objective of this study was to examine the possible relationship that may exist between personal innovativeness and organizational innovativeness on perceived usefulness, perceived ease of use and intention to use simulation technology. The outcome will help broaden the understanding of factors that impact the adoption and use of simulation techniques in projects, within the framework of the TAM.

Discussions in chapter 1 focused on implications of non acceptance of technology which may constitute a problem resulting in serious damages to any organization (Fahmy, 2005; Goldstein, 2007). For example, non acceptance of simulation technology cost Merrill Lynch Bank over $50 billion (Duffy et al., 2005; Labe, 2007). Also, statistics in two separate studies showed that non acceptance of technology was responsible for 57% decrease in performance level for physicians practicing in public tertiary hospitals in Hong Kong (Chau & Hu, 2002); and 39% decrease in productivity for hotel workers in Seoul, Korea (Ham et al., 2005). This quantitative correlational survey study has focused on factors that influence acceptance of simulation technology among members of the Project Management Institute (PMI) in the San Francisco Bay Area.

Interpretation of Findings

Results of simple linear regression analysis (β) showed a strong correlation among all constructs tested. The strongest relationship was found between perceived usefulness of simulation and intention to use simulation (β = .69). This is followed by personal innovativeness of the user and perceived ease of use of simulation (β = .66), perceived ease of use of simulation and intention to use simulation (β = .63), personal innovativeness of the user and perceived usefulness of simulation (β = .53), organizational innovativeness and perceived usefulness of simulation (β = .44), and finally, organizational innovativeness and perceived ease of use of simulation (β = .41).

The results of survey dimension inter-correlations indicate that on average, participants agreed most with perceived usefulness of simulation technology (4.37) followed by personal innovativeness (4.22), ease of use of simulation technology (4.10), organizational innovativeness (3.83) and finally, intention to use simulation technology (3.66). Based on these results, the researcher postulates that survey participants generally agree that simulation technology is useful and easy to use. Participants also generally agree that they exhibit personal innovativeness and therefore are more likely to experiment with new technologies. However, participants reported less than complete agreement (e.g., they somewhat agreed) that their organization is innovative and that they (the participants) have an intention to use simulation technology. Finally, the dimension scores were all positively and statistically significantly inter-correlated, $p < .01$.

Results from prior research in TAM corroborated these results, maintaining over the years that a strong relationship exist between the perceived usefulness of technology and an individual's intention to use the technology (Davis, 1989; Davis et al., 1989; Saade et al., 2008; Varol & Tarcan, 2009; Venkatesh & Davis, 2000; Venkatesh et al., 2003). For example, in three different tests conducted by Venkatesh et al. (2003) the researchers found high correlation ranging between Beta scores of 0.55 and 0.61 with $p < .001$ for perceived usefulness and voluntary intention to use technology. For Lee et al. (2006), tests revealed a Beta score of 0.66; while Varol and Tarcan (2009) obtained a Beta score of 0.63, confirming strong positive correlation between the constructs of perceived usefulness and intention to use technology.

Literature also confirmed findings presented in this research, that a strong positive correlation exists between the constructs of perceived ease of use and intention to use technology. The Beta score of 0.63 obtained in tests for these constructs compare with results by Schillewaert et al. (2005) with $\beta = .71$; Varol and Tarcan (2009) with $\beta = .69$; Robinson, Jr. et al. (2005) with $\beta = .54$; and Shang et al. (2005) with $\beta = .67$. This affirms the postulate that when individuals perceive that technology is easy to use, there is high probability that they will adopt the use of that technology.

The constructs of personal innovativeness as independent variable and perceived usefulness or perceived ease of use as dependent variables, score higher ($\beta = .53$ and $\beta = .66$ respectively), consistent with findings of Karahanna et al. (2002) with score of $\beta = .79$. However for the same constructs, Varol and Tarcan (2009), Schillewaert et al.

(2005), and Lee et al. (2006) had correlation scores of between β = .27 and β = .41 which although is statistically significant, was not as strong as results obtained in current research. A possible explanation could be the composition of sample frame used for each research. For example, this research surveyed professionals who are members of the Project Management Institute, and reside mainly in the Silicon Valley, California, considered the hub of high-tech for the nation; while Varol and Tarcan (2009) investigated hotel workers in Turkey, considered to be less innovative and with less exposure to technological innovations.

Finally results of simple linear regression tests on organizational innovativeness, as an independent variable, showed statistical correlation with perceived usefulness (β = .44, $p < .01$) and perceived ease of use (β = .41, $p < .01$) as dependent variables. This is in contrast to findings by Robinson et al. (2005), and Varol and Tarcan (2009) where results showed very low scores ranging from (β = -0.04 to β = .25).

In the current research however, results of scatter plot featuring the relationship between the standardized predicted values and the standardized residuals indicate that some heteroscedasticity is detected in the relationship between organizational innovativeness and perceived ease of use, resulting in a violation of the statistical assumption of homoscedasticity (constant error variance). This violation is based on the fact that the amount of scatter in the data points widens as the predicted values increase (Field, 2009; Mertler & Vannatta, 2005). To further elucidate, the prediction error increases as the predicted value increases resulting in non-constant error variance. Given

this violation in combination with the fact that internal reliability of the organizational innovativeness dimension is low (0.527), the results of this analysis should be interpreted with caution. Specifically, while the estimate of the predictive relationship between the variables may be reliable and valid, the accuracy of prediction for one's perceived ease of use based on his/her organizational innovativeness will depend on where he/she falls on the organizational innovativeness scale (Mertler & Vannatta, 2005). This issue was discussed further as a limitation to this quantitative correlational survey study in the following section.

Limitations to the Study

Results of the simple statistical linear regression test in this study show strong positive correlation among all the variables; however, generalizations may be made only in regard to the target population in the survey, i.e. membership of the Project Management Institute in the San Francisco Bay Area. Another limitation is the time constraint deadline that was set for all responses to be valid for analysis. It hard to speculate whether extending the deadline would have any significant effect on response rate, considering that the responses that arrived by mail after the set deadline was statistically insignificant. Participants were given the option to skip any question that they do not want to answer. This was a limitation on the research because it provided a loophole for incomplete responses.

A major limitation is in the interpretation of results for the organizational innovativeness construct. As already discussed in the previous section, results showing

significant positive statistical correlation between organizational innovativeness and perceived ease of use or perceived usefulness, could be misleading. Although significant efforts were made to clarify the items so that respondents would understand the questions, responses appear to be very subjective, depending on the individual respondent's mood or personal predisposition at the time of filling out the survey questionnaire. This resulted in highly disparate responses that accounted for the lower aggregate scores for the construct on both reliability coefficient (0.527) and the standardized coefficient ($\beta = .44$, $p < .01$; $\beta = .41$, $p < .01$) scores. Only two respondents skipped answer to the six items in this construct, and that was considered to be statistically insignificant on results of the analysis. A recommendation would be made for future research to examine ways of improving on the items in this construct in the following section.

Implications for Social Change

The findings in this research support the proposals that there is a statistically significant and positive correlation between the independent variables and the dependent variables. Specifically, the strong relationship found between perceived usefulness of simulation and intention to use simulation tools is an indication that given a situation where professionals are well educated about the usefulness of a technology, there is high probability that they would use the technology on the job. The results also show that the professionals who were surveyed indicated that they were personally motivated to try new technologies and tools. Results also show that employers of survey participants were

moderately motivated to try new technologies. Given the combination of motivations by employers and employees to try new technologies, and that over 75% of the respondents are project managers or project leaders with 62% in IT firms and 20% in manufacturing, adoption and use of simulation techniques for business processes would have significant impact on project outcomes. Companies would be able to run simulations and have fair knowledge of possible outcomes before committing valuable money and resources to projects that may fail. When risk of project failure is minimized, companies would generate additional revenues which translate to more profit. Potential benefits include positive social change to society which manifests in more jobs, and reduced costs for consumer products because of the efficiency introduced by the optimization of projects, utilizing simulation techniques.

Recommendations for Further Study

There is ample literature on the subject of simulation. However, most of these are focused on the functional rather than relational attributes of the concept. This study has investigated a link between the concept of simulation and social psychology concepts of reasoned action and technology acceptance. Simulation is widely embraced by practitioners of operations research, many of which are big corporations and their employees, but the future lies in acceptance by of the technique by many small and medium-sized companies and organizations that need to be convinced about the benefits of investing in such techniques for their businesses. It is in this area that further research is greatly needed, and use of theories and models from other disciplines, including social

psychology, would greatly enhance knowledge about simulation and contribute to social change.

This study has focused on a specific population; members of the PMI in Northern California. The study needs to be replicated in other geographic locations and with other demographic groups in order to help make generalizations on user acceptance of simulation technology. Further research needs to be carried out to improve on the instruments for the innovativeness constructs, especially on the items for organizational innovativeness. Finally, there is need for further research on correlation between acceptance of simulation technology and project failures in specific companies or organizations.

Conclusion

The underlying basis for conducting this quantitative survey research was to examine the possible correlation between personal innovativeness and organizational innovativeness on perceived usefulness, perceived ease of use, and intention to use simulation technology. A survey was conducted on a random sample of PMI members who reside in the San Francisco Bay Area, California, to test six hypotheses based on the following research questions:

1. To what extent, if any, does personal innovativeness of the user relate to perceived usefulness of simulation?
2. To what extent, if any, does personal innovativeness of the user relate to perceived ease of use of simulation?

3. To what extent, if any, does organizational innovativeness relate to perceived usefulness of simulation?
4. To what extent, if any, does organizational innovativeness relate to perceived ease of use of simulation?
5. To what extent, if any, does perceived usefulness of simulation relate to the intention to use simulation?
6. To what extent, if any, does perceived ease of use of simulation relate to the intention to use simulation?

Results of data analysis confirmed the findings of literature reviewed in Chapter 2; that in all cases, significant positive relationships exist and were moderate to substantial in strength. Generalizations were made only in regard to the population from which the sample was drawn, but suggestions were advanced about possible applicability to a wider population if this research is replicated. The importance of simulation to business was highlighted through this research, including implications of research findings for social change. The conclusion of this researcher is that when innovative individuals work for businesses that embrace innovation, acceptance of technological innovations, especially simulation techniques for business processes, would transform the way projects are implemented; generating more revenue, mitigate risks, and providing more jobs and benefits for the communities in which they are located.

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Appendix A: Requests for Usage Permission

Subject : Request for TAM2 usage permission

Date : Tue, May 18, 2010 03:27 AM CDT

From : **"Olurotimi Ladeinde" <olurotimi.ladeinde@waldenu.edu>**

To : Ergin Varol <varol@istanbul.edu.tr>, Ertugrul Tarcan <tarcan@istanbul.edu.tr>,

CC : Louis Taylor <louis.taylor@waldenu.edu>,

BCC : Timi Ladeinde <ladeinde@hotmail.com>,

Good morning Dr. Varol & Dr. Tarcan,

My name is Olurotimi Ladeinde and I am a Ph.D. student at Walden University. Currently, I am in the process of conducting research for my dissertation. I am interested in your application of the extended Technology Acceptance Model (TAM2) and the survey instrument that you used in your empirical study on the user acceptance of hotel information systems (Varol & Tarcan, 2009).

I would very much like to get your permission to utilize the model and instrument in my study on user acceptance of simulation. Thank you for your prompt response.

Olurotimi Ladeinde,
BA (Ibadan), MA (Manitoba).

Subject : Request for usage permission

Date : Mon, Oct 25, 2010 06:45 PM CDT
From : **"Olurotimi Ladeinde" <olurotimi.ladeinde@waldenu.edu>**
To : Fred Davis <FDavis@walton.uark.edu>
CC : Louis Taylor <louis.taylor@waldenu.edu>,
BCC : Timi Ladeinde <ladeinde@hotmail.com>,

Dear Dr. Davis,

My name is Olurotimi Ladeinde. I am a PhD student at Walden University School of Management. I am currently conducting my research on user acceptance of simulation technology, and would very much like to get your permission to utilize technology acceptance model (TAM) in my study.

Thank you for your prompt response.

Olurotimi Ladeinde.
BA (Ibadan), MA (Manitoba).

Subject : Request for usage permission

Date : Mon, Oct 25, 2010 07:03 PM CDT

From : **"Olurotimi Ladeinde" <olurotimi.ladeinde@waldenu.edu>**

To : Viswanath Venkatesh <vvenkatesh@vvenkatesh.us>

CC : Louis Taylor <louis.taylor@waldenu.edu>,

BCC : Timi Ladeinde <ladeinde@hotmail.com>,

Dear Dr. Venkatesh,

My name is Olurotimi Ladeinde. I am a PhD student at Walden University School of Management. I am currently conducting my research on user acceptance of simulation technology.

I would very much like to get your permission to utilize your proposed extension of the technology acceptance model (TAM2) from your 2000 publication with Dr. Davis (titled: A theoretical extension of the technology acceptance model) in my study.

Thank you for your prompt response.

Olurotimi Ladeinde.
BA (Ibadan), MA (Manitoba).

Subject : Request for usage permission

Date : Thu, 04 Nov, 2010 08:06 PM EDT

From : **"Olurotimi Ladeinde" <olurotimi.ladeinde@waldenu.edu>**

To : Heshan Sun <hsun@email.arizona.edu>, Ping Zhang <pzhang@syr.edu>,

CC : Louis Taylor <louis.taylor@waldenu.edu>,

BCC : Olurotimi Ladeinde <olurotimi.ladeinde@waldenu.edu>,

Dear Drs. Sun & Zhang,

My name is Olurotimi Ladeinde. I am a PhD student at Walden University School of Management. I am currently conducting my Dissertation research on user acceptance of simulation technology. In my research, I discussed the technology acceptance model (TAM) proposed in your journal article published by John Wiley & Sons, Inc. The article is listed below:

1. Sun, H., & Zhang, P. (2008). An exploration of affect factors and their role in user technology acceptance: Mediation and causality. *Journal of the American Society for Information Science & Technology, 59*(8), 1252-1263.

I would very much like to get your permission to utilize materials/diagrams of the TAM in the journal article listed above. The materials are only for individual use as described above, and proper credit and citations would be made in my report.

Thank you for your prompt response.

Olurotimi Ladeinde.
BA (Ibadan), MA (Manitoba).

Subject : request for usage permission

Date : Thu, 04 Nov, 2010 06:30 PM EDT

From : **"Olurotimi Ladeinde" <olurotimi.ladeinde@waldenu.edu>**

To : Patricia Kolb <pkolb@mesharpe.com>

CC : Louis Taylor <louis.taylor@waldenu.edu>,

BCC : Olurotimi Ladeinde <olurotimi.ladeinde@waldenu.edu>,

Dear Ms. Kolb,
My name is Olurotimi Ladeinde. I am a PhD student at Walden University School of Management. I am currently conducting my Dissertation research on user acceptance of simulation technology. In my research, I discussed the modified technology acceptance model (TAM) proposed in two journal articles published by M. E. Sharpe, Inc. The articles are:

1. Chau, P. Y. K. (1996). An empirical assessment of a modified technology acceptance model. *Journal of Management Information Systems, 13*(2), 185-204.

2. Chau, P. K. Y., & Hu, P. J. (2002). Examining a model of information technology acceptance by individual professionals: An exploratory study. *Journal of Management Information Systems, 18*(4), 191-229.

I would very much like to get your permission to utilize diagrams of the modified TAM in the two journal articles listed above. The materials are only for individual use as described above, and proper credit and citations would be made in my report.

Thank you for your prompt response.

Olurotimi Ladeinde.
BA (Ibadan), MA (Manitoba).

Appendix B: Usage Permissions Granted

Subject : Re: [Fwd: Request for TAM2 usage permission]

Date : Wed, May 19, 2010 07:02 AM CDT

From : **Ertugrul Tarcan <tarcan@akdeniz.edu.tr>**

To : Olurotimi Ladeinde <olurotimi.ladeinde@waldenu.edu>

CC : varol@istanbul.edu.tr

Dear Ladeinde,

Your request related to the utilization of the models and survey instrument in our study on the user acceptance of hotel information systems (Varol & Tarcan, 2009) is suitable for us.
Thank you for your interest.

Ergin Sait Varol, PhD,
Associate Prof. Dr.
Vocational School of Technical Sciences
Istanbul University
E-mail: varol@istanbul.edu.tr

Ertugrul Tarcan, PhD.
Assoc. Prof. Dr.
Akdeniz University
Alanya Faculty of Business
Alanya, ANTALYA - TURKEY
E-mail: tarcan@akdeniz.edu.tr

On Tue, 18 May 2010 22:41:33 +0300, varol wrote
> ----------
> Konu: Request for TAM2 usage permission
> Gönderen: "Olurotimi Ladeinde" <olurotimi.ladeinde@waldenu.edu>
> Tarih: 18 Mayıs 2010, Salı, 11:27
> Alıcı: "Ergin Varol" <varol@istanbul.edu.tr>
> "Ertugrul Tarcan" <tarcan@istanbul.edu.tr>
> Cc: "Louis Taylor" <louis.taylor@waldenu.edu>
> ----------
>
> Good morning Dr. Varol & Dr. Tarcan,
>
> My name is Olurotimi Ladeinde and I am a Ph.D. student at Walden
> University. Currently, I am in the process of conducting research

> for my dissertation. I am interested in your application of
the extended
> Technology Acceptance Model (TAM2) and the survey instrument that
> you used in your empirical study on the user acceptance of hotel
information
> systems (Varol & Tarcan, 2009).
>
> I would very much like to get your permission to utilize the model
> and instrument in my study on user acceptance of simulation. Thank
> you for your prompt response.
>
> Olurotimi Ladeinde,
> BA (Ibadan), MA (Manitoba).
>

Subject : RE: Request for usage permission

Date : Tue, Oct 26, 2010 02:21 AM CDT

From : **Fred Davis <FDavis@walton.uark.edu>**

To : Olurotimi Ladeinde <olurotimi.ladeinde@waldenu.edu>

Yes, youhave my permission to utilize TAM in your dissertation study.
Best wishes,
Fred Davis

From: Olurotimi Ladeinde [olurotimi.ladeinde@waldenu.edu]
Sent: Monday, October 25, 2010 6:45 PM
To: Fred Davis
Cc: Louis Taylor
Subject: Request for usage permission

Dear Dr. Davis,
My name is Olurotimi Ladeinde. I am a PhD student at Walden University School of Management. I am currently conducting my research on user acceptance of simulation technology, and would very much like to get your permission to utilize technology acceptance model (TAM) in my study.

Thank you for your prompt response.

Olurotimi Ladeinde.
BA (Ibadan), MA (Manitoba).

Subject : RE: Request for usage permission

Date : Tue, Oct 26, 2010 03:40 AM CDT

From : **Viswanath Venkatesh <vvenkatesh@vvenkatesh.us>**

To : Olurotimi Ladeinde' <olurotimi.ladeinde@waldenu.edu>

CC : Supreet Joglekar <SJoglekar@walton.uark.edu>

You have my permission for non-commercial use. I also advise you to look closely at TAM3 (Venkatesh and Bala 2008, Decision Sciences).

Sincerely,
Viswanath Venkatesh
Professor and George and Boyce Billingsley Chair in Information Systems
Walton College of Business
University of Arkansas
Fayetteville, AR 72701
Phone: 479-575-3869; Fax: 479-575-3689
Email: vvenkatesh@vvenkatesh.us
Website: http://vvenkatesh.com
IS Research Rankings Website: http://vvenkatesh.com/ISRanking

From: Olurotimi Ladeinde [mailto:olurotimi.ladeinde@waldenu.edu]
Sent: Monday, October 25, 2010 7:03 PM
To: Viswanath Venkatesh
Cc: Louis Taylor
Subject: Request for usage permission

Dear Dr. Venkatesh,
My name is Olurotimi Ladeinde. I am a PhD student at Walden University School of Management. I am currently conducting my research on user acceptance of simulation technology. I would very much like to get your permission to utilize your proposed extension of the technology acceptance model (TAM2) from your 2000 publication with Dr. Davis (titled: A theoretical extension of the technology acceptance model) in my study.

Thank you for your prompt response.

Olurotimi Ladeinde.
BA (Ibadan), MA (Manitoba).

Subject : Re: Request for usage permission

Date : Thu, 04 Nov, 2010 08:52 PM EDT

From : **Heshan Sun <hsun@email.arizona.edu>**

To : Olurotimi Ladeinde <olurotimi.ladeinde@waldenu.edu>

CC : Ping Zhang <pzhang@syr.edu>... more

Hi Olurotimi:

Thanks for letting us know. I do not see any problem with your use of our materials as long as proper credit is made.

Heshan

On Thu, Nov 4, 2010 at 5:06 PM, Olurotimi Ladeinde <olurotimi.ladeinde@waldenu.edu> wrote:

Dear Drs. Sun & Zhang,

My name is Olurotimi Ladeinde. I am a PhD student at Walden University School of Management. I am currently conducting my Dissertation research on user acceptance of simulation technology. In my research, I discussed the technology acceptance model (TAM) proposed in your journal article published by John Wiley & Sons, Inc. The article is listed below:

1. Sun, H., & Zhang, P. (2008). An exploration of affect factors and their role in user technology acceptance: Mediation and causality. *Journal of the American Society for Information Science & Technology, 59*(8), 1252-1263.

I would very much like to get your permission to utilize materials/diagrams of the TAM in the journal article listed above. The materials are only for individual use as described above, and proper credit and citations would be made in my report.

Thank you for your prompt response.

Olurotimi Ladeinde.
BA (Ibadan), MA (Manitoba).
****

Heshan Sun
Assistant Professor
SIRLS, University of Arizona
http://www.u.arizona.edu/~hsun/
****

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Subject : FW: request for usage permission

Date : Fri, 05 Nov, 2010 09:26 AM EDT

From : **Elizabeth Granda <egranda@mesharpe.com>**

To : olurotimi.ladeinde@waldenu.edu

Dear Olurotimi Ladeinde,

We are pleased to grant permission to you for the reprinting of: diagrams of
the modified TAM in the following two articles--

(1) Chau, P.Y.K. (1996). An empirical assessment of a modified technology
acceptance model. Journal of Management Information Systems, 13(2), 185-204.

(2) Chau, P.Y.K., & Hu, P.J. (2002). Examining a model of information technology acceptance by individual professionals: An exploratory study.
Journal of Management Information Systems, 18(4), 191-229.

For use in: Olurotimi Ladeinde, PhD dissertation, Walden University School of
Management

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(2) P.Y.K. Chau & P.J. Hu, "Examining a model of information technology acceptance by individual professionals: An exploratory study," Journal of
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With best wishes,
Elizabeth Granda

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Elizabeth Granda
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-----Original Message-----
From: Olurotimi Ladeinde [mailto:olurotimi.ladeinde@waldenu.edu]
Sent: Thursday, November 04, 2010 6:30 PM
To: Patricia Kolb
Cc: Louis Taylor
Subject: request for usage permission

Dear Ms. Kolb,
My name is Olurotimi Ladeinde. I am a PhD student at Walden University School of Management. I am currently conducting my Dissertation research on user

acceptance of simulation technology. In my research, I discussed the modified technology acceptance model (TAM) proposed in two journal articles published by M. E. Sharpe, Inc. The articles are:

1. Chau, P. Y. K. (1996). An empirical assessment of a modified technology acceptance model. Journal of Management Information Systems, 13(2), 185-204.

2. Chau, P. K. Y., & Hu, P. J. (2002). Examining a model of information technology acceptance by individual professionals: An exploratory study. Journal of Management Information Systems, 18(4), 191-229.

I would very much like to get your permission to utilize diagrams of the modified TAM in the two journal articles listed above. The materials are only for individual use as described above, and proper credit and citations would be made in my report.

Thank you for your prompt response.

Olurotimi Ladeinde.
BA (Ibadan), MA (Manitoba).

Appendix C: Survey Instrument

Demographics:

1. Gender
2. Age
3. Occupation
4. Employer
5. Industry

Survey instrument

SCALE	ITEMS
Perceived usefulness (PU)	
PU1	Using simulation technology increases my productivity.
PU2	Using simulation technology improves my job performance.
PU3	Using simulation technology enhances my effectiveness on the job.
PU4	Using simulation technology makes it easier to do my job.
PU5	Overall, I find simulation technology useful in my job.
Sources: Davis (1989), Chin & Todd (1995), Varol & Tarcan (2009).	
Perceived ease of use (PEOU)	
PEOU1	Learning to operate simulation software is easy for me.
PEOU2	I find it easy to get the technology to do what I want to do.
PEOU3	My interaction with simulation technology is clear and understandable.
PEOU4	Overall, I find simulation technology easy to use.
Sources: Davis (1989), Adams et al. (1992), Varol & Tarcan (2009).	
Intention to use (IU)	

IU1	I intend to use simulation tools in my job when it becomes available to me.
IU2	I intend to use simulation tools as often as needed.
IU3	To the extent possible, I would use simulation tools on my job frequently.

Sources: Ajzen & Fishbein (1980), Ajzen & Madden (1986), Varol & Tarcan (2009).

Personal innovativeness (PI)	
PI1	If I heard about a new technology, I would look for ways to experiment with it.
PI2	Among my peers, I am usually the first to try out new technologies.
PI3	In general, I am hesitant to try out new technologies.
PI4	I like to experiment with new technologies.

Sources: Argarwal & Prassad (1998), Varol & Tarcan (2009).

Organizational innovativeness	
OI1	The upper management of my company has a positive attitude toward change.
OI2	My boss has a positive attitude toward change.
OI3	In my company, power and control are concentrated in the hands of relatively few individuals.
OI4	The employees in my company possess a high level of knowledge and expertise.
OI5	In my company, rules and procedures are strictly enforced.
OI6	The employees in my company are linked to each other by interpersonal networks.

Sources: Robinson et al. (2005), Varol & Tarcan (2009).

Appendix D: Survey Approvals, Consent Forms and Questionnaire

IRB Approval

IRB Approval

Subject : IRB Materials Approved-Olurotimi Ladeinde
Date : Thu, Feb 24, 2011 10:39 PM CST
From : IRB <IRB@waldenu.edu>
To : Olurotimi Ladeinde <olurotimi.ladeinde@waldenu.edu>
CC : Louis Taylor <louis.taylor@waldenu.edu>... ▪ ▪▪▪▪more
Attachment : Ladeinde_Consent_Form.pdf

Dear Mr. Ladeinde,

This email is to notify you that the Institutional Review Board (IRB) has approved your application for the study entitled, "An Empirical Study on User Acceptance of Simulation Techniques for Business Process."

Your approval # is 02-24-11-0109947. You will need to reference this number in your dissertation and in any future funding or publication submissions. Also attached to this e-mail is the IRB approved consent form. Please note, if this is already in an on-line format, you will need to update that consent document to include the IRB approval number and expiration date.

Your IRB approval expires on February 23, 2012. One month before this expiration date, you will be sent a Continuing Review Form, which must be submitted if you wish to collect data beyond the approval expiration date.

Your IRB approval is contingent upon your adherence to the exact procedures described in the final version of the IRB application document that has been submitted as of this date. If you need to make any changes to your research staff or procedures, you must obtain IRB approval by submitting the IRB Request for Change in Procedures Form. You will receive an IRB approval status update within 1 week of submitting the change request form and are not permitted to implement changes prior to receiving approval. Please note that Walden University does not accept responsibility or liability for research activities conducted without the IRB's approval, and the University will not accept or grant credit for student work that fails to comply with the policies and procedures related to ethical standards in research.

When you submitted your IRB application, you made a commitment to communicate both discrete adverse events and general problems to the IRB within 1 week of their occurrence/realization. Failure to do so may result in invalidation of data, loss of academic credit, and/or loss of legal protections otherwise available to the researcher.

Both the Adverse Event Reporting form and Request for Change in Procedures form can be obtained at the IRB section of the Walden web site or by emailing irb@waldenu.edu : http://inside.waldenu.edu/c/Student_Faculty/StudentFaculty_4274.htm

Researchers are expected to keep detailed records of their research activities (i.e., participant log sheets, completed consent forms, etc.) for the same period of time they retain the original data. If, in the future, you require copies of the originally submitted IRB materials, you may request them from Institutional Review Board.

Please note that this letter indicates that the IRB has approved your research. You may not begin the research phase of your dissertation, however, until you have received the

Notification of Approval to Conduct Research (which indicates that your committee and Program Chair have also approved your research proposal). Once you have received this notification by email, you may begin your data collection.

Both students and faculty are invited to provide feedback on this IRB experience at the link below:

http://www.surveymonkey.com/s.aspx?sm=qHBJzkJMUx43pZegKImdiQ_3d_3d

Sincerely,
Jenny Sherer, M.Ed., CIP
Operations Manger
Office of Research Integrity and Compliance
Email: irb@waldenu.edu
Fax: 626-605-0472
Tollfree : 800-925-3368 ext. 1341
Office address for Walden University:
155 5th Avenue South, Suite 100
Minneapolis, MN 55401

Invitation to Participate in Research

Dear Colleague,
I am a member of PMI and also a doctoral student in Management at Walden University. As part of the requirement for my degree, I am conducting this research on user acceptance of simulation technology for business projects. I would very much appreciate your cooperation in helping a colleague by your participation in this survey.

Please read the attached consent form, and if you choose to participate in the study, you have the option to complete the survey online (https://www.surveymonkey.com/s/C9QNJFB) or return the completed paper version included with this packet using the postage-paid envelope included.

Please note that by completing the survey online or returning the paper survey constitutes your implied consent to participate in the study, as stated in the consent form.

Thank you.

Olurotimi Ladeinde.
Email: Olurotimi.Ladeinde@WaldenU.edu

Participant Consent Form

Participant Consent Form

Dear Study Participant,
You are invited to take part in a research study titled "An Empirical Study on User Acceptance of Simulation Techniques for Business Process". You were randomly chosen for the study from a list of current members of the Project Management Institute (PMI). **Please understand that this research is not PMI sponsored or funded, and it is independent of PMI's research program.**

The research is a continuing step in a larger study that will form the basis of my doctoral dissertation through Walden University. Your participation would go a long way in helping a fellow colleague, because I am a member of the PMI Silicon Valley Chapter.

Background Information:
The purpose of this study is to investigate factors that impact success or failure of projects through acceptance or non-acceptance of technological innovations by professionals, particularly project managers.

Procedures:
If you agree to be in this study, you will be asked to take a brief electronic survey located at this link: https://www.surveymonkey.com/s/C9QNJFB . If you choose to complete the survey now and do not have access to the internet, a printed questionnaire is included in this mail for you to complete and return to me using the postage-paid envelope included. **Please do not complete or mail back the paper questionnaire if you choose to take the survey online.**

The questionnaire consists of a total of 10 questions divided into 5 sections. The entire survey would take approximately 5 to 7 minutes to complete.

My goal is to get all responses by March 11, 2011 after which the link would be deactivated. I would very much appreciate your cooperation in helping me to reach my goal as quickly as possible.

Voluntary Nature of the Study:
Your participation in this study is voluntary. This means that everyone will respect your decision of whether or not you want to be in the study. If you feel stressed during the study you may stop at any time. You may skip any questions that you feel are too personal.

Risks and Benefits of Being in the Study:
There is no known risk as a result of your decision to participate in the study. Also, there is no direct benefit to you as an individual participant, but study results may help explain factors that influence project failures.

Compensation:
There is no compensation for participation in the study.

Confidentiality:
Any information you provide will be kept anonymous. The researcher will not use your information for any purposes outside of this research project. Also, the researcher will not include your name or anything else that could identify you in any reports of the study.

Contacts and Questions:

The researcher conducting this study is Olurotimi Ladeinde. The researcher's dissertation committee chairperson is Dr. Loius L. Taylor. You may ask any questions you have now. Or if you have questions later, you may contact any of the following:

Mr. Olurotimi Ladeinde
2405 Asilomar Dr.
Antioch, CA. 94531
Email: Olurotimi.Ladeinde@WaldenU.edu
Mobile: 925-255-3291

Dr. Louis L. Taylor,
Email: Louis.Taylor@WaldenU.edu

If you want to talk privately about your rights as a participant, you can call Dr. Leilani Endicott. She is the Walden University representative who can discuss this with you. Her phone number is 1-800-925-3368, extension 1210. Walden University's approval number for this study is **02-24-11-0109947** and it expires on **February 23, 2012.**

Statement of Consent:
In order to protect the privacy of all participants in this study and to keep the study completely anonymous, completion of this survey online, or returning completed survey questionnaire to the researcher using the postage-paid envelope supplied with the mailed packet would constitute your implied consent to participate in this study.

PMI List Rental Agreement

02/02/2011 07:14 8282930521 PAGE 01/01

Project Management Institute

List Rental Agreement & Guarantee

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Project Management Institute
Global Operations Center
14 Campus Boulevard
Newtown Square, PA 19073

This letter confirms our understanding regarding the rental of all lists ordered from the Project Management Institute (PMI) headquartered at 14 Campus Boulevard, Newtown Square, Pennsylvania 19073 USA. By signing this contract, we agree to the terms on the Order Form and List Rental Agreement.

All names and addresses are the exclusive and valuable property of PMI and are of a highly confidential nature. The List Renter will not disclose, transfer, duplicate, reproduce, or retain in any form or manner whatsoever all or any portion of the said mailing list(s), nor permit any third party, agent, client, employee, or contractor or their respective agents and employees to do so.

The List Renter agrees that the list will not be used for telemarketing or personal contact. On completion of this one-time mailing, the list renter agrees to destroy or return to you all magnetic disks, and to destroy all unused mailing labels, letters, envelopes, and other type of printed matter that contains names and addresses supplied by PMI.

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If List Renter or any of those referred to above, who shall be given access to the list(s), shall use the list(s) contrary to the provisions of this Agreement, the undersigned shall be unconditionally responsible for all costs and litigation expenses, including attorneys' fees, incurred by this unauthorized use.

The List Renter understands that any merge/purge drops are already figured into the base price of the list and that all adjustments to invoices after being processed by PMI will not be honored. CV Reports are not accepted. Full invoice amount is due. When invoiced, the List Renter/Broker agrees to make full payment to PMI for the list(s) rental(s) within 30 days of mail date.

The List Renter understands that the list(s) are monitored to prevent improper and unauthorized use of the list(s) by a combination of one or more methods of computer control and/or planted and/or varied names and addresses. The List Renter consents and agrees to the use of any or all of such methods. Any unauthorized uses of list will result in applicable fines and/or legal action.

The Undersigned agrees that this Agreement is being entered into in Newtown Square, Pennsylvania, and that in the event any litigation arises as a result of a breach of this Agreement, the courts located in Delaware County, Pennsylvania, shall be a proper venue for such litigation and shall have personal jurisdiction over the undersigned.

Renter Firm Information

Company _____
Contact OLUROTIMI LADEINDE
Address 2405 AGUAMAR DR.
City/St/Zip ANTIOCH, CA. 94531
Phone/Fax/E-Mail 925-255-3291
PMI List Manager Signature/Title _____

Signatures

For Renter Olurotimi Ladeinde
Dated 02/01/11
For Broker _____
Dated _____
Broker Company _____

Survey Questionnaire

Technology Acceptance Survey

1. Innovativeness

Please answer the questions in this section regardless of your current employment status. If you are currently employed, then answer the questions relating to your experience at work. If you do not have employment at this time, please answer the questions based on your last or previous employment.

1. How would you rate your level of comfort with taking risks at work by trying out or experimenting with new technologies. This would include trying out newly released software programs or hardware (e.g. Windows 7, the iphone, the android, the ipad, or cloud computing).

	Strongly Agree	Agree	No Opinion	Disagree	Strongly Disagree
1. If I heard about a new technology, I would look for ways to experiment with it.	◯	◯	◯	◯	◯
2. Among my peers, I am usually the first to try out new technologies.	◯	◯	◯	◯	◯
3. In general, I am hesitant to try out new technologies.	◯	◯	◯	◯	◯
4. I like to experiment with new technologies.	◯	◯	◯	◯	◯

2. Please rate your perception of the attitude of your employer, manager or supervisor towards change or new innovations. This includes supervisor or management attitude towards suggestions for change by you or your co-workers.

	Strongly Agree	Agree	No Opinion	Disagree	Strongly Disagree
1. The upper management in my company has a positive attitude toward change.	◯	◯	◯	◯	◯
2. My boss has a positive attitude toward change.	◯	◯	◯	◯	◯
3. In my company, power and control are concentrated in the hands of relatively few individuals.	◯	◯	◯	◯	◯
4. The employees in my company possess a high level of knowledge and expertise.	◯	◯	◯	◯	◯
5. In my company, rules and procedures are strictly enforced.	◯	◯	◯	◯	◯
6. The employees in my company are linked to each other by interpersonal networks.	◯	◯	◯	◯	◯

Technology Acceptance Survey

2. Usefulness

In this section, "simulation technology" is defined as any software or procedure that is used to create various scenarios or options. A software (e.g. Microsoft Excel or Microsoft Visual Basic) with features that may be used for forecasting or to create various scenarios is considered as simulation software.

If you (as an individual or as part of a project group) have utilized any simulation software in past or current projects, please indicate what you perceive as benefits or consequences as a result of your decision to adopt or use simulation software.

3. How would you describe the benefits or rewards that you derived from use or participation in use of simulation software.

	Strongly Agree	Agree	No Opinion	Disagree	Strongly Disagree
1. Using simulation technology increases my productivity.	◯	◯	◯	◯	◯
2. Using simulation technology improves my job performance.	◯	◯	◯	◯	◯
3. Using simulation technology enhances my effectiveness on the job.	◯	◯	◯	◯	◯
4. Using simulation technology makes it easier to do my job.	◯	◯	◯	◯	◯
5. Overall, I find simulation technology useful in my job.	◯	◯	◯	◯	◯

Technology Acceptance Survey

3. Ease of Use

In this section, "simulation technology" is defined as any software or procedure that is used to create various scenarios or options. A software (e.g. Microsoft Excel or Microsoft Visual Basic) with features that may be used for forecasting or to create various scenarios is considered as simulation software.

If you (as an individual or as part of a project group) have utilized any simulation software in past or current projects, please give your opinion on how easy or difficult it was to learn or adopt use of that simulation software.

4. How would you describe your experience in learning and use of a simulation software that you have used or are currently using.

	Strongly Agree	Agree	No Opinion	Disagree	Strongly Disagree
1. Learning to operate simulation software is easy for me.	○	○	○	○	○
2. I find it easy to get the technology to do what I want to do.	○	○	○	○	○
3. My interaction with simulation technology is clear and understandable.	○	○	○	○	○
4. Overall, I find simulation technology easy to use.	○	○	○	○	○

Technology Acceptance Survey

4. Intention to Use

In this section, "simulation technology" is defined as any software or procedure that is used to create various scenarios or options. A software (e.g. Microsoft Excel or Microsoft Visual Basic) with features that may be used for forecasting or to create various scenarios is considered as simulation software.

If you (as an individual or as part of a project group) have utilized any simulation software in past or current projects, please give your opinion on your intention to continue to use or not use the simulation software in future.

5. Please indicate your future intention regarding use of simulation software to perform your job duties.

	Strongly Agree	Agree	No Opinion	Disagree	Strongly Disagree
1. I intend to use simulation tools in my job when it becomes available to me.	○	○	○	○	○
2. I intend to use simulation tools as often as needed.	○	○	○	○	○
3. To the extent possible, I would use simulation tools on my job frequently.	○	○	○	○	○

Technology Acceptance Survey

5. Demographics

The following questions are included to help future research on this topic.

6. What is your gender?

- ◯ Male
- ◯ Female

Other (please specify)

7. Please choose one of these options that fits your Age Range.

- ◯ Under 25
- ◯ Between 25 and 35
- ◯ Between 36 and 45
- ◯ Between 46 and 55
- ◯ Over 55

8. Please choose one of these options that best describe your occupation.

- ◯ Analyst
- ◯ Architect
- ◯ Consultant
- ◯ Engineer
- ◯ Executive
- ◯ Lecturer
- ◯ Operations
- ◯ President/Vice President
- ◯ Project Leader
- ◯ Project Manager
- ◯ QA
- ◯ Team Leader

Other (please specify)

9. Please fill out this (optional) information.

Name of your Organization/Employer:

10. Please choose one of these options that best describe your industry.

- ◯ Academia
- ◯ Construction
- ◯ Consulting
- ◯ Financial Services
- ◯ Health/Human/Social Services
- ◯ Information Technology
- ◯ Manufacturing
- ◯ Petroleum
- ◯ Public Admin/Government

Other (please specify)

Curriculum Vitae

Olurotimi A. Ladeinde

Education	2011 Walden University Minneapolis, MN **PhD (Management: Information Technology)** Specialization: Information Systems Management / Operations Research / Decision Analysis 1979 University of Manitoba Winnipeg, Canada **MA (Political Science)** Specialization: Comparative Political Theory 1975 University of Ibadan Ibadan, Nigeria **BA (History & Political Science)**
Teaching Experience	2005 – 2010 Antioch Unified School District Antioch, CA. **Sub Teacher (Computer Science)** Antioch High School / Deer Valley High School 1979 – 1981 University of British Columbia Vancouver, Canada. **Graduate Teaching Assistant, Dept. of Pol. Science** 1981 – 1986 Tai Solarin University of Education Ijebu-Ode, Nigeria. **Senior Lecturer & Head of Dept. (Economics & Pol. Science)** 1976 – 1977 Government College Ketu, Epe, Nigeria. **Teacher (Government & Politics)**
Publications	Ladeinde, O. A. (1979). *Nigeria: The effects of conflict of legitimacy systems on political stability in the first republic.* (M.A. dissertation), The University of Manitoba, Canada. Available from ProQuest Dissertations and Theses database. (Publication No. AAT ML53660).

	Ladeinde, O. A. (2008). *The impact of operations research in predicting outcomes in organizational change process and development.* Unpublished research paper submitted for KAM V, School of Management, Walden University, Minneapolis, MN. Ladeinde, O. A. (2009). *The impact of scientific decision-making on organizational change process and development.* Unpublished research paper submitted for KAM VI, School of Management, Walden University, Minneapolis, MN. Ladeinde, O. A. (2010). *Research methods and techniques used in contemporary business process re-engineering projects.* Unpublished research paper submitted for KAM VII, School of Management, Walden University, Minneapolis, MN.
IT Experience	Work experience include extensive experience in software development working as contractor or full-time position with both small and large, well-known corporations. Details of job performed will be provided upon request. 07/2003 – 12/2007 HomePageStore, Inc. Walnut Creek, CA. **Chief Technology Officer (CTO)** 02/2003 – 05/2003 Kaiser Permanente Oakland, CA. **Consultant Software Developer** 04/2000 – 12/2001 THAP! Emeryville, CA. **Lead Software Engineer** 05/1998 – 03/2000 Mervyn's California Hayward, CA. **Consultant Systems Engineer / Sr. Systems Developer** 02/1998 – 04/1998 East Bay Municipal Util Dist. (EBMUD). Oakland, CA. **Programmer/Analyst** 10/1997 – 01/1998 3 COM Corporation Santa Clara, CA. **Systems Engineer** 04/1996 – 08/1997 ComputerLand Corporation Pleasanton, CA. **Sr. Systems Developer** 02/1996 – 03/1996 CHEVRON (Treasury) San Francisco, CA.

	Programmer/Analyst 12/1995 – 01/1996 Pacific Bell, Inc. San Ramon, CA. **Consultant** 05/1995 – 11/1995 Silicon Graphics, Inc. Mt. View, CA. **Programmer/Analyst** 07/1994 – 04/1995 CHEVRON (CITC) San Ramon, CA. **Programmer/Analyst** 08/1991 – 02/1994 Solectron Corporation Milpitas, CA. **Programmer** 09/1988 – 08/1991 ESOFT Oakland, CA. **Programmer**
Professional Affiliations	Member: Institute for Operations Research and Management Science (**INFORMS**). Member: Association of Information Technology Professionals (**AITP**). Member: Institute of Electrical & Electronic Engineers (**IEEE**) Member: Project Management Professionals (**PMI**).