T.C.
BAHÇEŞEHİR UNIVERSITY

EVALUATION OF PROJECT MANAGEMENT SYSTEMS WITH TECHNOLOGY ACCEPTANCE MODEL 3

M.S. THESIS

Pol IRGAV

Istanbul, 2011

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BAHÇEŞEHİR ÜNİVERSİTESİ

The Graduate School of Natural and Applied Sciences

Computer Engineering

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Supervisor: Assoc. Prof. Dr. Adem KARAHOCA

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This is to certify that we have read this thesis and that we find it fully adequate in scope, quality and content, as a thesis for the degree of Master of Science.

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9.9.2011 Pol IRGAV

ABSTRACT

EVALUATION OF PROJECT MANAGEMENT SYSTEMS WITH TECHNOLOGY ACCEPTANCE MODEL 3

IRGAV, Pol

Department of Computer Engineering

Supervisor: Assoc. Prof. Dr. Adem Karahoca

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The main goal of this thesis is to find the relationship between technology acceptance and project management. According to these purposes a literature review is done on the project management software and technology acceptance. As a result of literature review related work has been done to show the impact of technology acceptance on project management tools. This study was conducted with the support of a company in Turkey. The project management tools used in this company is used for experiments in this thesis. The member of project management team evolved in these experiments. During these experiments I tried to find the relationships between technology acceptance and project management software for a successful project management. The impacts of the constructs in technology acceptance model 3 are applied during the thesis. As a result of this thesis, the attitude towards using a project management tool is showed.

Keywords: Technology Acceptance, Reasoned action, Project Management.

ÖZET

PROJE YÖNETİM SİSTEMLERİNİN

TEKNOLOJİ KABUL MODELİ 3 İLE DEĞERLENDİRİLMESİ

IRGAV, Pol

Bilgisayar Mühendisliği Bölümü

Tez Danışmanı: Doç. Dr. Adem Karahoca

Eylül 2011, 50 Sayfa

Bu tezin ana amacı, proje yönetimi aracları ve teknoloji kabul teorisi arasındaki bağlantıya odaklanmaktır. Proje yönetimi ve Teknoloji Kabul teorisi arasınsındaki mevcut literatur calısmaları kullanılarak, yeni durum hakkında bilgiler elde edilmesi ile literature katkı sağlanılması hedeflenmektedir. Ayrıca, literatür taraması sırasında gelişen birkaç sorunu araştırmak için, deneysel bir yaklaşım ile sanal proje yönetimi gibi yeni teknolojilerin teknoloji adaptasyonu üzerinde nasıl bir etkiye sahip oldugu arastırılmıstır.Kabul faktörler, anksiyete uzantısı ile değiştirilmis bir TAM3 modeli benimseyerek bu model içinde yer alan değişkenlerin, Türkiye'deki internet servis sağlayıcı sektöründeki çalışanların perspektifinden proje yönetim araçlarının incelenmesi hedeflenmektedir.

Anahtar Kelimler: Teknoloji Kabul Modeli, Nedensel Aksiyon,Proje Yönetimi

TABLE OF CONTENT

LIST OF TABLES

LIST OF FIGURES

ABBREVIATIONS

Behavioral Intention	: BI
Computer Anxiety	: CANX
Computer Playfulness	: CPLAY
Computer Self Efficacy	: CSE
Goodness of Fit Index	: GFI
Image	: IMG
Information Technology	: IT
Job Relevance	: REL
Output Quality	: OUT
Perceived Ease of Use	: PEOU
Perceived Enjoyment	: ENJ
Perceived Usefulness	: PU
Perception of External Controls	: PEC
Project Management	: PM
Result Demonstrability	: RES
Subjective Norm	: SN
Technology Acceptance Model	: TAM
Theory of Reasoned Action	: TRA
Voluntariness	: VOL

1. INTRODUCTION

The development in internet technologies has opened new dimensions in project management field. As a result of these developments on the Internet, there is no project management depending on geographical boundaries. Projects managed by different points. As a result of this globalization the project management work turns in a challenging works. Therefore, the project management is a difficult and popular job. According to Cantu, information technologies establish communication links between project and teams. These communication channels supported via well designed software and hardware platforms. Cantu's this definition shows us, in order to achieve sustainable benefit of project management it is necessary to have a good support of a software and hardware platform. Beside the technology as a prerequisite is in the context. The technology adaptation of the project team members is so important for a high achievement. Beside the software, the technology acceptance of the users comes in to play.

One of the most interesting research areas in information system is technology acceptance. The first models were introduced in the 1970ies by Fisbein and Ajzen in 1975. They tried to understand why people use the technology. They tried to investigate why believes drive intentions. In 1986 Fred Davis introduced the technology acceptance model (TAM). This is the one of the common model in this area.

However, beside those basic problems the main aim of this thesis, the theory of technology acceptance variables, to investigate the effect on project management tools.

As mentioned before, the research aim of this thesis is to find the relationship between technology acceptance and project management tools. As a result of literature review related work has been done to show the impact of technology acceptance on project management tools.

Several theoretical models have been used to investigate the determinants of the acceptance and use of new information technology (IT) (Venkatesh, Morris, Davis, & Davis, 2003). The Technology Acceptance Model 3 (TAM3) is a powerful, robust, and

commonly applied model for predicting and explaining user behavior and IT usage (Agarwal & Prasad, 1999; Davis, 1989; King & He, 2006; Legris, Ingham, & Collerette, 2003). Davis, Bagozzi, and Warshaw (1989) based the Theory of Reasoned Action (TRA) for the development of TAM, which is used for analyzing the individual acceptance of IT. Although TAM is a useful theoretical model that understands and explains user behavior in IT implementation, it has to be integrated into a broader one that includes variables related to both human and social factors (Legris et al., 2003; Lucas & Spitler, 2000).

As a result, this study was conducted with the support of a company in Turkey. The project management tools used in this company is used for experiments in this thesis. The member of project management team evolved in these experiments. During these experiments I tried to find the relationships between technology acceptance and project management software for a successful project management.

2. LITERATURE AND BACKGROUND

2.1 PROJECT MANAGEMENT SOFTWARE

A large body of PM software literature has focused on the evaluation of different types of PM software packages and compared their strengths and weakness to help businesses and project professionals select the appropriate tools that suit their needs. Empirical research studies that have also been undertaken to evaluate the value of PM software and examine the pattern of its usage are limited. Fox, examined the effect of decision style on the use of PM software, and found that a project manager's decision style has a significant correlation with PM software usage. He also tested the effect of user satisfaction and training on the use of PM software and found that project managers seem to be satisfied with their tools and that there is a significant relationship between their level of satisfaction and level of utilization. Several other attempts made to study the use of PM software were limited to descriptive statistics, focusing instead on the technical factors rather than usage models and organizational effects.

2.2 THEORIES OF INFORMATION SYSTEMS USE

The first attention with the introduction of the technology acceptance model (TAM) is gained with Fred D.Davis in 1989. The studies before this work, deals only with level of satisfaction and attitudes on people's behaviors. Davis stated "diverse theoretical perspectives and built on social psychology research and presented a model of adoption and use". Acceptance of information system most commonly is introduced in TAM. TAM introduced by F.D. Davis, Bagozzi and Warshaw in 1989. TAM is the one of the most cited research of information systems.

Systems utilization has been identified as a proxy of an information system's success, and low usage of installed systems has been identified as a major factor underlying a lack of return from organizational investments in information technologies. However, usage will not occur unless the users' perspectives have been taken into account, and usage will not continue unless the users are satisfied with the system's performance.

Davis' Technology Acceptance Model (TAM), based on the Theory of Reasoned Action, has been widely applied. A large number of studies have supported TAM through a wide variety of applications. The major constructs, ease of use and usefulness, measure user intention toward the use of a technology. These two constructs have been supported over a wide variety of studies as powerful measures of user attitude toward using IT. Researchers, including Davis himself, recognize other important constructs that have been left out of TAM.

Prior research employing TAM has focused on three broad areas. First, some studies replicated TAM and focused on the psychometric aspects of TAM constructs (e.g., Adams et al., 1992; Hendrickson, Massey and Cronan, 1993; Segars&Grover, 1993). Second, other studies provided theoretical underpinning of the relative importance of TAM constructs that is, perceived usefulness and perceived ease of use (e.g., Karahanna, Straub, & Chervany, 1999). Finally, some studies extended TAM by adding additional constructs as determinants of TAM constructs (e.g., Karahanna & Straub, 1999; Venkatesh, 2000; Venkatesh & Davis, 2000; Koufaris, 2002). Synthesizing prior research on TAM, Venkatesh and Davis developed a theoretical framework that represents the cumulative body of knowledge accumulated over the years from TAM research (see Figure 1.1). The figure shows four different types of determinants of perceived usefulness and perceived ease of use individual differences, system characteristics, social influence, and facilitating conditions. Individual difference variables include personality and/or demographics (e.g., traits or states of individuals, gender, and age) that can influence individuals' perceptions of perceived usefulness and perceived ease of use. System characteristics are those salient features of a system that can help individuals develop favorable (or unfavorable) perceptions regarding the usefulness or ease of use of a system. Social influence captures various social processes and mechanisms that guide individuals to formulate perceptions of various aspects of an IT. Finally, facilitating conditions represent organizational support that facilitates the use of an IT.

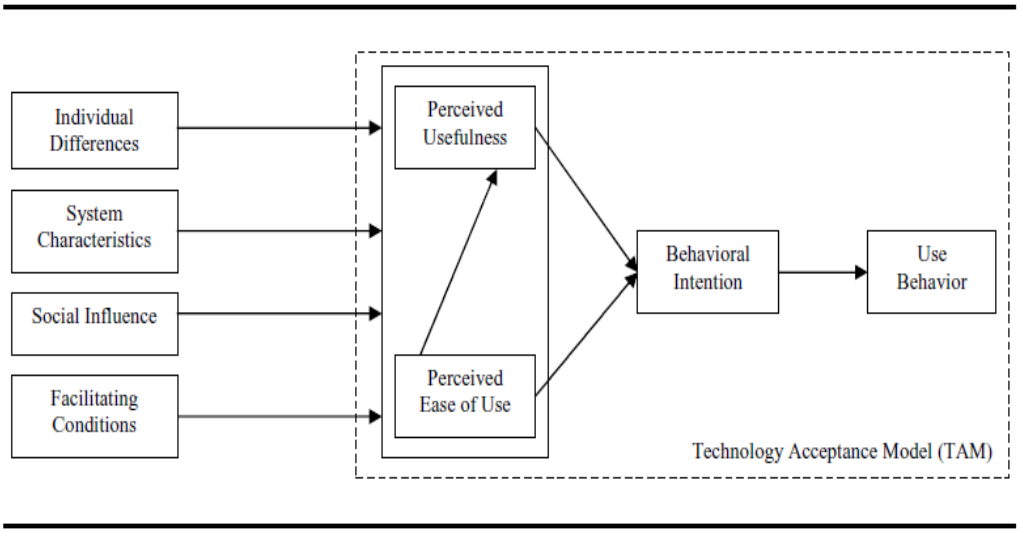

Figure 1.1: Theoretical framework technology acceptance model

3. RESEARCH MODEL AND HYPOTHESES

The research model tested in this thesis is shown in Figure 3.1. The following hypotheses were developed based on the findings of previous research on this subject.

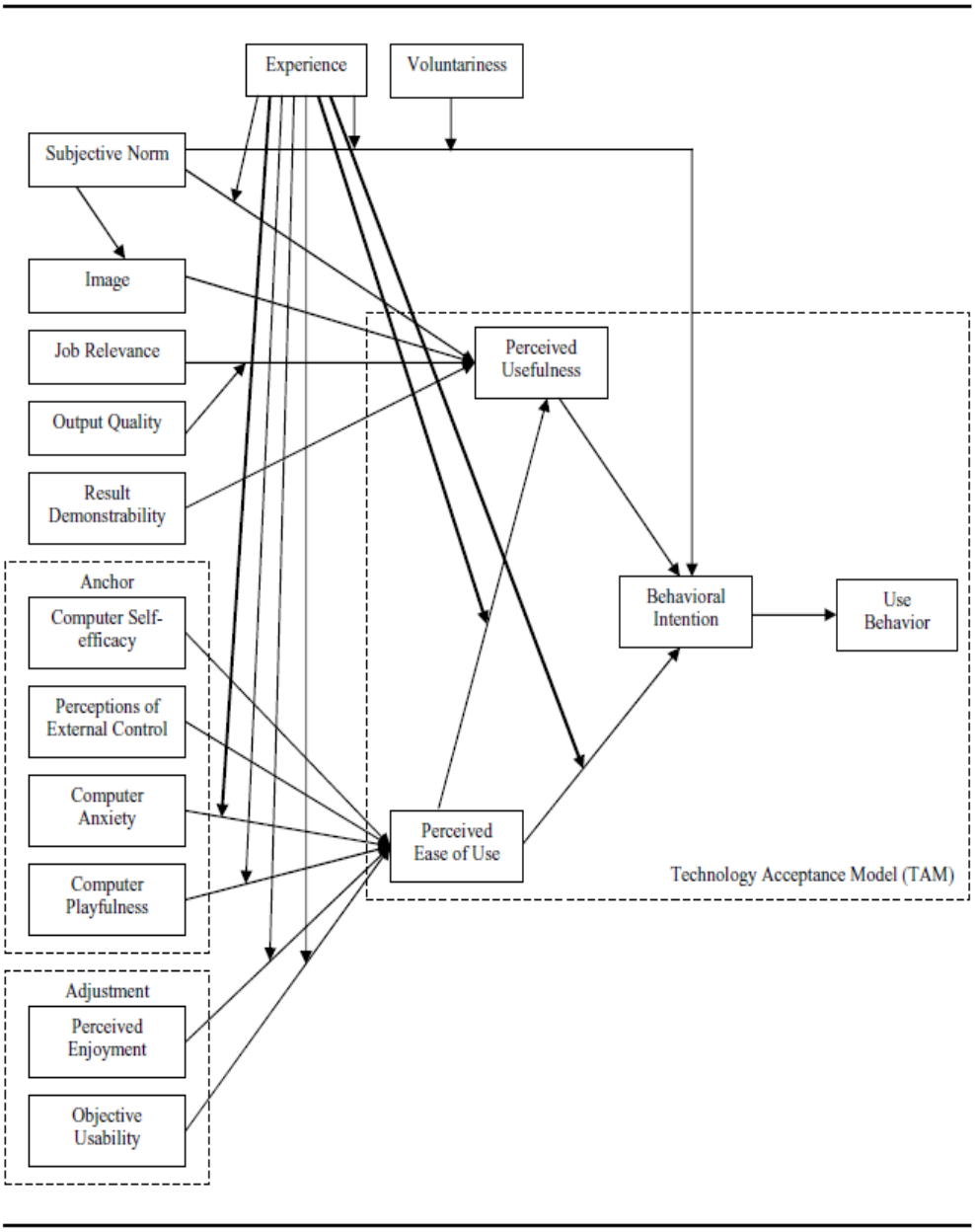

Figure 3.1: Technology acceptance model 3

3.1 PERCEIVED USEFULNESS

Perceived usefulness is described by Davis as follows ‘‘degree to which a person believes that using a particular system would enhance his or her performance” (Davis, 1989, p. 320). According to Davis explanation in the original TAM, perceived ease of use and perceived usefulness were predictors of attitudes toward use and both perceived usefulness and attitude toward use were predictors of behavioral intention to use (Davis, 1989). According to Davis, perceived usefulness is a major determinant of behavioral intention to use (Davis et al., 1989). The main reason that workers use project systems is that they find that the system improves their performance. Thus, perceived usefulness of project management systems may be critical for the use of the system. Moreover, many studies confirm the effect of perceived usefulness on behavioral intention to use (Tung & Chang, 2008b; Fu, Gallego, Luna, & Bueno, 2008; Farn, & Chao, 2006; Khalifa & Shen, 2008; Lee, 2006; Horst, Kuttschreuter, & Gutteling, 2007; Liao, Chen, & Yen, 2007; Pituch & Tung, 2007; Chang & Tung, 2008). Therefore, I hypothesize as follows:

H1: Behavioral intention to use positively affected by perceived usefulness.

TAM2 is an extension of TAM proposed by Venkatesh and Davis by identifying and theorizing about the general determinants of perceived usefulness that are result demonstrability, job relevance, image, output quality, subjective norm and perceived ease of use. Subjective norm and image two determinants fall into the category of social influence and the remaining determinants are system characteristics as per the theoretical framework shown in Figure 1.1. The definitions of the determinants of perceived usefulness are provided in Table 3.1. Theoretical processes social influence and cognitive instrumental provided in TAM2 in order to processes to explain the effects of the various determinants on perceived usefulness and behavioral intention. Social influence processes is represented by subjective norm and image as two determinants of perceived usefulness in TAM2 .TAM2 theorizes that three social influence mechanisms compliance, internalization, and identification will play a role in understanding the social influence processes. Compliance represents a situation in

which an individual performs a behavior in order to attain certain rewards or avoid punishment (Miniard & Cohen, 1979). According to Venkatesh and Davis work in 2000, "identification refers to an individual's belief that performing a behavior will elevate his or her social status within a referent group because important referents believe the behavior should be performed"(Venkatesh & Davis, 2000). Warshaw defines internalization as the incorporation of a referent's belief into one's own belief structure (Warshaw, 1980). TAM2 posits that subjective norm and image will positively influence perceived usefulness through processes of internalization and identification, respectively.

Table 3.1: Determinants of perceived usefulness

Determinants	Definitions
Perceived Ease of Use	The rate to which a person believes that using an IT will be free of effort (Davis, 1989).
Subjective Norm	The degree to which an individual perceives that most people who are important to him for the system usage (Fishbein & Ajzen, 1975; Venkatesh & Davis, 2000).
Image	The degree to which an individual perceives that use of an innovation will enhance his or her status in his or her social system (Moore & Benbasat, 1991).
Job Relevance	The degree to which an individual believes that the target system is applicable to his or her job (Venkatesh & Davis, 2000).
Output Quality	The degree to which an individual believes that the system performs his or her job tasks well (Davis,2009)
Result Demonstrability	The degree to which an individual believes that the results of using a system are tangible, observable, and communicable (Moore & Benbasat, 1991).

3.2 PERCEIVED EASE OF USE

Perceived ease of use described as ‘‘the degree to which a person believes that using a particular system would be free of effort” by Davis (Davis, 1989, p. 320). TAM asserts that perceived ease of use is a predictor of perceived usefulness and attitude toward use (Davis, 1989; Davis et al., 1989). The relationship between perceived ease of use and perceived usefulness explained by Davis and Venkathes as follows: If other things are equal, system use is easier, the more useful it can be (Davis, 1993; Venkatesh & Davis, 2000). The performance of the users directly affected with the degree of the simplicity of the system. (Gallego et al., 2008; Lee, Kang, & Kim, 2007; Lee, 2006; Tung, Chang, & Chou, 2008, Fu et al., 2006 ;). Therefore, I hypothesize as follows:

H2: Perceived usefulness is positively affected by perceived ease of use.

According to the TAM 3, perceived usefulness and perceived ease of use and their relative weights determines behavioral intention to use.
Therefore, I hypothesize as follows:

H3: Behavioral intention is positively affected by perceived ease of use.

Building on the anchoring and adjustment framing of human decision making, Venkatesh (2000) developed a model of the determinants of perceived ease of use. Table 3.2 presents the definitions of the determinants of perceived ease of use. Venkatesh (2000) argued that individuals will form early perceptions of perceived ease of use of a system based on several anchors related to individuals’ general beliefs regarding computers and computer use. The anchors suggested by Venkatesh (2000) are computer self-efficacy, computer anxiety, and computer playfulness, and perceptions of external control (or facilitating conditions). The first three of these anchors represent individual differences per Figure 1.1 that is, general beliefs associated with computers and computer use. Computer self-efficacy refers to individuals’ control beliefs regarding his or her personal ability to use a system. Perceptions of external control are related to individuals’ control beliefs regarding the availability of organizational

resources and support structure to facilitate the use of a system. Computer playfulness represents the intrinsic motivation associated with using any new system. Venkatesh (2000) suggested that while anchors drive initial judgments of perceived ease of use, individuals will adjust these judgments after they gain direct hands-on experience with the new system. Two system characteristics related adjustments that is, perceived enjoyment and objective usability were suggested by Venkatesh (2000) to play a role in determining perceived ease of use after individuals gain experience with the new system. Venkatesh (2000) theorized that even with increasing experience with the system, the role of two anchors computer self-efficacy and perceptions of external control will continue to be strong. However, the effects of the other two anchors computer playfulness and computer anxiety were theorized to diminish over time. Venkatesh (2000) further theorized that the effects of adjustments on perceived ease of use were stronger with more hands-on experience with the system. Although longitudinal studies were conducted, the specific moderating role by experience was not tested in Venkatesh (2000).

3.3 BEHAVIORAL INTENTION

Behavioral intention is defined by Ajzen and Fishbein as a measure of the likelihood that a person will get complete the given behavior (Fishbein & Ajzen, 1980). Motivational factors influence behavioral intention. These motivational factors are defined by Ajzen as the indications of how much effort they are planning to exert and how hard are people planning to try in order to perform the behavior (Ajzen, 1991, p. 181). Firstly a technology is intended to use by a user then actually the system is used by the user. Therefore, Mathison defines behavioral intention to use as the immediate determinant of actual use (Mathieson, 1991); however, behavior can be predicted by behavioral intention only if the person decides to either perform or not perform that behavior (Ajzen, 1991). If a system is indented to use by a person, he or she is expected to try more, and system will be greater (Ajzen & Madden, 1986).

Table 3.2: Determinants of perceived ease of use.

Determinants	Definitions
Computer Self-Efficacy	The ability to perform a specific task/job using the computer (Compeau & Higgins, 1995a, 1995b).
Perception of External Control	The organizational and technical resources exist to support the use of the system (Venkatesh et al., 2003).
Computer Anxiety	The degree of "an individual's apprehension, or even fear, when she/he is faced with the possibility of using computers" (Venkatesh, 2000, p. 349).
Computer Playfulness	The degree of cognitive spontaneity in microcomputer interactions" (Webster & Martocchio, 1992, p. 204).
Perceived Enjoyment	" The activity of using a specific system is perceived to be enjoyable in its own right, aside from any performance consequences resulting from system use" (Venkatesh, 2000, p. 351).
Objective Usability	"Comparison of systems based on the actual level (rather than perceptions) of effort required to completing specific tasks" (Venkatesh, 2000, pp. 350–351).

3.4 CROSSOVER EFFECTS

The general pattern of relationships suggested in Venkatesh and Davis (2000) and Venkatesh (2000) to hold in TAM3. Further, Venkatesh and Davis suggest that the determinants of perceived usefulness will not influence perceived ease of use and the determinants of perceived ease of use will not influence perceived usefulness. Thus, TAM3 does not posit any cross-over effects.

As noted earlier, two theoretical processes explain the relationships between perceived usefulness and its determinants: social influence and cognitive instrumental processes. The effects of the various factors that is, subjective norm, image, job relevance, output quality, and result demonstrability on perceived usefulness are tied to these two

processes. Davis and Venkatesh have no theoretical and empirical basis to expect that these processes will play any role in forming judgments about perceived ease of use. Perceived ease of use has been theorized to be closely associated with individuals' self-efficacy beliefs and procedural knowledge, which requires hands on experience and execution of skills (Davis et al., 1989; Venkatesh, 2000; Davis & Venkatesh, 2004). Further, Venkatesh (2000) suggested that individuals form perceived ease of use about a specific system by anchoring their perceptions to the different general computer beliefs and later adjusting their perceptions of ease of use based on hands-on experience with the specific system. Social influence processes (i.e., compliance, identification, and internalization) in the context of IT adoption and use represent how important referents believe about the instrumental benefits of using a system (Venkatesh&Davis, 2000). Even if individual gets information from important referents about how easy a system is to use, it is unlikely that the individual will form stable perceptions of ease of use based on the beliefs of referent others over and above his or her own general computer beliefs and hands-on experience with the system (e.g., Davis & Venkatesh, 2004). Further, the determinants of perceived ease of use represent several traits and emotions, such as computer self-efficacy, computer playfulness, and computer anxiety. There are no theoretical and empirical reasons to believe that these stable computer-related traits and emotions will be affected by social influence or cognitive influence processes.

Venkatesh suggests that the determinants of perceived ease of use will not influence perceived usefulness. The determinants of perceived ease of use suggested by Venkatesh (2000) are primarily individual differences variables and general beliefs about computers and computer use. These variables are grouped into three categories: control beliefs, intrinsic motivation, and emotion. Perceived usefulness is an instrumental belief that is conceptually similar to extrinsic motivation and is cognition (as opposed to emotion) regarding the benefits of using a system. The perceptions of control (over a system), enjoyment or playfulness related to a system, and anxiety regarding the ability to use a system do not provide a basis for forming perceptions of instrumental benefits of using a system. For example, control over using a system does not guarantee that the system will enhance one's job performance. Similarly, higher levels of computer playfulness or enjoyment from using a system do not mean that the system will help an individual to become more effective (e.g., Van der Heijden, 2004).

Therefore, we expect that the determinants of perceived ease of use will not influence perceived usefulness.

3.5 NEW RELATIONSHIPS POSITED IN TAM3

TAM3 suggest that experience will moderate the relationships between perceived usefulness of use and perceived ease of use computer anxiety and perceived ease of use and perceived ease of use and behavioral intention.

TAM3 suggest that with increasing hands-on experience with a system, a user will have more information on how easy or difficult the system is to use. While perceived ease of use may not be as important in forming behavioral intention in a later period of system use (Venkatesh et al., 2003), users will still value perceived ease of use in forming perceptions about usefulness. Vankatesh base this argument on action identification theory (Vallacher & Kaufman, 1996) that posits a clear distinction between high-level and low-level action identities. High-level identities are related to individuals' goals and plans, whereas low-level identities refer to the means to achieve these goals and plans. For instance, in the context of a word processing software use, a high-level identity can be writing a high quality report and a low level identity can be striking keys or use of a specific feature of the software (Davis & Venkatesh, 2004). Perceived usefulness and perceived ease of use are considered high-level and low-level identities respectively (Davis & Venkatesh, 2004; Venkatesh & Davis, 2000). With increasing experience, the influence of perceived ease of use (a low-level identity) on perceived usefulness (a high-level identity) will be stronger as users will be able to form an assessment of their likelihood of attaining high-level goals (i.e., perceived usefulness) based on information gained from experience of the low-level actions (i.e., perceived ease of use).

Experience will moderate the effect of computer anxiety on perceived ease of use, such that with increasing experience, the effect of computer anxiety on perceived ease of use will diminish. TAM3 suggest that, with increasing experience, system specific beliefs, rather than general computer beliefs, will be stronger determinants of perceived ease of use of a system. Venkatesh (2000) argued that system-specific objective usability and perceived enjoyment will be stronger determinants over time and the effects of general

computer beliefs (e.g., computer anxiety) will diminish because with increasing experience, users will develop accurate perceptions of effort required to complete specific tasks (i.e., objective usability) and discover aspects of a system that lead to enjoyment (or lack thereof). Computer anxiety is theorized as an anchoring belief that inhibits forming a positive perception of ease of use of a system (Venkatesh, 2000). Research on anchoring and adjustment has found that while anchors influence judgments, the role of anchors declines over time as adjustment information becomes available (Yadav, 1994; Wasnik, Kent, & Hoch, 1998; Mussweiler & Strack, 2001). Drawing on this, TAM3 suggests that the effect of computer anxiety on perceived ease of use will decline with increasing experience as individuals will have more accurate perceptions of the effort needed to use a system.

According to Venkatesh experience will moderate the effect of perceived ease of use on behavioral intention such that the effect will be weaker with increasing experience. Perceived ease of use that is, how easy or difficult a system is to use is an initial hurdle for individuals while using a system (Venkatesh, 2000). However, once individuals get accustomed to the system and gain hands-on experience with the system, the effect of perceived ease of use on behavioral intention will recede into the background as individuals now have more procedural knowledge about how to use the system. Consequently, individuals will place less importance on perceived ease of use while forming their behavioral intentions to use the system.

4. RESEARCH METHODOLOGY

The research methodology of this thesis is introduced in this section. Theoretical foundation for technology adoption and project management literature reviews are provided in previous sections. This section provides the research subjects and materials for the experiments.

4.1 SUBJECTS

The target population comprised the project team members of the internet service provider industry in Turkey. Total 64 project members participated in the study during the period of April to June. Respondents came from 7 different functional group of the company. %23 of the respondents were female and the average age of the respondents were 30. The most of the participants were engineering collage gradutes (%92). Table 3 shows the demographic profiles of the participants.

4.2 MATERIALS

A questionnaire was applied to the participants. The questionnaire has two main parts. First part covered demographic questions. The second part is designed for research question. In second part participant asked about agreement level for the system. The data collection instrument was constructed using a 7 point Likert scale with strongly agree and strongly disagree as the two endpoints.

Table 4.1: Demographic profiles of the respondents.

Demographic profiles of the respondents		
Gender (%)		
Female: 23	Male: 77	
Education Level (%)		
Undergraduate: 76,57	Graduate: 23,43	
Job Description (%)		
Project Engineer: 31	Sales Support Specialist: 7,81	Data Backbone Engineer: 15,6
Project Manager: 6,25	Operation Engineer: 7,81	Technical Support Engineer: 31
Working years in current company (years)		
Max:9	Min:0,8	Average: 3.6
Computer Experiance (%)		
7-10 years: 7,81	10-13 years: 70,3	>13 years: 21,8
Computer Use in week(h)		
Max:100	Min:0	Average: 30

Operationalization of the determinants of perceived ease of use (i.e., computer self-efficacy, perceptions of external control, computer playfulness, computer anxiety, objective usability, and perceived enjoyment) was consistent with Venkatesh (2000). Computer self-efficacy (CSE) was measured using four items adapted from Compeau and Higgins (1995). Perceptions of external control (PEC) were measured using four items adapted from the scale of facilitating conditions developed by Mathieson (1991) and Taylor and Todd (1995). Computer playfulness (CPLAY) was measured using four items adapted from Webster and Martocchio (1992). Computer anxiety (CANX) was measured using four items used in Venkatesh (2000). Perceived enjoyment (ENJ) was measured using four items adapted from Davis, Bagozzi, and Warshaw (1992).

Determinants of perceived usefulness were measured using items from Venkatesh and Davis (2000). Subjective norm (SN) was measured using four items adapted from

Taylor and Todd (1995). Image (IMG) and result demonstrability (RES) were operationalised using three and four items respectively from Moore and Benbasat (1991). Job relevance (REL) and output quality (OUT) were measured using three items each adapted from Davis et al. (1992).Voluntariness (VOL) was assessed using three items from Moore and Benbasat (1991). Even though we chose two sites where system use was voluntary and two sites where the use was mandatory, we collected data on user perceptions of voluntariness because, consistent with TAM2, TAM3 posits perceived, rather than actual, voluntariness as an important contextual variable. Table 4 shows summary of latent variables and corresponding items.

Table 4.2: Constructs, corresponding source and the items

CONSTRUCTS	REFERENCE STUDY	ITEMS	QUESTIONS
Perceived Usefulness (PU)	Venkatesh and Davis (2000)	PU 1	Using the project managemet tool improves my performance in my job.
		PU 2	Using the project managemet tool in my job increases my productivity.
		PU 3	Using the project managemet tool enhances my effectiveness in my job.
		PU 4	I find the system to be useful in my job.
Perceived Ease of Use (PEOU)	Venkatesh(2000)	PEOU 1	My interaction with the system is clear and understandable.
		PEOU 2	Interacting with the system does not require a lot of my mental effort.
		PEOU 3	I find the system to be easy to use.
		PEOU 4	I find it easy to complete the tasks.
Computer Self-Efficacy (CSE)	Compeau and Higgin (1995)		I could complete the job using a software package:
		CSE 1	... if there was no one around to tell me what to do as I go.
		CSE 2	... if I had just the built-in help facility for assistance.
		CSE 3	... if someone showed me how to do it first.
		CSE 4	...if I had used similar packages before this one to do the same job.
Perceptions of External Controls (PEC)	Mathieson (1991) and Taylor and Todd (1995)	PEC 1	I have control over using the system.
		PEC 2	I have the resources necessary to use the system.
		PEC 3	Given the resources, opportunities and knowledge it takes to use the system, it would be easy for me to use the system
		PEC 4	The system is not compatible with other systems I use.
Computer Playfulness (CPLAY)	Webster and Martocchio (1992)		The following questions ask you how you would characterize yourself when you use computers:
		CPLAY 1	...spontaneous
		CPLAY 2	...creative
		CPLAY 3	...playful
		CPLAY 4	...unoriginal
Computer Anxiety (CANX)	Venkatesh (2000)	CANX 1	Computers do not scare me at all.
		CANX 2	Working with a computer makes me nervous.
		CANX 3	Computers make me feel uncomfortable.

Table 4.2: Constructs, corresponding source and the items (continued)

Perceived Enjoyment (ENJ)	Davis, Bagozzi, and Warshaw (1992)	ENJ 1	I find using the system to be enjoyable.
		ENJ 2	The actual process of using the system is pleasant.
		ENJ 3	I have fun using the system.
Subjective Norm (SN)	Taylor and Todd (1995)	SN 1	People who influence my behavior think that I should use the system.
		SN 2	People who are important to me think that I should use the system.
		SN 3	The senior management of this business has been helpful in the use of the system.
		SN 4	In general, the organization has supported the use of the system.
Voluntariess (VOL)	Moore and Benbasat (1991)	VOL 1	My use of the system is voluntary.
		VOL 2	My supervisor does not require me to use the system.
		VOL 3	Although it might be helpful, using the system is certainly not compulsory in my job.
Image (IMG)	Moore and Benbasat (1991)	IMG 1	People in my organization who use the system have more prestige than those who do not.
		IMG 2	People in my organization who use the system have a high profile.
		IMG 3	Having the system is a status symbol in my organization.
Job Relevance (REL)	Moore and Benbasat (1991)	REL 1	In my job, usage of the system is important.
		REL 2	In my job, usage of the system is relevant.
		REL 3	The use of the system is pertinent to my various job-related tasks.
Output Quality (OUT)	Davis et al. (1992)	OUT 1	The quality of the output I get from the system is high.
		OUT 2	I have no problem with the quality of the system's output.
		OUT 3	I rate the results from the system to be excellent.
Result Demonstrability (RES)	Moore and Benbasat (1991)	RES 1	I have no difficulty telling others about the results of using the system.
		RES 2	I believe I could communicate to others the consequences of using the system.
		RES 3	The results of using the system are apparent to me.
		RES 4	I would have difficulty explaining why using the system may or may not be beneficial.
Behavioral Intention (BI)	Cheong and Park(2005)	BI 1	Assuming I had access to the system, I intend to use it.
		BI 2	Given that I had access to the system, I predict that I would use it.
		BI 3	I plan to use the system in the next <n> months.

5. RESULTS

5.1 RELIABILITY ANALYSIS

The reliability and validity of the measurement instrument was carried out using reliability and factor analysis. At the beginning of the study 15 constructs described via 50 questions: behavioral intention to use, result demonstrability, output quality, job relevance, image, voluntaries, subjective norm, perceived enjoyment, computer playfulness, perception of external controls, computer playfulness, perceived usefulness and perceived ease of use. After the initial analysis of the measurement model some revision done for a more reliable result. Croanbach's alpha scale is used for constructs revision. After specifying the constructs again, 35 items and 12 constructs were retained for further analysis.

Croanbach's alpha technique is used to measure the internal consistency. The level of alpha (α) that indicates an acceptable level of reliability of the scale and it is evaluated as;

- If $0{,}00 \leq \alpha < 0{,}40$ then the scale is non-reliable
- If $0{,}40 \leq \alpha < 0{,}60$ then the scale has a low reliability
- If $0{,}60 \leq \alpha < 0{,}80$ then the scale has a high reliability
- If $0{,}80 \leq \alpha < 1{,}00$ then the scale has a very high reliability (Kalaycı 2008, p.405).

Table 5.1 shows Croanbach's alpha measurements results. The result of Croanbach's alpha test is, 646, which means the internal consistency is in a high reliability range.

Table 5.1: Reliability Statistics

Cronbach's Alpha	N of Items
,646	35

Table 5.2 shows composite reliability of items. All of the items Croanbach's alpha values are with within level.

Table 5.2: Composite Reliability

Latent variable	Dimensions	Cronbach's alpha
SN	3	0,745
OUT	3	0,865
RES	4	0,775
IMG	3	0,836
CSE	2	0,903
PEC	3	0,691
CANX	4	0,947
ENJ	3	0,798
PEOU	3	0,678
PU	3	0,785
VOL	2	0,887
BI	2	0,866

Factor analysis was carried out to examine measurement convergent and discriminate validity. Typically convergent validity is considered to be satisfactory when items load high on their respective constructs (factors). As shown in Table 7, all items had high loading on their respective factors. Most exhibited loading higher than 0.60 on their respective factors, signifying desirable measurement convergent validity.

Table 5.3: Results of Factor Analyses.

	SN	OUT	RES	IMG	CSE	PEC	CANX	ENJ	PU	PEOU	VOL	BI
SN 2	**0,942**											
SN 3	**0,486**											
SN 4	**0,763**											
OUT 1		**0,935**										
OUT 2		**0,727**										
OUT 3		**0,948**										
RES 1			**0,716**									
RES 2			**0,547**									
RES 3			**0,500**									
RES 4			**0,660**									
IMG 1				**0,910**								
IMG 2				**0,905**								
IMG 3				**0,767**								
CSE 1					**0,960**							
CSE 3					**0,949**							
PEC 1						**0,505**						
PEC 2						**0,934**						
PEC 3						**0,567**						
CANX1							**0,890**					
CANX2							**0,968**					
CANX3							**0,965**					
CANX4							**0,883**					
ENJ 1								**0,681**				
ENJ 2								**0,924**				
ENJ 3								**0,890**				
PU1									**0,754**			
PU2									**0,875**			
PU4									**0,879**			
PEOU 1										**0,705**		
PEOU 2										**0,593**		
PEOU 4										**0,944**		
VOL 1											**0,963**	
VOL 2											**0,930**	
BI 2												**0,949**
BI 3												**0,937**

Discriminate validity was assessed by examining whether each item loaded higher on the construct it measured than on any other construct. The overall results indicated that the measurement exhibited reasonable discriminate validity.

5.2 ANALYSIS USING STRACTURAL EQUATIONAL MODELING

The partial-least-squares (PLS) analysis is used for structural equation modeling. (Chin and Newsted, 1999; Rabl, 2010). Due to the scales are not distributed normally in this study, the PLS technique was chosen that is able to handle this restriction (Chin and Newsted 1999).

XLSTAT-PLSPM tool is used to make the empirical analysis in this study.

PLS path modeling (PLSPM) focuses on maximizing the prediction power and minimizing the errors (Aparicio et al., 2009) and is applied to estimate the weights that defining scores of a set of non measurable variables, called latent variables, as linear combinations of their measurable sets of variables called manifest variables (Aparicio et al., 2009).As seen in Figure 5.1, manifest variables are items in questionnaire and latent variables are constructs in the model. The latent variables without predecessors are called exogenous variables while all others that has predecessors are called endogenous variables.

Each arrow of the PLS path diagram indicates a causal relationship between variables. Two models are supposed to compose these relationships; the inner model refers to the latent variables relationships whereas the outer model refers to manifest variables relationships (Aparicio et al., 2009).

The latent variable scales were validated by using the factor analysis technique. The loadings the manifest variables are shown in Table 7. If all the items load of a scale, highly on one factor, then the scale presents satisfactory convergent validity hence, the items with loadings lower than 0.5 should be removed from the scale (Aslan, 2008) if the associated latent variables is also have a low level of reliability.

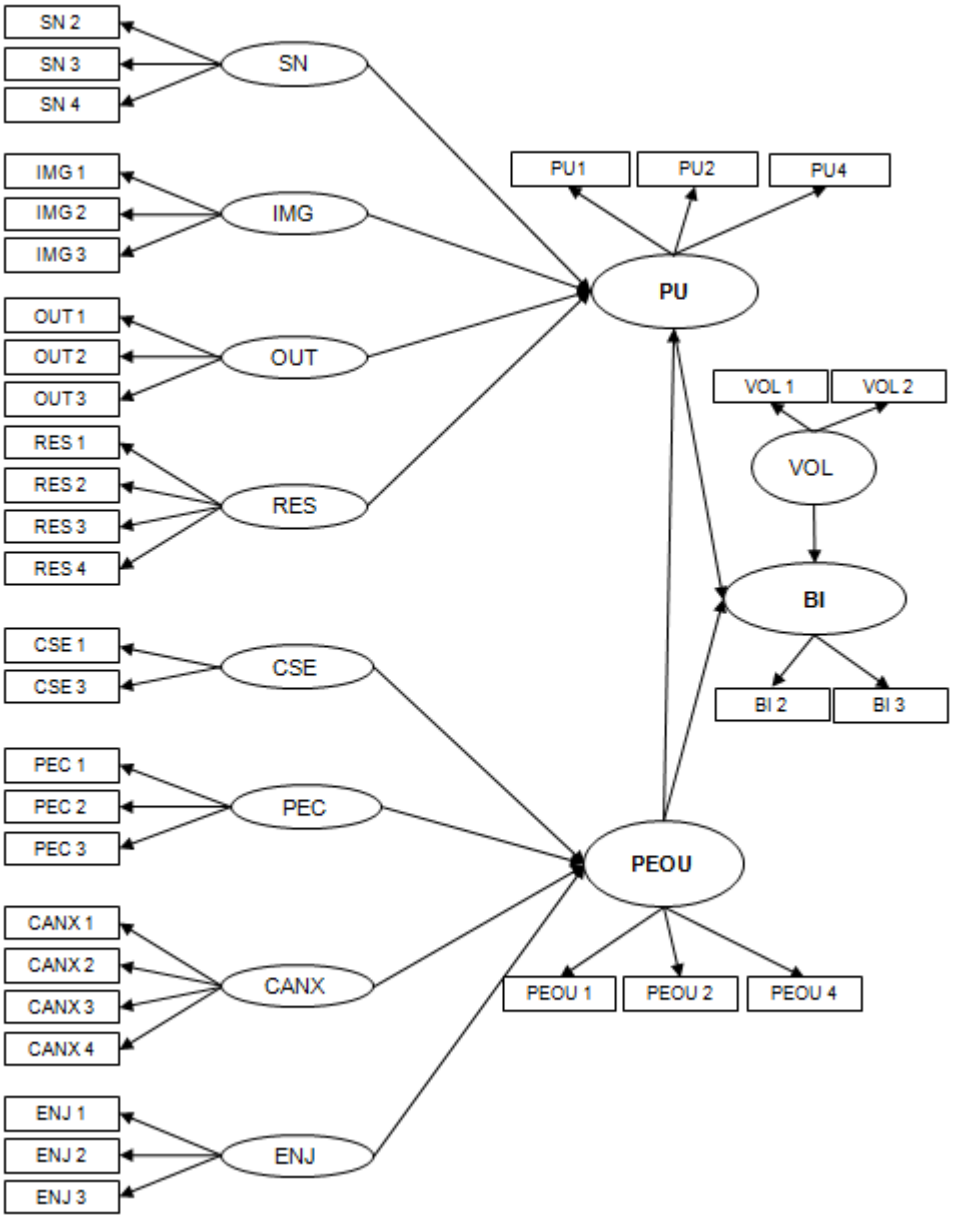

Figure 5.1: PLS-Path Modeling Graph

To examine the scales internal consistency, three measures were used:

1. Cronbach's alpha, where according to Kalaycı (2008, p.405) in basic research a value higher than 0.60 is acceptable,

2. The composite reliability evaluated by Dillon-Goldstein's rho (D.G. rho) (Tenenhaus et al., 2005), that should be higher than 0.70 (Ringle et al., 2006),
3. Fornell and Larcker's (1981) mean communalities as average variance extracted (AVE) measures, which should be greater than 0.50 (Chin, 1998) which means "that a latent variable is able to explain more than half of the variance of its indicators on average" (Henseler et al., 2009, p.299).

Table 5.4: Composite Reliability Analysis for Model.

Latent variable	Dimensions	Cronbach's alpha	D.G. rho	AVE
SN	3	0,745	0,841	0,645
OUT	3	0,865	0,907	0,767
RES	4	0,752	0,831	0,566
IMG	3	0,836	0,897	0,745
CSE	2	0,903	0,954	0,911
PEC	3	0,691	0,809	0,593
CANX	4	0,947	0,961	0,860
ENJ	3	0,798	0,875	0,703
PEOU	3	0,678	0,800	0,580
PU	3	0,785	0,875	0,702
VOL	2	0,887	0,946	0,897
BI	2	0,866	0,941	0,889

Table 5.4 shows the reliability indexes, the Cronbach's Alpha, D. G. Rho and AVE values. In this analysis, the single dimensionality of the latent variables has been confirmed by D.G. rho for all latent variables that have higher values than 0.8. All latent variables have a Cronbach's Alpha value that is higher than 0.6 and have an AVE value is higher than 0.5, confirming the consistency of the manifest variables.

According to Rabl (2010) for evaluating discriminate validity, the average variance extracted AVEs by the correlated latent variables is greater than the square of the correlation between the latent variables which means that a latent variable as a construct

is strongly correlated with its manifest variables as its indicators than with the other latent variables in the model, then discriminate validity obtains (Fornell et al. 1982; Chin, 1998). As shown in the Table 5.5, the discriminate validity appears satisfactory for all constructs at both the item and constructs levels.

Table 5.5: Discriminate Validity Analysis.

	SN	OUT	RES	IMG	CSE	PEC	CANX	ENJ	PEOU	PU	VOL	BI	AVE
SN	**1**	0,023	0,012	0,092	0,053	0,001	0,034	0,009	0,006	0,007	0,016	0,025	0,645
OUT	0,023	**1**	0,119	0,013	0,039	0,071	0,101	0,044	0,187	0,217	0,034	0,013	0,767
RES	0,012	0,119	**1**	0,083	0,111	0,000	0,173	0,076	0,126	0,157	0,102	0,000	0,566
IMG	0,092	0,013	0,083	**1**	0,047	0,065	0,008	0,005	0,016	0,022	0,000	0,040	0,745
CSE	0,053	0,039	0,111	0,047	**1**	0,009	0,000	0,051	0,041	0,051	0,027	0,051	0,911
PEC	0,001	0,071	0,000	0,065	0,009	**1**	0,110	0,013	0,144	0,084	0,113	0,002	0,593
CANX	0,034	0,101	0,173	0,008	0,000	0,110	**1**	0,005	0,203	0,236	0,205	0,043	0,860
ENJ	0,009	0,044	0,076	0,005	0,051	0,013	0,005	**1**	0,127	0,072	0,010	0,029	0,703
PEOU	0,006	0,187	0,126	0,016	0,041	0,144	0,203	0,127	**1**	0,401	0,129	0,094	0,580
PU	0,007	0,217	0,157	0,022	0,051	0,084	0,236	0,072	0,401	**1**	0,119	0,013	0,702
VOL	0,016	0,034	0,102	0,000	0,027	0,113	0,205	0,010	0,129	0,119	**1**	0,054	0,897
BI	0,025	0,013	0,000	0,040	0,051	0,002	0,043	0,029	0,094	0,013	0,054	**1**	0,889
AVE	0,645	0,767	0,566	0,745	0,911	0,429	0,860	0,703	0,580	0,702	0,897	0,889	**0**

Reliable and valid outer model estimation allow an assessment of the inner path model estimates (Henseler et al., 2009) Similarly R^2, Goodness-of-Fit Index (GFI) is another measure of model fit which measures the relative amount of variance and covariance in the sample covariance matrix that is together explained by the population covariance matrix. As it is stated by Schermelleh-Engel et al. (2003) the GFI should be between 0 and 1, with values close to 1 of good fit otherwise the data probably do not fit the model if the GFI is negative or much larger than 1 (Schermelleh-Engel et al., 2003).

Table 5.6: Goodness of Fit Indexes

Models	GFI
Absolute	0,477
Relative	0,804
Outer model	0,964
Inner model	0,834
Mean R^2	0,334

The absolute GFI=$\sqrt{((\text{mean } (R^2) * mean\ communality))}$ values as shown in Table 5.6, are in acceptable range of 0 < GFI < 1.

In PLSPM approach the structural model evaluates the causal associations between the latent variables and the statistics of concern are path coefficients and R^2. According to the Table 5.7. BI constructs results are meaningful statistically. The significance vale is below 0,005 which make results statistically acceptable. The significance value is 0,000.

The R^2 values for the significant constructs show that the percentage of the variance in an endogenous latent variable is explained by the associated exogenous latent variables. Chin (1998) defines the values of 0.67, 0.33 or 0.19, for R^2 measurement, respectively as, substantial, moderate and weak, and states that if certain inner path model structures explain an endogenous latent variable by only a few exogenous latent variables then the moderate R^2 may be acceptable (Henseler et al., 2009).

Table 5.7: BI Constructs R^2 Analysis.

R²	F	Pr > F	R²(Bootstrap)
0,623	23,082	0,000	0,118

The impact of the PU, VOL and PEOU variables over to BI constructs is shown in Table 5.8.

Table 5.8: Impact and contribution of the variable to BI.

	VOL	PU	PEOU
Correlation	0,219	0,036	-0,242
Path coefficient	0,187	0,178	-0,271
Correlation * path coefficient	0,041	0,006	0,066
Contribution to R² (%)	36,293	5,615	58,091
Cumulative %	36,293	41,909	100,000

As shown in table 12 PEOU has negative impact for attitude to use the system. Also the contribution of the PEOU variables to R^2 of BI is %58. The main reason of this negative attitude can be the design of the project management tools.

The graphically representation of the path coefficient and contribution of BI variable can be seen on Figure 5.2.

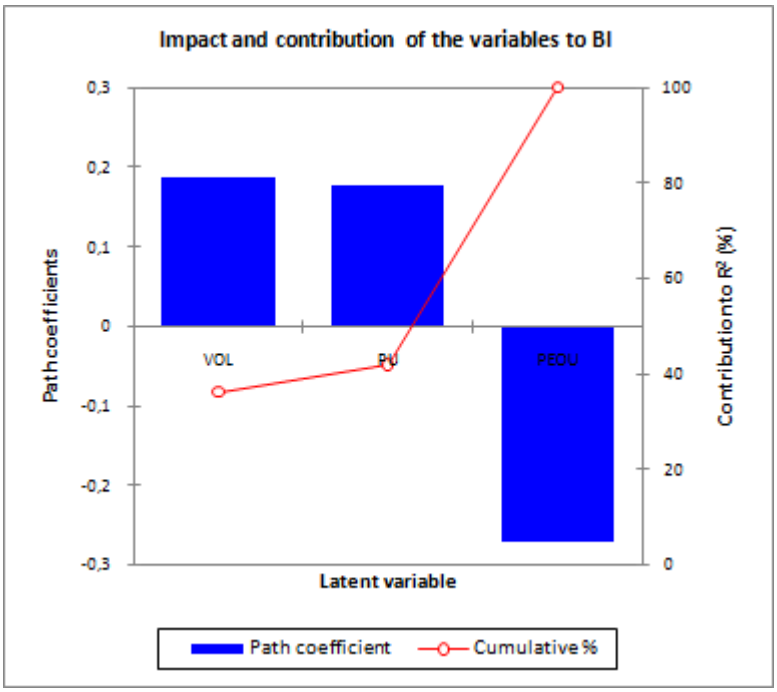

Figure 5.2: Impacts of other variables to BI.

According to the Table 5.9. PEOU construct results are meaningful statistically. The significance value is below 0,005 which make results statistically acceptable. The significance value is 0,000.

Table 5.9. PEOU Construct R^2 Analysis.

R^2	F	Pr > F	R^2(Bootstrap)
0,382	12,188	0,000	0,425

The impact of the CSE, ENJ, PEC and CANX variables over to PEOU construct is shown in Table 5.10.

Table 5.10. Impact and contribution of the variable to PEOU.

	CSE	ENJ	PEC	CANX
Correlation	0,204	-0,356	-0,379	-0,450
Path coefficient	0,173	-0,263	-0,250	-0,351
Correlation * path coefficient	0,035	0,094	0,095	0,158
Contribution to R^2 (%)	9,236	24,594	24,806	41,364
Cumulative %	9,236	33,830	58,636	100,000

According to the results, ENJ, PEC and CANX latent variables have negative impact on the PEOU latent variable. The graphically representation of the path coefficient and contribution of PEOU variable can be seen on Figure 5.3.

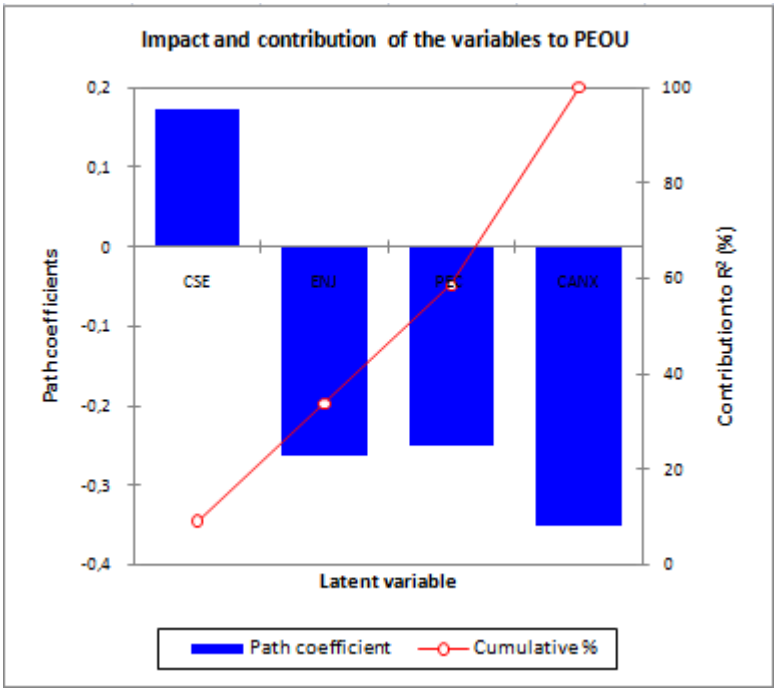

Figure 5.3: Impact of other variables to PEOU.

According to the Table 5.11. PU constructs results are meaningful statistically. The significance vale is below 0,005 which make results statistically acceptable. The significance value is 0,000.

Table 5.11. PU Construct R^2 Analysis.

R^2	F	Pr > F	R^2(Bootstrap)
0,476	14,742	0,000	0,529

The impact of SN, IMG, OUT, RES and PEOU variables over to PU is shown in Table 5.12.

Table 5.12. Impact and contribution of the the variable to PU.

	PEOU	OUT	IMG	SN	RES
Correlation	0,619	0,377	0,154	0,060	-0,431
Path coefficient	0,438	0,136	0,195	0,001	-0,288
Correlation * path coefficient	0,271	0,051	0,030	0,000	0,124
Contribution to R^2 (%)	56,824	10,792	6,294	0,009	26,081
Cumulative %	56,824	67,616	73,910	73,919	100,000

RES has negative impact to PU latent variable. PEOU latent variable has %56 impact to PU latent variable.

The graphically representation of the path coefficient and contribution of PU variable can be seen on Figure 5.4.

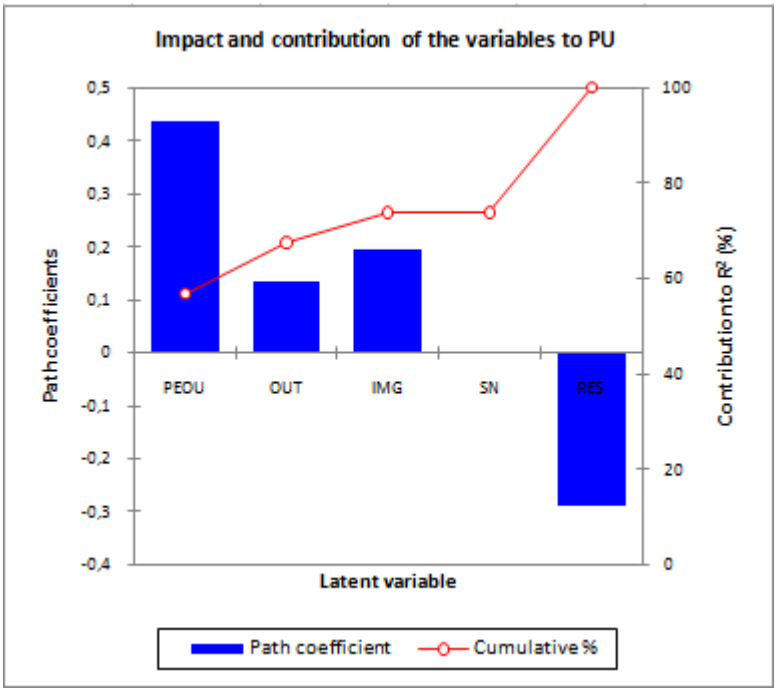

Figure 5.4: Impact of other variables to PU.

Path coefficient value of an exogenous variable in a construct demonstrates that 1 unit change on that variable will impact the endogenous variable of the construct by the proportion of path coefficient value.

The hypothesis, "H1: Behavioral intention to use, positively affected by perceived usefulness." is correct. Since PU has %5.6 impact to BI.

The hypothesis, "H2: Perceived usefulness is positively affected by perceived ease of use." is correct, PEOU has %56 impact to R^2 value of PU.

The hypothesis, "H3: Behavioral intention is positively affected by perceived ease of use." is not correct for this project management tool. It has %58 negative impact to BI.

6. DISCUSSION

TAM 3 have been constructed using reliability and structural equation modeling (SEM), which allow measuring latent variables with manifest variables from surveys. The estimation method is Partial Least Squares Path Modeling (PLS-PM) and the analysis tool is XLSTAT-PLSPM. The proposed methodologies have been applied to a sample of 64 respondents from 7 different departments of the company.

Perceived usefulness, perceived ease of use and voluntariness has significant role on behavioral intention of the project management software.

The results of this thesis support the TAM3 research findings that perceived usefulness and perceived ease of use are important variables affecting the acceptance of a project management tools.

The other result of this study is that perceived ease of use explains perceived usefulness as in TAM3 research results. The frequency of using the system is enhanced by the improvement perception about ease of use of project management system's perceived usefulness. Figure 6.1 shows the direct and indirect impacts of the endogenous and exogenous variable relationships.

The PLS analysis findings show that: PEOU has direct positive affect to PU but also have direct negative affect to BI. After users gain experience the impact of the PEOU to PU will increase according to Vankatesh (2008).

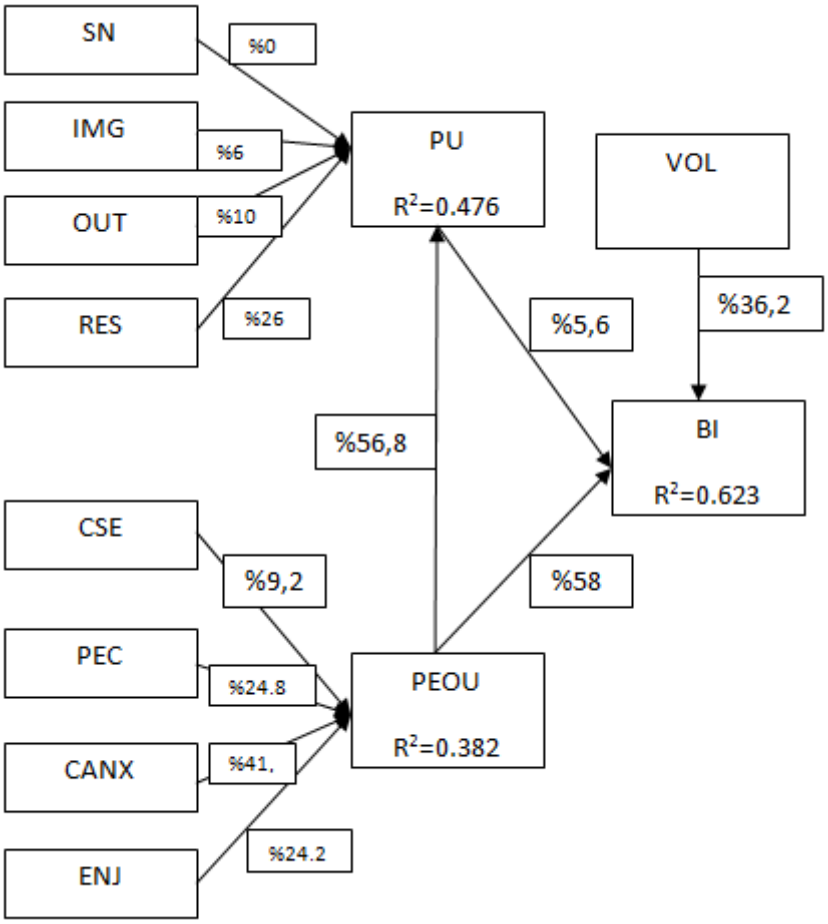

Figure 6.1: The impact of the research model.

7. CONCLUSION AND FUTURE WORK

Information technologies are becoming increasingly complex and implementation costs are very high. Implementation failures of many of today's information technologies cost millions of dollars for organizations. Further, low adoption and high underutilization of I have been a major problem for organizations in terms of realizing the benefits (both tangible and intangible) of information technology implementations (Jasperson et al., 2005). If we can develop a rich understanding of the determinants of information technology adoption and use and interventions that can favorably influence these determinants, managers can proactively decide on implementing the right interventions to minimize resistance to new information technologies and maximize effective utilization of information technologies.

In this thesis, a project management tool is evaluated with TAM3. The reliability results show TAM3 model fits for this kind of problem. The tested project management tool is used in an internet service provider company. The user participated in the questionnaire are experienced with computer. But the system is newly activated in the company. The results show that users are not satisfied with the performance of the system. According to the results of this thesis the user satisfaction study can be done. In the future this analysis should be applied again. The results of the model should show the effects of the experience during time period.

The future studies also should have more participants for more reliable results.

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