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CONTENTS

Sr. No.	TITLE & NAME OF THE AUTHOR (S)	Page No.
1.	IMPACT OF EMPLOYEE DEMOGRAPHICS ON TRAINING; FOR IMPROVED SERVICE DELIVERY: A STUDY ON BANKING SECTOR <i>NITISH KULSHRESTHA, DR. L K SINGH, DR. SAROJ KUMAR DASH & DR. SAVITA MOHAN</i>	1
2.	AN INDUCTIVE APPROACH TO IDENTIFYING THE JOB SATISFACTION FACETS AND JOB SATISFACTION LEVEL IN AN EXTREME ENVIRONMENT IN BANKING SECTOR EMPLOYEES IN NORTHERN REGION IN SRI LANKA <i>A. SARAVANABAWAN & LIRONG LONG</i>	6
3.	AREA EFFICIENT APPROACH FOR 64-BIT MULTIPLICATION USING CONFIGURABLE DEVICES <i>DINESH KUMAR & G.C. LALL</i>	11
4.	THE EVOLUTION OF TECHNOLOGY ACCEPTANCE MODEL: A LITERATURE REVIEW <i>INDER SINGH & DEVENDRA KUMAR PUNIA</i>	15
5.	CONSUMER BEHAVIOUR ON FAST MOVING CONSUMER GOODS – A STUDY WITH REFERENCE TO PERSONAL CARE PRODUCTS IN MADURAI DISTRICT <i>K.MUNESWARAN & DR. C. VETHIRAJAN</i>	22
6.	STUDY OF CHANNEL SATISFACTION OF VIDEOCON TELECOM SERVICES AND ITS COMPETITORS IN PUNJAB <i>RAZIA SEHDEV, DR. YUVRAJ BHATNAGAR & PRANAV RANJAN</i>	28
7.	INTEREST FREE BANKING: A POTENTIAL SUBSTITUTE TO CONVENTIONAL BANKING IN THE CONTEMPORARY GLOBAL FINANCIAL SCENARIO <i>DR. FAROOQ A SHAH</i>	35
8.	A STUDY ON DIMENSION OF SMARTPHONE AND ITS INFLUENCE ON CONSUMER PREFERENCE <i>DR. S. A. SENTHIL KUMAR & M. JAMAL MOHAMED ZUBAIR</i>	39
9.	CENTRALISED SYSTEM FOR e-PROCUREMENT- A NEW RISE IN PUBLIC SECTOR: A CASE STUDY <i>SHYNA K S & SAYED MOHAMMED V V</i>	41
10.	EFFECT OF ELECTRONIC MOBILE MONEY TRANSFER ON FINANCIAL LIQUIDITY AND GROWTH OF MICRO AND SMALL ENTERPRISES: A CASE OF NAIROBI CITY, KENYA <i>DUNCAN MOMANYI NYANG'ARA, WILLIAM MACHANI NYANG'ARA & Kennedy O. Moenga</i>	46
11.	CORPORATE SOCIAL RESPONSIBILITY IN BUSINESS: A CASE STUDY ON GRAMEEN PHONE LIMITED BANGLADESH <i>ARJUN KUMAR DAS, SUJAN KANTI BISWAS & DR. KUNAL SIL</i>	52
12.	EFFECTIVENESS OF TRAINING EVALUATION PRACTICES – AN EMPIRICAL STUDY <i>DR. SHOBHARANI H. & DR. MAMATHA S. M.</i>	58
13.	IMPACT OF LEARNING STYLES ON e-LEARNING ENVIRONMENT: AN EMPIRICAL STUDY <i>SHAKEEL IQBAL</i>	64
14.	THE EFFECT OF BOARD STRUCTURE ON FINANCIAL PERFORMANCE OF SRI LANKAN LISTED BANKS <i>RAVIVATHANI THURASINGAM</i>	69
15.	DISAGGREGATED VOLATILITY - A CASE STUDY IN INDIAN STOCK MARKET <i>DR. NALINA K. B.</i>	74
16.	CUSTOMER SATISFACTION OF E-BANKING IN BANGLADESH WITH FOCUS ON DUTCH BANGLA BANK LTD.: THE CONTEXT OF TWENTY FIRST CENTURY <i>MOSAMMOD MAHAMUDA PARVIN & MD. MASUDUL HASSAN</i>	83
17.	ENHANCING THE PERFORMANCE OF LEACH PROTOCOL IN WIRELESS SENSOR NETWORKS <i>NUTAN SINDHWANI & ROHIT VAID</i>	91
18.	MULTI CRITERIA DECISION MAKING USING FUZZY TOPSIS <i>PRATHIBA PH & KARTHIKEYAN R</i>	95
19.	MEASURING THE EFFECT OF CAPABILITY VERSUS USABILITY IN PURCHASE DECISION OF SMART PHONES <i>JITESH BISHT & LAKSHMI SHANKAR IYER</i>	100
20.	AN IMPACT OF GREEN COMPUTING IN HAZARDOUS DEVICE MANUFACTURING & MAXIMIZE ENERGY EFFICIENCY <i>CHITHRA MOL C. R, R. VIJAYASARATHI & THAMIL KUMARAN V. C</i>	107
21.	EFFECTIVE DYNAMIC ROUTING PROTOCOL: ANALYSIS OF VARIOUS SECURE DATA ROUTING PROTOCOL AND DATA AGGREGATION IN WIRELESS SENSOR NETWORKS <i>S.MOHAMED SALEEM & P.SASI KUMAR</i>	115
22.	HEAT TRANSFER ENHANCEMENT IN AIR CONDITIONING SYSTEM USING NANOFLUIDS <i>R. REJI KUMAR, M. NARASIMHA & K. SRIDHAR</i>	120
23.	e-COMMERCE: AN ANALYSIS OF CONCEPTUAL FRAMEWORK <i>ABU ZAFAR AHMED MUKUL & SABRINA HOQUE CHOWDHUARY</i>	126
24.	e-COUNSELING FOR INSTITUTIONS OF HIGHER LEARNING IN GHANA: WHAT ARE THE REQUIREMENTS? <i>KEVOR MARK-OLIVER</i>	131
25.	TAX INCENTIVES AND INVESTMENT BEHAVIOUR: AN EMPIRICAL REVIEW OF THE TAX PAYERS PERCEPTIONS <i>OBARETIN OSASU & DR. CHINWUBA OKAFOR</i>	135
26.	METHODS OF DATA SECURITY USED IN COMPUTER NETWORK <i>ZOBAIR ULLAH</i>	138
27.	CONSUMERS CHOICE OF RETAIL STORES WITH REFERENCE TO THEIR DEMOGRAPHIC INFLUENCERS <i>APEKSHA JAIN & MANOJ KUMAR SHARMA</i>	141
28.	GRID COMPUTING: INTRODUCTION AND APPLICATION <i>ANUDEEP RANDHAWA, HEENA GULATI & HARISH KUNDR</i>	143
29.	CONSUMER BEHAVIOR TOWARDS e-BANKING IN HDFC BANK <i>CHANABASAPPA TALAWAR</i>	147
30.	ROLE OF SMALL INDUSTRIES DEVELOPMENT BANK OF INDIA (SIDBI) IN THE PROMOTION OF ENTREPRENEURSHIP IN U.P. <i>DR. MOHD. SHOEB</i>	152
	REQUEST FOR FEEDBACK	158

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THE EVOLUTION OF TECHNOLOGY ACCEPTANCE MODEL: A LITERATURE REVIEW

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ABSTRACT

Now days, organizations are investing enormous amount in Information Technology to achieve productivity gain, excellence and competitive advantage. Academicians and practitioners have conducted many researches to determine the gain from IT investment. Actual productivity gain can only be achieved through adoption and use of technology in the organization. In this paper, extensive review of literature has been done on TAM and its other related theories such as TRA, and TPB.

KEYWORDS

TRA, TPB, TAM, TAM2, UTAUT.

1. INFORMATION TECHNOLOGY AND ITS IMPACT ON ORGANIZATIONAL PERFORMANCE

From many decades, Researchers and practitioners have discussed on whether investment in Information Technology improves the organizational performance or not? These discussions have coin the term information technology productivity paradox.

1.1. IT PRODUCTIVITY PARADOX

There is a debate from many decades that whether the computers contributes to productivity growth or not. The success of a business is generally depends on the ability of the firm to provide real value to their customers without using much labor, capital, or other inputs (Brynjolfsson and Hitt 1998). Productivity growth doesn't come from working harder but primarily from working smarter. Productivity growth comes from working smarter usually means adopting new technology and techniques. There have been many anecdotes about whether IT investment gives any productivity gain or not. On the one hand, there are many success stories like Dell and Cisco those transected billions of dollars via internet. On the other hand, there are many stories about abandoned systems investment, cost overrun, and IT failure (Brynjolfsson and Hitt 1998). The aggregate statistics suggest that productivity has grown more between 1950 and 1973 and become slow down since 1973. In the late 1980, payoffs from IT have been debated among the researchers and practitioners resulting in coining the term "IT Productivity Paradox" (Brynjolfsson 1993; Brynjolfsson and Yang 1996).

2. INFORMATION PAYOFF

There have been many studies at different level – that is, the economy level, industry level and firm level (Devaraj and Kohli 2000). Studies during late 1980s focused IT investment impact on whole economy, but in early 1990s, researchers had reexamined the data and look at the IT investment behavior of firm level. The results from firm level studies show the positive correlation between IT and productivity gain (Devaraj and Kohli 2000). Researchers also measure some intangible value created by IT at firm-level. Firm-level studies found that there is positive relation of IT investment and productivity and contradicting claims of "Productivity Paradox" (Brynjolfsson and Hitt 1995, 1996; Malone 1997). Organizations adopting IT technologies at a faster rate found to be getting more benefits from IT. Survey suggests that the prime motive of managers to use IT is to improve customer services and quality consistently above cost savings (Brynjolfsson and Hitt 1997).

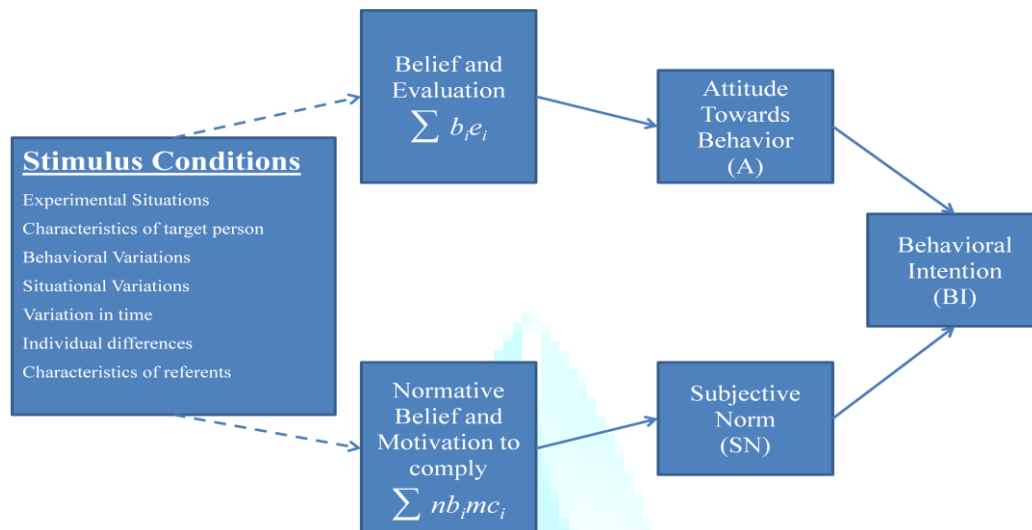
There were several studies, which assessed about IT investment and its effect on organizational performance. Researchers and academicians uses different variables, levels (economy, industry, and firm), and technologies to determine IT payoff. Some studies found positive relationship between IT investment and organizational performance, but other studies found negative relationship between technology investment and organization performance. According to Devaraj & Kohli, the main effect of Information technology on organizational performance is not because of enormous investment in it but the adoption and actual use of Information Technology. The adoption of technology may be mandatory or voluntary. In mandatory adoption, subjective norms have a significant effect on intention. In Voluntary, the adopters perceive that adoption is non-mandatory (Devaraj and Kohli 2003).

3. EVOLUTION OF TECHNOLOGY ACCEPTANCE MODEL

There are several theories which have been used to determine the individual's behavioral intention to accept or reject technology, such as the Theory of Reasoned Action (Fishbein and Ajzen 1975), the Theory of Planned Behavior (Ajzen 1991), and the Technology Acceptance Model (Davis 1989). The TAM is most popular model in the field of information systems to determine the individual's behavioral intention to use information technology (Alshare and Alkhatieb 2008). The TAM was developed by (Davis 1989) to find out the user acceptance of information technology.

The Technology Acceptance Model developed from two foundation theories, TRA and TPB. The TRA and TPB are the general purpose theoretical models from social psychology usually used to determine the behavioral intention of individuals to perform a particular behavior, where Behavioral intention can jointly determined by individual's attitude towards that behavior and subjective norm (Davis et al. 1989).

FIGURE 1: THE THEORY OF REASONED ACTION MODEL



Source: Obtained from Fishbein /Ajzen, Belief, Attitude, Intention, and Behavior, Figure 7.2(Schematic representation of effects of stimulus variables on intentions), p. 334

Behavioral intention is a measure of the strength of an individual's intention to perform a particular behavior (Davis et al. 1989). Attitude refers to an individual's favorable and unfavorable feelings about performing an intended behavior (Fishbein & Ajzen, 1975, p. 216). Subjective norm refers to "the person's perception that most people who are important to him think he should or should not perform the behavior in question" (Fishbein & Ajzen, 1975, p. 302).

According to TRA, there are two factors that have been used to determine the behavioral intentions: an individual factor or "attitudinal" factor and social or "normative" factor. The symbolical representation of equation of the theory is as follows:

$$BI = (A_B) w_1 + (SN) w_2 \quad (1)$$

Where, B belongs to the Behavior; I belong to the intention to perform behavior; A_B is the attitude towards performing behavior; SN is the subjective norm; w_1 is empirical weight assigned to A and w_2 is empirical weight assigned to SN (Fishbein & Ajzen, 1975, p. 301), where, the relative weights of the attitudinal and normative factors may vary from one person to another. Behavioral Intention (BI) is a linear function of sum of two weighted variables Attitude (A_B) and Subjective Norm (SN).

According to Theory of reasoned action, a person's attitude toward performing a specified behavior can determined by his or her salient beliefs about perceived outcomes or consequences of performing the behavior multiplied by evaluation of those consequences or outcomes:

$$A_B = \sum_{i=1}^k b_i e_i \quad (2)$$

Where, A_B is the attitude toward behavior, b is the salient belief about performing the specified behavior B leads to consequence or outcome i , e is the person's evaluation of consequence or outcome i and k is the number of beliefs a person hold about the specified behavior (Fishbein & Ajzen, 1975, p. 301).

The above equation represents information-processing view of attitude structure and change, which posits that external stimuli do not affect person's attitude directly but can influence the person's belief formation which influence the person's attitude.

The normative component of the TRA model, SN, deals with influence of the behavior through social environment. According to TRA, a person's subjective norm (SN) is determined by sum of his or her normative beliefs (nb_i) about perceived expectation of specified referent individuals and groups and multiplied by his or her motivation to comply (mc_i) with those expectations (Fishbein & Ajzen, 1975, p. 302):

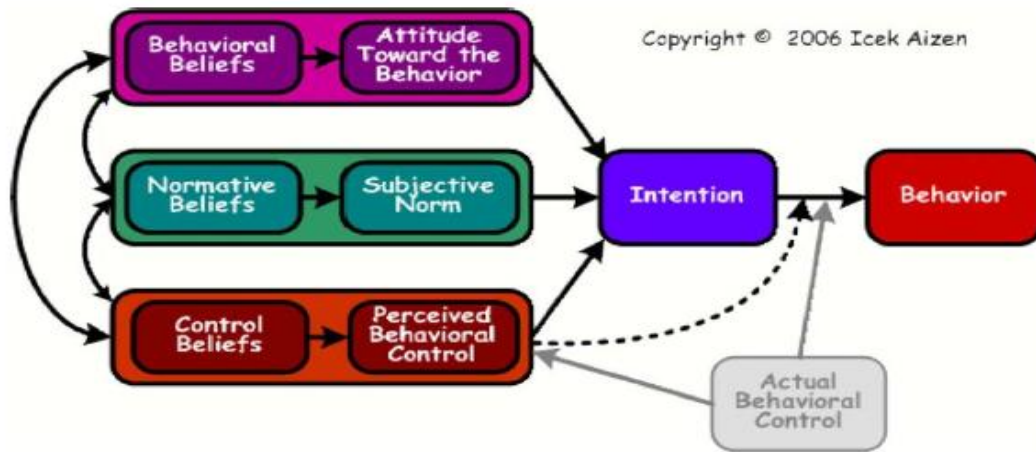
$$SN = \sum_{i=1}^k nb_i mc_i \quad (3)$$

Where, SN is the subjective norm, nb_i is the normative belief (i.e. the person's belief that referent individual or group i think that he or she can or can't do the specified task), mc_i is the motivation comply with referent individual or group i , k is the number of individual or group referents.

According to Davis, et al., TRA is a general model as such; the belief construct is not included for performing a particular behavior (Davis et al. 1989). Researchers those who are using TRA model in his or her research to study human behavior should first identified the belief construct for that particular behavior being assessed (Davis et al. 1989). Previous study suggested that eliciting five to nine salient beliefs are sufficient to conclude the individual's behavior to do the specified behavior (Fishbein and Ajzen 1975).

The theory of reasoned action has been widely used in many domains and applied research (Davis et al. 1989). The TRA deals with prediction and explanation of behavior that is usually under an individual's volitional control. In TRA, behavioral intention can be determined by attitude towards the behavior and subjective norms, under a person's volitional control (Ajzen 1991). Theory of planned behavior is an extension of the theory of reasoned action that will allow us to include consideration of non-volitional factors as determinants of behavior.

FIGURE 2: THEORY OF PLANNED BEHAVIOR



Source: <http://people.umass.edu/ajzen/tpb.diag.html>

The TRA was not use for prediction of a specific behavior in a given situation. The TPB framework designed to predict human behavior in specific contexts. TPB differs from TRA by adding perceived behavioral control, which plays an important part in the TPB (Ajzen 1991). Perceived behavioral control differs from Rotter’s (1966) concept of perceived locus of control, locus of control remain stable across situations and actions, whereas perceived behavioral control vary across situations and actions (Ajzen 1991). According to TPB, perceived behavioral control refers to the individual’s perceived ease or difficulty of performing a specific behavior. According to Ajzen, behavioral achievement can be determined by perceived behavior control and behavioral intention (Ajzen 1991).

$$BI = (A_b) w_1 + (SN) w_2 + (PBC) w_3 \quad (4)$$

According to above formula of behavioral intention, behavioral intention to perform behavior at different situation and kinds can predicted by attitude towards behavior, subjective norm, and perceived behavioral control. Where, w_1 is the empirical weight assigned to A, w_2 assigned to SN, and w_3 assigned to PBC respectively. Performance of the behavior can facilitate by multiplying each control belief (c) with the perceived power (p) of the particular control factor.

$$PBC = \sum_{i=1}^n cb_i p_i \quad (5)$$

The results of products are the summation of the n salient control beliefs to produce the perception of behavioral control.

According to Ajzen, the strength of individual’s intention to perform the specific behavior is determined by the favorable attitude and subjective norm towards that behavior, and the perceived behavior control (Ajzen 1991). According to TRA, the attitude, subjective norm, and perceived behavior control relatively vary across the behaviors and situations. In the previous researches’, TPB have been widely used across many domains such as meat consumption (Bonne et al. 2007), intentions to smoke (Smith et al. 2007; Walker et al. 2006), leisure (Walker et al. 2006), condom use(Bryan et al. 2006), technology adoption and use (Baker et al. 2007; Brown and Venkatesh 2005).

4. INFORMATION TECHNOLOGY ACCEPTANCE

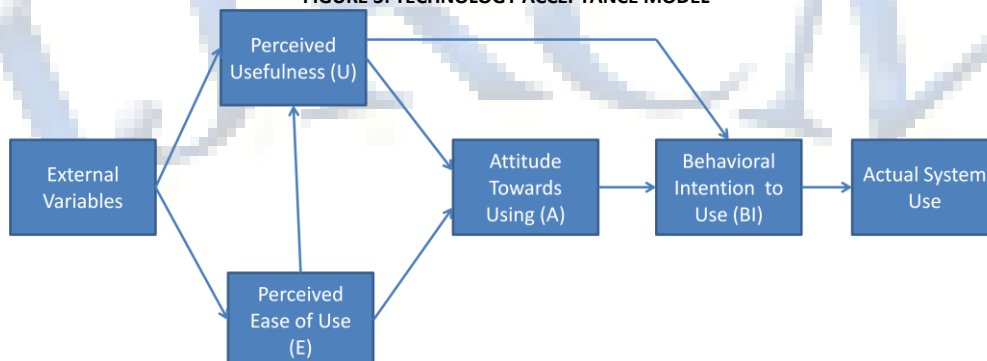
The Theory of Reasoned Action and the Theory of Planed Behavior were widely used to examine human behavior in general.

4.1. TECHNOLOGY ACCEPTANCE MODEL

The Technology Acceptance Model has been used specifically to determine technology acceptance and usage behavior. Technology acceptance model was developed by Devis (1986). TAM was an adaptation of Theory of Reasoned Action, and it was specifically tailored to find out the determinants of technology acceptance of new technologies, used by the end users. TAM is theoretically justified and parsimonious model to predict user behavior across wide range of end user computing technologies. Researchers and practitioners can utilize TAM model to predict why a particular technology accepted or rejected by the end user, so that they can pursue corrective steps. The key purpose of TAM model is to determine the impact of external factors on internal beliefs, attitudes and intentions (Davis et al. 1989).

There are two main beliefs used in TAM, perceived usefulness and perceived ease of use, which were primary used for computer acceptance behaviors. Perceived usefulness (PU) defines that using the particular technology improve his or her job performance. Whereas, perceived ease of use (PEOU) defines that using a particular technology is free of efforts (Davis et al. 1989).

FIGURE 3: TECHNOLOGY ACCEPTANCE MODEL



The TAM model shows that actual usage of technology can determined by behavioral intention to use technology, but behavioral intention can be jointly determined by attitude towards using technology and perceived usefulness, with relative weights, forming the following equation:

$$BI = A + U$$

Form the equation, the A-BI relationship explain that people attitude to perform particular behavior have positive effect on his or her intention. The U-BI relationship explains that people form positive behavior about intention to use particular technology, if he or she thinks that using the technology improves his

or her job performance. Subjective Norm was not included in TAM, just because of its uncertain theoretical and psychometric status (Davis et al. 1989). According to TAM, Attitude towards a particular technology can jointly determined by perceived usefulness (U) and perceived ease of use (EOU), with their relative weights estimated by linear regression:

$$A = U + EOU$$

TAM model represents that there is direct effect of Perceived usefulness (U) on behavioral intention over and above attitude (A). The above equation also posits that perceived usefulness also influence the attitude (A). Perceived ease of use (EOU) has also significant positive effect on attitude. The TAM model also represent that improved perceived ease of use (EOU) contributes to improve the performance. So, perceived ease of use (POU) has direct effect on perceived usefulness (Davis et al. 1989). Perceived usefulness also effected by external fctors over and above perceived ease of use (EOU) and forming the following equation:

$$U = EOU + \text{External Factors}$$

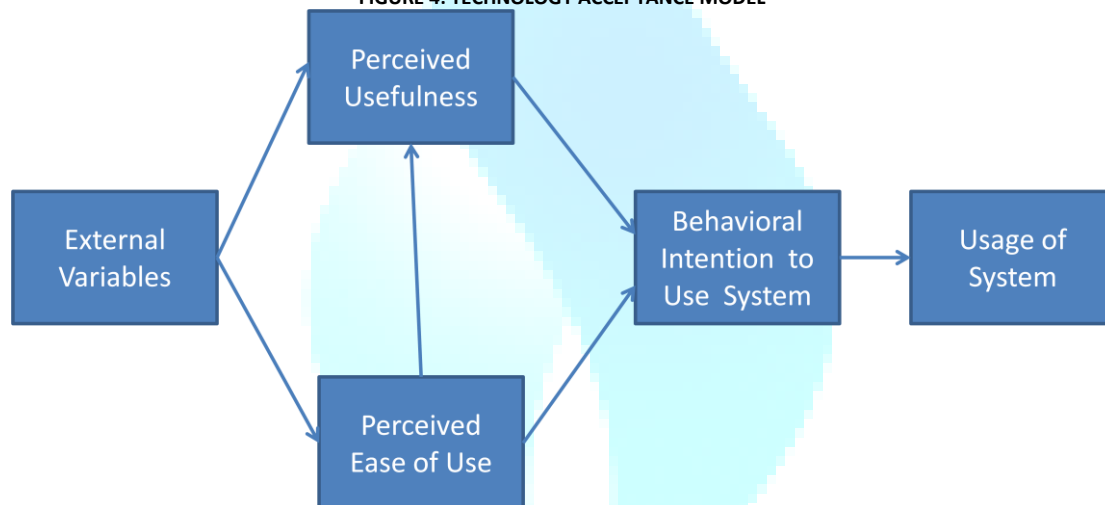
According to TAM, perceived ease of use can be influenced by extrenal factors. There are many features of an interface such as menus, icons, etc. which enhance the usability of particular computer system.

$$EOU = \text{External Factors}$$

The impact of external factors on perceived ease of use has been documented by many researchers (Davis et al. 1989). There is a controvesy in the literature regarding inclusion of attitude in the final model of TAM. The Attitude towards using a technology was omitted by (Davis et al. 1989) in their final model. Based on empirical analysis in their final model it was found that there is weak link between perceived usefulness and attitude, and there is strong link between perceived usefulness and behavioral intention. On the basis of empirical analysis attitude was excluded from the final TAM model. An exhaustive literature review reveals that many researchers have not included attitude in their research model. But in few studies (Sanchez-Francis and Roldan 2005) and (Gong et al. 2004) it was found that attitude has a positive correlation with other constructs (perceived usefulness, perceived ease of use and behavioral intention) of TAM model. (Gong et al. 2004) have not given any explanation about inclusion of attitude construct in their research model. Accroding to (Sanchez-Francis and Roldan 2005), though, there were many researchers including Davis (1989), suggested it was not meaningful to include attitude construct in TAM model, but they obtained positive correlation suggest otherwise. So, (Sanchez-Francis and Roldan 2005), suggested to include attitude construct in TAM studies.

Subjective Norm (SN) was a critical construct of theory of reasoned action and theory of planned behavior, but this construct was also excluded from the TAM to detremine the behavioral intention to use technology. It was acknowledged by (Fishbein and Ajzen 1975) that subjective norm is the least understood facet of theory of reasoned action. There was no significant relation found between subjective norm and behavioral intention to use (Davis et al. 1989). Hence, there was no evidence which shows significane relationship between subjective norm and behavioral intention, this construct was not included in the original TAM model (Davis et al. 1989).

FIGURE 4: TECHNOLOGY ACCEPTANCE MODEL



Source: (Venkatesh and Davis 1996)

While TAM model has been widely used to predict acceptance and usage behavior by using two key construct perceived usefulness and perceived ease of use, but still, it is limited to provide sufficient information to IT professional and managers to be in a better position to conduct effective intervention programs to improve user acceptance of new technologies. This limitation influence the researchers (Venkatesh and Davis 2000) to focus on the antecedents of perceived usefulness and perceived ease of use. As depicted in the TAM model that there are few other external factors which impact on intention to use computer system. According to Davis, et al., there are various external factors such as individual differences, situational constraints and managerial controllable intervention that impinging on behavioral intention to use system mediated through two key beliefs about system usage: perceived usefulness and perceived ease of use (Davis et al. 1989).

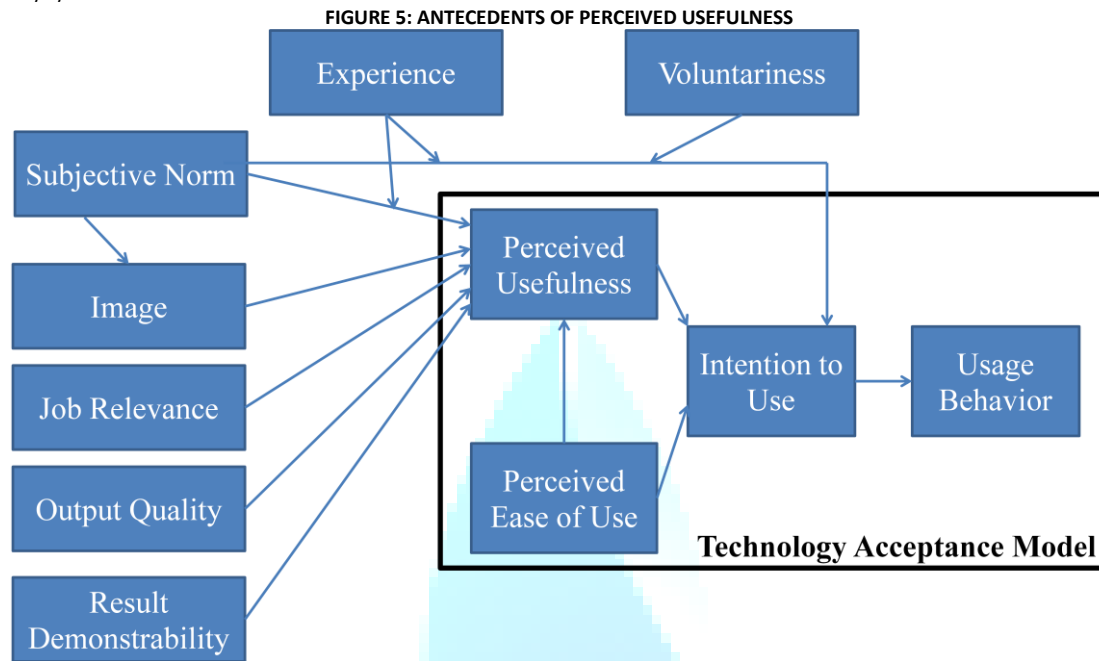
4.2. ANTECEDENTS OF PERCEIVED USEFULNESS

TAM has been found as well-established robust and parsimonious model for predicting user acceptance and usage. Many empirical test on TAM model suggests that perceived usefulness has consistently been a strong determinant of technology usage intention, with standard regression coefficients typically around 0.6 (Venkatesh and Davis 2000). During study it was found that perceived usefulness is a fundamental driver of usage intentions, it was important to determine the determinants of this construct and how its influence changes over time with increasing experience using the system (Venkatesh and Davis 2000). Perceived ease of use is also a direct construct to predict usage behavior and has a less consistent effect on intention across many studies, but there are many studies in which researcher have determine the determinants of perceived ease of use, but determinants of perceived usefulness have relatively overlooked (Venkatesh and Davis 2000).

A better understanding of detremnants of perceived usefulness will provide us useful information to design organizational interventions to improve user acceptance and usage of new information system. (Venkatesh and Davis 2000) extnded the TAM by adding additional determinants of TAM's perceived usefulness and assessed that how these determinants will change over time and gaining experience with the target system. The TAM model they extended referred to as TAM2.

Using TAM as strating point, in TAM2 (Venkatesh and Davis 2000) included some additional theoretical constructs spanning social influence processes (Subjective norm, voluntariness, and image) and cognitive instruments processes (job relevance, output quality, result demonstrability, and perceived ease of use). TAM2 was tested using four logitudinal field studies. These four sites spanned a range of industries, organizational contexts, functional areas, and the type of systems be used. From these four sites two sites were choosen, where the usage was mandatory and the other two sites chooses where the usage was voluntary. The questionnaires were distributed to potential users at three different points in time: after initial training (T1), on month after implementation (T2), and three months after implementation (T3). Self-reported usage behavior was measued at T2 and T3, and also five months after implementation (T4). The results from the study suggests that study 1 and 2, the use of the new system was voluntary while study 3 and 4, the use of new system was mandatory. TAM2 was strongly supported in all the four organizations and three time periods. The results explaining upto 60% of the variance in perceived usefulness. Futhermore,

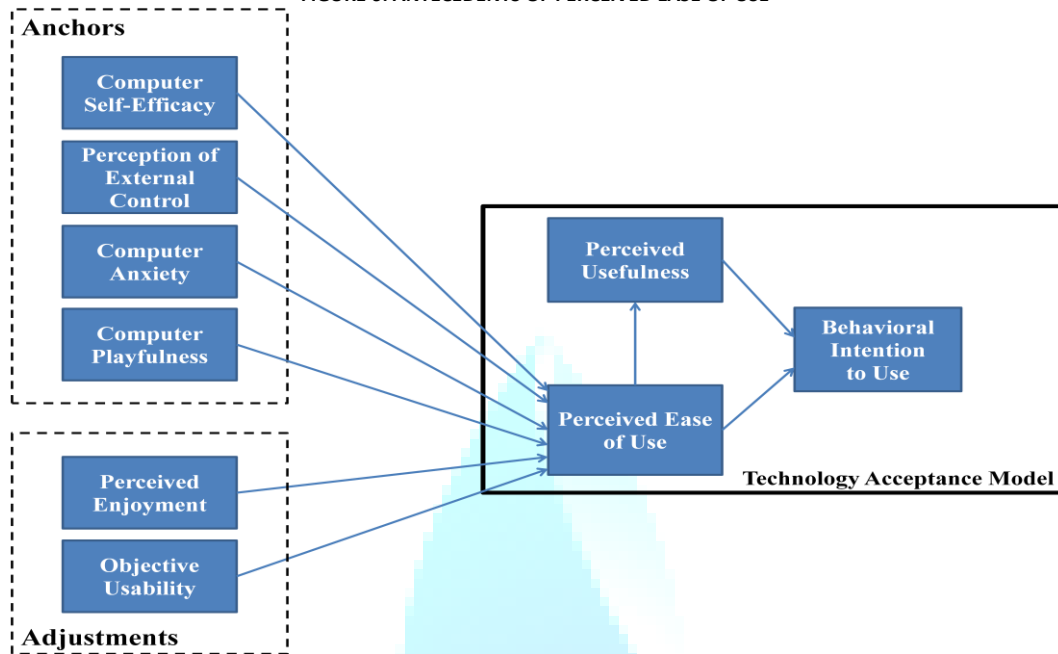
TAM2 extends TAM by showing that subjective norm exerts a significant direct effect on usage intention over and above PU and PEOU for mandatory system use but not for voluntary system use.



4.3. ANTECEDENTS OF PERCEIVED EASE OF USE

Previous studies suggest that perceived ease of use is an important determinant that influences user acceptance and usage behavior of new computer systems. Although, there have been several researches conducted in order to determine the impact of perceived ease of use on behavioral intention to use system, very less work has been conducted to understand the other determinants that influence the TAM's perceived ease of use (Venkatesh 2000). There were many studies conducted by many researchers with emphasize on system design characteristics or training when trying to enhance user perception of the ease of use of the system, but they overlooked the other controlled variables such as individual difference and variables that were a results of a new system-user interaction (Venkatesh 2000). A theoretical model was developed by (Venkatesh, 2000), based on anchoring and adjustment-theoretical framework.

FIGURE 6: ANTECEDENTS OF PERCEIVED EASE OF USE



Source: (Venkatesh 2000)

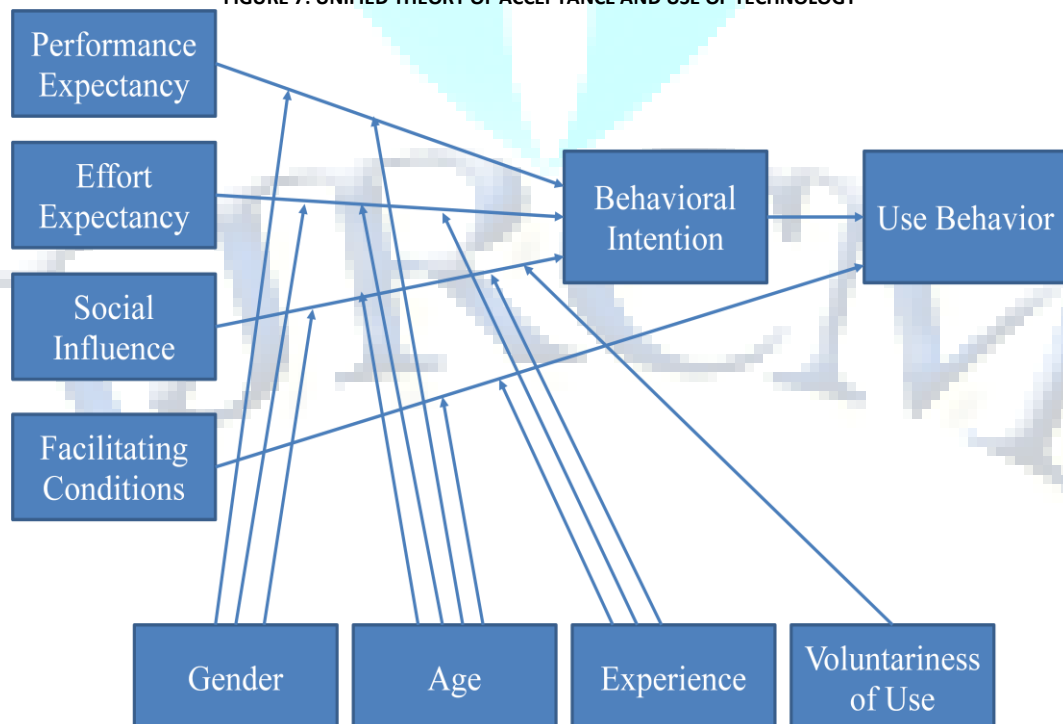
The proposed model control (internal and external – conceptualized as computer self-efficacy and facilitating conditions, respectively), intrinsic motivation (conceptualized as computer playfulness), and emotion (conceptualized as computer anxiety) as anchors that determine early perceptions about the ease of use of new system.

The extended TAM was tested in three different organizations among 246 employees over three-month period to test the impact of computer self-efficacy, perception of external control, computer anxiety, computer playfulness, perceived enjoyment, objective usability on intention to use new system mediated through a key construct of TAM model perceived ease of use. The results obtained from the regression analysis shows that all the determinants were significantly relate with the perceived ease of use, and there was 60% of the variance in the system-specific perceived ease of use. The findings from this research model suggest that there is a need for an increased focus on individual difference variables in order to enhance user acceptance for new system, rather than more emphasize on perception and design characteristics (Venkatesh 2000). Results also suggest organizing basic training programs to improve computer skills, as they have strong impact on acceptance and usage behavior.

5. UNIFIED THEORY OF ACCEPTANCE AND USE OF TECHNOLOGY (UTAUT)

Unified Theory of Acceptance and Use of Technology (UTAUT) (Venkatesh et al. 2003) proposes that an individual’s intention to use an information system is driven by performance expectancy, effort expectancy, and social influence. Actual system usage is driven by intention to use the system and by facilitating conditions. In the model, these constructs are moderated by gender, age, experience, and voluntariness of use. The model draws from a number of earlier models that attempt to explain an individual’s behavior (theory of reasoned action, technology acceptance model, motivational model, theory of planned behavior, and a combined theory of planned behavior/technology acceptance model, model of PC utilization, innovation diffusion theory, and social cognitive theory). Validation tests conducted by (Venkatesh et al. 2003) found that UTAUT explained 70% of the variance in information system usage intention.

FIGURE 7: UNIFIED THEORY OF ACCEPTANCE AND USE OF TECHNOLOGY



Source: (Venkatesh et al. 2003)

The four constructs that directly affect intention and behavior in UTAUT are performance expectancy, effort expectancy, social influence, and facilitating conditions. Performance expectancy refers to an individual's expectation that using the system will result in better job performance. Effort expectancy refers to an individual's expectation about the difficulty involved in using the system. Social influence refers to an individual's perception of how other individuals of importance to him/her feel about him/her using the system. Last, facilitating conditions refers to an individual's perception of factors that exist within the organization that would encourage his/her use of the system.

6. CONCLUSIONS

However, Theory of Reasoned Action (TRA) and Theory of Planned Behavior (TPB) have been used by many researchers and academicians, but these theories were widely used in to determine the human behavior in general. TAM was developed by Davis, and is widely used model in information systems to determine the individual's behavioral intention to use information technology. Perceived Usefulness (PU) and Perceived Ease of Use (PEOU) are the main factors of Technology Acceptance Model. There were many researchers, those who extended the Technology acceptance model by determining the external factors that have significant positive or negative effect on the individual's behavioral intention to accept or reject the Technology.

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