

VALIDITY OF THE TECHNOLOGY ACCEPTANCE MODEL (TAM): A SENSEMAKING PERSPECTIVE

BUSHRA AAFAQI

International University College of Technology Twintech (IUCTT)

MUHAMAD JANTAN
*Centre for Policy Research
Universiti Sains Malaysia*

T. RAMAYAH
*School of Management
Universiti Sains Malaysia*

ABSTRACT

This study investigates whether sensemaking activities influence technology acceptance and if the strength of relationship between TAM's constructs changes over a period of time. This study was a panel-based longitudinal study, whereby data was collected in three stages within a single semester. The setting of the study was at the School of Management, USM. The major findings of the study showed that sensemaking does influence the TAM if activities are undertaken at high and low levels and also sensemaking influences individual constructs of TAM rather than the whole model. This study failed to prove that there is a significant change in the strength of relationship between TAM constructs over a period of time under sensemaking influence, which is that sensemaking activities were found not to exhibit any moderation effect on the TAM constructs. Sensemaking acts as an external variable which influences TAM rather than moderate the strength of the relationship between TAM constructs. This could be because the technology in question was mandatory to be used by the subjects rather than voluntary. Implications for managers are discussed.

Keywords: *Sensemaking; Technology Acceptance Model (TAM); moderating effect; longitudinal study.*

ABSTRAK

Kajian ini mengkaji sama ada aktiviti "sensemaking" mempengaruhi penerimaan teknologi dan juga sama ada kekuatan perhubungan antara

konstruk Model Penerimaan Teknologi (TAM) berubah dengan peredaran masa. Kajian ini berasaskan panel longitudinal di mana data dikumpulkan tiga kali dalam satu semester pengajian. Kajian ini dijalankan di Pusat Pengajian Pengurusan, Universiti Sains Malaysia. Penemuan utama kajian ini adalah "sensemaking" mempengaruhi TAM dan juga mempengaruhi konstruk individu TAM tetapi tidak mempengaruhi model TAM secara keseluruhan. Kajian ini juga tidak dapat membuktikan bahawa kekuatan perhubungan berubah dengan peredaran masa." "Sensemaking" tidak berupaya menyederhanakan perhubungan antara konstruk dalam TAM. Sebaliknya "sensemaking" bertindak sebagai pemboleh ubah luaran yang mempengaruhi TAM dan bukannya menyederhanakan kekuatan perhubungan antara konstruk TAM. Penemuan ini mungkin disebabkan teknologi yang dikaji adalah diwajibkan untuk digunakan oleh responden kajian dan bukannya secara sukarela. Implikasi untuk pengurus juga dibincangkan.

Kata kunci: *Sensemaking; Model Penerimaan Teknologi (TAM); kesan penyederhana; kajian longitudinal.*

INTRODUCTION

Technology is a very broad term that can be related to every facet of life. It is an essential component in any organisation. Technology today is considered one of the most important factors in gaining competitive advantage and to succeed in this competitive era of globalisation. It helps in faster production and decision-making. For March and Sproull (1990), competition is one of the leading factors that makes organisations exploit new and superior technologies. According to Voon Seng Chuan, the Managing Director of IBM Malaysia, "Technology is an essential component for success and is an enabler for businesses as it provides the value-added advantage to achieve greater competitiveness and higher productivity so crucial to enable local companies to leap-frog to greater heights in the global market". He further said that the Malaysian government is putting a lot of effort to promote technology adoption among local manufacturing companies to ensure that they remain competitive in the global marketplace (Boey, 2002).

Successful business organisations recognise the importance of technology in running an efficient operation and maintaining their competitive edge. The exploitation of technology is a necessity and one can try new technologies only when an individual is ready to adopt the new technology. Successful exploitation of technology occurs at the individual level, as it is the individual employee who operates the

various technologies purchased by the organisation. Thus, adoption of technology leads to another aspect of this whole scenario; that is, how to enhance an individual's desire to use a given new technology. It means that success of any organisation today is largely dependent on their ability and willingness to exploit and adopt new technology in their day-to-day operations. Despite much investment in technology, returns on technology investment have been minimal. (Hammond, 1994; Wood, Ford, Miller, Duffin & Sobezky, 1995; Hsieh-Yee, 1996; Jamaludalin, 2004; Tay, Tan, Tan & Md. Ismail, 2004). Jamaludalin (2004) found that only 24% of respondents used online library as most were comfortable going to the physical library as a form of social networking. Tay *et al.* (2004) also found that only 46% had experience using the online library. Again, from this 46% of users, 84% only used the online library less than once a week which points to a wastage of the services provided. Only 10 to 15% of all ERP implementations across Malaysia have a smooth introduction, while some 30% of the implementations experience challenges or a significant shortfall in delivered benefits ("ERP: Integrating for K-effectiveness", 2002).

The primary reason behind this dilemma is the human factor, that is, operators/users of the technology refusing to wholly adopt the technology to fully utilise the potential of the technology. This reluctance can be explained in various ways; one of it could be that operators/users of the technology are not usually involved (participate) in its adoption process. This could be one reason why technology implementation fails in any given organisation, as employees are reluctant to change.

Objectives of this Study

The main objective of this study was to promote a better understanding and eventually, prediction, and management of the technology adoption process. Thus, this study sets out to achieve the following objectives:

- (1) to investigate the relationship between technology adoption and adopter's mental framework;
- (2) to determine whether the perception about new technology changes over a period of time under the influence of sensemaking; and
- (3) to determine the extent of influence of sensemaking processes on the technology adoption model.

LITERATURE REVIEW

It is very crucial for organisations today to adopt new technology or to accept new technology, and find new ways of doing work in order to maintain or enhance their competitive position in the industry. Managers or the top management must know what leads to the acceptance of a given technology and how to enhance the technology adoption in a given organisation. This section will shed some light on the issues based on past research done on the major components of this study.

Technology Acceptance Model (TAM)

One way of examining the adoption and usage of IT is to use models of planned behaviour, one of the most well known is the Technology Acceptance Model (TAM) (Davis, 1989). This is an established model of computer usage and has been validated through testing with a number of technologies (Davis, 1989; Davis, 1993; Igbaria, 1993; Igbaria, Schiffman, & Weickowski, 1994; Dishaw & Strong, 1999) and cultures (Straub, Keil & Brenner, 1997). The work of Davis (1989) has been elaborated on by others who have added further variables to the TAM so as to account for a greater amount of the variance in usage. External variables are theorised to influence behavioural intention to use, and actual usage indirectly through their influence on Perceived Usefulness (PU) and Perceived Ease of Use (PEOU). PU can be defined as “the degree to which a person believed that using a particular system would enhance his or her productivity” and PEOU as “the degree to which a person believes that using a particular system would be free of effort” (Davis, 1989: 320).

Jantan, Ramayah, and Chin (2001) used the refined TAM model to study the various factors influencing personal computer acceptance by small and medium sized companies. TAM was replicated by Basyir (2000) to study the various factors associated with acceptance of Internet shopping behaviour. Wong (2001) extended the refined TAM in order to examine the impact of extrinsic and intrinsic motivational factors in influencing individual’s acceptance of Internet job search. In order to study the factors affecting perceived ease of use, perceived usefulness, and the use of Internet, Ramayah, Zainuddin, and Fok (2003c) used the TAM incorporating self-efficacy and its determinants as influencing factors. In order to find the receptiveness of E-banking by Malaysian consumers, Ramayah, Jantan, Mohd. Noor, Razak, and Koay (2003a) used the TAM model incorporating prior experience, volume of transaction, training, and external pressure as the external variables.

There are few studies done on how the perception of current users and non-users of a given technology differ in terms of its usage and ease of use (Ramayah, Ma'ruf, Jantan, & Osman, 2002). They found that there are significant differences in both group's perception about a given technology. A study done by Ndubisi, Jantan, and Richardson (2001) on TAM's validity among Malaysian entrepreneurs found that among entrepreneurs, IT usage was influenced directly by perceived usefulness and indirectly (via usefulness) by perceived ease of use.

The present study uses a different approach. Rather than looking at the technical perspective of TAM, this study analyses it from a user-centric perspective. To do that, sensemaking processes were used to identify whether these processes influence TAM or not, and whether these processes changes the strength of relationship between PU, PEOU and usage behaviour (UB) over time.

Sensemaking Model and its Characteristics

According to Pereira (2002), sensemaking can be defined as the cyclical process of taking action, extracting information from stimuli resulting from that action, and incorporating information and stimuli from that action into the mental framework that guide further actions. Glynn (2000) accounted sensemaking as a conceptual approach to studying the active and intellectual processes that support building a clear representation of information stimuli. Sensemaking is also defined as the process that involves placing stimuli into some kind of framework (Dunbar, 1981).

According to Choo (2001), sensemaking helps in knowledge creation and decision-making. It involves interpreting raw data of the environment by enactment, selection, and retention of IT-related aspects. A sensemaking approach to decision-making gives a fresh perspective to technology adoption. Traditionally, most of the research had focused on TAM model of technology adoption rather than focusing on the adopter itself (Malhotra & Galletta, 1999). A sensemaking approach enriches the technology adoption decision-making, since it focuses on the mental framework of the adopter during the course of deciding whether to accept or reject a given technology.

According to Weick (1995), there are seven distinguishing characteristics that set sensemaking apart from other explanatory processes such as understanding, interpretations, and attribution. Weick further said that sensemaking is understood as a process that is grounded in identity construction, retrospective, enactive of sensible

environments, social, ongoing, and cue extraction factors and it is driven by plausibility rather than accuracy.

For the present study, only three processes of sensemaking, which are cue extraction, social influence and retrospective behaviour, would be measured as independent variables because identity construction, plausibility and enactment come under the umbrella of cue extraction, and since the objective of this study is to find whether sensemaking has influence over time on TAM, only the ongoing element of sensemaking process is being taken in consideration.

Applications of the Sensemaking Model

Sensemaking has been of interest to many researchers and there have been much research done on this and with several different approaches. According to Lundberg (2000), when making decisions at the workplace, all managers go through the process of plausibility, that is in order to make a decision, having accurate information is less important than having some information. That is, if there was some information available, it would enhance the decision making for the acceptance or rejection of a new technology.

To cope with uncertainties and ambiguities in starting a new business, the entrepreneur must develop a vision or mental model of how the environment works (sensemaking) and then be able to communicate to others and gain their support (Hill & Levenhagen, 1995). They asserted from their findings that metaphors are useful in coping with large amounts of data and that metaphors offer a flexible framework for understanding and interpretation of information. Weick (1979) also proposed that the best means of coping with equivocality is the use of equivocality. Goodman, Griffith, and Fenner (1990) further said that these processes explain the development of an individual's technology model, how changes occur in individual's behaviour with respect to the technology, and how it evolves over time.

Sensemaking and TAM

Description of conditions for sensemaking at organisations can be referred to as uncertainty or ambiguity. It comes from the "imprecision in estimates of future consequences conditional on present actions" (March, 1994). That is, the uncertainty in any event, in our case technology adoption, initiates the process of sensemaking and through this process only an individual can reduce the uncertainty level and be able to make a more definitive decision. Hence, when making

decisions about technology adoption, individuals go through the process of uncertainty reduction through sensemaking activities. In a study by Stinchcombe (1990) on oil drilling technology, he argued that uncertainty changes over the course of time. That is, as people start the sensemaking activities - collecting information, discussing with peers - uncertainty levels change and this would lead to a more definitive perception about the technology. Hence, from here it can be deduced that to reduce uncertainty, people undertake sensemaking activities which help them construct a more definite - positive or negative - perception about a given technology, and thus it changes over time.

A study done by Ramayah *et al.* (2002) on perceived usefulness (PU) and perceived ease of use (PEOU) of a given technology by an individual found that there are significant differences in both group's perception about Internet banking. They found that users are more definitive about the information related to Internet banking and it is reflected in the stronger relationship between PU, PEOU, and Usage behaviour (UB). From here it can be concluded that direct experience (retrospective component of sensemaking) with Internet banking or past technology adoption experience influences the PU, PEOU, and UB. Ndubisi *et al.* (2001) studied TAM's validity among Malaysian entrepreneurs and they found that entrepreneur IT usage was influenced directly by perceived usefulness and indirectly (via usefulness) by perceived ease of use. Drivers in this study were prior experience, data intensity, staff support, training, technical support, and external influence/pressure. All these drivers influenced PU and PEOU directly or indirectly and later PU and PEOU determined UB. These drivers can be seen as sensemaking activities as more information can be gathered through training and technical support, prior experiences accounts for retrospective activities, and staff support and external pressure accounts for social activities of sensemaking.

A study done by Jantan and Ndubisi (2002) tried to find if PU, PEOU, and usage of the systems will be higher if there are more computing skill and technical backing using TAM. It was found that these two components directly influence the system usage and also changes the perception about PEOU and PU as more of computer skill and technical backing is introduced. Hence, it can be said that more skill and technical backing can change the perception of TAM constructs and also directly influence the UB. Similarly, Ramayah and Jantan (2003) studied the relationship between motivational variables (intrinsic and extrinsic), demographic variables and Internet usage activities. It was found that gender and education level directly influences usage. Result findings also show that Internet usage is largely influenced by its perceived

usefulness. Ramayah, Jantan and Noraini (2003b) investigated the impact of intrinsic and extrinsic motivation on Internet usage in Malaysia. Their results were in line with the above-mentioned study, that is, they also found that Internet usage is largely influenced by perceived usefulness, followed by perceived enjoyment, and perceived ease of usage.

Theoretical Framework

Pereira (2002) theorised the plausible relationship between the two but provided no empirical support. Hence, this study will use Pereira's conceptual model as the basis of this empirical research.

As shown in the theoretical framework in Figure 1, sensemaking process through which an individual makes sense of stimuli available in the environment is being theorised in this study to have influence on Technology Acceptance Model (TAM). This means that sensemaking surrounds an individual's decision-making of technology adoption and the more of the activities done in the process would have influence on the strength of the relationship between the three constructs of TAM that are PU, PEOU, and UB.

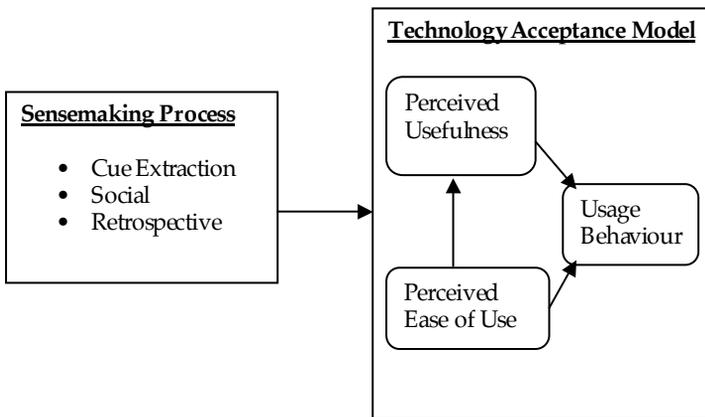


Figure 1
Research model

Hypotheses

Competitive rivalry in the industrial environment is the leading force for the adoption of a new technology. Any changes would be followed

by uncertainty, in this case uncertainty of the usefulness and ease of use of a given technology, which largely causes resistance from employees (individuals) toward its adoption. Sensemaking activities are related to the risk/ uncertainty reduction strategy, that is, sensemaking typically reduces the level of uncertainty as the individual indulges in search of information related to the technology. This can be done from various methods/channels, for example through cue extraction or through prior experience with similar experience (March, 1994). Few studies have found that as more and more sensemaking activities are undertaken, the uncertainty level changes about a given technology, hence constructing a more definitive mental framework about a given technology (Stinchcombe, 1990). Based on the literature found, this study hypothesised the following:

The first hypothesis is formulated to test whether PEOU, PU, and UB changes with the level of sensemaking.

H₁: Perceived ease of use, perceived usefulness, and usage behaviour changes with the level of sensemaking activities.

The second hypothesis is generated to look at the changes in all three variables in the TAM model to establish the impact of time. The mean differences will be examined to see whether there had been any changes.

H₂: Perceived ease of use, perceived usefulness and usage behaviour changes over time.

The third hypothesis looks at the impact of time on TAM (relationships between PEOU, PU, and UB) and will be determined by looking at the differences in strength of the relationship (i.e. the coefficient of determination, R²) for each time period.

H₃: The strength of relationship between perceived ease of use, perceived usefulness, and usage behaviour changes over time as more sensemaking activities are done.

The fourth hypothesis seeks to find out whether sensemaking activities have any moderating effects on the relationship between TAM constructs over three periods of time. Three-stage hierarchical regression will be used for these analyses.

H₄: The more an individual undertakes sensemaking activities, the greater will be the strength of the relationship between perceived ease of use, perceived usefulness, and usage behaviour.

METHODOLOGY

This study attempts to examine the changes that occur in an individual's perception about a given technology over a period of time as they gather more sense about the technology via various sensemaking activities. As there was a time horizon involved, this study is longitudinal in nature using a panel approach. The population for this study included MBA students of Universiti Sains Malaysia. This population was chosen, since we collected data about a number of variables over different time periods, and we wanted the same respondents at each stage. In this research, SPSS (Statistical Package for Social Sciences) was taken as the technology in question and from all MBA students, the statistics class students were chosen as the sample comprising of a total 74 students. These students were chosen because in this course, students would be exposed to SPSS, which was the first time for most of the students.

The research instrument that was used for data collection was a self-administered questionnaire. The questionnaire was divided into 3 sections, which were independent variable, dependent variable, and respondent's profile related questions. The researcher herself developed the questions related to the independent variable based on literature while the items for TAM were adopted from Davis (1989) (see Table 1) Data was collected at three points in time during the course of 15 weeks. First stage data was collected just before the respondents were given hands-on experience with SPSS. Second stage data was collected in the eight week of the semester when students were doing their SPSS project for the course. Third stage data was collected just after students submitted their SPSS project, that is, in the last class of the semester.

Table 1
Questionnaire Sources

Section	Sample Question	Source
Sense Making		
Cue Extraction	The extent to which I tried to search for information about SPSS from my friends	Self developed from literature
Social elements	My course mates find SPSS to be useful to them in their day-to-day use.	

(continued Table 1)

Section	Sample Question	Source
Retrospective elements	From my past experience, I found other statistical packages to be easier to use.	
Perceived ease of use	Learning to use SPSS will be easy for me.	Davis (1989)
Perceived usefulness	Using SPSS would improve my job performance.	Davis (1989)
Intention to use	I intend to use SPSS at my workplace.	Davis (1989)

DATA ANALYSIS AND RESULTS

Demographic Profile of Respondents

Out of 74 respondents who participated in this study, the majority of them were males, constituting 54.8% of the sample. The majority of the respondents were between 20 to 29 years, which is 52.8% of the respondents, while 41.1% of the respondents were Malays, followed by 32.9% Chinese, and 16.4% Indian.

Hypothesis Testing

Test for hypothesis 1

Sensemaking process consisted of three factors after the exploratory factor analysis as we theorised: cue extraction, social element, and retrospective element. All those factors for each stage were combined together by finding their average to create a overall sensemaking variable labeled sensemaking as we are only interested in the level of sensemaking and not for each component of sensemaking. The level was derived by dividing the values into high and low levels of sensemaking by taking median as the cut off point. Independent samples t-test was run between TAM constructs for these three SM at three stages.

Table 2
Summary of Independent Samples t-tests

SM1	Low (Mean)	High (Mean)	t-value
PEOU	4.47	5.16	-3.96**
PU	4.52	5.26	-3.38**
UB1	4.65	5.19	-2.52**
SM2	Low	High	t-value
PEOU2	4.37	4.96	-2.25*
PU2	4.19	5.02	-3.07**
UB2	4.14	5.00	-3.20**
SM3	Low	High	t-value
PEOU3	4.05	5.38	-6.05**
PU3	4.07	5.53	-5.95**
UB3	3.96	5.41	-6.43**

** p< 0.01, *p< 0.05

It can be seen from Table 1 that the mean for each construct of TAM, which are, PEOU, PU, and UB, differs between high and low sensemaking process in relative sense. All the mean differences for each stage and each construct are significant. That is, at the first stage SM high - low and PEOU and PU mean difference was significant at 1% significance level, while SM high - low and UB mean difference was significant at 5% significance level. For the second stage, all mean differences were significant at 5% level of significance, and at the third stage, all mean differences were significance at 1% significance level.

As the result shows significant differences in influencing TAM constructs between low sensemaking and high sensemaking, we conclude that PEOU, PU, and UB changes with the level of sensemaking.

It can be seen from Figure 2 that when an individual undertakes high level sensemaking activities, his or her usage behaviour would be significantly different from that of individuals who undertake low level sensemaking activities. Thus H_1 of the study is supported.

Test for hypothesis 2

Nonparametric test for K related samples were employed to find the changes in the mean distance for variables during the three time periods. Results from these tests are summarised in Table 3.

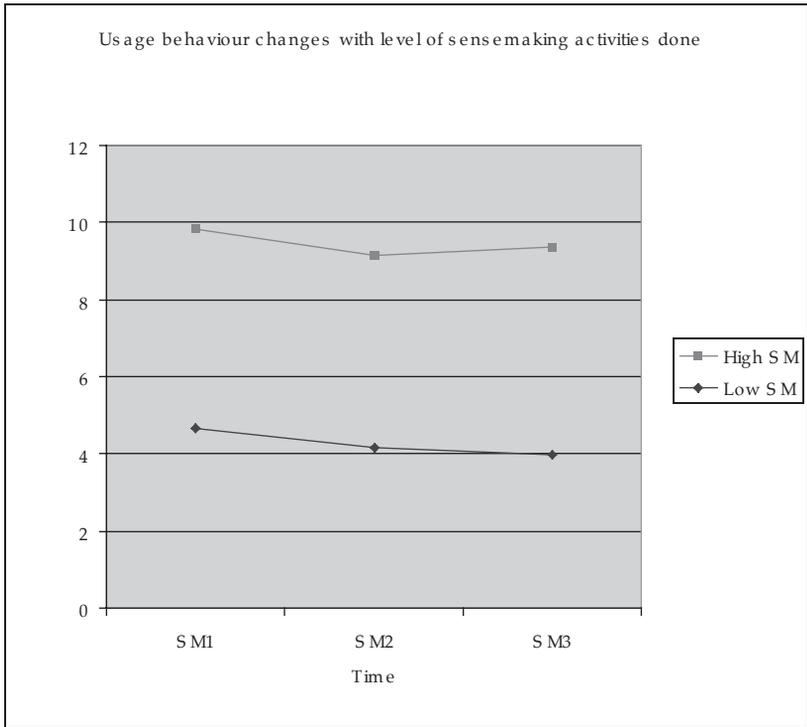


Figure 2
Changes in usage behaviour with level of sensemaking activities undertaken

Table 3
Nonparametric Tests for Variables

TAM Variables	T1	T2	T3	Significant	
PEOU	2.03	1.92	2.05	.67	No
PU	2.01	1.93	2.06	.72	No
UB	2.11	1.85	2.03	.23	No

From Table 3, it can be observed that changes in PEOU, PU, and UB are insignificant, that is, the mean distance difference over three periods did not show any significant changes in the mean rank. Hence, based on the results, H2 is not supported.

Test for hypothesis 3

The impact of time on TAM (relationships between PEOU, PU, and UB) was analysed by looking at the differences in strength of the relationship (i.e. the coefficient of determination, R^2) for each time period. Thus, this entails two stages: the determination of R^2 using regression analysis, followed by the determination of the significance of the differences in R^2 .

Since TAM posits two basic relationship (PEOU on PU, and PEOU, PU on UB), hence two different sets of regression were run (Figure 3) for each respective time period.

From Figure 3, it can be seen that R^2 between PEOU and PU has increased from 0.36 to 0.63 from the initial to final stages. It means that at T3 63.2% of the changes in PU can be attributed to PEOU as compared to 35.7% at T1. R^2 between PEOU and PU, and UB has also increased from 0.60 to 0.72, that is at T3 72.0% of the variance in usage behaviour is described by PEOU and PU. See Figure 3 for R^2 relationships and changes that took place during the three stages.

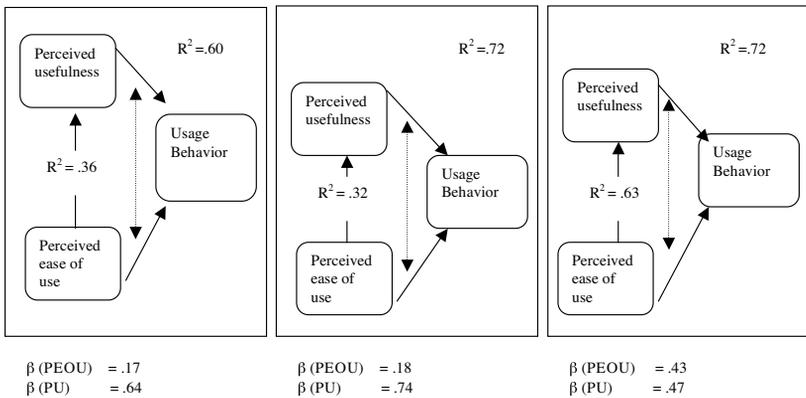


Figure 3
 R^2 changes in TAM model over three stages

Plotting β changes for three stages for PEOU and PU shows that as time passes, the importance for PU decreases whereas the importance of PEOU increase (see figure 4).

Beta changes over time

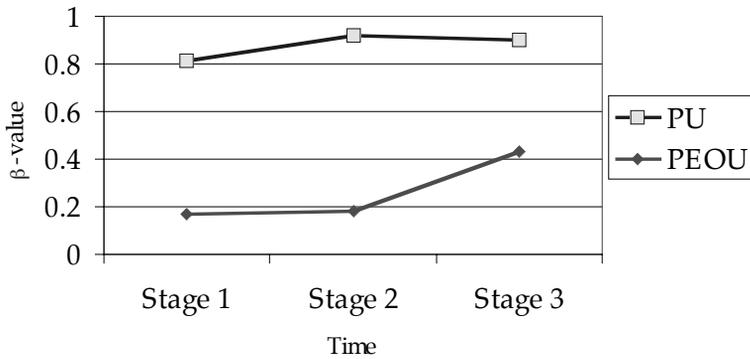


Figure 4

β Changes over a period of time

To address the issue of how significant are these changes in R^2 , the methodology proposed by Steiger (1990) was used. Table 4 summarises the differences in R^2 between any two time periods.

Table 4

Summary of Results of Z-Statistics to Find the Significance in R^2 Change

TAM Constructs	T1 to T2	T2 to T3	T1 to T3
PEOU and PU	0.25	-2.69**	-2.31*
(PU & PEOU) and UB	-1.22	0.03	-1.25

** $p < 0.01$, * $p < 0.05$

Summary of results of Z-statistics, which was done to find if R^2 change is significant in predicting the TAM constructs from one time period to another, are shown in Table 5. It can be seen that there is a statistically significant difference between R^2 when predicting PU from T2 to T3 by PEOU. That is, as time passes, the predictive power of PEOU strengthens for PU. Also R^2 change is significant in predicting PEOU and PU. The other relationships at different times are insignificant. That is, R^2 change is not significant over time period for PEOU and PU, and UB. Hence, it can be said that since R^2 changes do not follow a

specific pattern, but only two significant R^2 change out of six relationships, this hypothesis is partially supported.

Test for hypothesis 4

Six sets of hierarchical regression were tested to find out if sensemaking activities have a moderating effect on the relationship between TAM constructs over three periods of time. Three-stage hierarchical regression was adopted in these analyses.

At the first stage, the independent variables for a respective relation were input in a block (for example, in the first regression, PEOU was the independent variable). At the second stage, the moderator for instance, SM was input. In the final stage, the interaction factors between the independent variable and the moderator, for example interaction between PEOU and SM (PEOU*SM) were included in the third block.

The same steps were followed for all six hierarchical regressions. Results of the hierarchical regressions indicated that there is no moderating influence of sensemaking activities on TAM. Sensemaking also does not influence the relationship between the TAM constructs. Hence, H_4 , which says the more an individual undertakes sensemaking activities, the greater will be the strength of the relationship between PEOU, PU, and UB, is rejected.

After presenting the detailed results of each test, in summary, it can be concluded that the results of the analysis show that; (1) TAM constructs (PU, PEOU, and UB) do not vary over time, (2) TAM constructs (PU, PEOU, and UB) vary by the level of sensemaking behaviour, (3) the strength of the relationship between TAM constructs vary between initial (T1) and during (T2) stages, and (4) the strength of the relationship between TAM constructs does not vary by the level of sensemaking activities undertaken. In conclusion it can be said that sensemaking influences the level of each of the individual construct of TAM but not the relationship between the constructs.

DISCUSSION AND CONCLUSION

Influence of Sensemaking on TAM

From the findings, it is apparent that sensemaking activities do influence the TAM constructs. There are significant differences in

influence on TAM when sensemaking activities are done at high or low levels. Thus, it could be said that sensemaking influences the TAM constructs, i.e. the more sensemaking activities are done, the greater would be the PU, PEOU, and UB. This result is in line with findings of Ramayah *et al.* (2002), who found that users and non-users have differences in perception regarding usefulness and ease of use of a given technology. Once an individual experiences a given technology and tries it, the individual's perception changes and he/she will be more definitive about his/her PU, PEOU, and therefore UB is enhanced. Reasons that can be forwarded for sensemaking activity's influence on TAM could be due to the fact that when an individual tries to know about a given technology, discusses it with his or her peers, tries the technology himself or herself, the uncertainty level is reduced, and this leads to a more definitive perception regarding the technology's usefulness and ease of use, thus influences the usage behaviour.

PEOU, PU, and UB Changes Over Time

This study found that PEOU, PU, and UB do not change over a period of time. The reason for that could be because this study was done in a mandated environment and people tend to behave differently when they are mandated to do or use a given technology, and there are differences in the underlying relationships of technology acceptance model and the mandatory use situation (Brown, Massey, Montoya-Weiss, & Burkman, 2002). In the present study, students were required to use SPSS for their project analysis, hence possibly that is the reason why there were insignificant changes in PEOU, PU, and UB over time.

From Figure 4, it could be seen that as the time passes by, the importance of PU reduces and importance of PEOU increases. This is in line with the findings of Brown *et al.* (2002), whereby they found that when a technology is being adopted in a mandated environment, PEOU becomes more important in its utilisation rather than perceived usefulness.

Strength of Relationship between TAM Constructs Changes over Time

It has been found from the study that even though the strength of relationship between TAM constructs changes over time, most of the time these changes were not significant. That is, even though an individual undertakes low or high levels of sensemaking, the strength of relationship between TAM changes, but it is not significant

statistically. The reason for that could be because the present study was done in a mandated environment, whereby all the students were required to learn SPSS, hence the reason for no significant changes could be because even though they do or do not perform any activity to reduce the uncertainty about SPSS, they still had to learn it and use it in their project.

Nevertheless, the findings did reveal that the changes did take place in the strength of relationships, hence, organisations should give importance to the individual's perception creation in order to enhance a new technology adoption.

Moderating Effect of Sensemaking

There is no significant difference in strength of relationship between TAM constructs as the level of sensemaking activities undertaken increases. Although by right there should have been significant differences because as can be seen from hypothesis 1, it was shown that there are significant differences between PEOU, PU, and UB when sensemaking activities are done at high and low levels. However, when the changes in the strength of relationship were analysed, it was found that sensemaking activities do not act as a moderator in the relationship between PEOU and PU, and (PEOU and PU) and usage behaviour. Again, the reason for this could be due to the fact that this study was done in a mandated environment whereby, the level of sensemaking does not really matter as a given student has to use SPSS even though he or she did not ask about it from anyone, or have never experienced it before. According to Brown *et al.* (2002), when individuals must perform specific behaviours, the importance of their beliefs and attitudes as antecedents to the usage behaviour is likely to be minimised. They might not like performing the mandated behaviour, but they do it because they are required to do so. Hence, it can be said that one of the main reason why the present study found no significant changes in the strength of relationship between TAM constructs is because the present study was conducted in a mandated environment.

As a conclusion it can be said that sensemaking activities only influence the TAM constructs, i.e. the more sensemaking activities are undertaken, the greater PU, PEOU, and UB would be, but not the strength of relationship. Therefore sensemaking acts as an external variable, which influences TAM. Sensemaking significantly enhances the strength of relationship between perceived usefulness and perceived ease of use, but not the level of each construct.

Limitations

Like any study, this one is not without its limitations. There are several potential limitations to this research that should be recognised. As such, some discussion of the limitation of this present study is in order. One of the main limitations of this study is that the setting of the data collection was from a small group. As the data was collected from a Statistics class at USM, the generalisation of findings is very minimal, as the subjects of this study do not represent nation wide technology adopters at organisations. Thus, the respondents may not be a true representation of the entire population of a typical organisation. Also, as this study was done only in a mandated setting, if it would have been compared between mandated and voluntary settings, then the difference could be explained better.

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