December 2004

Translation and Validation of the Technology Acceptance Model and Instrument for Use in the Arab World

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Abstract

The United Arab Emirates has embraced information systems and technology at an astonishing rate over the past decade. As the pace of economic diversification and globalisation intensifies, UAE decision makers in industry and government are facing ever-greater numbers of technology uptake decisions. The single, most important factor in determining success or failure of information systems and technologies (IS & T) is user acceptance and support. The Technology Acceptance Model (TAM) provides a fast and reliable predictive estimate of user acceptance. This paper reports the development and validation of a UAE Arabic TAM evaluation instrument and confirms the applicability of the Technology Acceptance Model and questionnaire for use in the Arab world.

Keywords: Technology Acceptance Model (TAM); Technology Uptake; Diffusion of Innovation

INTRODUCTION

The single, most important factor in determining success or failure of information systems and technologies (IS & T) is user acceptance and support. (Sauer, 1992; Lowry, 1993). Even a lackluster system will succeed if the users like it and the people who produce and support it. Lack of user support and acceptance can cause even technically superior and sophisticated applications and systems to fail. Given the central role of information systems in organisations, how can we predict the acceptance of a new information system / technology by users so as to increase our chance of success and minimise our risk of making a wrong choice?

The Technology Acceptance Model (TAM) (Davis, 1986, 1989; Davis, Bagozzi, *et al*, 1989) and instrument have been exhaustively validated as providing predicative measures of critical success factors in information systems projects. (Adams, Nelson *et al*, 1992; Hendrickson, Massey *et al*, 1993; Moore & Benbasat, 1991; Davis, 1993; Davis & Venkatesh, 1995; Hartwick & Barki, 1994; Segars & Grover, 1993; Subramanian, 1995). The TAM questionnaire is easily adapted to a particular technology for a given user community and provides a reliable predictor of critical success factors in technology uptake for that community.

Most applications of TAM have been performed in Western countries and organizations. A 1998 pilot study by Rose and Straub (1998) aimed at assessing whether TAM was valid and useful in Islamic countries. Their study, which did not include the UAE, surveyed six countries in the Middle East. Their preliminary conclusions suggested that TAM appeared to be an effective predictor of IT success so long as critical religious and cultural imperatives are taken into account. Although Straub, Loch & Hill (2001) went on to study user acceptance in Arab countries using a cultural influence modeling approach, questions raised in the 1998 study remained open.

RESEARCH STAGES, OBJECTIVES, AND METHODS

The objectives and methods employed in each stage of this study were:

1. **Stage 1 – Objective:** Identification of any religious and cultural issues that are critical to the success of information systems and technology (IS & T) projects in the UAE.

   Method: Seven focus groups were interviewed during the period February through April 2003 for the purposes of identifying any critical religious and cultural factors that may require modification of the TAM instrument for use in the UAE. The content of the focus group responses was coded and the content analysed to inform this research question. Work by research methodologists such as Yin (1993, 1994), Stake (1995), Maxwell (1996), Miles & Huberman (1994) and others has validated qualitative research methods including content analysis and case studies as a reliable empirical methodologies for conducting generalizable qualitative research.

2. **Stage 2 – Objective:** Authoritative translation of the TAM questionnaire into Arabic used in the UAE to produce a UAEU Technology Acceptance Model (UAEU-TAM) instrument;

Method: Initial translation of TAM instrument from English to Arabic was followed by three independent back-translations into English, establishing its content validity. The reliability of the UAEU-TAM questionnaire was determined through the calculation of its Cronbach α score.

3. **Stage 3 – Objective:** Pilot study of the UAEU-TAM instrument.

   Method: A pilot study of the UAEU-TAM instrument was conducted during April 2003 at United Arab Emirates University. The variance accounted for in the model was assessed through multiple regression analysis. The construct validity of the instrument was assessed through factor analysis.

RESULTS

Stage 1: Religious and Cultural Imperatives Critical for Successful IS & T UAE Implementation

The initial stage of this project was aimed at identification of any religious and cultural issues that are critical to the success of information systems and technology (IS & T) projects in the UAE. Seven focus groups involving 44 participants were conducted in the UAE during the period February through April 2003, representing both genders and all tribal areas of the UAE. Each focus group was comprised of individuals residing in one of the seven Emirates comprising the UAE (Abu Dhabi, Dubai, Sharjah, Ajman, Umm Al Quwain, Ras Al Khaimah, and Fujirah). Participants were 20 male and 24 female information systems students aged 19-24 years, enrolled in upper level information systems courses at United Arab Emirates University. Representing both genders and all tribal areas of the UAE, the focus groups provided authoritative cultural and religious views sought. Table 1 below shows the questions discussed.

The interview script was distributed in advance to participants, who were asked to think about the questions before the interview session. Each of the interviews concluded with a statement by each focus group summarizing each group's view of the issues. The space limitation precludes inclusion of these summaries in this forum. The summary statements, in the words of the focus group participants, are presented in full in the final report of this study, available from the author or United Arab Emirates University (Lowry, 2003).

ISLAMIC RELIGIOUS VALUES AND INFORMATION TECHNOLOGY

1. **To what extent, if any, do Islamic religious values affect decisions about information technology use?**
2. **Please identify specific Islamic religious values that may affect decisions about information technology use.**
3. **Please identify examples of how Islamic religious values may affect a Muslim's perception of the usefulness of an information technology?**
4. **Please identify examples of how Islamic religious values may affect a Muslim's perception of the ease of use of an information technology.**

UAE CULTURAL VALUES INFORMATION TECHNOLOGY

1. **To what extent, if any do UAE cultural values affect decisions about information technology use?**
2. **Please identify specific UAE cultural values that may affect decisions about information technology use.**
3. **Please identify examples of how UAE cultural values may affect a Muslim's perception of the usefulness of an information technology?**
4. **Please identify examples of how UAE cultural values may affect a Muslim's perception of the ease of use of an information technology.**

Table 1: UAEU – TAM Focus Group Interview Script

Summary of Focus Group Results

Analysis of the content of the responses by the seven focus groups indicates that:

1. Information systems and technology are encouraged and acceptable when used in a moral and lawful manner that is consistent with the principles and teachings of Islam. Prohibitions that arise on religious grounds are generally similar to those that arise in advanced non-Islamic countries such as Australia (Australian Computer Society, no date a & b: Britain, (British Computer Society, no date) and the United States (Association for Computing Machinery, no date).

2. Perceptions of usefulness and ease of use are tempered by Islamic values. Strong prohibitions and social sanctions against offending IS & T applications enjoy both wide public support and the force of law. Examples of offending technologies and practices include viewing pornographic web sites, hacking, and e-commerce transactions that include ***riba***, a form of interest charge.

3. Cultural influences are another matter and can have a significant influence on the acceptability of IS & T. Although GCC countries share many cultural similarities, several of the focus groups pointed out that it would be mistaken to assume cultural homogeneity from even closely located Arab countries. For example, while it is customary for men and women to work separately in the UAE, both genders regularly work and socialize together in nearby Bahrain. The preference for face-to-face business and social relations customary in UAE may affect acceptance of one or another IS & T. Other participants pointed out that while considerable and rapid uptake of IS & T in the UAE has and is continuing at a rapid pace, acculturation

4. Finally, a number of participants reminded us that Islam and cultural life are interwoven to a greater extent than many other cultures. Some participants expressed a view that some religious and cultural values run counter to some IS & T applications that were, after all, developed outside the Arab world. A strong desire for IS & T uptake is balanced by a cautious and conscious desire to avoid western acculturation. However, the UAE has for some time fully committed its considerable resources to preparing its young people for a diverse, post-petroleum economy. Most students in UAE preparing for business careers study in the English language in environments in which IS & T are an integral and central part of their study and work. IS & T uptake should be seen as part of the larger social development taking place in UAE and the GCC.

Stage 2: Developing an Arabic TAM Instrument for the UAE

The Technology Acceptance Model (TAM), first developed by Davis in the 1980s has been exhaustively validated as providing predicative measures of acceptance of an information system or technology. The Davis Technology Acceptance model is shown in Figure 1 below.

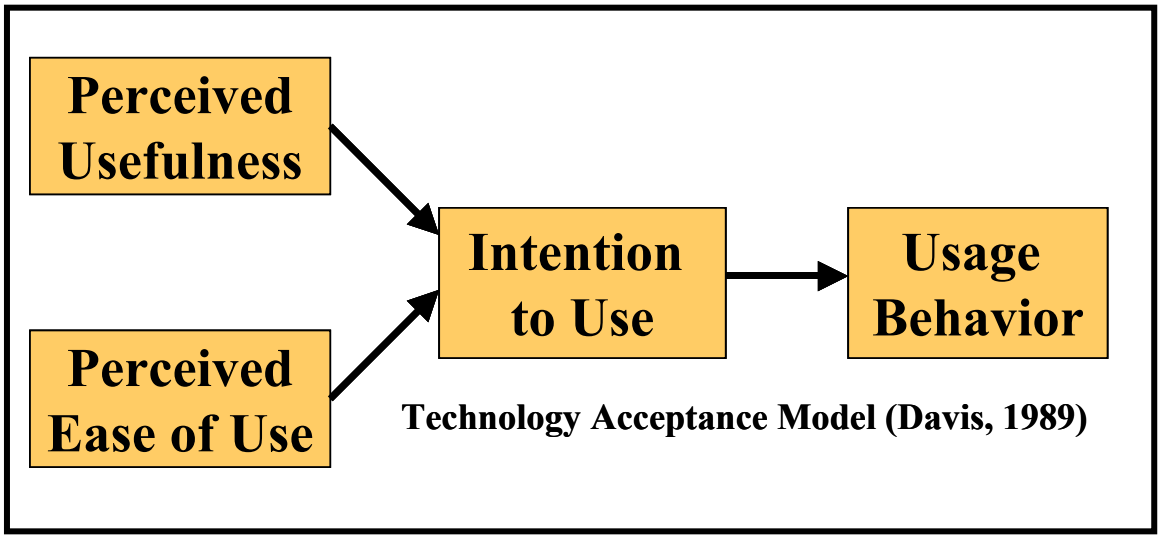

Figure 1: Technology Acceptance Model (Davis, 1989)

The model consists of two independent variables, **Perceived Usefulness** (**PU**) and **Perceived Ease of Use** (**PEU**). These converge in an intervening variable, **Intention to Use** (**IU**), which determines **Usage Behavior** (**UB**), the dependent variable in the TAM model. TAM measures **Intention to Use** as a predictor of **Usage Behavior**. TAM is grounded in Fishbein & Ajzen's (1975) **Theory of Reasoned Action** and the complimentary **Theory of Planned Behavior** (Mathieson, 1991).

A basic TAM instrument consists of three sections:

1. **Demographics:** gender, age, education level or program, self-characterised use pattern, and number of hours per week using the subject information technology.

2. **Intention to Use:** consists of five items that together express the attitude of the respondent toward use of the subject information technology. A seven point Likert scale is used for each item. The range of scores is 5-35. A score of 5 is completely negative. A score of 35 is completely positive.

3. **Perceived Usefulness / Perceived Ease of Use:** Items 7-16 is Perceived Usefulness items. Items 17-26 are Perceived Ease of Use Items. Seven point Likert scales are also used for these items. The range of scores is 20-140. A score of 20 is completely negative and a score of 140 completely positive.

Development of the UAE-TAM Questionnaire

The TAM questionnaire is easily adapted to a particular technology for a given user community. It provides reliable measures of the critical success factors. TAM has gained wide acceptance since its introduction in 1989 due to its reliability and proven predictive value.

Development of a TAM instrument in Arabic for the UAE was accomplished as follows:

1. A Generic English Language TAM Instrument show in Appendix A of the final research report (Lowry, 2003). This version was the basis for translation into UAE Arabic. The initial translation was performed by a UAE national in Abu Dhabi and is shown in Appendix B of the final research report. A copy of this report can be obtained from the author.
2. Three independent back-translations of the Arabic UAEU-TAM instrument were performed. The back-translated TAM instruments are show in Appendix C, Appendix D, and Appendix E and of the final research report (Lowry, 2003).
3. Content analysis of the three independent back translations indicates that the UAEU-TAM questionnaire has been accurately translated into UAE Arabic. The UAEU-TAM instrument shown in Appendix B of the final report is accepted as a robust version based on the high degree of agreement between the three independent back-translations and the Arabic Translation shown in Appendix B of the final report (Lowry, 2003).

Stage 3: Validating the UAE-TAM Instrument Through a Pilot Study

The validated UAEU-TAM questionnaire was used as the basis for a pilot case study conducted in the United Arab Emirates during April 2003. The participants were students enrolled in a Management Information Systems course during the Spring 2003 semester. All students had occasion to use the University's Blackboard course management technology during the semester. The pilot study was focused on validating the UAEU-TAM questionnaire, rather than on Blackboard technology. Preparing the UAEU-TAM questionnaire for this purpose required the substitution of the Arabic translation of ***Blackboard*** (**نظام البلاك بورد (السبورة)**) for the generic ***New Tech*** (**التقنية الحديثة**). The ***Blackboard*** version of the UAEU-TAM questionnaire is available in Appendix F of the final report (Lowry, 2003).

The Pilot Study

A pilot study was conducted during April 2003 for the purpose of validating the UAEU-TAM instrument. A group of 53 students enrolled in a Management Information Systems course at United Arab Emirates University were asked to evaluate the University's **Blackboard** course management technology by mean of the UAEU-TAM instrument. The survey was conducted over two days, one on the Al Jimi (male) campus and the other on the Al Maqam (female) campus. The results were evaluated using SPSS, version 11.5.0. Participant demographics are shown in Table 2.

gender	female	37
	male	16
age group	>21	19
	21-25	34
education level	BBus (Management]	9
	MBus [Accounting]	9
	BMIS	35

Table 2: UAE-TAM Pilot Study Demographics - 2003

As the aim was to observe and assess the UAE-TAM instrument in use, rather than to obtain views regarding ***Blackboard*** course management software, participation was limited to a narrowly focused group of students enrolled in management information systems classes at United Arab Emirates University. The values, views, and professional interests of students, developed whilst in tertiary study, are carried forth into professional roles in which TAM can perform a useful predictive role in the uptake of technologies. As imminent graduates of UAE University, these students will soon take on responsible professional roles in the government and private sectors.

Suitability of Variables for Analysis

The validity of the instrument was assessed through and multiple regression analysis and factor analysis. While the survey results provide some interesting insights into student views regarding ***Blackboard***, the purpose of the survey was to pilot test the UAEU-TAM instrument.

The UAEU-TAM instrument was pretested in a pilot study to determine its suitability for factor analysis, its reliability, and its construct validity. Content validity was established in Stage 2. The instrument and its constituent items were assessed to determine their suitability for structure detection.

Two tests were used for this purpose:

1. The **Kaiser-Meyer-Olkin Measure of Sampling Adequacy** is a statistic that indicates the proportion of variance in the model that may be caused by underlying factors. The range of output values is .0 to 1.00. Higher values approaching 1.00 indicate that factor analysis may be useful with the data. Values below 0.50 indicate that the factor analysis is unlikely to be useful.
2. **Bartlett's Test of Sphericity** tests whether the correlation matrix is an identity matrix, which indicates that the variables in the model are unrelated and therefore unsuitable for structure detection. Small values, less than 0.05, of the significance level indicate that a factor analysis is likely to be useful with the data

Both tests were applied to the set of Intention to Use (IU), Perceived Usefulness (PU), Perceived Ease of Use (PEU) as well as all variables in the model. The results are shown in Table 32 below.

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		
Intention to Use Variables (IU)		**.775**
Perceived Usefulness Variables (PU)		**.815**
Perceived Ease of Use Variables (PEU)		**.833**
Model Variables – (IU, PU, PEU)		**.709**
Bartlett's Test of Sphericity		**Sig.**
Intention to Use Variables	**(IU)**	**. 000**
Perceived Usefulness Variables	**(PU)**	**.000**
Perceived Ease of Use Variables	**(PEU)**	**. 000**
Model Variables	**(IU, PU, PEU)**	**.000**

Table 3: KMO and Bartlett Test Results

The high Kaiser-Meyer-Olkin output values for all individual models and for all variables in the model indicate that they are suitable for factor analysis. The Bartlett's Test of Sphericity significance level values for all individual models and for all variables in the model are all 0.0000, indicating that the variables are well-suited for factor analysis.

Regression Analysis Results

Following the survey, the data in each of four sub-models were subjected to regression analysis. In each case, the principal **IU**, **PU**, and **PEU** variables were entered at independent variables with each of four dependent variables. The variables and their value of r^2 are:

1. **Frequency of Use** $r^2 = .713$
2. **Pereceived Usefulness** $r^2 = .791$
3. **Perceived Ease of Use** $r^2 = .703$
4. **Intention to Use** $r^2 = .614$

Each sub-model explains a relatively large amount of the variance, in excess of 70% in all except the model in which **Intention to Use** was the dependent variable, which accounted for 61% of the variance for that model.

Instrument Reliability

The internal reliability of the UAEU-TAM questionnaire was ascertained by calculating Cronbach α coefficients of the pooled survey responses. The Cronbach α score of 0.8363 for the UAEU-TAM instrument comfortably exceeds an accepted benchmark value of **0.7** (Cronbach, 1951; Nunnaly, 1967) for exploratory research. None of the items in the instrument was rejected as a result of this test.

Instrument Construct Validity

Construct validity was assessed by factor analysis using principal components and Varimax rotation with a cutoff value of 0.5. All variables loaded onto one or more factors at this level. Table 4 below displays the results of factor analysis for the variables in the model.

	Factor						
	1	2	3	4	5	6	7
iu-tedious to enjoyable	.684						
iu-foolish to wise	.678						
iu-unfavorable to favorable	.796						
iu-harmful to beneficial	.695						
iu-negative to positive	.805						
pu-work support		.694					
pu-work performance		.575					
pu-work effectiveness		.573					
eu-easy to remember		.757					
eu-clear and understandable		.749					
eu-easy learn			.835				
pu-work quality			.735				
pu-work speed				.584			
pu-work accomplishment				.556			
pu-work easier				.521			
pu-work useful				.839			
eu-easy to use				.506			
eu-cumbersome					.668		
eu-difficult					.839		
eu-rigid and inflexible					.811		
eu-a lot of mental effort						.807	
eu-do what I want it to							.776
pu-work control	.507		.678				
pu-work productivity	.554		.541				
eu-a lot of effort						.677	.503

Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization.
a Rotation converged in 4 iterations

Table 4: Rotated Component Matrix – UAEU-TAM Instrument
UAEU-TAM Model Variables

Presentation and Interpretation of Factor Analysis Results

The TAM instrument has been validated on many occasions, as indicated above. It has demonstrated consistently high discriminant ability and construct validity. It is not unusual for the variables to load on two or three factors, depending on whether the instrument is constructed for two variables, PU and PEU, or for three or more variables.

The variables in Table 12 loaded onto 7 factors as shown.

1. **Factor 1:** This is the **Intention to Use** factor. All five **IU** variables loaded into Factor 1. None of them loaded onto another factor. Two **PU** variables, "work control" and "work productivity", also loaded onto Factor 1. Factor 1 represents the study group's **Intention to Use** *Blackboard* as all of the **IU** variables loaded on Factor 1, and ***only*** on Factor 1. The loading of two **PU** variables, "work control" and "work productivity", suggest a utilitarian judgement by the study group that is consistent with previous TAM studies which have found that perceived usefulness has the strongest effect on **Intention to Use**, the dependent variable in the model.

2. **Factor 2:** Three **PU** and two **PEU** variables loaded onto Factor 2. These include "work support", "work performance", "work effectiveness", "easy to remember", and "clear & understandable". Factor 2 is an almost even mixture of **PU** and **PEU** variables. The emphasis is on work support, performance, and effectiveness, but **EU** variables are also important. Given a choice, the study group would select or accept a product it saw as substantively improving work performance provided it is also easy to remember how to use it. Instructions, perhaps in the form of a manual or online help facility, are also important for this group.

3. **Factor 3:** Four variables loaded onto Factor 3. Two EU variables, **"**easy to learn" and "work quality", loaded with two **PU** variables, "work control", and "work productivity." The two **PU** variables also loaded on Factor 1. Factor 3 also balances **PU** and **PEU** considerations. "Work quality" is nearly evenly balanced with "easy to learn". Factors 2 and 3 are similar and may conflate in a larger study group.

4. **Factor 4:** Four **PU** variables loaded onto Factor 4. These are "work speed", "work accomplishment", work easier", "work useful", and "easy to use". One **PEU** variable, "easy to use", also loaded on Factor 4. Again, PU considerations appear to be balanced by PEU perceptions in the view of the study group.

5. **Factor 5:** Three EU variables, "cumbersome", "difficult", and "rigid and inflexible", loaded onto Factor 5. This factor represents negative feelings and low support for the technology being studied. Factor 5 is homogenous and consists of qualities that most respondents, including the study group, consider undesirable. These include: "cumbersomeness", "difficult", and "rigid and inflexible". Clearly these are qualities to avoid and individuals and groups who perceive an information system or technology as having them will avoid using the information system or application.

6. **Factor 6:** Two **EU** variables loaded onto Factor 6. Both variables, "a lot of mental effort" and a "lot of effort", are "negative". It is likely that this factor would be conflated into Factor 5 in a larger study group.

7. **Factor 7:** Two variables loaded onto Factor 7. As one is "do what I want it to" and the other is "a lot of effort", the variables loading onto this factor is contradictory and likely reflects the small size of the pilot group, N=53. As it stands, this factor is of little value in predicting information system use and would require further study to understand or interpret.

Summary of Factor Analysis Results

For the group studied, the seven factors may were collapsed into four groups:

1. Factor 1, Intention to Use, is most clearly discriminated in the responses by this study group. It is the most discrete factor in the model from the TAM perspective.

2. Factors 2, 3, and 4 are admixtures of PU and PEU variables, perhaps reflecting the sophistication of judgement that this group has developed through experience in the use of **Blackboard**. TAM factors normally load on one of the main model variables when a TAM instrument is used for predicting acceptance by individuals who have little experience with the technology under consideration. These results may also indicate that the study group, all Arabs and Muslims, may view PU and PEU variables as more interconnected than previous findings among Western groups. Additional study will be required to gain a clearer picture.

3. Factors 5 and 6 are both comprised of loadings from variables that would result in a negative intention to use the technology by study group respondents.

4. Factor 7 is meaningless and contradictory, most likely an artefact of the small size of the study group.

FINDINGS AND DISCUSSION

1. The study has produced a validated translation of a TAM instrument into Arabic as used in the UAE. While Arabic has many dialectic and geographic variations, the author was often reminded that there is only **one** written version of Arabic. The content validity, quality, and robustness of the translation were verified by the results of three separate back-translations from the Arabic to English versions of the TAM questionnaire.

2. While earlier research by Rose and Straub (1998) suggested that TAM may be applicable across the Arab world, direct evidence from seven focus group interviews failed to suggest any specific Islamic or UAE cultural features that would warrant adding items to the TAM instrument. Space limitations preclude inclusion of the transcriptions of focus group responses, which are contained in full in the final

research report available from the author (Lowry, 2003). However, factor analysis results suggest that TAM may work differently in the UAE than in the West, as discussed below.

3. Results from regression analysis indicate that the factors in the TAM for the study group explain the majority of the variance in the model.
4. Factor analyses indicate that the study group may consider PU and PEU qualities together and may balance their formation of Intention to Use an information system or technology by a **Perceived Difficulty** factor.

The Technology Acceptance Model in the UAE

Although 7 factors were identified through factor analysis, six of them might usefully be condensed into three factors, for now excluding the seventh, contradictory, factor as discussed below. The three factors might be thought of as:

1. **Intention to Use** (dependent variable);
2. **Perceived Usability** (condensed Factors 2, 3, 4);
3. **Perceived Difficulty to Use** (Factors 5 & 6).

Figure 2 suggests a Technology Acceptance Model for our study group, and by extension, the UAE.

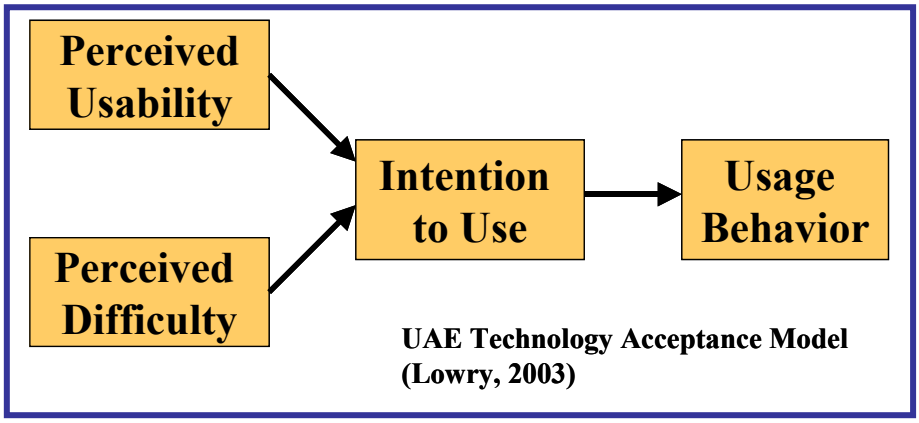

Figure 2: A Technology Acceptance Model for the UAE

This UAE Technology acceptance model might conflate the two Western factors, **Perceived Usefulness** and **Perceived Ease of Use**, into a single factor "**Perceived Usability**". This reflects the three factors that appear to combine PU and PEU considerations into a single factor. The emergence of another factor, which is here named "**Perceived Difficulty**", may represent a countervailing factor that competes with **Perceived Usability** factors in forming the intention to use. More study is required to determine if this is the case, both in the UAE and Arab world and in the West as well. While the Davis Technology Acceptance Model has certainly proven its value and robustness since its introduction in the 1980s, the present results may indicate a shift in thinking as experience and sophistication with information systems is far more widely diffused than was the case when TAM was first introduced by Davis in 1986 (Davis, 1986a, 1986b). Additional study to determine if these three factors, slightly different from the PU, PEU, and IU factors in the Western TAM model, emerge in subsequent TAM studies conducted in the UAE.

CONCLUSION

The United Arab Emirates has embraced information systems and technology at an astonishing rate over the past decade and is now one of the most "wired" nations in the modern world. As the pace of economic diversification and globalization intensifies over the next two decades, UAE decision makers in industry and government will be faced with ever-greater numbers of technology uptake decisions. Many UAE firms and government organizations have matured to the stage when they have had to move from fragmented legacy systems to expensive, critical IT applications such as Enterprise Resources Planning systems, Supply Chain Management and Logistics, Customer Relationship Management, Product Life Cycle Management, and Business Process Reengineering. While existing legacy systems were developed over long periods of time as sponsoring organizations developed, adoption of strategic IS & T applications must be proactively and holistically planned and implemented in a coordinated effort over a relatively short time period, placing considerable strain on the organization in the process. While there may have been some degree of latitude for experimentation and error

during past periods of development, the UAE is competing in an unforgiving and fast-moving global arena in which an unerring choice of a successful strategic IS & T application is a mandatory condition for the survival of the enterprise. In an unforgiving environment, decision makers need and appreciate any substantive help toward reduction of the risk of an incorrect IS & T choice. It is likely that the correct application of the UAEU-TAM instrument can provide some reduction of this risk.

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ACKNOWLEDGEMENT

The research project entitled “Translation and Validation of the Technology Acceptance Model and Instrument for Use in the IS & T Industry of the United Arab Emirates”, project number 03-4-11/01, was fully funded by the United Arab Emirates University Office for Scientific Research.

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