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Attitudes, satisfaction and usage: factors contributing to each in the acceptance of information technology

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Abstract. This research tests and develops the Technology Acceptance Model (TAM), introduced by Davis (1986), which attempts to explain end users' attitudes to computing technologies. It introduces several new variables, including compatibility, user characteristics, system rating and the end-user computing satisfaction (EUCS) construct, a surrogate measure for IT success and acceptance. A questionnaire with over seventy items was completed by a large number of users and LISREL, a technique for modelling a system of structural equations, was used to analyse the responses. The output shows the model as a whole fits the data very well and indicates significant relationships between variables in the model. These results confirm that TAM is a valuable tool for predicting attitudes, satisfaction, and usage from beliefs and external variables. They also show that relative advantage of the system contributed most to attitudes and satisfaction. Compatibility (of the system to the task performed) contributed most to usage and was the most important antecedent of the belief variables, including relative advantage.

1. Introduction

The acceptance of information technology (IT) has become a fundamental part of the MIS research plan for most organizations (Igbaria 1993). Acceptance of IT by managerial, professional, and operating level personnel as users is deemed a necessary condition for its success; however, resistance to computer systems by managers and professionals is a widespread problem (Attewell and Rule 1984, Davis *et al.* 1989, Igbaria and Chakrabarti 1990). Davis (1993) argues that lack of user acceptance has long been an impediment to the success of information systems which, if avoided, would improve performance on the job which is the goal of most organizationally based information systems.

This paper takes spreadsheets, as an important end-user system in the end-user computing (EUC) domain, as its IT product particular focus and examines user acceptance of such computing technology. User acceptance of IT was looked at from three angles: user attitudes, usage and satisfaction as major indicators of user acceptance. Throughout this paper 'user acceptance' will be taken to refer to any of these or all three constructs put together.

User acceptance is often the focus of MIS implementation research in determining the success or failure of an IT product (Swanson 1988, Davis *et al.* 1989, Thompson *et al.* 1991, Davis 1993, Igbaria 1993), and the importance of understanding the antecedents of attitudes toward computers, satisfaction, and usage is underscored by many MIS researchers (e.g. Robey 1979, Swanson 1982, Lee 1986, Igbaria and Chakrabarti 1990, Igbaria 1990, Thompson *et al.* 1991, DeLone and McLean 1992, Torkzadeh and Dwyer 1994, Etzadi-Amoli and Farhoomand 1996, Szajna 1996). Thus, the important question addressed in this paper is:

What are the factors that contribute to user attitudes, satisfaction, and usage of computing technologies in organizational settings?

Melone (1990) suggests the structure of attitudes has an impact on user cognition and behaviour. Fishbein and Ajzen (1975) proposed that individuals' attitudes toward an object play an important role in influencing their subsequent behaviour toward it and there is evidence that user attitudes are positively related to computer usage (Igbaria and Chakrabarti 1990, Igbaria 1990, Lucas 1978, Robey 1979). Hence, this paper is an attempt to investigate such structure and plausible

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network of relationships of attitude with selected antecedent variables: demographic, computer experience, user training and organizational support; and key outcome variables: system usage and user satisfaction.

1.1. *Research framework*

The theory of reasoned action (TRA) is a widely studied model from social psychology which is concerned with the determinants of consciously intended behaviours (Ajzen and Fishbein 1980, Fishbein and Ajzen 1975). The foundation of the TRA conceptual framework is provided by the distinction between beliefs, attitudes, intentions, and behaviours. According to TRA, a person's performance of a specified behaviour is determined by his or her behavioural intention (BI) to perform the behaviour, and BI is jointly determined by the person's attitude (A) and subjective norms (SN) concerning the behaviour in question.

The Technology Acceptance Model (TAM), first introduced by Davis (1986), is an adaptation of TRA specifically tailored for modelling user acceptance of information technology. 'The goal of TAM is to provide an explanation of the determinants of computer acceptance that is general, capable of explaining user behaviour across a broad range of end-user computing technologies and user populations' (Davis *et al.* 1989, p. 985).

A key purpose of TAM, therefore, is to provide a basis for tracing the impact of external factors on internal beliefs, attitudes, and intentions. TAM was formulated in an attempt to achieve these goals by identifying a small number of fundamental variables suggested by previous research dealing with cognitive and affective determinants of computer acceptance.

TAM postulates that two particular beliefs, perceived usefulness and perceived ease of use, are of primary relevance for computer acceptance behaviours (Davis *et al.* 1989), as depicted in Figure 1. Similar to TRA, TAM postulates that computer usage is determined by BI, but differs in that BI is viewed as being jointly determined by the person's attitude toward using the system (A) and perceived usefulness. According to TAM, attitude toward using the system (A) is jointly determined by usefulness and ease of use. However, TAM does not include the TRA's subjective norms construct as it was found non-significant (Davis *et al.* 1989).

Following Thompson *et al.* (1991) and Davis (1993), it was deemed necessary to drop BI and link attitude to actual behaviour directly. Thompson *et al.* (1991) argue that BI should be excluded because we are interested in actual behaviour (system usage). Such behaviour has already taken place in the past, while BI is 'the person's subjective probability that he will perform the behavior in question' (Fishbein and Ajzen 1975, p. 12) and is thus dealing with future behaviour. Since this research is concerned with acceptance which has already taken place, it was considered appropriate to follow Thompson *et al.*

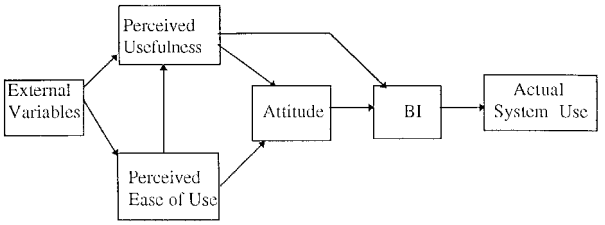

Figure 1. Technology acceptance model (TAM)

1.2. *Research model*

The research model was built based on TAM while introducing several modifications which were not in TAM. User satisfaction is conceptualized as the affective reactions of individuals toward the use of computer applications in general. This suggests that the satisfaction construct is to be placed parallel to the attitudes construct in the research model. As explained in the measurement section, the satisfaction construct is measured by the end-user computer satisfaction instrument, EUCS, and this abbreviation is used in the model from now on.

Enjoyment was introduced and placed parallel to the main belief constructs of TAM (usefulness or relative advantage and ease of use) as a cognitive response. Although enjoyment was not among beliefs incorporated in TAM, Davis *et al.* (1992) and Igbaria *et al.* (1994) used enjoyment and fun respectively as a belief variable in their research model which was built based on TAM. Several external variables were incorporated in the model since Davis *et al.* (1989) recommended some external factors to be tested in future research such as system features, user characteristics, situational constraints and managerially controllable interventions. The research general model is depicted in Figure 2. The external variables are divided into three groups: demographic variables (in this case just course of study); end-user background variables (training, computer experience, computing support); system variables, which include system rating, compatibility and image (as defined in the hypotheses section).

Belief variables are the three user perceptions about the system's characteristics: **relative advantage; ease of use; enjoyment.** These beliefs affect attitude toward using the system and end-user computing satisfaction (EUCS). Igbaria *et al.* (1996) propose a model in which relative

advantage and enjoyment directly affect usage. However, their model excludes attitude towards the system and the basis of the TAM model being further explored in this work is that belief variables influence usage primarily through their effect on attitude. Since Davis *et al*. (1992) and Igbaria *et al*. (1996) stress the importance of relative advantage, the possibility of a direct effect on usage is explored in this study. The research variables and causal relationships hypothesized between these variables are depicted in the research model in Figure 3.

1.3. *Hypotheses*

Based on several studies mentioned earlier, it is expected that attitudes will influence system usage, but TAM also postulates that beliefs about the system influence attitudes toward the system. Thus the following hypothesis is proposed.

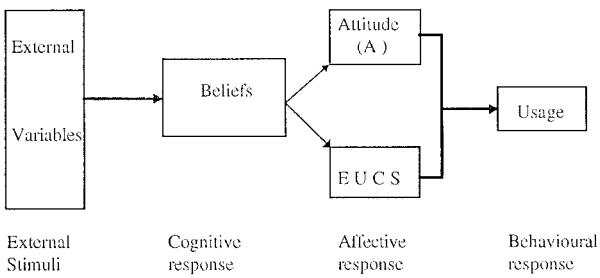

Figure 2. The research general model

- **Hypothesis 1: Attitude towards system usage will mediate the relationships between beliefs about the system and system usage.**

User satisfaction was defined as an attitudinal construct. This suggested placing it in parallel with the attitude construct in the research model and as an antecedent to usage. Baroudi *et al*. (1986) provide some evidence that 'the user's satisfaction with the system may lead to system usage'. Hence, similar to Hypothesis 1, the following is proposed.

- **Hypothesis 2: EUCS will mediate the relationship between beliefs about the system and system usage.**

TAM postulates that beliefs about the system will influence attitudes toward using the system. Since user satisfaction is parallel to Attitude the following two hypotheses are straightforwardly derived from TAM.

- **Hypothesis 3: Each of ease of use, enjoyment, and relative advantage will have a significant direct effect on attitude towards using the system.**
- **Hypothesis 4: Each of ease of use, enjoyment, and relative advantage will have a significant direct effect on satisfaction (EUCS).**

Davis *et al*. (1992) hypothesized that ease of use impacts on enjoyment. This is replicated in the first part of the following hypothesis. However, TAM postulates

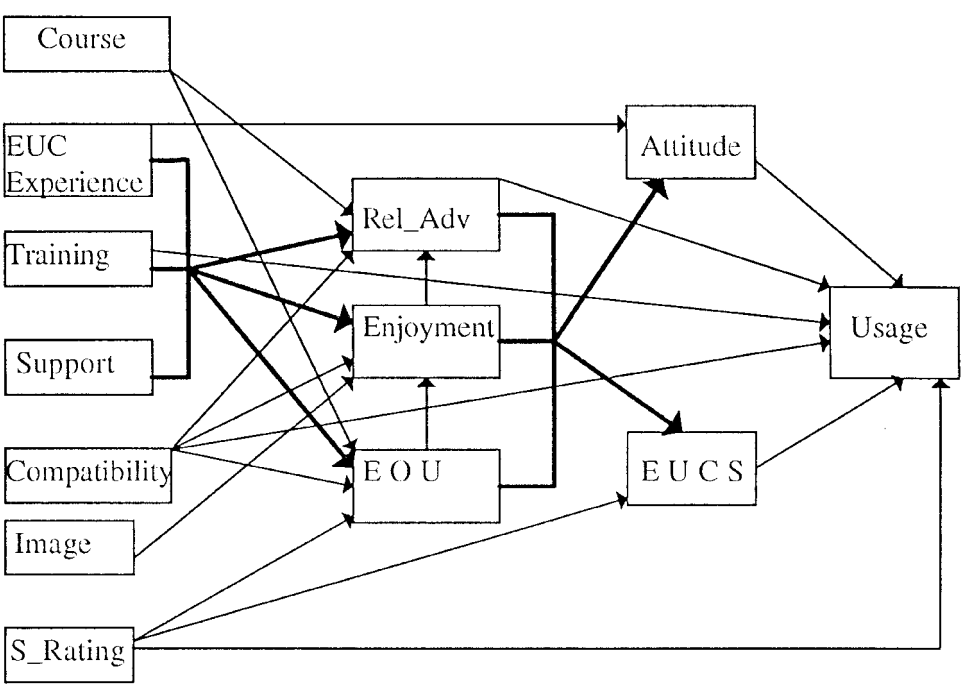

Figure 3. The research model

that ease of use is an antecedent to relative advantage. Thus by introducing enjoyment as a belief variable, it is hypothesized that it will mediate the relationship between ease of use and relative advantage.

- **Hypothesis 5: Ease of use will have a significant direct effect on enjoyment and enjoyment will mediate the relationship between ease of use and relative advantage.**

Igbaria (1990) and Igbaria (1993) studied the effect of training and support on belief variables. This paper hypothesizes that training and support will have significant effects on enjoyment, relative advantage, and ease of use. Moore and Benbasat (1991) developed the compatibility construct to measure the perceptions of adopting an IT innovation. Compatibility refers to the degree to which a system is perceived as being consistent with the existing values, needs, and past experiences of potential adopters. For the first time this research hypothesizes that compatibility will have significant effects on the three belief variables. Thus the following hypothesis is proposed.

- **Hypothesis 6: Training, support, and compatibility variables will have significant direct effects on enjoyment, relative advantage, and ease of use.**

Szajna (1996) recommended introducing an experience factor when studying TAM, thus EUC experience is introduced and expected to play a strong role in the acceptance model. Hence, the following hypothesis is proposed.

- **Hypothesis 7: EUC experience will have a significant direct effect on the three beliefs (enjoyment, relative advantage and ease of use) and also a significant direct effect on attitudes towards usage.**

Nelson and Cheney (1987) present and empirically evaluate a conceptual model of how training can impact on the acceptance of IS within the organization. In addition, following Davis *et al*. (1992) and Igbaria *et al.* (1996) it is postulated that relative advantage has a direct impact on usage. This paper hypothesizes that compatibility would have a direct impact on usage. The following hypothesis is proposed.

- **Hypothesis 8: Training, compatibility, and relative advantage will have significant direct effects on system usage.**

Moore and Benbasat (1991) developed the image construct to measure the perceptions of adopting an IT innovation. Image refers to the degree to which use of a system is perceived to enhance one's image or status in one's social system. For the first time this research hypothesizes that image will have a significant effect on some belief variables. Thus the following hypothesis is proposed.

- **Hypothesis 9: Image will have a significant direct effect on enjoyment.**

Overall system characteristics (named here system rating) was explored by Lucas (1978), Swanson (1982), Rivard and Huff (1988), Igbaria and Chakrabarti (1990) and Amoroso and Cheney (1992) as system quality. Most previous research investigated its relationship with actual system use. This relationship will be tested in addition to the relationship between this construct and ease of use as well as with user satisfaction.

- **Hypothesis 10: System rating will have significant direct effects on ease of use, EUCS, and system usage.**

Two demographic variables, gender and course were first identified as a subset of the external variables for this study. In a preliminary study it was found that gender did not contribute to any belief, attitude or behavioural variables identified for this study. Thus it was decided to remove gender and have course as the single demographic variable. The following hypothesis is proposed.

- **Hypothesis 11: Course, as a demographic variable, will have significant direct effects on relative advantage and ease of use.**

2. Method

2.1. *Sample and procedure*

The data for this study were gathered from 329 respondents by means of a questionnaire survey (see Appendix). Final year university students who had just spent one year working in industry as part of a sandwich degree programme were approached in normal class room lectures for data collection. These students are not traditional students as they have spent one year in the work environment. They consider the year out as a prerequisite for employment which offers them more motivation to behave and think as company employees. Also, in many modern organizations the students during their year in industry are given the same training as full time employees since they are required to apply the same skills on the same type of work. In many ways these students have been treated as normal employees during

their year in the work environment. Since the study concerned their behaviour during that year and was administered very soon after their return to the academic environment, these students could be considered as representatives of a junior management group of employees and thus suitable respondents to handle the issues being researched.

The issue of using student respondents has been debated in recent research, for instance, Barrier and Davis (1993) considered the question 'Are graduate students appropriate research surrogates for managers in evaluating new IS technology?' and concluded that 'the answer to the research question... is a qualified yes'. However, it has to be acknowledged that there are limitations in using students. It must be emphasized that the students used in this study had only had one year of experience in employment and therefore can only be considered representative of the most junior management group in most organizations. As such their views and perceptions will be narrower and more restricted than those of more experienced managers.

The respondents had been employed in a variety of manufacturing, services, merchandising, and financial organizations in a wide range of functional areas throughout UK. Of the participants, 68% were males and 32% females, 59% were studying some type of business programme, 34% an engineering programme and 7% a chemistry programme.

2.2. *Measures*

The constructs described earlier where measured using the following indicators (shown in detail in a condensed version of the questionnaire presented in the appendix).

2.2.1. *Course.* A single item question was used for the respondent's degree programme.

2.2.2. *EUC experience.* EUC experience was assessed by five items asking respondents to indicate their years of experience in using computers, writing computer programs and using similar packages; and their current skill level with this and other packaged application software.

2.2.3. *Organizational support.* The measure of organizational support incorporated two broad categories of support experience during their industrial placement: First, application development support, which is quite specific and includes availability of development assistance and specialized instruction and guidance in developing and using applications. Second, general support, developed by Igbaria (1990), which includes top management encouragement and allocation of resources.

2.2.4. *Training.* Training was assessed using nine items. Respondents were asked to indicate the extent to which each of nine different sources contributed to the increase of their knowledge and expertise during their industrial placement. These sources include: another trainee, member of staff, software expert, course on package features, course on model building, course on advanced features, self training. The response options ranged from (1) none to (5) extensive.

2.2.5. *Compatibility.* Compatibility was measured by the three item scale developed by Moore and Benbasat (1991).

2.2.6. *Image.* Image was measured by the three item scale developed by Moore and Benbasat (1991).

2.2.7. *Ease of Use.* This refers to the degree to which an individual believes that using a particular system would be free from physical and mental effort (Davis 1989). Ease of use was measured by the six-item scale developed by Davis (1989) with two more items added to the scale later by Moore and Benbasat (1991).

2.2.8. *Relative advantage.* This refers to the degree to which an individual believes that using a particular system would enhance his or her job performance (Davis 1989). Relative advantage was measured by the six-item scale developed by Davis (1989) with two more items added to the scale later by Moore and Benbasat (1991).

2.2.9. *Enjoyment.* This refers to the extent to which the activity of using the system is perceived to be enjoyable in it's own right, apart from any performance consequences that may be anticipated (Davis *et al.* 1992). Enjoyment was measured by the three-item scale used by Davis *et al.* (1992).

2.2.10. *Attitudes toward using the system.* There are many definitions of the attitude construct. What concerns IS researchers is a definition that is considered sound by psychologists and compatible with the interests of IS researchers. McGuire (1969) defined attitude as: an evaluative response to an antecedent stimulus or attitude object. Ajzen (1988) developed McGuire's definition by describing attitude as a pre-disposition to respond favourably or unfavourably to an object, person, event, institution, or another discriminable aspect of the individual's world. Ajzen's definition of attitude emphasizes the notion of evaluation. Based on the work of Ajzen and Fishbein (1980), Davis (1993) developed an attitudes scale. The instrument asked individuals to rate five items according to how they feel about using the technology on a five-point semantic differential scale.

2.2.11. *End-user computing satisfaction (EUCS).* Bailey and Pearson (1983) defined user information satisfaction (UIS) as a multidimensional attitude of the user toward different aspects of an information system, whereas Ives *et al.* (1983) defined UIS as the extent to which users believe the information system available to them meets their information requirements. Although the UIS instrument has gone through refinements, Doll and Torkzadeh (1988) note it has not been validated for assessing specific end-user applications and it also ignores important ease of use aspects of man-machine interface. They argue that the nature of the UIS instrument items assume a more traditional computing environment and, like user knowledge, involvement and information product items are not application specific. Instead they developed the 12-item instrument of end-user computing satisfaction (EUCS).

Torkzadeh and Doll (1991) published a test-retest reliability for the EUCS instrument, which examines the stability of individual items and subscales as well as the 12-item instrument. The results suggest that the instrument is internally consistent and stable. Zmud and Boynton (1991) used a set of 'filtering rules' for identifying well-developed MIS survey instruments and, from the 119 scales investigated, the EUCS instrument developed by Doll and Torkzadeh (1988) was one of only three scales to pass these rules.

In a repeated test-retest reliability of the EUCS instrument at two points in time, separated by a two year interval, Hendrickson *et al.* (1994) add further support for the reliability of the EUCS measure. A confirmatory factor analysis for EUCS was carried out by Doll *et al.* (1994) which completes one exploratory-confirmatory research cycle by more rigorously validating the EUCS instrument. The results enhance the utility of the EUCS by providing confirmation that it explains and measures the user satisfaction construct and suggest that it can now be used as a standardized measure of user satisfaction with a specific application.

The EUCS instrument developed by Doll and Torkzadeh (1988) is a second-order factor model that consists of five first-order factors measured by 12 items:

- content (4 items);
- accuracy (2 items);
- format (2 items);
- ease of Use (2 items);
- timeliness (2 items).

The research reported here employs this instrument, but only 10 items are used as the two items of timeliness (response time and information updating) were not relevant to the stand alone IT product used in this study, as they are more related to network systems.

2.2.12. *System rating (S_Rating).* A single item question was used to measure respondents' perceptions about the overall characteristics of the specific technology they were using.

Usage. System usage has been studied by a number of researchers in the past two decades (Lucas 1975, Robey and Zeller 1978, Ein-Dor and Segev 1982, Ives and Olson 1984, Srinivasan 1985, Trice and Treacy 1988, Davis *et al.* 1989, Igbaria 1990, Amoroso and Cheney 1992, Torkzadeh and Dwyer 1994). Ives *et al.* (1983) argued that system usage can be a surrogate indicator of system success under certain conditions. System usage is often operationalized using self-reported measures of actual usage. Five indicators were found in several studies on MIS usage (Srinivasan 1985, Lee 1986, Igbaria *et al.* 1989, Davis *et al.* 1989, Thompson *et al.* 1991, Davis 1993, Igbaria 1993). These five indicators were adapted for this study and became: (1) perceived daily use; (2) perceived frequency of use; (3) the number of applications used; (4) perceived usage level; (5) sophistication level of applications used. Respondents are asked to indicate their perceptions of usage level on a five-point scale ranging from (1) none to (5) extremely extensive in the first three indicators. The last two indicators were incorporated in this study as they were believed to reflect good measures of system usage. In a spreadsheeting environment a good indication of overall acceptance of the technology can be provided by measuring the sophistication level (i.e. using macros, menus, data validation, etc.) of the applications used. Sophistication level was measured by asking respondents to indicate the sophistication level of their spreadsheet applications on a five-point scale ranging from (1) low to (5) high.

3. Data analysis

The data collected was analysed using LISREL which is a 'second generation' multivariate modelling technique. LISREL aims to explain the structure or pattern among a set of latent (unobserved or theoretical) variables, each measured by one or more manifest (observed or empirical) and typically fallible indicators (Joreskog and Sorbom 1989, Hayduk 1987, Diamantopoulos 1994).

The LISREL model assumes a causal structure among a set of latent variables. These latent variables appear as underlying causes of the observed variables. The model consists of two sets of equations: firstly, the measurement model equations which specify how the latent variables (or hypothetical constructs) are measured in terms of the observed variables, and how these are used to describe the measurement properties (validities and reliabilities) of the observed variables.

And secondly, the structural equation model which specifies the causal relationships among the latent variables and is used to describe the causal effects.

3.1. *The measurement model*

The measurement model is concerned with reliability and construct validity; also it determines the extent to which the operationalization of a construct actually measures what it purports to measure. It specifies the relationships between unobserved (latent) variables and observed (manifest) indicator variables. Two separate equations describe this model. The first relates the endongenous variables to the relevant indicators and the second links the exogenous to their indicators. The variables and the number of indicators in the two equations for this present study are shown in Table 1.

To simplify the measurement model, some variables measured with multiple items (indicators) were reduced to only one indicator. For those latent variables which do not have typical (formal) instruments or scales, the single-item global scale strategy used by Torkzadeh and Dwyer (1994) was implemented. An aggregate or a composite item was used to represent the multiple items that measure each of them. Training and EUC experience were each assigned a single indicator valued with the mean of the multiple items used to measure that variable, and the 13 items of the Support construct variable were reduced to two indicator variables S_SPPRT and GEN_SPPRT.

A confirmatory factor analysis (CFA) for the eight remaining constructs which have formal multiple item instruments or scales was carried out, to examine the psychometric properties for these eight constructs and the overall results are shown in Table 2.

The χ^2/DF ratio of the model is 1.68 ($p < 0.001$) which, compared to 5, the most accepted ratio (Bollen and Long 1993), indicated a very good fit. The GFI was 0.829 and the AGFI 0.801 , which being close to 1 are very good as well. The RMSR is 0.041 , which being so small also indicates a very good fit.

Despite the good fit it is necessary to consider deleting the weakest items. Items with a factor loading below 0.4 were considered. Only three items were found to have such low loadings, two items of the ease of use scale and one item of the usage scale. These three items were deleted and the measurement model was reestimated, yielding the results shown in Table 3.

The χ^2/DF ratio of the revised measurement model is now 1.70 ($p < 0.001$) which is still a very good fit, being only a marginal change of (0.02) from the initial measurement model. The GFI (0.840) and AGFI (0.812) improved and can be considered very good as well. The RMSR improved slightly to 0.038 which still indicates a very good fit.

With the earlier single item strategy of the informal multiple items constructs, the revised LISREL measurement model is now as shown in Table 4.

4. Results

4.1. *Evaluation of Structural Model*

A diagrammatic representation of the initial structural model is shown in Figure 4. This model was tested using the LISREL 7 structural equations computer programme and Table 5 gives the maximum likelihood estimates (MLE) standardized values of the path coefficients and the corresponding t-values.

Table 1. Latent variable and numbers of indicators in questionnaire.

Type of variable	Latent variables	Number of indicators
endogenous	η_1 (Ease of Use)	8
endogenous	η_2 (Enjoment)	3
endogenous	η_3 (Relative Advantage)	8
endogenous	η_4 (Attitude)	5
endogenous	η_5 (EUCS)	10
endogenous	η_6 (Usage)	5
exogenous	ξ_1 (Course)	1
exogenous	ξ_2 (EUC Experience)	5
exogenous	ξ_3 (Training)	9
exogenous	ξ_4 (Support)	13
exogenous	ξ_5 (Compatibility)	3
exogenous	ξ_6 (Image)	3
exogenous	ξ_7 (S_Rating)	1

Table 2. Goodness of fit results for initial measurement model.

Degrees of freedom	891
Chi-square	1492.70 (p= 0.000)
Goodness of fit index (GFI)	0.829
Adjusted goodness of fit index (AGFI)	0.801
Root mean square residual (RMSR)	0.041

Table 3. Goodness of fit results for revised measurement model.

Degrees of freedom	765
Chi-square	1303.36 (p= 0.000)
Goodness of fit index (GFI)	0.840
Adjusted goodness of fit index (AGFI)	0.812
Root mean square residual (RMSR)	0.038

Table 4. Revised measurement model loadings.

Construct (latent)/variable	Observed variable	Completely standardised factor loading (λ)	Reliability of a scale
Course	COURSE	0.95	
EUC Experience	EUC_EXP	0.95	
Training	TRAIN	0.94	
System rating	S_RATING	0.95	
Support			
Application	S_SPPRT	0.95	
General	GEN_SPPRT	0.50	
Relative Advantage			0.82
	RA1	0.59	
	RA2	0.55	
	RA3	0.56	
	RA4	0.75	
	RA5	0.62	
	RA6	0.61	
	RA7	0.55	
	RA8	0.65	
Compatibility			0.73
	COMP1	0.57	
	COMP2	0.80	
	COMP3	0.63	
Ease of Use			0.80
	EASE1	0.63	
	EASE2	0.45	
	EASE4	0.49	
	EASE5	0.43	
	EASE7	0.41	
	EASE8	0.99	
Enjoyment			0.85
	ENJ1	0.85	
	ENJ2	0.83	
	ENJ3	0.77	
Image			0.87
	IMG1	0.81	
	IMG2	0.94	
	IMG3	0.75	
Attitude			0.82
	ATT1	0.65	
	ATT2	0.65	
	ATT3	0.59	
	ATT4	0.55	
	ATT5	0.68	
EUCS			0.81
Content	C1	0.63	
	C2	0.72	
	C3	0.61	
	C4	0.65	
Accuracy	A1	0.85	
	A2	0.96	
Format	F1	0.86	
	F2	0.77	
Easiness	E1	0.49	
	E2	0.99	
Usage			0.79
	USE1	0.83	
	USE2	0.84	
	USE3	0.65	
	USE4	0.53	

It is important to assess the 'reasonableness' of the model, so the output was scrutinized for the occurrence of any of the four conditions suggested by Joreskog and Sorbom (1986). These concern the standard errors of the parameter estimates, the variances and the correlations. First, none of the standard errors should be very large; second, the parameter estimates should not be highly correlated; third, all variances and related matrices should be positive definite; and fourth, all absolute correlations should be less than one. None of the possible problem situations mentioned in these conditions occurred in this model and so it was safe to proceed to the next stage.

The next step is to assess the goodness of fit of the model. Chi-square divided by the number of degrees of freedom was used as the goodness of fit indicator, as recommended by Joreskog and Sorbom (1986) and Hayduk (1987). A value of the ratio of a chi-square to the number of degrees of freedom (χ^2/DF) which is less than 5 can be considered adequate for large models (Bollen and Long 1993). Using this test criteria, the value of 1.964 ($p < 0.001$) for this model indicates a very good fit.

Other criterion are the goodness of fit index (GFI) and the adjusted goodness of fit index (AGFI), which approach unity the better the model fits the data. The values of 0.798 and 0.769 respectively indicate a good model fit. A third criterion is the root mean square residual (RMSR). This is a measure of the average of the residual variances and covariances and values close to zero indicate a good model fit. The value obtained in this model was 0.047 is indicating a very good fit.

For an overall evaluation, the goodness of fit of the model can be said to be very good, given the large number of parameters to be estimated.

The next step in the evaluation process is to improve the fit of the model by inspecting the structural portion of the model. The path coefficients (βs and γs) were examined to see if they were significantly different from 0. Parameters whose t-values are greater than or equal to ± 2 are considered to be significantly different from 0 (Joreskog and Sorbom 1986). For the initial structural model 18 parameters fell in this group but the remaining 14 parameters did not. In fact five of these 14 parameters were found to be on the border of the 0.05 significant level. These five were given another chance while the other nine were fixed at zero and the revised model was re-estimated. After the first and second passes through the parameters and re-estimating the model in each pass, the results of the final revised model are shown in Table 6.

There was an increase of chi-square of 20 with an extra 14 degrees of freedom so that the ratio of χ^2/DF for the revised model was 1.957 ($p < 0.001$) indicating a minor change of 0.007 in this fit criterion. The RMSR

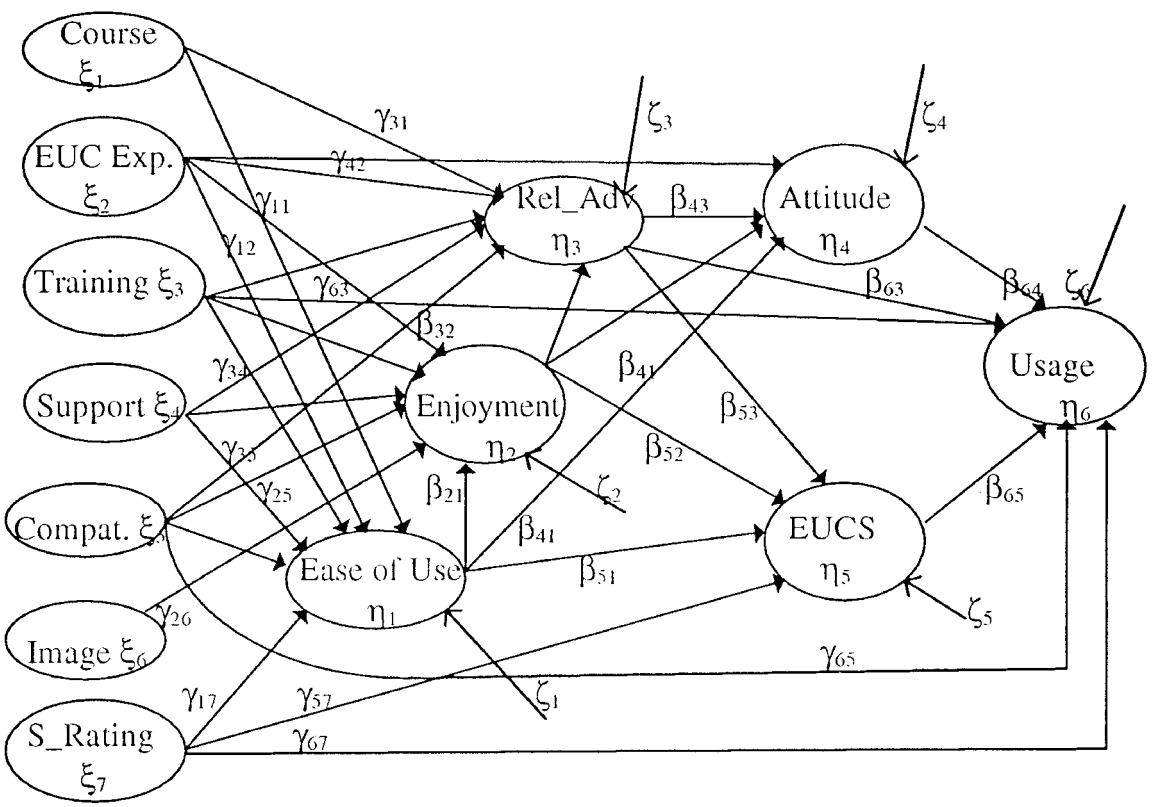

Figure 4. Initial structural model

Table 5. MLE of parameters — initial structural model.

Parameter	Path	Standardised value	*t*-value
β_{21}	EOU→ENJ	0.185	2.657**
β_{41}	EOU→ATTITUDE	0.302	4.400**
β_{51}	EOU→EUCS	0.005	0.067
β_{32}	ENJ→REL_ADV	0.223	2.567*
β_{42}	ENJ→ATTITUDE	0.126	1.732
β_{52}	ENJ→EUCS	0.096	1.119
β_{43}	REL_ADV→ATTITUDE	0.481	5.773**
β_{53}	REL_ADV→EUCS	0.251	2.345*
β_{63}	REL_ADV→USAGE	0.181	2.053*
β_{64}	ATTITUDE→USAGE	0.232	2.682**
β_{65}	EUCS→USAGE	− 0.109	− 1.679
γ_{11}	COURSE→EOU	− 0.207	− 3.050**
γ_{31}	COURSE→REL_ADV	− 0.125	− 1.892
γ_{12}	EUC_EXP→EOU	0.356	0.023
γ_{22}	EUC_EXP→ENJ	− 0.033	− 0.612
γ_{32}	EUC_EXP→REL_ADV	0.141	0.009
γ_{42}	EUC_EXP→ATTITUDE	0.147	2.788**
γ_{13}	TRAINING→EOU	0.088	0.928
γ_{23}	TRAINING→ENJ	0.062	0.701
γ_{33}	TRAINING→REL_ADV	− 0.093	− 1.003
γ_{63}	TRAINING→USAGE	0.153	2.986**
γ_{14}	SUPPORT→EOU	− 0.172	− 1.784
γ_{24}	SUPPORT→ENJ	− 0.003	− 0.370
γ_{34}	SUPPORT→ REL_ADV	0.167	1.790
γ_{15}	COMPATBL→EOU	0.455	5.725**
γ_{25}	COMPATBL→ENJ	0.524	5.632**
γ_{35}	COMPATBL→REL_ADV	0.420	4.046**
γ_{65}	COMPATBL→USAGE	0.279	3.371**
γ_{26}	IMAGE→ENJ	0.116	2.077**
γ_{17}	S_RATING→EOU	0.275	4.452**
γ_{57}	S_RATING→EUCS	0.223	2.372*
γ_{67}	S_RATING→USAGE	0.229	4.055**
Measure of goodness of fit for the whole model			
			985
Degrees of freedom			1934.70 (p= 0.000)
Chi-square			0.798
Goodness of fit index (GFI)			0.769
Adjusted goodness of fit index (AGFI)			0.047
Root mean square residual (RMSR)			

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

was almost unchanged (an increase of 0.002). A comparison of the path coefficients, squared multiple correlations and coefficients of determination for the initial and revised models indicated that the values were only marginally different.

Finally, one needs to check the modification indices which are measures associated with the fixed and constrained parameters of the model (Joreskog and Sorbom 1989). A modification index (MI) is a measure of predicted decrease in χ^2 if any single constraint is added or removed and the model is re-estimated. It is accompanied by a prediction of the estimated change of that parameter. When the MIs were checked it was noticed that no parameter stood in need of being fixed or relaxed which is a strong support for the overall stability of the model. The overall assessment of the fit criteria indicates that the data fit the revised model very well.

The variance explained (R^2) for each of the endogenous variables was as follows: ease of use (0.362); enjoyment (0.474); relative advantage (0.419); attitude (0.586); satisfaction (0.180); and usage (0.501).

Many researchers recommend calculating the overall impact of each variable in the causal model (Ross 1975, Pedhazur 1982, Hellevik 1984, Li 1986). The direct effect can be identified as the magnitude of the path coefficient (β or γ) along the path connecting the cause and the effect variables. An indirect effect represents those effects interpreted by the intervening variables; it is the product of the path coefficients along

Table 6. MLE of parameters — revised structural model.

Parameter	Path	Standardised value	*t*-value
β_{21}	EOU→ENJ	0.205	3.00**
β_{41}	EOU→ATTITUDE	0.345	5.33**
β_{51}	EOU→EUCS	0.000	–
β_{61}	EOU→USAGE	0.000	–
β_{32}	ENJ→REL_ADV	0.238	2.78**
β_{42}	ENJ→ATTITUDE	0.000	–
β_{52}	ENJ→EUCS	0.000	–
β_{43}	REL_ADV→ATTITUDE	0.545	6.72**
β_{53}	REL_ADV→EUCS	0.307	2.84**
β_{63}	REL_ADV→USAGE	0.000	–
β_{64}	ATTITUDE→USAGE	0.306	4.14**
β_{65}	EUCS→USAGE	0.000	–
γ_{11}	COURSE→EOU	− 0.181	− 3.27*
γ_{31}	COURSE→REL_ADV	0.000	–
γ_{12}	EUC_EXP→EOU	0.000	–
γ_{22}	EUC_EXP→ENJ	0.000	–
γ_{32}	EUC_EXP→REL_ADV	0.000	–
γ_{42}	EUC_EXP→ATTITUDE	0.143	2.75**
γ_{13}	TRAINING→EOU	0.000	–
γ_{23}	TRAINING→ENJ	0.000	–
γ_{33}	TRAINING→REL_ADV	0.000	–
γ_{63}	TRAINING→USAGE	0.177	3.45**
γ_{14}	SUPPORT→EOU	0.000	–
γ_{24}	SUPPORT→ENJ	0.000	–
γ_{34}	SUPPORT→REL_ADV	0.110	2.00*
γ_{15}	COMPATBL→EOU	0.431	5.65**
γ_{25}	COMPATBL→ENJ	0.509	5.82**
γ_{35}	COMPATBL→REL_ADV	0.429	4.22**
γ_{65}	COMPATBL→USAGE	0.334	4.27**
γ_{26}	IMAGE →ENJ	0.122	2.23*
γ_{17}	S_RATING→EOU	0.251	4.15**
γ_{57}	S_RATING→EUCS	0.230	2.65**
γ_{67}	S_RATING→USAGE	0.192	3.50**

Measure of goodness of fit for the whole model

Degrees of freedom	999
Chi-square	1954.88 (p= 0.000)
Goodness of fit index (GFI)	0.797
Adjusted goodness of fit index (AGFI)	0.770
Root mean square residual (RMSR)	0.049

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

an indirect route from the cause to the effect via tracing arrows in the headed direction only. When more than one indirect path exists, the total indirect effect is their sum (Ross 1975, Li 1986).

Total effect is calculated as the sum of direct effect and indirect effect(s) of an independent variable on its related dependent variable.

The significant paths (direct effects) that emerged in the revised model are depicted in Figure 5. For a more complete picture, the direct, indirect and total effects of the exogenous variables are provided in the upper part of Table 7. Those for the endogenous variables are provided in the lower part of Table 7.

4.2. *Hypotheses testing*

The results also enabled each of the proposed hypotheses to be tested.

Hypothesis 1 stated that attitudes toward system usage will mediate the relationships between ease of use, enjoyment, and relative advantage and usage. In the revised model, the attitude to usage link was found to be significant (β= 0.306, $p < 0.01$), so this hypothesis is supported.

Hypothesis 2 claimed that end-user computing satisfaction (EUCS) mediates the relationships between beliefs and usage. However, in the revised model EUCS

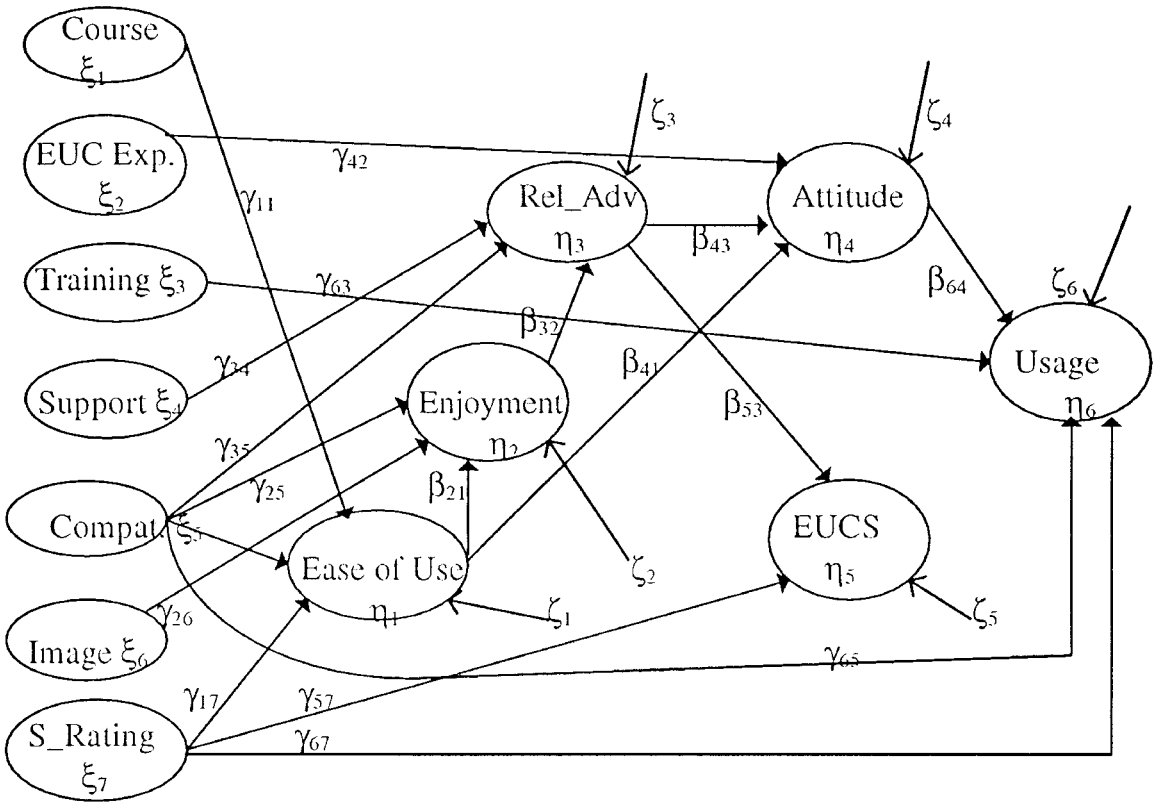

Figure 5. Revised structural model

is not among the predictors of usage, so the results do not support this hypothesis. Further discussion of EUCS is presented later.

Hypothesis 3 stated that ease of use, enjoyment, and relative advantage will have significant effects on attitudes. Ease of use and relative advantage were found to have significant effects on attitudes (β= 0.345, $p< 0.01$) and (β= 0.545, $p< 0.01$) respectively, but enjoyment did not have a significant link. Hence, this hypothesis is partially supported.

Hypothesis 4 proposed that ease of use, enjoyment, and relative advantage will be among the predictors of EUCS. However, only relative advantage proved to be so (β= 0.307) at ($p< 0.01$). Thus this hypothesis is only partially supported and the role of EUCS is discussed later.

Hypothesis 5 stated that ease of use will have a significant effect on enjoyment and enjoyment will have a significant effect on relative advantage. By looking at the revised model it was found that both paths were significant at ($p< 0.01$) level. EOU→ENJ was significant with (β= 0.205) and ENJ→REL_ADV was significant with (β= 0.238). So this hypothesis is fully supported.

Hypothesis 6 proposed that each of training, support and compatibility have a significant effect on user's beliefs. In the revised model, it was found that support has a significant effect on relative advantage (γ= 0.110) at ($p< 0.05$) and compatibility has a significant effect on all three beliefs (γ= 0.431 for COMPATBL→EOU) (γ= 0.509 for COMPATBL→ENJ) (γ= 0.429 for COMPATBL→REL_ADV) all at ($p< 0.01$). Thus it is fair to conclude that this hypothesis is partially supported.

Hypothesis 7 stated that EUC experience has a significant effect on the three beliefs and attitudes toward system acceptance. This is partially supported since the revised model shows that only the EUC experience to Attitude link is significant (γ= 0.143) at ($p< 0.01$).

Hypothesis 8 proposed that training, compatibility, and relative advantage will have significant effects on system usage. In the revised model, training has a significant impact on usage (γ= 0.177) at ($p< 0.01$), but compatibility was found to have a stronger significant effect on usage (γ= 0.334) at ($p< 0.01$), and , although the relative advantage to usage link was found to be significant in the initial model it was not found to be so in the revised model. Thus hypothesis 8 is only partially supported.

Hypothesis 9 stated that Image has a significant effect on enjoyment, and it was found that the image to enjoyment link was significant (γ= 0.122) at ($p< 0.05$), which supports the hypothesis.

Table 7. Direct, indirect and total effects of antecedent variables on endogenous variables.

Effect→	EOU			Enjoyment			Rel Adv.			Attitude			EUCS			Usage		
	D	I	T	D	I	T	D	I	T	D	I	T	D	I	T	D	I	T
Cause↓																		
Course	−0.181		−0.181		−0.037	−0.037		−0.009	−0.009		−0.005	−0.005		−0.003	−0.003		−0.002	−0.002
Image				0.122		0.122		0.029	0.029		0.016	0.016					0.005	0.005
Training																0.177		0.177
EUC_Exp										0.143		0.143					0.044	0.044
Support							0.110		0.110		0.060	0.060		0.034	0.034		0.018	0.018
Compat.	0.431		0.431	0.509	0.088	0.597	0.429	0.141	0.570		0.461	0.461		0.175	0.175	0.334	0.141	0.475
S_Rating	0.251		0.251		0.054	0.054		0.013	0.013		0.097	0.097	0.230	0.004	0.234	0.192	0.030	0.222
EOU				0.205		0.205		0.049	0.049	0.345	0.028	0.373		0.015	0.015		0.114	0.114
Enjoy.							0.238		0.238		0.130	0.130		0.073	0.073		0.040	0.040
Rel_Adv										0.545		0.545	0.307		0.307		0.167	0.167
Attitude																0.306		0.306
EUCS																		
R^2		0.362			0.474			0.419			0.586			0.180			0.501	

D= Direct effect, I= Indirect effect, T= Total effect

Hypothesis 10 is fully supported since overall system characteristics perceived by users were found to affect their perception of ease of use (γ= 0.251), satisfaction (γ= 0.230) and usage (γ= 0.192) all at ($p < 0.01$).

Hypothesis 11 concerned the impact of course on user's beliefs. The results show that students studying engineering and sciences find spreadsheets less easy than their counterparts on business programmes. This might be related to the applications used by engineers and scientists being more complex. However, users, whatever their course backgrounds, found spreadsheets relatively advantageous in performing their jobs so the link Course to Rel_Adv was not significant. Thus the hypothesis is only partially supported.

5. Discussion

The study results confirm the importance of individual, organizational and IT characteristics in influencing user perceptions, attitudes, satisfaction, and usage. The results also confirm the general structure of the TAM model, showing that the effects of user perceptions are channelled through attitudes which impact on usage, rather than the perceptions having a direct effect on usage.

The effects found for the three belief variables, ease of use, enjoyment and relative advantage are important in indicating the role of attitudes. Although the direct effect of relative advantage on usage was tested, it was not found to be significant. However, relative advantage does have an overall effect on usage due to its significant effect on attitude and the significant effect of attitude on usage. This total effect can be seen in Table 7. In a somewhat similar fashion, the direct effect of enjoyment on attitude was not found to be significant, but an overall effect of enjoyment on attitude and hence in turn on usage arises from the direct effect of enjoyment on relative advantage. These total effects are also shown in Table 7. Ease of use is more complex in that the total effect on attitude (and thence on usage) is the combination of a significant direct effect and an indirect effect through its direct effect on enjoyment and so on through relative advantage, which is why it has a larger total effect on usage as shown in Table 7.

The effects of the three belief variables on EUCS are rather similar to their effects on attitude, except that the only direct effect is from relative advantage and ease of use impacts on EUCS through influence on enjoyment which in turn influences relative advantage.

The link between Usage and EUCS , including the possibility of causality in either direction has been studied by Srinivasan 1985, Baroudi *et al.* 1986, Doll and Torkzadeh 1991, Amoroso and Cheney 1992, DeLone and McLean 1992, Torkzadeh and Dwyer

1994. Although EUCS was strongly correlated with the four indicators used to measure usage, 'correlation does not imply causality' (Kenny 1979, p 1). Baroudi *et al.* (1986) suggest three models for the relationship between satisfaction and usage:

1. the dominant or 'traditional model': satisfaction and usage are not related;
2. usage influences satisfaction: as system usage increases it leads to increased user satisfaction. This model is based on the belief that system use leads users to be more familiar with the system and to discover new uses for it which will, in turn, lead to enhanced user satisfaction with the system;
3. satisfaction influences usage: the more satisfied the user is with the system the more he or she will be inclined to use it. This model assumes that as use demonstrates that a system meets a user's needs, satisfaction with the system should increase, which should further lead to greater use of that system.

Furthermore, Delone and McLean (1992) argue that system use and user satisfaction affect each other at the same time and that the type of relationship between them is 'reciprocal'. Torkzadeh and Dwyer (1994) report that this issue is still debated among MIS researchers and practitioners, and further study is required to investigate the causality direction between the two constructs.

The present study succeeded in supporting the fundamental similarity between satisfaction and the social and cognitive psychologists' notion of an attitude suggested by Melone (1990) and Doll and Torkzadeh (1991). Melone (1990) showed that the concept of 'user satisfaction' poses problems when used to evaluate a computer system. It is not clearly defined, nor is there a theoretical base for its development. She suggests that 'user attitude' might be a better substitute, as it already has a strong theoretical foundation in many other disciplines.

This present study investigated both concepts and found that user attitude is an antecedent to and a major determinant of system usage whereas user satisfaction is not. End-user computing satisfaction (EUCS) was expected to impact on system usage and be influenced by beliefs (relative advantage, EOU, and enjoyment). Hypothesis 9 confirms the second part of this expectation, but, the LISREL analysis did not support the hypothesis that EUCS mediates the relationship between these beliefs and usage.

Thus, in summary, this study hypothesized the third model of Baroudi *et al.* (1986) and found no support for this type of relationship. However, further analysis was carried out to investigate if any of the other models were significant in the data, including the reciprocal relationship, but it was found that the traditional model was the only one supported by this present data.

Another primary objective of this paper was to determine how much each determinant of attitudes toward acceptance, satisfaction, and usage contributes to each of these as a target variable. To find this contribution, use of the total effect coefficients is recommended (Ross 1975, Pedhazur 1982, Li 1986).

Using the data in Table 7, the exogenous variables contributing most to each of attitudes, satisfaction, and usage, can be arranged in descending order (i.e. starting with the greater total effect). Similarly the endogenous variables contributing most to each of them can be arranged in descending order. These factors are shown in Tables 8 and 9.

These tables show that the relative advantage of the system perceived by the user was the most contributing factor to attitudes and satisfaction whilst compatibility of the system to the task performed was the most contributing factor to usage, as well as to relative advantage. Relative advantage is also a significant contributing factor to usage, but is not as important as those factors which contribute directly, since it only contributes through attitudes. Similarly enjoyment has a small total contribution to usage as it is only contributing indirectly through relative advantage.

6. Conclusions

The results from this research provide a model for predicting three major variables (attitudes, satisfaction, and usage) used by MIS researchers as criterion measures of IS success related to several antecedent variables in a network of relationships. This model was found to have a very good fit to the data. The results also provide the contributing factors to each of the three outcome variables and the amount that each factor contributes to its target variable.

The most striking aspect of these results is the importance of compatibility. This construct refers to the extent to which a system is being perceived as

Table 8. Exogenous variables that contribute most to the three outcome variables.

Attitudes	EUCS	Usage
Compatibility [0.461]	S_Rating [0.234]	Compatibility [0.475]
EUC Experience [0.143]	Compatibility [0.175]	S_Rating [0.222]
S_Rating [0.097]	Support [0.034]	Training [0.177]

Table 9. Endogenous variables that contribute most to the three outcome variables.

Attitudes	EUCS	Usage
Relative advantage [0.545]	Relative advantage [0.307]	Attitudes [0.306]
Ease of use [0.373]	Enjoyment [0.073]	Relative advantage [0.167]
Enjoyment [0.130]	Ease of use [0.015]	Ease of use [0.114]
—	—	Enjoyment [0.040]

consistent with the users needs, values and experiences. For the first time, this research linked compatibility to the three belief variables. The results show the strong and dominant effect of compatibility on these beliefs variables, which feeds through relative advantage to a very significant impact on attitudes. There is also a strong direct and a weaker indirect impact on usage, making compatibility the most important antecedent of all endogenous variables, except EUCS. Thus compatibility should be a major concern of management when trying to increase the acceptance of such systems.

This research also suggests that the usage-satisfaction relationship is ambiguous and equivocal. The study found a strong positive correlation between satisfaction and usage but it failed to establish any direction of causality between them. Further research could aim to determine how these concepts are related and what the implications for management are as a consequence of such a relationship.

Comparing attitude with user satisfaction, this study supports the direction suggested by Melone (1990). She suggested that user attitude might be a better substitute, as it already has a strong theoretical foundation in many other disciplines. This study points to attitude being an antecedent to and a predictor of usage whereas satisfaction does not prove to be so. Hence, this study suggests that attitude is 'more than' a substitute for satisfaction and that satisfaction should be used as a complement to usage when evaluating end-users' acceptance of computer technologies. Being employed together, both subjective and objective measures should compensate for the shortcomings of each other and lend more insight in the situations of captive use and the less accurate self-report measures applied these days in the MIS research.

The amount of variance explained by the predicting factors for each of the three outcome variables suggests the need to investigate a more comprehensive acceptance model. In particular, it indicates there may be value in examining the normative beliefs and subjective norms not considered in TAM which constitute major components of the TRA base model.

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Appendix: Questionnaire (Condensed version)

Please circle the most appropriate number of each statement which correspond most closely to your desired response.

N.B. Throughout the questions 'S/S' means Spreadsheet system(s).

	Strongly Disagree	Disagree	Uncertain	Agree	Strongly Agree
RELATIVE ADVANTAGE					
1 Using S/S improved the quality of some tasks of my work in industry	1	2	3	4	5
2 Using S/S gave me greater control over my work in industry.	1	2	3	4	5
3 Using S/S enabled me to accomplish some tasks more quickly.	1	2	3	4	5
4 Using S/S increased my productivity while working in industry.	1	2	3	4	5
5 Using S/S improved my job performance in some tasks of my work in industry.	1	2	3	4	5
6 Using S/S enhanced my effectiveness on some tasks of my work in industry.	1	2	3	4	5
7 Using S/S made it easier to do some tasks of my work in industry.	1	2	3	4	5
8 *Overall*, I found using S/S to be advantageous in various tasks of my work in industry.	1	2	3	4	5
COMPATABILITY					
1 Using S/S was compatible with all aspects of some tasks in my work in industry.	1	2	3	4	5
2 I think that using S/S fitted with the way I liked to do some tasks of my work in industry.	1	2	3	4	5
3 Using S/S fitted into some tasks of my work style while in industry.	1	2	3	4	5
EASE OF USE					
1 I believe that S/S are cumbersome to use.	1	2	3	4	5
2 Learning to use S/S was easy for me.	1	2	3	4	5
3 Using S/S was often frustrating.	1	2	3	4	5
4 I believe that it was easy to get S/S to do what I want it to do while in industry.	1	2	3	4	5
5 It was easy for me to remember how to perform tasks using S/S.	1	2	3	4	5
6 While working in industry, my using S/S system required a lot of mental effort .	1	2	3	4	5
7 While working in industry, my interaction with S/S system was clear and understandable.	1	2	3	4	5
8 Overall, I believe that S/S system was easy to use.	1	2	3	4	5
ENJOYMENT					
1 Based on my industrial experiences, I believe using S/S to be enjoyable.	1	2	3	4	5
2 The actual process of using S/S is pleasant.	1	2	3	4	5
3 While working in industry, I had fun using S/S.	1	2	3	4	5
IMAGE					
1 People in my employing organisation who use S/S have more prestige than those who do not.	1	2	3	4	5
2 People in my employing organisation who use S/S have a high profile.	1	2	3	4	5
3 Using S/S was a status symbol in my employing organisation.	1	2	3	4	5

ATTITUDE

Please make a cross mark in the place that best describe your opinion

***All things considered*, my using spreadsheets in accomplishing various tasks in industry was:**

		extremely	*quite*	*neither*	*quite*	*extremely*	
1	Bad	———— :	———— :	———— :	———— :	————	Good
2	Foolish	———— :	———— :	———— :	———— :	————	Wise
3	Unfavourable	———— :	———— :	———— :	———— :	————	Favourable
4	Harmful	———— :	———— :	———— :	———— :	————	Beneficial
5	Negative	———— :	———— :	———— :	———— :	————	Positive

END-USER COMPUTING SATISFACTION (EUCS)

Please circle the number that corresponds to your best description of *spreadsheet system (S/S):*

1= Almost never 2= Some of the time 3= About half of the time 4= Most of the time 5= Almost always

		Never				*Always*
1	Did S/S provide the precise information you need?	1	2	3	4	5
2	Did the S/S information content meet your needs?	1	2	3	4	5
3	Did the S/S provide reports that seem to be just about exactly what you need?	1	2	3	4	5
4	Did the S/S provide sufficient information?	1	2	3	4	5
5	Was the S/S accurate?	1	2	3	4	5
6	Were you satisfied with the accuracy of the S/S?	1	2	3	4	5
7	Do you think the output was presented in a useful format?	1	2	3	4	5
8	Was the information clear?	1	2	3	4	5
9	Was the S/S user friendly?	1	2	3	4	5
10	Was the S/S easy to use?	1	2	3	4	5

TRAINING

Please indicate the extent to which each of the following contributed to the increase of your S/S knowledge and expertise during your industrial placement:

		None				Extremely extensive
1	A trainee explained features	1	2	3	4	5
2	A member of staff explained features	1	2	3	4	5
3	A S/S expert explained features	1	2	3	4	5
4	A central S/S expert explained features	1	2	3	4	5
5	A course on S/S package features	1	2	3	4	5
6	A course on S/S model building	1	2	3	4	5
7	A course on S/S advanced features	1	2	3	4	5
8	Through a tutorial package	1	2	3	4	5
9	Through self study	1	2	3	4	5
	Other (specify)	1	2	3	4	5

USAGE

1 On an average working day in industry that you used a computer, how much time have you spent using spreadsheets?
(please tick *one* box)

Almost never	
Less than 1/2 hour	
From 1/2 - 1 hour	
1 - 2 hours	
2 - 3 hours	
More than 3 hours	

2 On average, how frequently did you use spreadsheets while working in industry?
(please tick *one* box)

Less than once a month	
Once a month	
A few times a month	
A few times a week	
About once a day	
About once a day	

3 For each spreadsheet package listed below indicate your level of usage (or None) while working in industry:

	None				Extremely extensive
LOTUS 1-2-3	1	2	3	4	5
SUPERCALC	1	2	3	4	5
EXCEL	1	2	3	4	5
SYMPHONY	1	2	3	4	5
Other, (specify)	1	2	3	4	5

4 What is the level of sophistication (using macros, menus, data validation, etc.) of the S/S applications that you have worked with or used?

Least sophisticated				*Highly sophisticated*
1	2	3	4	5

5 How many different S/S applications have you worked with or used in industry?
(please tick *one* box)

Just One application	
Two applications	
3 to 5 applications	
6 to 10 applications	
More than 10 applications	

The next section is used to assess the computing support you were provided with in your area during your industrial placement.

SPREADSHEETING SUPPORT

Which of the following category or categories best indicate the type and level of support on spreadsheets (S/S) you were provided with:

		None				*Extremely extensive*
1	Manuals	1	2	3	4	5
2	Online help	1	2	3	4	5
3	Tutorial package	1	2	3	4	5
4	Another trainee	1	2	3	4	5
5	Member of staff in your area	1	2	3	4	5
6	S/S expert in your area	1	2	3	4	5
7	Central S/S expert	1	2	3	4	5
8	Hotline to S/S expert	1	2	3	4	5
	Other (specify) . . . . . -	1	2	3	4	5

GENERAL COMPUTING SUPPORT

Please circle the one number of each statement that best describes the level of general computing support in your employing organisation:

1= Almost never 2= Some of the time 3= About half of the time 4= Most of the time 5= Almost always

		Never				**Always**
1	There was a person available to whom computer users could turn to for help	1	2	3	4	5
2	A central support was available to help with computer problems	1	2	3	4	5
3	Training courses were readily available for us to improve our computing abilities	1	2	3	4	5
4	Management provided most of the necessary help and resources for computing	1	2	3	4	5
5	Management was really keen to see that we were satisfied with use of our computers	1	2	3	4	5

SYSTEM RATING

For those S/S package(s) I have worked with or used, I would rate the overall characteristics to be:

Poor		*Average*		*Excellent*
1	2	3	4	5

EUC EXPERIENCE

The next set of questions assesses the actual experience you have working with computers and your experience in using spreadsheet packages:

1	How long have you used computers?				____ years	
2	Have you ever written programs in a computer language?				Yes / No	
	***If Yes,* for how long?**				____ years	
3	How long have you used spreadsheet packages?				____ years	
		Low				*High*
4	Describe your current skill level with spreadsheets	1	2	3	4	5
5	Have you ever used other packaged application software?				Yes / No	

If Yes, please indicate the level of each used:

	None				Extremely extensive
WORD PROCESSING	1	2	3	4	5
DATABASES	1	2	3	4	5
GRAPHICS	1	2	3	4	5
MODELLING	1	2	3	4	5
CAD/CAE	1	2	3	4	5
Other, ...	1	2	3	4	5

COURSE

In which department or type of department are you registered ?

Business School	
A Science Department	
An Engineering Department	
Other, ...	