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# An Integrated Model of EIS Use

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## ABSTRACT

*This study develops and tests a model of the key determinants of EIS utilization. The validity of the model is tested against data from 216 EIS users in the UK. The results suggest that perceived usefulness positively influence EIS use. Ease of use, information quality, user involvement, subjective norm, and facilitating conditions positively influence both use and perceived usefulness. Participation positively influences information quality and involvement, MIS maturity positively influences information quality, and use experience positively influences perceived ease of use, while, contrary to expectations, training had no influence on beliefs. Implications for theory and practice are outlined.*

## 1- INTRODUCTION

Over the last decade, many organizations have been implementing Executive Information Systems (EIS) to support the work of their executives (Bajawa et al., 1998). Despite the high potential EIS hold for providing organisational benefits, few have successfully developed EIS (Rainer and Watson, 1995). Young and Watson (1995) argue that EIS fail because they are not accepted i.e. not used by their potential users. These failures reflect the wide range of managerial and technical issues that need to be investigated to ensure successful implementation of EIS.

Only recently have researchers started to test theoretical models and hypotheses to explain EIS adoption, use, and impact (e.g. Bajawa et al, 1998; Bergerion et al, 1995; Leidner & Elam, 1995). This study extends the Technology Acceptance Model (TAM) using theories from social psychology and IS success literature to explain EIS utilization. Following is a discussion of the research model and hypotheses, the methodology, results, and conclusion.

## 2- THE PROPOSED MODEL AND HYPOTHESES

The research model (fig.1) extends TAM by adding subjective norm, facilitating conditions, involvement, and information quality to perceived ease of use and perceived usefulness to explain use. It also adds subjective norm, facilitating conditions, information quality, and involvement to ease of use to explain perceived usefulness. Consistent with TAM, the proposed model incorporates four external factors; namely, participation, information systems maturity, computer training, and use experience; as potential determinants of information quality, involvement, and ease of use.

### 2.1 Perceived Usefulness (PU)

PU is "the degree to which the person believes that using a certain technology will enhance his or her performance" (Davis, 1989). Previous studies provide strong support to the positive relationship between PU and usage (e.g. Adams et al, 1992; Bergeron et al, 1995; Igbaria et al., 1995; Straub et al., 1995; Sjazna, 1996). Therefore, the following hypothesis is proposed.

**H1** ***Perceived usefulness positively influences use.***

### 2.2 Perceived Ease of Use (PEOU)

PEOU is "the degree to which a person believes that using a certain system is effort free" (Davis, 1989, p.320). PEOU was reported to positively influence perceived usefulness (Mathieson, 1991; Sjazna 1996; and Igbaria et al 1997). Igbaria et al (1997), Thompson et al (1991) Adams et al (1992), and Matheison (1991) found PEOU to positively influence usage. However, Davis et al. (1989), Davis (1989), Straub et.al (1995), and Sjazna (1996) found PEOU to have no direct influence on usage. Since the Theory of Planned Behavior (Ajzen, 1991) implies that PEOU directly influences behavior, and TAM proposes that PEOU positively influence perceived PU and use, the following hypotheses are proposed.

**H2.1** ***Perceived ease of use positively influences use.***

**H2.2** ***Perceived ease of use positively influences perceived usefulness.***

### 2.3 Information Quality

Information quality is defined in terms of the timeliness, accuracy, format, and relevance of the information generated by an information system (Seddon and Kiew, 1994). The direct link between information quality and use is supported by considerable empirical evidence (Delone and Mclean, 1992). Further, information quality had a positive influence on perceived usefulness (Seddon & Kiew, 1994). Delone and Mclean (1992) model of IS success and its extended version (Seddon, 1997) suggests that information quality is an antecedent of both use and PU. Also TAM and the Theory of Reasoned Action (Fishbein & Ajzen, 1975) imply that system-related beliefs will influence perceived usefulness. Thus the following hypotheses are proposed:

**H3.1** ***Information quality positively influences use***

**H3.2** ***Information quality positively influences perceived usefulness***

### 2.4 User Involvement

Involvement is "the degree to which the user believes that the system possesses two characteristics: relevance and importance" (Hartwick & Barki, 1994). Swanson (1974) found that appreciation is positively related to use. Also Javenpaa and Ives (1991) reported a positive impact of involvement on use. Involvement was also positively related to PU (Seddon and Kiew, 1994). Moreover, Taylor and Todd (1995) and Igbaria et al (1997) recommended the inclusion of involvement in the framework of use models. Therefore, the following hypotheses are proposed:

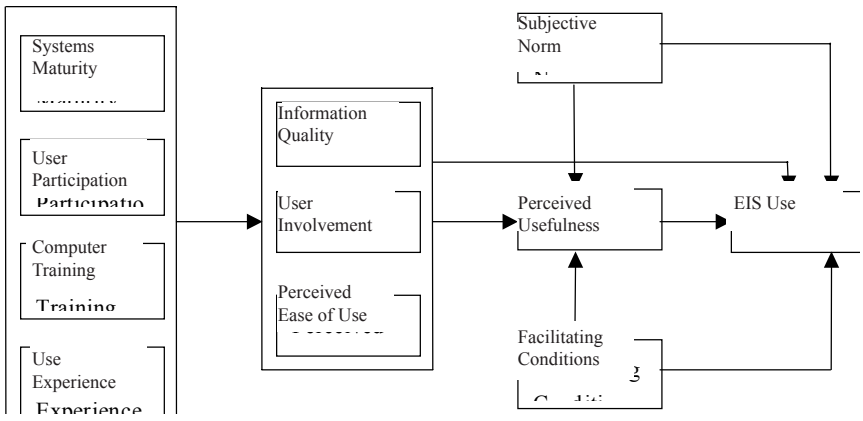
**H4.1** ***Involvement positively influences use***

**H4.2** ***Involvement positively influences perceived usefulness***

### 2.5 Subjective Norm (SN)

SN is "the person's perception that most people who are important to him think he should or should not perform the behaviour in question" (Fishbein and Ajzen, 1975). SN was reported to positively influence use (Bergeron et al, 1995; Thompson et al, 1991; Vandenbosch and Huff, 1997). SN was positively related to attitudes toward usage (Hartwick and Barki,

*Figure 1. The integrated model of EIS use*



1994). Social factors were also found to influence outcome expectations of computer use (Compeau and Higgins, 1995). Moreover, the theory of reasoned action and the Triandis model support the influence of SN on usage. Thus, the following hypotheses are proposed.

**H5.1** ***Subjective norm positively influences use***
**H5.2** ***Subjective norm positively influences perceived usefulness***

### 2.6 Facilitating Conditions

Facilitating conditions are "objective factors in the environment that can make an act easy to do" (Triandis, 1980). In the context of EIS, Bergeron, et al. (1995) reported a positive relation between EIS sophistication (as an indicator of facilitating conditions) and use. According to Triandis (1980) facilitating conditions are expected to directly influence usage. On the other hand, TAM proposes that systems characteristics will influence use indirectly through beliefs. Therefore, the following hypotheses are proposed:

**H6.1** ***Facilitating conditions positively influence use***
**H6.2** ***Facilitating conditions positively influence perceived usefulness***

### 2.7 Participation

Participation is "a set of behaviors or activities performed by the potential users or their representatives during the system development process" (Barki & Hartwick, 1989). Participation was positively related to system appreciation (Swanson, 1974), and involvement (Hartwick and Barki, 1994; Javenpaa and Ives, 1991). Moreover, Taylor and Todd (1995) recommended the incorporation of participation in use models. Also, according to TAM, participation is expected to influence use indirectly through beliefs. Therefore, the following hypotheses are proposed

**H7.1** ***Participation positively influences perceived ease of use***
**H7.2** ***Participation positively influences information quality***
**H7.3** ***Participation positively influences involvement***

### 2.8 Information Systems (IS) Maturity

IS maturity is "the overall status of the MIS function within the organisation" (King and Sabherwal, 1992). Cheney and Dickson (1982) reported that MIS organisational sophistication positively influence information satisfaction and usage. Mahmood and Becker (1985) reported a significant relation between satisfaction and some items of Nolan's maturity benchmarks. Igbaria et al (1997) and Taylor and Todd (1995) recommenced the consideration of organisational context factors in future use studies. Further, according to TAM external factors such as IS maturity is expected to influence use indirectly through beliefs. Thus, the following hypotheses are proposed:

**H8.1** ***Information system maturity positively influences perceived ease of use***
**H8.2** ***Information system maturity positively influences information quality***
**H8.3** ***Information system maturity positively influences involvement***

### 2.9 Computer Training

Training refers to the extent of computer related training received by the user from internal and external sources. Little is reported about the impact of training on user perceptions in the literature (Agarwal et. al., 1996). End-user computing training was positively related to satisfaction (Cronan & Douglas, 1990; Sandars & Courtney, 1985). Also training had a positive influence on PEOU (Igbaria et al, 1997) According to TAM training is expected to indirectly influence usage through beliefs. Therefore, the following hypotheses are proposed.

**H9.1** ***Computer training positively influences perceived ease of use***
**H9.2** ***Computer training positively influences information quality***
**H9.3** ***Computer training positively influences user involvement***

### 2.10 Use Experience

This is defined in terms of length of use and the level of use expertise. Length of use was positively related to information quality (Gatian, 1994; Sanders and Courtney, 1985) and PEOU (Thompson et. al., 1994). Past experience with any behavior is also considered the most important source of information about the ease of performing such behavior (Ajzen, 1991). Further, it is consistent with TAM to propose an indirect link between experience and usage through beliefs. Therefore, the following hypotheses are proposed.

**H10a.1** ***Length of use positively influences perceived ease of use***
**H10a.2** ***Length of use positively influences information quality***
**H10a.3** ***Length of use positively influences user involvement***
**H10b.1** ***Use expertise positively influences perceived ease of use***
**H10b.2** ***Use expertise positively influences information quality***
**H10b.3** ***Use expertise positively influences involvement***

## 3- METHODOLOGY

A mail survey was used to gather data to test the model. The questionnaire was pilot tested on MBA part-time students who were full time managers. Given that the questionnaire items were driven from verified sources, the pilot study resulted in few changes in the wording of some questions.

### 3.1 Selection of Respondents

The research was conducted on the UK customer list of a major EIS vendor. Out of the 960 questionnaires sent, 216 usable were returned giving 22.5% effective response rate. The respondents consisted of 14.7% one level below the CEO, 48.9% two levels below the CEO, 13.7% three levels below the CEO, and 22.8% more than three levels below the CEO. The average age was 39 years and 88.5% were men. The EIS users came from various industries; 22.6% manufacturing and engineering, 19.4% finance and banking, 19.4% retail, 10.1% pharmaceuticals and chemicals, 9.7% health sector, 4.1% public utilities, 1.8% local government, and 12.9% other industries.

### 3.2 Measures

***EIS Use***. Based on Fishbein and Ajzen's (1975) recommendations, use was measured by three indicators; the extent of dependence on EIS compared to other sources (personal contacts and paper-based sources) (Khalil & Elkordy, 1999), frequency of use (Bergeron, et al, 1995), duration of use (Mawhinney and Lederer, 1990).

***Perceived Usefulness and Perceived Ease of Use***. Two 4-item scales developed by Davis (1989) were used to measure PU and PEOU.

***Information Quality***. This was measured using 9 items of the end user computing satisfaction scale developed by Doll and Torkzadeh's (1988).

***Involvement.*** This was measured using 6-items of the involvement scale developed by Barki and Hartwick (1994).

***Subjective Norm***. This was measured using a 4-item scale based on Bergeron et al. (1995) and Thompson et al. (1991) measures of social factors.

***Facilitating Conditions.*** Sophistication of EIS is used as a surrogate of facilitating conditions. This study adapted the instrument developed by Bergeron et.al (1995) to measure EIS sophistication.

***Participation.*** This was measured using the user responsibility sub-scale developed by Hartwick and Barki (1994).

***Information Systems Maturity***. This was measured using the 9-item scale developed by king and Sabherwal (1992).

***Computer Training:*** This was measured by asking respondents to describe the computer related training they received from their company, vendors, college, and self-training (Nelson, 1991).

***Use Experience***. Length of EIS use (Leidner & Elam, 1995) and computer use expertise (Thompson et al, 1995) were used as indicators of the user experience.

## 4- ANALYSES AND RESULTS

### 4.1 Construct Validity and Reliability

Table 1 shows the results of the reliability and factor analysis. The internal consistency reliability of all construct was found adequate, except for EIS use which fell slightly below the recommended 0.7 level (Nunnally, 1978).

### 4.2 Tests of Hypotheses:

To test the research hypotheses, five stepwise regression equations were run with EIS use, perceived usefulness, perceived ease of use, information quality, and involvement as the dependent variable (table 2). Only the independent variables that met the 0.05 significance level for entry were included. Adjusted R square measures the total variance explained in the dependent variable by all the independent variables in the equation. Standardized beta coefficients of the independent variables determine their relative importance in predicting the dependent variable.

*Table 1 Reliability and Factor Analysis Results*

| Variable name | Reliability coefficient | Variance extracted |
|---|---|---|
| EIS use | .69 | 62% |
| Perceived usefulness | .93 | 83% |
| Ease of use | .89 | 72% |
| Information quality | .91 | 58% |
| Involvement | .95 | 81% |
| Subjective norm | .79 | 62% |
| participation | .92 | 65% |
| IS maturity | .81 | 55% |

#### *4.2.1 EIS Use*

Equation one in table 2 shows that PU, SN, facilitating conditions, information quality, and PEOU explain 47.1% of the total variance in use, which compares favorably with previous studies (Igbaria et. al, 1995, 1997; Bergeron et al, 1995). Involvement did not enter the equation and thus had no influence on use. Therefore, hypotheses H1, H2.1, H3.1, H4.1, H5.1 are accepted, while, hypothesis H6.1 is rejected.

#### *4.2.2 Perceived Usefulness*

Equation two in table 2 shows that involvement, EOU, information quality, SN, and facilitating conditions explain 47.6% of the variance in PU with involvement being the most important determinant followed by information quality. These results are consistent with Seddon and Kiew (1994) and Bergeron et al (1995). Therefore, hypotheses H2.2, H3.2, H4.2, H5.2, and H6.2 are accepted.

#### *4.2.3 Perceived Ease of Use*

Equation three in table 2 shows that computer use expertise and length of EIS use explain 9% of the variance in PEOU. This result is consistent with Thompson et al. (1994). On the other hand, participation, IS maturity, and training showed no relation to PEOU. Thus, hypotheses H10a.1 H10b.1 are accepted, while H7.1, H8.1, and H9.1 are rejected.

#### *4.2.4 Information Quality*

As depicted by equation four (table 2), only participation and IS maturity were found to influence information quality explaining 11% of its total variance, with maturity as the major determinant. These results highlights the importance of the overall IS functional maturity on the information quality of the EIS. Thus hypotheses H7.2 and H8.2 are accepted, while H9.2, H10a.2, and H10b.2 are rejected.

#### *4.2.5 Involvement*

Only participation had an influence on involvement, explaining 2.4% of its total variance (equation five, table 2). The findings are consistent with Hartwick and Barki (1994). Therefore, hypothesis H 7.3 is accepted, while hypotheses H 8.3, H9.3, H10a.3 and H10b.3 are rejected.

## 5-DISCUSSION AND CONCLUSION

Table 3 depicts the results of the hypotheses testing. To summarize, EIS use was found to be determined in order of importance by perceived usefulness, subjective norm, facilitating conditions (EIS sophistication), ease of use, and information quality. Thus, in terms of explaining use, the model received significant support. The results also show that PU is determined in order of importance by involvement, information quality, subjective norm, ease of use, and facilitating conditions. Thus, in terms of explaining PU, the model received full support.

Future investigations should aim to increase the explained variance in use and PU by exploring other potential determinants such as intrinsic motivation (Venkatesh, 1999), self-efficacy (Campeau and Higgens, 1995), and affect (Triandis, 1980). Use intention was excluded from this model because of the focus on explaining current behavior rather than predicting future one. Future models could improve the explained variance in use by including intention and testing the model across an expanded period of time (longitudinal study). Furthermore, the investigation of the linkage between EIS use and performance will add to the practical relevance of this line of research.

On the other hand, the results provide limited support to the model's explanation of PEOU, information quality, and involvement. However, external factors are not expected to hold consistent effect on beliefs unlike the more established relationship between beliefs, attitudes and behavior (Fishbein and Ajzen, 1975). This does not diminish their importance in advancing the understanding of the use behavior when they are found related to beliefs. Therefore, more research effort should be directed to exploring the key determinants of beliefs (Agarwal et al, 1996).

These results also have implications for EIS practice. Persuasive communications directed at PU, PEOU, involvement, and information quality would produce significant changes in the use of existing systems and promote the acceptance of new ones. Also subjective norm appears as an important determinant of both use and PU, suggesting that both behavior and

*Table 2 Stepwise Regression Results*

| | Adjusted R square | F Ratio | Standardized Beta |
|---|---|---|---|
| **1- EIS Use** | **0.471** | **39.267*****| |
| **Variables in equation one:** | | | |
| Perceived usefulness | | | .248*** |
| Subjective norm | | | .273*** |
| Facilitating conditions | | | .221*** |
| Ease of use | | | .124* |
| Information quality | | | .136* |
| **2- PU** | **0.476** | **40.134***** | |
| **Variables in equation two:** | | | |
| Involvement | | | .382*** |
| Information quality | | | .226*** |
| Subjective norm | | | .159** |
| Ease of use | | | .123* |
| Facilitating conditions | | | .103* |
| **3- PEOU** | **0.09** | **11.311***** | |
| **Variables in equation three:** | | | |
| Computer use expertise | | | .282*** |
| Length of EIS use | | | .151* |
| **4- Information quality** | **0.11** | **14.11***** | |
| **Variables in equation four:** | | | |
| IS maturity | | | .305*** |
| Participation | | | .146* |
| **5- Involvement** | **0.024** | **6.355**** | |
| **Variables in equation five:** | | | |
| Participation | | | .17** |

*P≤0.05, **P≤0.01, ***P≤0.001

*Table 3: Results of Hypotheses Testing*

| Hypotheses | Support |
|---|---|
| EIS Use | |
| H1 Perceived usefulness positively influences use. | Yes |
| H2.1 Perceived ease of use positively influences use. | Yes |
| H3.1 Information quality positively influences use. | Yes |
| H4.1 User involvement positively influences use. | No |
| H5.1 Subjective norm positively influences use. | Yes |
| H6.1 Facilitating conditions positively influences use. | Yes |
| Perceived Usefulness | |
| H2.2 Perceived ease of use positively influences PU. | Yes |
| H3.2 Information quality positively influences PU. | Yes |
| H4.2 User involvement positively influences PU. | Yes |
| H5.2 Subjective norm positively influences PU. | Yes |
| H6.2 Facilitating conditions positively influences PU. | Yes |
| Perceived Ease of Use | |
| H7.1 Participation positively influences PEOU | No |
| H8.1 IS maturity positively influences PEOU | No |
| H9.1 Training positively influences PEOU | No |
| H10a.1 Length of use positively influences PEOU | Yes |
| H10b.1 Use expertise positively influences PEOU | Yes |
| Information Quality | |
| H7.2 Participation positively influences information quality | Yes |
| H8.2 IS maturity positively influences information quality | Yes |
| H9.2 Training positively influences information quality | No |
| H10a.2 Length of use positively influences information quality | No |
| H10b.2 Use expertise positively influences information quality | No |
| Involvement | |
| H7.3 Participation positively influences involvement | Yes |
| H8.3 IS maturity positively influences involvement | No |
| H9.3 Training positively influences involvement | No |
| H10a.3 Length of use positively influences involvement | No |
| H10b.3 Use expertise positively influences involvement | No |

perceptions could be socially constructed. Another implication for systems design is that involvement and information quality are more important than perceived ease of use in enhancing the system's perceived usefulness. Moreover, the increase in the number of features available to users (EIS sophistication) could facilitate the system's use in performing a variety of tasks and thus lead to more utilization. The availability of EIS capabilities can also enhance the user's perceptions of the system usefulness. These findings highlight the importance of providing the users with more capable systems as well as more user-friendly ones.

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