

Evaluating the Factors Affecting DSS Usage by Senior Managers in Local Authorities in Egypt

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Abstract

The study of factors influencing the adoption and use of information systems in less developed countries is an important area to address since differences in culture, social structure and business approaches may have significant effects on the benefits derived from importing Western-influenced IT technology, concepts and management approaches. This study examines the usage of a decision support system (DSS) in Egyptian local authorities using an adapted Technology Acceptance Model (TAM). The centrally-developed DSS had been rolled out to 27 Governorates in Egypt for use by Chief Executive Officers. The results demonstrated that TAM could be applied to a specific system within a developing country. Both perceived ease of use (PEU) and perceived usefulness (PU) had a significant direct effect on DSS usage. PEU dominated over PU whose effect on DSS usage was negative.

TAM was extended by defining nine external variables: Task Characteristics, Cultural Characteristics, Environmental Characteristics, DSS Characteristics, Internal Support, External Support, Top Management Support, Organisational Characteristics and Decision Maker Characteristics. Top Management Support and Organisational Characteristics exerted the greatest effect, while Environmental Characteristics and Task Characteristics had a negative effect on DSS usage.

The successful use of a DSS requires that the user has a significant amount of independence and autonomy in the decision-making process. However, the organisational structure of Egyptian government is hierarchical, with long chains of command and only the top level able to make decisions. In conjunction with interviews, the quantitative results suggest that the perceived usefulness of the DSS is reduced in an environment where there is a lack of autonomy, a command and control culture and little requirement for decision making in implementing centrally-made decisions.

This study indicates the importance of taking into account external factors when examining IT technology adoption globally. In particular, many aspects of culture, including the background and characteristics of the decision-maker will strongly influence the perception of management support systems.

Keywords: Decision Support Systems, Technology Acceptance Model, Developing countries, Strategic Decision Making, Structural Equation Modelling, Local Authorities in Egypt, DSS cross-cultural research.

INTRODUCTION

The usage and non-usage of IT within the developed and non-developed world poses challenging problems for IS researchers and practitioners. While IT usage in the developed world has been well-studied (Alavi & Joachimsthaler, 1992; Al-Gahtani & King, 1999; Boynton, Zmud, & Jacobs, 1994), the study of strategic usage of IT in developing world is a relatively new field in which research is only just being established (Kamel, 1995; Rose & Straub, 1998)

In some countries poverty, trade barriers and lack of infrastructure constitutes massive constraints to IT usage (Goodman & Green, 1992; Krovi, 1993; Lu, Hsieh, & Pan, 1989). However, the usage of IT is not always constrained by resources alone. Where resources are available whether local or imported, non-usage of IT is still prevalent (Ibrahim, 1985; Nidumolu & Goodman, 1993; Shibanda & Musisi-Edebe, 2000) Local usage of global systems may be affected by local politics and culture. For example, local usage of Geographical Information Systems in India is affected by cultural attitudes to maps and cartography. Using maps is not seen as important in a country where it is usually easier to ask someone for directions (Walsham, 2001). In China, a reliance on intuition and informal approaches to managerial decision making debilitates against the effective use of management information systems (Hempel & Kwong, 2001). In Malaysia, the cultural view of computer systems as symbols of power limits their use to senior figures in authority (Walsham, 1993).

Since effective usage of IT is important for economic advancement in developing countries and the delivery of benefits from IT deployment in organisations, and IT usage is clearly affected by local cultural conditions, it is important to develop an understanding of the factors that drive local usage in order to benefit from global information systems. Quantitative and qualitative models are needed which are transferable between countries and cultures. Such models should be standardised to such an extent that the instrument and its outcomes are globally comparable.

The Technology Acceptance Model (TAM; Davis, 1989) has the potential to become a standard model for predicting IT adoption and, through extension, for analysing IT usage. TAM explains the extent of adoption of an information system in terms of the perception of the ease of use (PEU) and perceived usefulness (PU) of the IT, concepts which may be investigated simply through items on a questionnaire. The concepts may be used to predict adoption, or to explain subsequent usage, as is the case in this study.

TAM has been extensively applied in the developed world (Boudreau, Gefen, & Straub, 2001; Legris, Ingham, & Collette, 2003). However until recently little work has been on the application of TAM to developing countries. Rose and Straub (1998) established the transferability of TAM to less developed countries, particularly focussing on Arabic countries. Using a sample of professional knowledge workers from five Arabic countries, including Egypt, they demonstrated that TAM successfully predicted general computer technology adoption in these Arabic cultures. Recently, Brown (2002) applied TAM to the use of Web-CT in South Africa and Kamel & Assem (2003) described the application of TAM to the introduction of electronic banking in Egypt.

This study builds on the work of Rose and Straub (1998). Firstly, it confirms the conclusion of Rose and Straub (1998) that TAM successfully transfers to Egypt. Secondly, it applies TAM to a homogenous population of professionals in the public sector. While Rose and Straub used a sample of managers and professionals in the airline, public and health sectors, surveying attitudes to general IT, this study uses a sample of chief executive officers and their supporting DSS unit managers within Egyptian governorates. Furthermore this study addresses the actual use of, rather than intention to use, a decision support system developed in Egypt by the central government and distributed to local government centres.

This study further extends the work of Rose and Straub (1998) by identifying and modelling the antecedents which influence PEU and PU. Identifying the antecedents may increase the explanatory power of the model, and lead to the identification of suitable strategies for encouraging information system adoption and effective usage which, while globally applicable, are sensitive to local culture and conditions.

Following a description of the information system and its context, the use of TAM in the developing world is briefly reviewed and the rationale for its extension, modification and use to study this specific system in Egypt is provided. The derivation of the antecedents is then discussed and the model established. Results are briefly described and we conclude that the relative importance of PEU is higher than PU suggesting that the usability of DSS is may have a significant effect on its use for decision making in local authorities in developing countries. Analysis of the antecedents suggested that PEU was greatly influenced by cultural characteristics and the effect of external support, raising some important implications for the construction of research models of information technology adoption.

DSS WITHIN THE EGYPTIAN GOVERNORATES PROJECT

Egypt is a developing country of 70 million inhabitants where IT penetration and adoption is relatively advanced. The Egyptian government has a history of pursuing IT initiatives and promoting IT usage in the public and private sector. Recently it has begun to pursue e-government and geographical information system projects. One such government-initiated project is the Information and Decision Support Centre (IDSC) or Governates project (El Sherif, 1990; Kamel, 1998; Nidumolu, Goodman, Vogel, & Danowitz, 1996). This centrally initiated project provided resources for each governorate to establish decision support centres (DSCs) consisting of units for computer resources, decision support, library, publications and statistics. These DSCs were to provide coherent electronic information to senior management to support public sector decision making.

To ensure standardisation, a suite of decision support applications was developed for the governorates by central government, within a cabinet IDSC, and then rolled out to governorates. The systems developed centrally covered various sectors of the Egyptian economy (Nidumolu et al., 1996) including population, health and housing. Governorates then established multiple DSCs at a lower district level. Senior managers could then draw information from district DSCs or from the governorate DSCs which collated information from district DSCs. By 1998, some 1202 DSCs were located across the 27 Egyptian governorates, employing 7300 staff (Table 1).

DSCs support the centrally-provided applications providing reports to senior executives.

The centrally developed DSS provided a focus for the study of DSS usage by senior managers within a developing country. A focus on usage, particularly the constructs provided by TAM, was particularly salient when a pilot study suggested that only 33% of executives actually made use of the output of the DSS. This raised the question of why usage of DSS by executives is so limited despite the extensive government investment and support for the system.

ADAPTING AND EXTENDING THE TECHNOLOGY ACCEPTANCE MODEL

The basic Technology Acceptance Model was adapted in this study to reflect the fact that the DSS was already in use, and to support the investigation of factors influencing PU and PEU.

Since the DSS was already in use, the attitude and intention to use constructs were omitted and effort was concentrated on the link between PEU, PU and actual system usage. Systems usage was derived from self-reported estimates of percentage use of the DSS in strategic decisions, level or depth of use and frequency of use. Statements used in this research to operationalise the PEU and PU were adapted from Davis's study (1989), with minor changes in wording and the addition of one item to PU: "lower cost", which reflects the developing world's environment, where cost is an important factor in using DSS.

In order to expand understanding of why DSS are used in developing countries, this study extended TAM by specifying the external variables which may influence PEU and PU. The Technology Acceptance Model demonstrates that a significant amount of system usage behaviour can be explained in terms of the user's perception of usefulness (PU) and ease of use (PEU). External constructs are characteristics of the environment or the system that influence the user's perception. If executives perceived the DSS as difficult to use, what influenced their perception? Some studies have investigated some of the influencing variables (Keil, 1995; Phillips, Calantone, & Lee, 1994; Taylor & Todd, 1995; Taylor & Todd, 1995b; Venkatesh, 2000), but they do not relate these variables to TAM.

For each selected variable, the hypothesis was that the effect of the variable on DSS usage was entirely dependent on PU and PEU. Figure 1 below depicts the research model employed in the study.

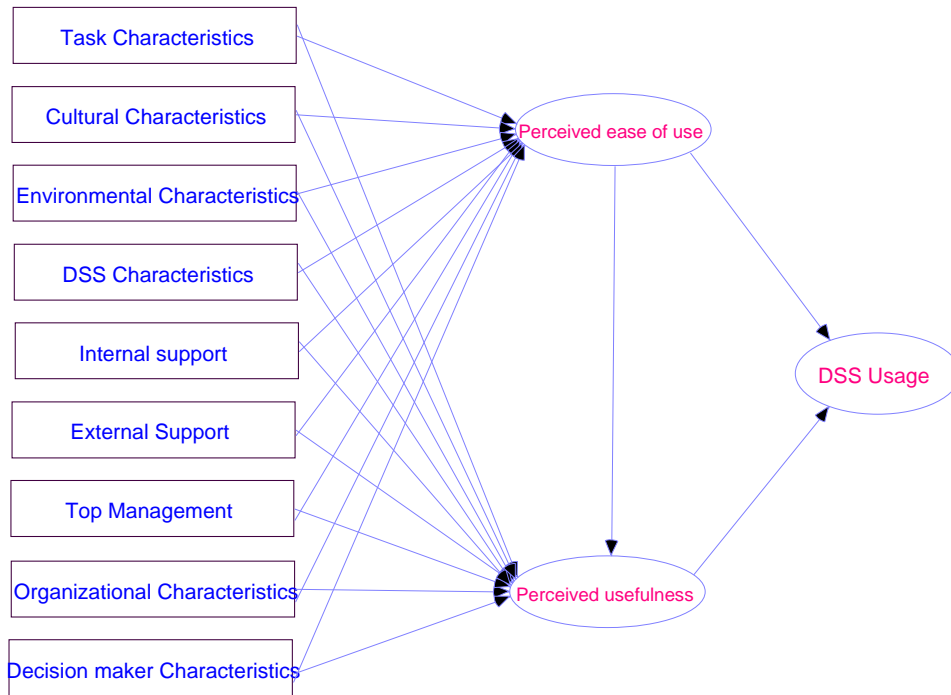


Figure 1: Conceptual DSS Usage Model for SDM in Egypt

Task Characteristics

Most strategic decisions are characterised by uncertainty and complexity (Kivijarvi & Zmud, 1993). Increasingly complex decisions require significant expertise, insight and intuition, and may be made more effectively using information systems. However, with highly complex decision situations, ‘the answers are obtained through subjective opinions rather than from objective data’ (Daft & Lengel, 1986). Previous studies in end user computing have shown that PU and PEU are influenced by task/tool fit (Keil et al, 1995).

In laboratory studies, the effectiveness of DSSs increased with increasing task complexity (Webby and O'Connor, 1994). Blili et al (1998) found that the more complex the task, the more alleviation would be sought using end-user computing (EUC). However, they also suggest that increased task uncertainty reduces the perceived importance of EUC. So if the decision makers perceived DSS as a supporting tool in complex and uncertain situations their usage of the systems will increase specially if they realise that the system is easy to use. Based on this it is reasonable to assume that task characteristics will influence PU and PEU. Hence:

H1. Perceived ease of use and perceived usefulness of decision support systems fully mediate the influence of task characteristics variables on usage of DSS.

Cultural Characteristics

Cultural factors are increasingly cited as significant influences on IT adoption. Leidner et al (1995) suggested that cultural differences need to be understood before IT developed in one country can be implemented in another. Group Decision Support Systems were not as well received in an Asian country as in the US because of different attitudes towards the appropriateness of expressing disagreement. A comparative analysis of management information systems success between the US and Latvia suggested that Latvian managers with extensive experience under the Soviet management model were less likely to participate in information system development for fear of being seen as incompetent (Ishman et al, 2001). From studying the transfer of IT to the Arab world, Straub et al (2001) suggest that specific components of Arab culture have an influence on how IT is viewed and the extent to which it might be utilised. Kambayashi and Scarbrough (2001), in a comparative survey of managers in UK and Japanese firms, found a greater willingness to use information sharing systems in the UK than in Japan. They conclude that national cultural attributes may influence managerial preferences for the use of information.

In studying cultural effects, Hofstede's four dimensions of culture provide an influential benchmark. Straub et al (1997) applied the four cultural dimensions of power-distance, uncertainty avoidance, individualism and masculinity to predict whether TAM would transfer across different cultures represented by the US, Switzerland and Japan. Here the cultural dimension served to provide a cultural classification rather than any causal link to TAM. Their findings suggested that TAM might not transfer across cultures since it appeared not to predict technology acceptance in Japan. Veiga et al (2001) propose extending TAM using individualism, uncertainty avoidance, and power distance, together with Hofstede's fifth construct, short/long term orientation as constructs influencing PEU and PU. They argue that cultural characteristics will influence the core variables of TAM.

Since the adoption of IT in a non-western culture is a core theme of this paper, it seems sensible to suggest that cultural influences will affect PU and PEU. Hofstede's dimensions of culture were used as a basis for testing this construct, since they are widely accepted. Hence:

H2. Perceived ease of use and perceived usefulness of decision support systems fully mediate the influence of cultural characteristics variables on usage of DSS.

DSS Characteristics

Previous studies have found that certain DSS characteristics seem to have an important influence on the effectiveness of the systems: user-friendliness; ease of use; size (cost) of DSS; range of alternatives; timeliness, accuracy and relevancy of output (Igbaria, Pavri, & Huff, 1989; Udo & Davis, 1992a; Udo & Davis., 1992b). Also some researchers attempting to measure IS success have put forward factors related to DSS characteristics like system quality, information quality, information use and user satisfaction with the information (DeLone & McLean, 1992; Li, 1997). The technical quality of the DSS may influence DSS usage. Indeed, it is clear that the quality and accessibility of the information provided by the DSS is important (Kraemer et al., 1993). Low technical quality, whether real or imagined may influence DSS usage.

Gupta and Nemati (1999) highlight the operational integrity, performance and reliability of a DSS as important factors affecting successful implementation. Whether perceptions of technical quality are gained through rumours or through formal evaluation processes, inadequate data storage, modelling capacity, processing speed, accessibility and reliability may influence PEU and PU, hence:

H3. Perceived ease of use and perceived usefulness of decision support systems fully mediate the influence of DSS characteristics variables on usage of DSS.

Environmental Characteristics

In the local authorities, the political environment represented by centrally imposed laws, strategies and policies is of great significance. The government plays a major role in local authorities in both developed and developing countries, as regulator and/or investor (Blanning, Bui, & Tan, 1997). In Egypt the government dominates the shape of IT development in the country, so control over the computing infrastructure has frequently been associated with the political control of information, particularly to reinforce the power of the government (Nidumolu et al., 1996). The government in Egypt is highly centralised and the public administration system is still dominant. So the heads of cities ought to closely follow the central government plans and priorities and therefore most of the important decisions are made centrally. Because of lack of incentive to use the systems by decision makers in local authorities, ease of use might play an important role as internal incentive to use the system. Both "favourable government policies" and "uncertainty in environment" have been identified as key facilitators of the strategic use of IT (King & Teo, 1996). Hence, environmental characteristics were proposed as an antecedent:

H4. Perceived ease of use and perceived usefulness of decision support systems fully mediate the influence of environmental characteristics variables on the usage of DSS.

Organisational Characteristics

Many studies have investigated the influence of organisational attributes on the effectiveness of information systems in general (Cheney, Mann, & Amoroso, 1986; Lind, Zmud, & Fischer, 1989) and DSS in particular (Guimaraes, Igarria, & Lu, 1992; Sanders & Courtney, 1985). Nidumolu et al. (1996) noticed that, in the Governorates project, training associated with computers and problems analysis had to be centralised in Cairo because of lack of local computer training facilities and trainers. Organisational characteristics may also include extent of centralisation of management structure and hence of planning, and the level of communication of information occurring within the organisation.

H5. Perceived ease of use and perceived usefulness of decision support systems fully mediate the influence of organisational characteristics variables on usage of DSS.

Internal Support Characteristics

Internal support given to decision makers within the organisation either through training within the organisation or other sources of support may be a significant influence on PE and PEU. That internal support may come from formal channels such as IT training, or informal support from other colleagues who are using the system. Aladwani (2002) found that, in Kuwait, internal computing support did not positively influence end-user computing. Furthermore, Young and Watson (1995) did not find that the level of internal support influenced EIS acceptance. We would suggest that internal support including the availability of experienced DSS staff, training opportunities and a network of supportive colleagues would be a significant influence on the executive perception of the usefulness of the DSS and its ease of use and hence it might affect the level of DSS usage. Based on this it is reasonable to assume that internal support characteristics will influence PU and PEU. Hence:

H6. Perceived ease of use and perceived usefulness of decision support systems fully mediate the influence of internal support characteristics variables on usage of DSS.

External Support Characteristics

Due to insufficient internal technical expertise, especially in developing countries, the availability and quality of external support may be an important determinant of DSS effectiveness in strategic decision making. Recommendations from outside consultants were found to be an important variable in using IT strategically (Neo, 1988). Past research suggests that when new computer-based technology is complex and the related knowledge is difficult to transfer, mediators (i.e. vendors and consultants) play an important role in the diffusion of the technology (Attewell, 1992). Good relationships with external vendors or consultants are a facilitator of success in end user computing (Shayo, Guthrie, & Igbaria, 1999). Good vendors may act as surrogate IT departments, providing business-specific advice and technical support. Perceptions of usefulness may be influenced by the rhetoric and comments of both government agencies and suppliers; this in turn might increase the effective usage of DSS. Based on this it is reasonable to assume that external support characteristics will influence PU and PEU. Hence:

H7. Perceived ease of use and perceived usefulness of decision support systems fully mediate the influence of external support characteristics variables on usage of DSS.

Decision Maker Characteristics

The importance of decision maker characteristics as determinants of information systems success has been emphasised by several authors (Guimaraes et al., 1992; Igbaria et al., 1989; Sanders & Courtney, 1985). Babcock et al (1995) concluded that organisations that enjoy a higher level of IT use tend to have managers who have

positive attitudes toward IT. They concluded that this positive attitude did not grow with age, but was obtained through education. Chen and Lee (2003) emphasise the importance of decision makers' cognitive style, beliefs and assumptions about how the world works. The decision maker's attitude to DSS is likely to be expressed in terms of their perception of usefulness and ease of use. This in turn may affect their level of usage. Hence:

H. 8 perceived ease of use and perceived usefulness of decision support systems fully mediate the influence of decision maker characteristics variables on the usage of DSS.

Top management support characteristics

It is important that top management participation be active, and not merely symbolic. Simply giving the go-ahead for the DSS implementation in the organisation is not sufficient (Ang & Teo, 1997). Some of the ways that top management can demonstrate its support could be by providing the necessary resources and leadership, by setting goals and policies for DSS and showing interest by participating in DSS design and development (Ang & Teo, 1997; King, 1996). In one case study of EIS implementation, the managing director of a communications company perceived EIS to be useful and encouraged its development and adoption by senior executives, since it suited his management style. His successor, whose focus was on marketing rather than trend analysis, did not see any value in an EIS and its use soon halted (McBride, 1997). Senior management support is recognised as an important factor in IT adoption. For example, Nasirin and Birks (2003) report that senior management awareness of the benefits of DSS was a leading factor in ensuring smooth system implementation. The pilot study found that some heads of cities became hands-on users of the DSS while others depended on reports from the system provided by IT specialists. In both cases the exposure to the DSS influenced their perception of the usefulness of the DSS and their judgement of the business benefits of the DSS and hence the extent of their support for the use of the DSS within their organisation. Since the importance of top management support is widely recognised, it features in this model:

H9. Perceived ease of use and perceived usefulness of decision support systems fully mediate the influence of top management characteristics variables on usage of DSS.

RESEARCH METHOD

Preparing the Questionnaire

Items to measure the selected external variables were developed from a synthesis of a combination the extant literature and interviews carried out during an early pilot study in Egypt. Discussion with academics and IT practitioners led to the development of draft questions for each construct which were validated by academics who were interested in the area of DSS in a five universities in America, Australia, UK, Israel and Egypt. The revised questions were then translated into Arabic using the back

translation technique (Brislin, 1986). Further revision of the questionnaire occurred following a pilot study conducted on a number of senior executives and IT managers in local government in Egypt.

Sample and Procedure

The revised questionnaire was sent to a sample derived from the directory of DSS units in the local governments issued by IDSC which included all local authorities and units of DSS in each governorate all over Egypt as indicated in Table 1 below.

Table 1: Profile of DSS units in local Governorates

No.	Governorate	DSS Unit	Employees	Computers
1	Ministry of village development	3	17	21
2	Trustee of Local Management.	1	10	10
3	Cairo	41	386	146
4	Giza	44	352	167
5	Kalubya	60	363	94
6	Alexandria	25	208	124
7	Beheira	96	624	191
8	Matrough	18	86	39
9	Menouffia	35	300	77
10	Gharbeya	79	512	45
11	Kafr El Sheik	59	373	98
12	Damietta	24	197	68
13	Dakhlia	76	616	146
14	North Sinai	33	142	92
15	South Sinai	20	84	57
16	Port Said	20	82	67
17	Ismailia	40	163	116
18	Suez	18	80	65
19	Sharkia	73	371	155
20	Bani Suef	31	192	45
21	Fayoum	29	186	79
22	Menia	39	232	114
23	Assiut	97	477	169
24	New Valley	22	137	49
25	Red Sea	13	62	55
26	Souhag	76	411	199
27	Kena	67	344	101
28	Aswan	48	232	120
29	Luxor	15	61	38
Total		1202	7300	2668

Source: IDSC in 1/11/1998

Over a two month period, 450 questionnaires were personally delivered to Governorates across Egypt. Some questionnaires were posted to remote Governorates. This effort resulted in a high response rate (68%). Of 309 questionnaires returned, 294

(about 73.5%) were valid and 12 incomplete. To ensure that the valid responses were representative of the larger population, a non-response bias test was used to compare the early and late respondents. χ^2 tests showed no significant difference between the two groups of respondents at the 5% significance level, implying that non-response bias is not a concern. Additionally, 12 interviews were undertaken with the CEO and IT staff in local governments in Egypt to validate the data collected by questionnaire.

Data Analysis

Cronbach's coefficient α was used to assess the reliability of all multi-item scales. All scales showed reasonable reliability (Ramaprasad, 1987), ranging from 0.65 for task characteristics to 0.81 for external support characteristics (Table 2). It should be noted that not all exceed Nunnally's (1967) generally accepted alpha level of 0.7.

Table 2: Cronbach's coefficient α for constructs

Factors	α
DSS usage (3 items)	0.70
PEU (6 items)	0.69
PU (7 items)	0.72
Task characteristics (5items)	0.65
Cultural characteristics (4 items)	0.78
DSS characteristics (12 items)	0.68
Environmental characteristics (4 items)	0.71
Organisational characteristics (7 items)	0.78
Internal support characteristics (5 items)	0.74
External support characteristics (3 items)	0.81
Decision maker characteristics (12 items)	0.68
Top management support (6 items)	0.79

Following Taylor & Todd (1995), because of sample size limitations, multi-item constructs for the external variables were measured using a summated scale derived as the average value of all items pertaining to these constructs. The AMOS 4.0 program (Arbuckle & Wothke, 1999) was used to test the hypothesised linear effect of each group of variables on PEU, PU and DSS usage.

The hypothesised research model is shown in Appendix 2. The goodness of fit measures for this model, summarised in Table 3, indicated a significant $\chi^2 = 245.207$, $df = 226$, $p = .181$. This result indicated a good fit, as the probability level was above the generally accepted critical value $p = .05$, and hence supported the research hypotheses.

Table 3: Fit measures for the research model

Fit Measure	Research model characteristics
Discrepancy (CMIN)	245.21
Degrees of freedom	226
P	0.18
Number of parameters (NPAR)	123

Discrepancy / df (CMINDF)	1.084
NFI	0.66
GFI	0.95
Adjusted GFI	0.91
Parsimony-adjusted GFI	0.65
Normed fit index (NFI)	0.68
Relative fit index (RFI)	0.55
Incremental fit index (IFI)	0.96
Tucker-Lewis index (TLI)	0.94
Comparative fit index (CFI)	0.95
Parsimony ratio (PRATIO)	0.75
Parsimony-adjusted NFI (PNFI)	0.50
Parsimony-adjusted CFI (PCFI)	0.72
RMSEA (PCLOSE)	0.02
P for test of close fit	1.00

Each construct was individually tested in the model. The results are shown in Table 4 and indicate a significant fit and supported the hypotheses. Additionally, the parameter estimates and their T-values are shown in Appendix 3.

Table 4. Hypotheses testing results

Hypothesis	χ^2	probability	DF	Variance
Task characteristics	77.604	0.310	169	1.6
Cultural characteristics	159.859	0.237	148	1.4
DSS characteristics	283.041	.239	267	1.05
Environmental characteristics	166.829	.300	158	1.2
Organisational characteristics	201	.402	197	1.2
Internal support characteristics	173.021	.442	171	1.00
External support characteristics	168.819	.077	144	.96
Decision maker characteristics	292.842	.124	266	1.10
Top management characteristics	199.883	.231	186	1.10

The results of this research showed that PEU's total, direct and indirect, effect on DSS usage was 2.36 (variance, 1.5) while PU was -0.41 (variance, 1.5) (Table 5). Additionally, three external factors had a negative impact on DSS usage. The implications of these results are discussed below.

Table 5. Total effect of factors on DSS usage

Perceived Ease of Use	2.36
Top Management Support	0.188
Organisational characteristics	0.112
Decision maker characteristics	0.076
Internal Support characteristics	0.017
External Support characteristics	0.012
Cultural characteristics	0.002
Environmental characteristics	-0.02
Task characteristics	-0.091
DSS characteristics	-0.116
Perceived Usefulness	-0.41

DISCUSSION

The purpose of this study was two fold. Firstly, the study confirmed the validity of the adapted TAM in a developing country. In contrast to previous studies, a specific application was selected which was developed in the developing country and then rolled out across the country to all districts. This focus enabled the study of a more homogenous population of users of a single application while accessing a relatively large population. The application was in use by staff whose tasks were influenced by it, hence actual use could be measured, rather than intention to use. Secondly, the study extended TAM by identifying and exploring a set of external variables which may determine PU and PEU. Once PEU and PU are confirmed as determinants of system usage, the study of the factors which influence the user's perception is essential to explaining why a particular user perception of usefulness and ease of use should develop and what, practically, can be done to alter that perception. The nine antecedents selected are considered the most probable influences but the list of factors is neither definitive nor exhaustive.

Validating adapted TAM in Egypt

Rose & Struab (1998) point out that a majority (more than 70 studies) of TAM studies have been done in the developed world. A few studies have used TAM outside the developed world (Doll, Hendrickson, & Deng, 1998; Ghorab, 1997). Therefore there is a need to accumulate further studies to indicate the general applicability of TAM.

This study confirmed Rose and Struab's finding that TAM transferred successfully to the Arab world. Furthermore, Perceived Usage (PU) and Perceived Ease of Use (PEU) showed a significant direct effect on DSS usage at 0.001 and 0.10 levels and in consequence confirmed all earlier cited studies about TAM (Davis, 1989; Igbaria, Zinatelli, Cragg, & Cavaye, 1997). As TAM proposes, both PU and PEU are important in technology acceptance and usage. However, their relative importance in the acceptance process has been shown to be different in previous studies. For instance, Davis (1993) found that usefulness dominated ease of use, whereas Adams, Nelson and Todd (1992) found ease of use to be more influential than usefulness. In

this study, the fitness of the model was substantially reduced when the link between PEU and PU was removed. This indicates that PEU dominated PU.

Furthermore, the application of an adapted TAM to the actual use of a DSS in a large organisation extends the validity of TAM since most empirical studies of TAM have examined relatively simple end-user technologies, often in controlled environments.

The contrasting positive effect of PEU (2.36) on DSS usage and negative effect of PU (-0.41) may suggest that decision-making managers in local authorities are more likely to use DSS technologies on the basis of ease of use and user friendliness rather than because of the functions it performs for them. Decision makers with difficulties in using the system might, as a consequence of their lack of skills training, be discouraged from using the system and may not be able to observe the potential benefits. This emphasises the importance of having features and services to support the usability of an information system. This result is also consistent with Agarwal & Prasad, (1999) where ease of use predicted usefulness. A bias towards seeing the DSS more as a vehicle for publicity and increasing the political prestige of senior managers rather than seeing it as technically useful may explain the dominance of PEU. This result is also consistent with Nidumolu et al. (1996).

Factors Affecting DSS usage

The study showed that the external variables played a significant role in explaining DSS usage in the context of the model, mediated by PEU and PU. It suggested that top management support, organisational characteristics, decision maker characteristics, internal support characteristics, external support and cultural characteristics in order were the most positive significant influences of DSS usage.

Environmental characteristics and task characteristics had a negative effect on DSS usage. The function of a DSS is to provide relevant information to enable decision makers to determine considered solutions for less-structured problems. The use of a DSS assumes that the decision maker has a significant amount of independence in using his/her judgement to make decisions. If that autonomy is absent or limited, then the DSS usefulness is substantially reduced. So the DSS depends on a particular type of organisational environment which may in itself be culturally influenced. A DSS may not only require an organisational environment which encourages individualism and autonomy, but may also catalyse autonomy in that it provides information which reduces the decision maker's dependence on organisational structures.

Interviews suggested that most of the important decisions were made by the centralised government and local decisions were quite simple, although qualitative in nature. The organisational structure of Egyptian government is based more on a hierarchy of power vested in individuals. This culture, which reflects Egyptian culture, means that decisions are handed down a chain of command and expected to be implemented. Indeed, the spread of the DSS in this study was influenced by the culture of command and control. Hence there is a paradox, in that an information system which needs individualism to be effective is being rolled out in a culture that is characterised by a lack of autonomy and significant power distance. In such an environment, task complexity may be low, since a significant element of local

management involves implementing centrally-made decisions, and hence the perceived usefulness of the DSS is reduced.

An analogous initiative in Egypt's Ministry of Education, the Technology Development Center, involved establishing multimedia centers and computer laboratories in secondary schools. These centres were rarely used, except for special occasions (Warschauer, 2003). The Egyptian educational system is hierarchical to the extreme, with long chains of command and only the top level able to make decisions. In one case, a request of a teacher to see a copy of a CD that he uses in the school could only be granted permission by the vice-minister for education. Technology was serving purpose of hierarchy and transmission, rather than horizontal networking (Warschauer, 2003).

If strategic decisions are being made by stakeholders higher up the hierarchy and being transmitted to the executives, then the executive's involvement concerns interpretation of that decision, rather than making it. In that context, information held in the DSS will have little bearing on the outcome of the decision making process. This may explain this negative relationship between PU and top management support. Hence the study suggests that the championing of a DSS by top management may not be effective unless subordinates are given sufficient managerial autonomy to justify its use. Encouragement to use a DSS, involving marketing the system, providing the resources to buy the system and providing technical support will not be fruitful unless the business environment which catalyses its use is also provided.

A DSS not only carries in it assumptions about who will make decision and their autonomy, but also assumptions about how decisions will be made and in what business context. The DSS may encourage, if not assume, the rationalisation of the decision making processes, such that decisions result from an objective analysis of the provided information. If the local, culturally determined, decision making style is less formal, more subjective and depends on power hierarchies and social influence, then the perceived usefulness of the DSS may be low.

Egyptian culture is less inclined to use systematic and formal planning procedures than its Western counterparts. Decision makers will rely more on extrapolations from experience and intuition. Strategic decisions in most of the Egyptian cities are made by powerful individuals (rather than groups) who frequently rely on personal knowledge and intuition rather than objective criteria or formal and quantitative methods (Moores & Gregory, 2000; Seliem, Ashour, Khalil, & Millar, 2003). One of the DSS staff expressed his negative feelings about the way that decision makers made their decisions, stating that:

"Most managers seek the information that they need in their own personal way. Much of this information remains in a soft form, in the mind of the manager, and is verbally communicated mainly in private meetings rather than written memos or reports. In the formal meetings, employees will compete for privileged confidence of the boss and manoeuvre to get close to him by [expressing] agreement with what he is saying and the decision will be in the end what the boss thinks is right and suitable according to his viewpoint "

The DSS studied here had been developed indigenously within Egypt and was not commercial off-the-shelf (COTS) software imported from the west. However, the development was led by a western-trained software engineer (El Sherif & El Sawy, 1988; El Sherif, 1990). Rose and Straub (1998) highlight the fact many students from developing countries attend Western universities and then go back to their home countries. As such western philosophies concerning business processes, formal decision-making, the software development process and the purpose of the information system are imported into the development and implementation of the DSS. Such local technical leaders, on returning from western universities and commercial companies, transmit cultural assumptions about technology. Heeks (1999) suggests the need to develop indigenous software development in which the cultural sensitivities of the local environment are reflected in the software.

If the DSS reflects ways of thinking which are basically foreign to the Egyptian nationals, and places a value on the formalisation of information and decision-making which is foreign to the Egyptian civil servants, then those executives, feeling culturally lost when faced with using the DSS, are likely to look outside their own organisation for support. Hence the extent of external support, which will essentially be providing cultural education in the westernising of business and decision-making processes, will strongly influence whether the system is useful and can indeed be used at all. Results suggested that external support was seen as more influential than internal support.

External support may not be subject to the cultural norms which drive the organisation internally. Advice from an external consultant may be more easily accepted than internal advice, particularly in a hierarchical organisation where status and position is of significant importance. Interviews suggested that internally in the organisation there were significant cultural barriers arising from the power distance between chief executives and more junior IT managers. The head of one city council stated:

"DSS and IT in general is like a sledge hammer waiting to fall on our heads. We have managers that think they know how to use it and don't. They trained the IT staff to use this system but not the city managers. And if any one is going to train me around its use, it is better to be an experienced head of city council who has used the system. I don't understand why we needed it, what it can do for us, so I have no intention to use it".

Furthermore, the effectiveness of internal support may be limited by resources as well as cultural norms. While in some private organisations, internal computing support may be a significant positive factor, the same may not apply in public institutions, particularly in developing countries, where staffing may be inadequate and skill levels low. It may be that such a lack of formal support forces users to rely in their own personal networks. One participant suggested that he depended totally on his own self development in relation to DSS and he *"used his own personal connections to get the facilities for his department"*.

However, interview participants expressed dissatisfaction with vendor support. One of the participants said:

"We were wrong to depend on the help that we get from the vendors, because all what they care about is to get the goods delivered and that's it in most cases. This may be because most of them are agencies serving many manufacturers. So they are all salesmen and do not have real expertise"

It is reasonable to assume that the experience, attitudes and management style of the DSS user will influence their perception of the DSS, the extent to which they use the DSS and the usefulness of the DSS in producing effective strategic decisions. Like many information systems, the benefits attained from a DSS may be limited by inadequacies in the user.

The role of the military is significant as a socialisation agent and in managing public sector activities (Gotowicki, 1997). The decision makers in local government in Egypt tend to be ex-military staff, appointed centrally, with little awareness of IT. One ex-army city executive stated:

"As you see I am in my early fifties. At the time when I graduated from university none of this type of knowledge was available. According to my experience, I used to make decisions according to rules and regulations. When I heard about DSS I read a book about it and I did not feel that it could do much for me. I am willing to learn even at this age but when I find the proper way of doing that"

If the attitudes of the users are influenced by their background and by the national culture, the background and culture will influence their perception of the value of the DSS.

CONCLUSIONS

This study confirmed the validity of extending the applicability of the adapted TAM to predict the actual usage of DSS in this type of environment. The study showed that managers in local authorities are more likely to use DSS on the basis of PEU rather than PU. This emphasises the importance of having services within and outside the organisation to support the usability of information systems. The study also contributes to a move in TAM research away from confirming the relevance of PEU and PU to technology adoption towards identifying the influences on the participants' perception of ease of use and usefulness. This study identified some of the influencing external factors that could affect the usage of DSS in local authorities in less developed countries, mediated by PEU and PU. Top management support, organisational characteristics, decision maker characteristics, internal support characteristics, external support and cultural characteristics were all influential in encouraging DSS usage. In contrast, environmental and task characteristics negatively affected DSS usage.

In conjunction with interviews, the quantitative results suggest that there is a mismatch between the autonomy and independence in decision-making that the DSS supports and the hierarchical command and control culture prevalent within the Egyptian public sector. Furthermore, the nature of Egyptian culture may inhibit junior staff from seeking internal support.

This study indicates the importance of taking into account external factors when examining IT technology adoption globally. In particular, many aspects of culture, not only defined as cultural characteristics, but also influenced through top management support, organisational characteristics and the background and characteristics of the decision-maker will strongly influence the perception of management support systems.

LIMITATIONS

Further development of the instrument used in this study would be desirable. Although, validated, results suggest some difficulty with measuring task, DSS and decision maker characteristics. Rose and Straub (1998) raise concerns about culturally-dependent bias in Arab respondents which may apply to this study. In addition, no attempt was made to differentiate between the response of chief executives of local authorities and the DSS managers. Interviews suggested they may sometimes take different views of DSS usage. Furthermore, generalisation of the results for Egypt to the rest of the Arab should not be taken for granted. While Hofstede (1997) grouped all Arab countries in one category, each country still has its own unique social, political, and cultural structure.

FUTURE RESEARCH

This study suggests a range of implications for further research. Firstly, both the quantitative and qualitative aspects of this study indicated the importance of cultural influences on DSS usage. As significant work is developed in this area and applied to TAM (Straub et al, 1997; Veiga et al, 2001) there will be a need to expand the repertoire and depth of cultural models which provide the basis for exploring IT adoption amongst different countries. The variables described by Hofstede (1997) provide a coarse model on which it would be unwise to depend. Such universal measures are crude and sweep the subtleties of cultural difference under the carpet (Walsham, 2001, p188). A whole raft of other cultural attributes such as criticism avoidance, respect, consideration and patronage need to be considered. Hence attention should be paid to developing richer cultural constructs which may give deeper understanding of the cultural determinants of IT adoption and usage. In addition, models of power should be explored and power constructs developed in order to understand and test the influence of power on IT adoption across cultures. Secondly, the unidirectional nature of the model in which the external variables influence PU and PEU, and PU and PEU influence DSS usage omits the interaction between external variables and any feedback from actual DSS usage. Culture may influence organisational characteristics, which in turn influences the decision maker's characteristics. Top management may influence the culture. The external influences on TAM may be better portrayed as a web of influences, which would require more complex models to represent. There is a clear need to understand the interaction between variables, which may in themselves be closely coupled. Thirdly, there is a need to study the culture of the software itself. The way it represents information and dictates processes may be culturally determined. This needs to be recognised when software is being distributed globally. The culture of the software may be compared to the local culture in order to identify points of conflict

and understand the issues which may result in local non-acceptance of the globally distributed software.

Finally, an understanding of the interaction between local and global factors may be a key element in global information management studies. IT adoption may be affected by both global networks of interacting factors and local networks. Studies which focus on the interface between global and local influences on IT adoption may help in identifying what managerial and technical actions are needed to make globally distributed software sensitive to local requirements arising from culture, business processes and attitudes to technology.

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Appendix 1

Questionnaire items used to measure antecedent constructs influencing PEU and PU.

For each statement respondents were asked to indicate their agreement that the characteristic influences the use of the DSS in making strategic decisions on a five-point Likert scale from strongly disagree (1) to strongly agree (5).

1. Task characteristics.

Complexity of problem or issue recognition
Complexity of analysis and evaluation of alternatives in strategic decisions
Complexity of choice and implementation in strategic decisions
Strategic decision processes as a whole are too complex to be computerised
Strategic decision making tasks are too 'person centred' to be computerised

2. Cultural characteristics

Individualism (extent to which people act solely in their own interest).
Masculinity (extent to which assertive behaviour is desired over modest behaviour).
The cultural gap among decision-makers and DSS staff (education, training, experience and background).
Uncertainty avoidance (extent to which people feel uncomfortable with uncertainty).

3. DSS characteristics

Overall cost effectiveness of DSS
Ease of use of DSS.
Adequacy of DSS's data storage capacity.
Adequacy of DSS's modelling capacity.
Adequacy of DSS's processing speed.
Accessibility of DSS.
Ease of use of built-in help facility for assistance.
Usage of DSS is voluntary/compulsory.
DSS meets the requirements of decision-makers.
DSS reliability.
Ease of finding the required data.
Tangible/intangible benefits of DSS usage.

4 Environmental characteristics

Competition among local governments
Favourable government policies.
Uncertainty in local government environment.
Favourable market conditions.

5. Organisational characteristics

Size of the organization

Location of DSS staff /department in the organisational structure.

Degree of decentralisation.

Information intensity.

Integration among departments in relation to data/information exchange and sharing experience.

Planning integration between using DSS and overall planning process.

Computer facilities

6. External support characteristics

Recommendations from outside consultants.

Advice and support from the vendors.

Support from government agencies.

7. Decision-maker characteristics

Years of experience.

Cognitive style (analytical/heuristic)

Self-efficiency.

Attitudes towards DSS.

Involvement in the development of DSS

Level of training and education.

Innovativeness of decision-maker.

Fear from using DSS in making strategic decisions

Familiarity with DSS usage.

Ability to interpret DSS output.

Ability to change and use new methods to make strategic decisions.

Confidence in DSS usage

8. Internal support characteristics

Training/consultation within organization.

Advice provided by other colleagues/friends.

Providing library (books and software manuals).

Access to help desk or hotline.

Experience of DSS staff in implementation of DSS technology and supporting decision-makers.

9. Top management characteristics

Top management understanding of DSS.

Rewarding efforts of using DSS to meet set goals at sectional, department, divisional, and corporate level.

Setting policies and goals for DSS

Offering funds

DSS design and development

Developing a core of internal experts who will train others (local resident expert).

Appendix 3

Regression Weights for the Research Model

		Estimate	SE	P
PEU	← External support	0.10	0.07	0.14
PEU	← Internal support	-0.04	0.08	0.62
PEU	← Top management	0.24	0.10	0.02**
PEU	← Decision maker	0.00	0.11	0.98
PEU	← Culture	-0.05	0.06	0.43
PEU	← DSS	-0.17	0.12	0.17
PEU	← Environmental	0.04	0.09	0.64
PEU	← Organisational	-0.05	0.08	0.56
PEU	← Task	0.01	0.07	0.92
PU	← Decision maker	0.51	2.89	0.86
PU	← Top management	-6.15	59.56	0.92
PU	← Internal support	0.79	9.70	0.93
PU	← External support	-2.80	25.16	0.91
PU	← Organisational	1.72	12.26	0.89
PU	← Environmental	-0.93	10.24	0.93
PU	← DSS	4.95	42.34	0.91
PU	← Culture	1.23	11.41	0.91
PU	← Task	-0.09	2.70	0.97
PU	← PEU	26.77	250.75	0.91
DSS usage	← PU	0.72	0.21	0.00***
DSS usage	← PEU	0.95	0.54	0.08*

Note: Data are maximum likelihood estimates. Estimates without a P value are fixed parameters. P values significant at 0.10 are followed by *, at level 0.05 followed by ** at level 0.001 followed by ***.

Estimates of correlations among exogenous variables

EXTERNAL <--> DMCHARAC .005
INTERNAL <--> DMCHARAC .115
TOPMANAG <--> EXTERNAL .103
INTERNAL <--> TOPMANAG .017
TOPMANAG <--> DMCHARAC .145
INTERNAL <--> EXTERNAL .016
TASK <--> CULTURE -.019
TASK <--> DSSCHARA -.099
TASK <--> ENVIRONM -.005
TASK <--> ORGANISA -.083
EXTERNAL <--> TASK -.158
DMCHARAC <--> TASK .001
INTERNAL <--> TASK -.027
CULTURE <--> DSSCHARA .003
CULTURE <--> ENVIRONM .015

CULTURE	<-->	ORGANISA	.020
EXTERNAL	<-->	CULTURE	-.038
DMCHARAC	<-->	CULTURE	.040
INTERNAL	<-->	CULTURE	-.080
TOPMANAG	<-->	CULTURE	-.107
DSSCHARA	<-->	ENVIRONM	.178