FACTORS ASSOCIATED WITH INFORMATION AND COMMUNICATION TECHNOLOGY APPLICATIONS IN DECISION MAKING

Noreha Mohamed Yusof[1], Chooi-Leng Ang[2]
Faculty of Quantitative Sciences, Universiti Utara Malaysia,
06010 UUM Sintok, Kedah Darul Aman, Malaysia.
E-mail: [1]noreha@uum.edu.my, [2] ang@uum.edu.my

Abstract: The rapid and pervasive growth of Information and Communication Technology (ICT) has forced organizations worldwide to re-examine the role of ICT in supporting their business goals. The aim of this study was to determine factors associated with the use of ICT in decision making among the listed organizations on Kuala Lumpur Stock Exchange (KLSE). Three categories of contextual factors, namely organizational, technical and process were examined to determine if their affect ICT applications in decision making. The results revealed that process factors, specifically data support was associated with the use of ICT even through support from top management, incentive from the government, team working and friendly output formats were perceived to help promote the use of ICT in decision making among the responding organizations.

Keywords: Information and Communication Technology (ICT), Decision Making, Decision Support Systems (DSS)

Abstrak: Perkembangan pesat Teknologi Maklumat dan Komunikasi (ICT) memaksa organisasi di seluruh dunia menitikberatkan peranan ICT dalam menyokong matlamat perniagaan mereka. Tujuan penyelidikan ini adalah untuk mengenal pasti faktor-faktor yang berkaitan dengan penggunaan ICT dalam pembuatan keputusan oleh syarikat-syarikat yang tersenarai di Bursa Saham Kuala Lumpur (BSKL). Terdapat tiga kategori faktor iaitu organisasi, teknikal dan proses dikenal pasti diuji samada terdapat kesan ketiga-tiga faktor ini dalam penggunaan ICT semasa pembuatan keputusan. Hasil kajian mendapati faktor proses khususnya sokongan data berkait rapat dengan penggunaan ICT sungguhpun faktor sokongan daripada pihak atasan, insentif daripada kerajaan, kerjasama dalam kumpulan dan format output yang mesra pengguna telah dilihat dapat membantu penggunaan ICT dalam membantu keputusan di kalangan organisasi kajian.

Kata kunci: Teknologi Maklumat dan Komunikasi (ICT), Pembuatan Keputusan, Sistem Sokongan Keputusan

1. Introduction

Decision making was formally defined by Herbert Simon (Mallach, 2000). According to Simon, every decision must go through the three phases which are intelligence, design and choice. The duration spent on each phase varies depending on the decision maker himself and also the nature of the decision being made. ICT affects and influences people make decisions (Yu & Chiang, 2002). This issues has been widely discussed (e.g. Hedelin and Allwood, 2002; Pereira, 1999; Udo, 2000; Feraud, 1998 and Chow, 2001).

ICT provide managers with capability to access internal and external information that is relevant to decision making (Nord & Nord, 1995). Advances in ICT also enhance the possibilities of collecting data and generating information for supporting marketing decision making (Bruggen, Smidts & Wierenga, 2001). This has a positive impact on decision making performance. A review of literature has revealed that many factors affect the success or failure of an information system. However, among these factors, some might influence ICT use in decision making and DSS while others might not. In this study, we regrouped the factors into three major categories: organizational, technical and process.

1.1 Organizational Factors

Liang and Hung (1997), Hedelin and Allwood (2002), Ang, Davies & Finlay (2001a) have studied factors that affected IT applications in a company. The factors that might affect ICT use in decision making were: experienced model builders or IT expertise (Othman et al., 1996; Ang et al., 2001a), support from top management (Ang et al., 2001a; Liang & Hung, 1997), availability of technical support (Hedelin & Allwood, 2002), proper user training (Ang et al., 2001a), team working such as willingness to cooperate among cross-functional members (Purba & Shah, 2000) and maturity of IS application (Hedelin & Allwood, 2002; Liang & Hung, 1997).

Bruggen et al. (2001) found that the environment in which the decision-maker is operating and the decision maker who uses the system affect system use. Furthermore, Othman et al. (1996), Buttery and Tamaschke (1995), Wang (1994) and Gray (2001) have found that it might be relevant for the managerial personnel to have some IT training due to the increase ICT usage opportunities.

Table 1 summarises the literature on organizational factors:

Table 1: Summary of the literature on organizational factors

Factor	Source
• Experienced model builders	Othman et al., 1996 Ang, Davies and Finlay, 2001b Bruggen et al., 2001
• Support from top management	Liang and Hung, 1997 Ang et al., 2001a
• Incentive from the government	Matthew Mok, 2002
• Availability of technical support	Hedelin and Allwood, 2002
• Proper user training	Ang et al.,2001b Othman et al.,1996 Buttery and Tamaschke, 1995 Gray, 2001
• Team working such as willingness to cooperate among cross-functional members	Purba and Shah, 2000
• Maturity of IS application	Hedelin and Allwood, 2002 Liang and Hung, 1997

1.2 Technical Factors

From the literature review, several technical factors have been identified. The factors are friendly user interface (Sambrook, 2001), friendly output formats (Othman et al., 1996), on-line help facilities and credibility of IS applications (Liang & Hung, 1997).

Software technology is designed to provide managers with the capability to access internal and external information that is relevant to decision making (Nord & Nord, 1995). The need of friendly user interface for example is one of the important aspects in developing software technologies.
The environment in which users encounter information has a substantial impact on the way this information is evaluated and integrated. Specifically, user interfaces that provide users control over

the content, order, and duration of product-relevant information cause information to have higher value and to become increasingly usable over time (Pereira, 1999; Whitten, 1990).

Table 2 summarises the literature related to technical factors:

Table 2: Summary of literature on the technical factors

Factor	Source
• Friendly user interface	Sambrook, 2001 Pereira, 1999 Whitten, 1990 Othman et al., 1996
• Friendly output formats	Othman et al., 1996
• On-line help facilities	Liang and Hung, 1997
• Credibility of IS applications	Liang and Hung, 1997

1.3 Process Factors

There are three items listed under the umbrella of process factors. They are data supports such as availability of relevant data and in proper format, problems complexity such as difficult to build appropriate model, and model building software such as proper development tools (Liang & Hung, 1997).

The three items are actually related to each other. There should be sufficient data available to support any kind of problem or situation involved. Meanwhile, a 'complex problem' might be hard to model adequately. Some real life problems very often cannot be interpreted into something that can be understood thoroughly in order to build a model that sufficiently represents the problem itself.

Several writers have given the overall view of process factors. For example, Laver (1989) and Pinkerton (1990) have discussed issues on data in IT applications. Laver (1989) mentions that no matter how subtle the processing, the information we could extract depends critically on the nature and quality of the input data. For example, IT systems can shift immerse amounts of data, but unless their programming is accurate and appropriate they will merely sweep it up into tidy, but irrelevant, heaps.
Besides, in order to capture, organize and transfer information and knowledge, organizations need to take advantage of the new computing and telecommunications technologies now available and develop a technical infrastructure capable of delivering information to employees worldwide. With such an enormous capacity for information transfer available, it is critical for firms to develop a consistent and well-organized method for identifying, capturing, organizing, formatting and distributing information on the knowledge web (Neef, 1999).

Table 3 shows a summary of the literature on process-related factors:

Table 3: Summary of the literature on process factors

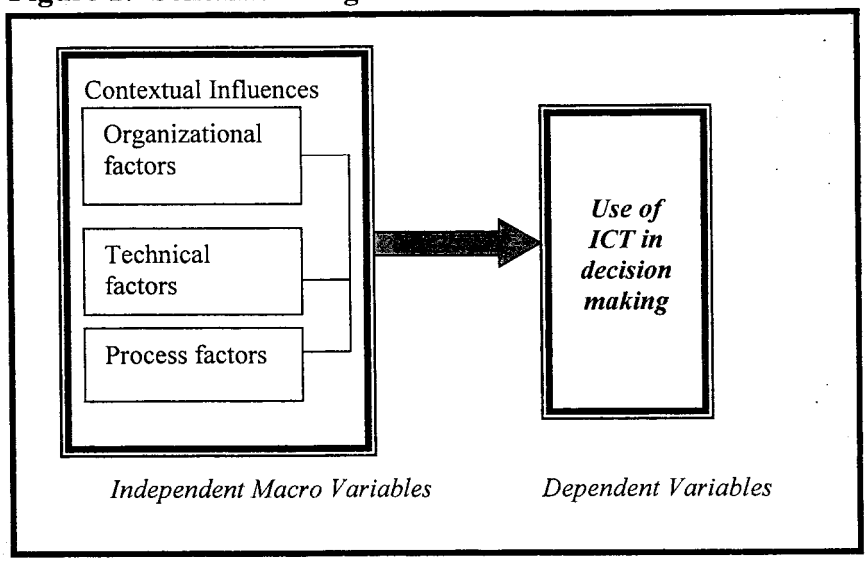
Factor	Source
• Data support such as availability of relevant data and in proper format	Liang and Hung, 1997 Neef, 1999 Laver, 1989 Pinkerton, 1990
• Complex problems such as difficult to build appropriate model	Liang and Hung, 1997 Bruggen, Smidts and Wierenga, 2001
• Model building software such as lack of proper development	Whitten, 1990

The literatures reviewed were used to develop the questionnaire of this study.

2. Theoretical Framework

Figure 1 presents the research framework of the study. It was influenced by past factor research and the unique characteristics affecting private agencies, such as experienced model builders, support from top management and friendly user interface (Othman et al., 1996; Ang, Davies & Finlay, 2001a; Whitten, 1990). The independent variables were divided into three categories namely organizational, technical and process factors. The dependent variable was the use of ICT in decision making.

Figure 1: Schematic diagram of the theoretical framework



2.1 The Dependent Variables

The study recognized various measurement of ICT use as dependent variables (e.g. frequency, scope, and the nature of ICT use). This study aimed to investigate the extent of ICT use in business and specifically its use in decision making. Therefore, the monthly ICT usage was used as the dependent variable.

2.2 The Independent Variables

This study intended to determine factors associated with the applications of ICT in a company, and to empirically explore the three sets of contextual factors identified in the literature (organizational, technical and process) that potentially influence the extent of ICT use in decision making. A comprehensive list of factors influencing the use of ICT has been compiled from past literature discussed early on (e.g. Purba & Shah, 2000; Pereira, 1999; Neef, 1999).

3. Data Source

The survey questionnaire was mailed to 500 companies selected randomly from the companies listed on the Kuala Lumpur Stock Exchange (KLSE) in 2002. The questionnaire targeted IT managers or their equivalent. A total of 64 replies were received and used for analysis. The purpose rate is about 13.5 percent. The distribution of responses is shown in Table 4.

Table 4: The distribution of responses

	No. of Responses	Percentage %
Without follow-up	42	65.6
After first follow-up	12	18.8
After second follow-up	10	15.6
Total	64	100

4. The questionnaire

As no suitable instrument was readily available, an instrument had to be developed. The questions were designed to identify the factors that might affect the use of DSS applications in their company. The factors were divided into three groups, namely organizational factors, technical factors and process factors. A total of 14 items were developed to operationalise the dependent variables. The respondents were required to identify the degree of importance of each factor using a 5-point scale with 1= 'Not important' to 5= 'Very important'. The dependent variables consisted of a single item using ratio scale.

4.1. Instrument Validation

The Cronbach's alpha for the respective measurement constructs are shown in Table 5. All of them have a value above 0.7, which are at acceptable level (Hair, Anderson, Tatham & Black, 1992).

Table 5: Reliability coefficients for each measurement

Measurement	No. of Item	Alpha
Organizational Factors	7	0.80
Technical Factors	4	0.88
Process Factors	3	0.72

Factor analysis, was then used as an exploratory technique to summarise the structure of a set of variables. The results of factors analysis could confirm whether or not the theorized dimensions emerge (Sekaran, 2000). Factors analyses were performed on the three measurements listed in Table 5. The three measurements had the eigenvalues and percent of variances as shown in Table 6.

Table 6: Validity coefficients for each measurement

Measurement	Eigenvalue	% of Variance
Organizational Factors	3.68	52.53
Technical Factors	2.99	74.73
Process Factors	1.94	64.51

The measurement verification process revealed that the instrument has had acceptable validity and reliability. The data collected were ready for data analysis.

5. Analysis and Results

5.1 Descriptive Statistics of The Contextual Factors

In this study three categories of factors were being addressed. The results are shown in Table 7. Under the organizational category, the respondents indicated that 'support from top management' (4.55) was the most important for the application of ICT in decision making. This was followed by 'proper user training' (4.34) and 'availability of technical support' (4.25). The results are quite consistent with the work of Liang and Hung (1997) which also found the 'support from top management' highly affect ICT usage.

Under the technical category, the respondents indicated that 'friendly output formats' was the most important factor (4.34). The results also supported the findings of Liang and Hung (1997) that 'friendly output format' and 'friendly user interface' were the important ICT success factors.

For the process category, the respondents indicated that 'data support' (4.44) greatly influence to the applications of ICT in decision making.

Table 7: List of factors

Factor	Mean*	Std. Dev.
Organizational:		
• Experienced model builders	3.47	1.43
• *Support from top management*	*4.55*	*0.94*
• Incentive from the government	3.36	1.51
• Availability of technical support	4.28	0.92
• Proper user training	4.34	0.98
• Team working	4.25	1.14
• Maturity of IS applications	3.95	1.09
Technical:		
• Friendly user interface	4.27	1.23
• *Friendly output format*	*4.34*	*1.13*
• On-line help facilities	3.75	1.16
• Credibility of model outputs	4.05	1.37
Process:		
• *Data support*	*4.44*	*1.05*
• Complex problem	3.48	1.26
• Model building software	3.45	1.43

*measured on a 5-point scale

Taking all the factors together, the top three factors that most affect the use of ICT in decision making are 'support from top management', 'data support', and 'friendly output format' which tie with 'proper user training'. We may conclude that managers would use ICT to support their

decision making if the top management encouraged them. On top of that, the computerized database must be in place and the system has to be easy enough to use after some training to turn out information in a format that meets user's requirement.

5.2 The Contextual Variables Associated With The Extent of ICT Use

5.2.1 Multiple Regression Analysis

To ensure no violation of the assumptions and absence of outliers, the process to examine the assumptions and outliers was carried out. The normality plots of variables showed no violation of normality assumptions. The VIF (Variation Inflation Factor) was less than 10 for each variable indicating that there was no multicollinearity problem. In order to ensure the observation-to-factor ratio was above 5, regression analysis was performed separately for each category of the contextual variable against the extent of ICT use as dependent variable. From the results, only significant factors were selected to run as the combined factor set in the final regression analysis. The four regression analysis outputs are shown in Table 8.

Table 8: Summary statistics of regression analysis for ICT use

Predictor set	R^2	Adj. R^2	Std. Error	F-value	Sig.
Organizational	0.10	-0.09	0.17	0.92	0.495
Technical	0.08	0.02	0.17	1.33	0.271
Process	0.15	0.10	0.16	3.42	0.023*
Combined-factor	*0.14*	*0.10*	*0.16*	*4.78*	*0.012**

*2-tail exact $p<0.05$

Organizational Factors

The results of regressing the seven factors in the organizational category as independent variables against the extent of ICT use can be seen in Table 8. However, all the seven items were not significantly related to the extent of ICT use ($p>0.10$). This implied that organizational factors would not affect the use of ICT un decision making. We could conclude that organizational factors that were found to affect ICT use in general (e.g. Ang et al., 2001a, and Hedelin and Allwood, 2002) would not influence ICT use in decision making. This may be because decision making is something very personnel and takes place individually.

Technical Factors

The results of regressing the four factors in the technical category as independent variables against the extent of ICT use is shown in Table 8. The four factors explained about only two percent of variation in the extent of ICT use. Only one factor has positive significant effect, i.e. 'friendly output format' ($p< 0.10$ with beta=0.416). Decision makers would use an IT application only if it could produce the information in the format needed to assist in decision making.

Process Factors

According to Table 8, the three factors in the process category explained about 10 percent of the variation in the extent of ICT use, of which only one factor has positive significant association ($p<0.01$). Organizations with a distributed data support are associated with the extent of ICT use (beta=0.417). Again the emphasis is on the availability of data, not the problems or software. Here, we can conclude that the respondents (human) still play a big role in decision making and ICT is only used to provide necessary information. This mode of usage is called file-drawer DSS (Alter, 1980) or data-driven DSS (Power, 2001).

Combined-factors set

Considering only the independent variables that showed a significant association with the extent of ICT use in the previous three regressions, two independent variables (one technical factor and one process factor) were entered simultaneously into the fourth regression. However, only one independent variable gave a significant relationship with the extent of ICT use (adjusted R^2=0.10), i.e. 'data support' (beta=0.509) at the 0.01 significant level.

It appeared that the ICT usage level of the responding companies would improve if there were good data support. This is understandable, as data after being processed by ICT, is important for decision making.

6.0 Conclusion

The four most important factors perceived to influence the use of ICT applications in decision making were 'support from top management', 'friendly output format' , 'proper user training' and 'data support'.

However, regression analysis revealed that only 'data support' had a significant association with such usage.

We can make a conclusion that to encourage the use of ICT in an organization, it should have support from the top management. Without the support from the top management, the applications of ICT and its development cannot go far. However, to promote the use of ICT in decision making, the database must be readily available to support such application. Good data support for ICT applications and friendly output format are important in decision making as both elements contribute to a better understanding of a problem and identifying more alternatives or feasible solutions.

Another conclusion that could be deduced from the study is that DSS application among the leading companies in Malaysia is still at the 'file-drawer' nor 'data analysis' level where data or information is the main output to support decision making. The decision making process is still very much being carried out by the decision maker.

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