

DETERMINANTS OF DSS USAGE IN LARGE-SCALE BUSINESS FIRMS IN TAIWAN

Dr. Ching-cha Hsieh

*Department of Business Administration
National Taiwan University
21, Hsu-chow Road
Taipei, Taiwan 10020
Republic of China*

ABSTRACT

This field study investigated the factors that affect the use of decision support systems (DSS) by large-scale business firms in Taiwan. Two thirds of the 92 firms surveyed had more than 300 employees, more than NT\$1,000 million in annual sales revenue, and had been using computers for more than four years. The principal findings showed that technology availability, training programs, decision makers' awareness, length of computer use, and formal MIS planning, are positively associated with the use of DSS.

[Keywords] – decision support systems, computer usage, DSS usage.

INTRODUCTION

Decision support systems (DSS) are one of the most popular tools used by knowledge workers (Davis, 1985). The proper use of DSS may increase

an organization's effectiveness and improve its competitive edge by improving personal efficiency, facilitating interpersonal communication, promoting learning or training and increasing organizational control (Alter, 1980). In 1982 it was estimated that \$600 billion would be spent on knowledge worker compensation in the U. S. (Poppel, 1982). Within five years computer support could cut this cost by saving 15% of knowledge worker time (Leitheiser, 1986). Therefore, business firms tend to use DSS whenever possible. However, due to some of the features of DSS, such as interactive processing mode and ad hoc analysis, it requires a sophisticated data base management system (DBMS) in order to implement DSS. In the age of 1970, only those firms with main-frame computers and DBMS could afford it. Today, with the widespread availability and cost down of microcomputers and software packages such as DBase, Lotus, and IFPS, etc, nearly all businesses, no matter how small, can afford to use DSS (DeLone, 1988; Vazsonyi, 1981; Lu, 1988).

Moreover, a recent study (Lu, 1988) pointed out several important characteristics of DSS that make it especially appealing to organizations in newly industrialized countries, such as the Republic of China on Taiwan. However, available evidence shows that DSS are seldom used in Taiwan. In a questionnaire survey conducted in Taiwan, no governmental agencies indicated that they were using DSS (Lo, 1985). Through a small-scale interview, including a dozen large-scale firms, Lu (1988) found no trace of DSS in use. Meanwhile, Lee and Mao (1987) discovered that the number one problem of computerization for business firms in Taiwan is "the development and implementation of DSS." Therefore, to understand the reasons for the absence of DSS in Taiwan business firms appears significant and interesting.

This study investigated the factors that are associated with DSS use for business firms in Taiwan. A questionnaire survey was conducted for 92 large-scale business firms. Chi-square and F tests were performed to test the research hypotheses. Five major factors were found to have a positive effect on DSS use in Taiwan business firms.

RESEARCH VARIABLES AND HYPOTHESES

Factors Affecting Using DSS Use

Numerous factors can affect whether or not a firm will use DSS. Previous studies are numerous. In a proposal for research on information systems, Mason and Mitroff stated (1973),

. . . that an information system consists of at least one PERSON of a certain PSYCHOLOGICAL TYPE who faces a PROBLEM within some ORGANIZATIONAL CONTEXT for which he needs EVIDENCE to arrive at a solution and that the evidence is made available to him through some MODE OF PERSENTATION.

The words in capital letters point out six entities in MIS research. The factors affecting DSS use derived from past studies can be classified into six categories corresponding to the above six entities. In this paper, however, only three entities will be considered; "the decision maker" (PERSON), "the decision task" (PROBLEM), and "the organizational context". For each of the three entities, there are a great number of attributes which can affect whether or not a firm will use DSS. Fourteen factors have been chosen from the existing literature. A brief discussion about the selected variables is presented below.

Lack of understanding about computers is a frequently cited reason for failure to consider computer opportunities (Neidleman, 1979; Weber and Tiemeyer, 1981). However, there are ways to overcome these shortcomings. Computer experience, top management support (Couger and Wergin, 1974; Greenwood, 1981; Lu, 1988; Rockart and Flannery, 1983; Keiser and Srinivasan, 1982), and computer training (Heise, 1980; Weber and Tiemeyer, 1981; Handerson and Treacy, 1986) can increase computer knowledge and thereby enhance the chances of DSS use. The level of MIS planning (DeLone, 1988), the availability of DSS technology (Lu, 1988), and the needs for DSS (Lu, 1988; Motivalla and Pheny, 1982; Schroeder and Benbasat, 1975) are other factors related to the organizational context.

In the category of decision maker's characteristics, some studies found a positive relationship between user attitude and the successful use of information systems (King and Rodriguez, 1978; Lucas, 1978; Robey and Zeller, 1978; Maish, 1979). Age, computer knowledge, education, and job experience are also found to affect the quality of information use (Fuerst and Cheney, 1982; Sanders and Courtney, 1985; Lucas, 1975; Schewe, 1976). Although the above five factors are related to the successful use of information systems, they could also be factors which influence whether or not DSS are used. Finally, Lu (1988) found that decision makers did not use DSS simply because they were unaware of DSS; therefore, another factor, "the decision maker's awareness of DSS", is also included in this study.

In the category of decision task, the nature and the complexity of task are also factors which influence user satisfaction (DeLone, 1988). The nature of the task is composed of three features of a decision task:

- a task that requires "what . . . if . . ." analysis
- a task that is repetitive
- a task that has time pressure

Therefore, two factors related to decision task, i. e., the nature and complexity of the task that influence DSS usage, are also included. A total of fourteen factors were chosen for this field study, and are listed below:

I. factors related to organizational context

1. length of computer use (COMPUTERAGE)
2. top management support (SUPPORT)
3. computer training program (TRAINING)
4. formal MIS planning (PLANNING)
5. availability of DSS technology (TECHNOLOGY)
6. need for DSS (NEED)

- II. factors related to decision maker
 - 7. attitude of decision maker (ATTITUDE)
 - 8. age of decision maker (AGE)
 - 9. computer knowledge of decision maker (COMPUTERKNOW)
 - 10. educational background of decision maker (EDUCATION)
 - 11. job experience of decision maker (JOB)
 - 12. decision maker's awareness of DSS (AWARENESS)
- III. factors related to decision task
 - 13. nature of task (NATURE)
 - 14. complexity of task (COMPLEXITY)

Hypotheses

The fourteen factors discussed above are formulated into hypotheses. The hypotheses test whether large-scale business firms in Taiwan tend to use DSS when they have:

- H1: longer time in computer use
- H2: higher level of top management support
- H3: higher level of company provided computer training
- H4: formal MIS planning
- H5: higher level of availability of DSS technology
- H6: higher level of need for DSS
- H7: decision makers with more positive attitudes toward DSS
- H8: decision makers who are relatively young
- H9: decision makers with higher level of computer knowledge
- H10: decision makers with higher educational background
- H11: decision makers with more job experience
- H12: decision makers who are aware of DSS
- H13: decision tasks that requires "what . . . if . . ." analysis, are repetitive have time pressure
- H14: decision tasks that requires complex computation

METHODOLOGY

The hypotheses listed above were tested against data collected from large-scale business firms in Taiwan. The sample of DSS users was selected randomly from all firms listed in the *Taiwan top 1000 manufacturers and top 300 service firms* in the July issue of *Commonwealth* (1988).

A telephone survey was conducted before the questionnaires were mailed. This was done for two reasons. First, the research was aimed at the individual decision maker, not the organization itself. The telephone survey was required to determine which individual DSS user or non-user would be chosen. Second, we felt that decision makers might have difficulties distinguishing DSS, EDP, CAD, and word processing, etc. Through the telephone survey, the definition of DSS was clarified.

The questionnaires were mailed to 200 firms. Forty-six firms returned the questionnaires. Three weeks later, a follow-up was made and an additional fifty-five questionnaires were returned. In total, there were one hundred and one responses. The response rate was 50.5%, however nine of them were incomplete. The valid questionnaires were ninety-two, and the usable return rate was 46%.

The measurement of the fourteen factors is briefly discussed below. Since several variables had not been previously validated, subjective assessment by the chosen subjects (Leitheiser 1988) about the organization, the user, and the task was used in some cases. With regard to the variable "DSS use", a business firm was classified as "DSS user" as long as DSS were used in the organization, only those firms without any DSS were considered "not to use DSS".

The factors affecting DSS use are presented in Table 1 as they were measured from questionnaire responses. Among them, six are composite measures. All the questionnaire items were carefully chosen from past studies (Schultz and Slevin, 1974; Lucas, 1978; Robey, 1979; King and Rodriguez,

1978; Bailey and Person, 1983; Schewe, 1976; Thorne, 1977; Ginzberg 1981; Swanson, 1974; Swanson, 1981; Baroudi and Orlikowski, 1988). Fourteen factors were tested. If the full questionnaire items of each factor were used, the questionnaire would be too long. Therefore, a subset of questionnaire items for each factor was used.

A pilot run on 17 decision makers from tow local firms was conducted. A factor analysis was performed on the results of the pilot run, and several questionnaire items were further eliminated. A five-point, instead of a seven-point, Likert type scale was used in order to match Chinese semantics.

Table 1. Factors DSS Use

Factor	Questionnaire-Item
COMPUTERAGE (C)	length of computer use
SUPPORT (S)	supporting score (scale from 1 to 5)*
TRAINING (T)	training score (scale from 1 to 5)
PLANNING (P)	having formal MIS planning or not
TECHNOLOGY (Y)	technology score (scale from 1 to 5)*
NEEDS (N)	needs score (scale from 1 to 5)*
ATTITUDE (A)	attitude score (scale from 1 to 5)*
AGE (G)	age of the decision maker
COMPUTERKNOW (K)	computer knowledge score of the decision maker (scale from 0 to 7)*
EDUCATION (E)	education of the decision maker
JOB (J)	years of job experience of the decision maker
AWARENESS (W)	awareness score (scale from 1 to 5)*
NATURE (R)	score for fitness to use DSS (scale from 1 to 5)*
COMPLEXITY (X)	complexity score (scale from 1 to 5)

*: composite measures

RESULTS

Of the ninety-two firms surveyed, sixty-four of them (69.6%) did not have DSS, the other twenty-eight firms (30.4%) had at least one DSS. Depending on the nature of measurement scale, either chi-square or F test was used to test the hypothesized association of each of the fourteen hypotheses. Summaries of the chi-square and F tests for each hypothesis are presented in Table 2. Notations used in the summary table are explained as follows: Explain the notations here. For the first hypothesis, H1, the "C,U" notation, implies that the length of computer use and the use of DSS are independent. For the associations proposed in this study, the null hypothesis assumed independence (no association). If no significant difference was found, the independence model was accepted and the association was thereby rejected. All null hypotheses were rejected at an alpha level of 0.05. The statistical package used was SPSS Puls on IBM PC.

Table 2. Summary of Statistical Test

Hypothesis	Model Tested	Chi-Square	F Value	Sig	Conclusion
H1: Longer time of computer use is positively associated with the use of DSS	Ho: C,U	10.75	—	0.0295	Reject C,U
H2: Higher level of top management support is positively associated with the use of DSS	Ho: S,U	—	2.27	0.1365	Accept S,U

Hypothesis	Model Tested	Chi-Square	F Value	Sig	Conclusion
H3: Higher level of company provided computer training is positively associated with the use of DSS	Ho: T,U	—	5.22	0.0250	Reject T,U
H4: Formal MIS planning is positively associated with the use of DSS	Ho: P,U	17.88	—	0.0001	Reject P,U
H5: Higher level of availability of DSS technology is positively associated with the use of DSS	Ho: Y,U	—	5.68	0.0196	Reject Y,U
H6: Higher level of DSS needs is positively associated with the use of DSS	Ho: N,U	—	1.26	0.2655	Accept N,U
H7: The positive attitudes of decision makers are positively associated with the use of DSS	Ho: A,U	—	2.38	0.1270	Accept A,U
H8: Age of decision maker is positively associated with the use of DSS	Ho: G,U	4.04	—	0.5442	Accept G,U

Hypothesis	Model Tested	Chi-Square	F Value	Sig	Conclusion
H9: Decision maker's computer experience is positively associated with the use of DSS	Ho: K,U	9.52	—	0.1465	Accept K,U
H10: Educational background the decision maker is positively associated with the use of DSS	Ho: E,U	1.07	—	0.5855	Accept E,U
H11: Decision makers with longer job experience tend to use DSS	Ho: J,U	2.60	—	0.8577	Accept J,U
H12: Decision maker's awareness of DSS is positively associated with the use of DSS	Ho: W,U	—	6.22	0.0147	Reject W,U
H13: Nature of task is positively associated with the use of DSS	Ho: R,U	—	0.83	0.3651	Accept R,U
H14: Complexity of task is positively associated with the use of DSS	Ho: X,U	—	2.93	0.097	Accept X,U

DISCUSSION

The primary findings of this study indicate that organizational context is the key to DSS use for large-scale business firms in Taiwan. This study found five factors that affect DSS use. Of these five factors, four of them (technology availability, training programs, the length of computer use, and formal MIS planning) were related to the organizational context, while one factor (the awareness of decision makers) was related to the decision maker. None of the factors was related to the decision task.

Business firms with a long time of computer use tend to use DSS more. This finding can be seen as an empirical evidence to Nolan's stage theory, in which computerization is an organizational learning and growing process (Nolan, 1979). Although new DSS technology is available today, business firms need time to learn. The longer the computer experience of a business firm is, the faster the learning pace will be. Therefore, a firm with a long time of computer use can seize the opportunities that new DSS technology would provide more easily and quickly.

Firms with higher level company provided training tends to use DSS more. Training can improve the ability of the DSS designer and change the attitudes of the decision maker in an organization, therefore, the possibility of DSS use is increased. Consequently, training programs may be one of the best strategies to promote DSS in an organization.

In this study, it was found that formal MIS planning exerts a significant effect on DSS use. Scanning and forecasting technology trends is usually one of the essential steps in formal MIS planning. Therefore, a firm with MIS planning can detect the existence of DSS technology and thus increase the chances of DSS use.

In this study, it was found that the availability of DSS technology in an organization can affect DSS use. Technology availability is a new factor proposed in this study. It was measured by composite concepts, including

the availability of hardware, software, data and qualified DSS designer in an organization, as well as a policy that supports end-user computing. These findings suggest that "technology approach" is probably one of the most effective strategies for DSS implementation. The technology approach provides the equipment for new technology in an organization to induce people to use them. For example, a firm can provide the required hardware and software systems for developing DSS or install a demonstration DSS.

The last factor, the decision maker's awareness of DSS, can also affect a firm's use of DSS. Therefore, it suggests that the "informational approach" is another effective strategy for DSS implementation. This approach informs users about the new technology and helps them to use it. For example, a firm can provide DSS orientation seminars to help decision makers understand what DSS is and when DSS can be used in their jobs.

Among the nine rejected hypotheses, top management support, users' attitudes and computer knowledge were important factors in studies of MIS success. (Coager and Wergin, 1974; Greenwood, 1981; Lu, 1988; Rockart and Flannery, 1983; Keiser and Srinivasan, 1982; King and Rodriguez, 1978; Lucas, 1978; Robey and Zeller, 1978; Maish, 1979). However, they did not show statistical significance in our study. There are two possible reasons. First, it could be the result of the interactive effects of the other factors, for example, if the factors related to the organizational context are all equal, then users' attitude and computer knowledge might have a positive association with DSS use. Second, it could be due to the measurement scale, since only part of the questionnaire items from previous studies were used in this study.

Six other factors, including age, educational background and job experience of the decision maker, the need for DSS, and the nature and complexity of task are not associated with DSS use. However, if the alpha (α) level is raised to .100, the complexity of the task shows statistical significance. Furthermore, if organizational factors were equal, the results of the above factors might be different.

LIMITATIONS AND SUMMARY

This study has two main limitations. First, the findings of this study apply only to large-scale firms in Taiwan. Whether the results can be extended to medium and small business is a matter of speculation. Second, the measurement scale used in this study may cause distortions to the results. The measurement scale for factors of technology availability, and awareness of DSS were developed without complete testing of the validity and reliability. For other factors that had previously well developed questionnaires, only part of the questions were used in order to shorten the questionnaire.

Out of the ninety-two firms surveyed, twenty-eight had at least one DSS, the use ratio reached 30.4%. These findings are quite interesting, since past studies showed that DSS were seldom used in Taiwan. However, due to the sampling method used, this ratio neither implies that 30% of decision makers in the large-scale firms of Taiwan are using DSS nor represents that the DSS utilization percentage is as high as 30%.

In this study, five factors were found to be positively associated with DSS use; including the length of computer use, company provided computer training, formal MIS planning, technology availability and the decision maker's awareness of DSS. These findings suggest that training programs, formal MIS planning, the installation of hardware and software systems for developing DSS, the acquisition of DSS designers, the installation of a DSS demonstration system, and orientation seminars for decision makers are proper implementation strategies.

All of the factors related to the decision maker and the decision task, with the exception of the DSS awareness, did not show statistical significance. However, if the organizational context factors were all equal, then different results might possibly be shown. A case study of a large organization with many DSS users and non-users would be a helpful approach, since individual and task differences could be better studied under circumstances in which

the organizational contexts are all the same.

REFERENCES

- [1] Alter, S. L., *Decision Support Systems: Current Practice and Continuing Challenges*, Addison-Wesley Publishing Co., (1980), pp. 95-108.
- [2] Bailey, J. E. and Pearson, S. W., "Development of a Tool for Measuring and Analyzing Computer User Satisfaction", *Management Science*, (1983, May), pp. 530-545.
- [3] Couger, J. D. and Wergin, L. M., "Systems Management: Small Company MIS", *Infosystems*, (1974, October), pp. 30-33.
- [4] Davis, G. B. and Olson, M. H., *MIS: Conceptual Foundations, Structure and Development*, 2nd Ed., McGraw-Hill, (1985).
- [5] DeLone, W. H., "Determinants of Success for Computer Usage in Small Business", *MIS Quarterly*, (1988, March), pp. 51-61.
- [6] Fuerst, W. L. and Cheney, P. H., "Factors Affecting the Percent of Utilization of Computer-Based Decision Support Systems in the Oil Industry", *Decision Sciences*, (1982, October), pp. 554-569.
- [7] Greenwood, F., "The Ten Commandments of Small Business Computerization", *Journal of Small Business Management*, (1981, April), pp. 61-67.
- [8] Handerson, J. C. and Treacy, M. E., "Managing End-User Computing for Competitive Advantage", *Sloan Management Review*, (1986, Winter), pp. 3-14.
- [9] Heise, J., "Personnel Acceptance, Management Understanding Are Success Factors, Says Small Computer Turnkey", *Data Management*, (1980), pp. 26-29.
- [10] Keiser, K. and Srinivasan, A., "User-Analyst Differences: An Empirical Investigation of Attitudes Related to System Developments", *Academy of Management Journal*, (1982, September), pp. 630-646.

- [11] King, W. R. and Rodriquez, J. I., "Evaluating Management Information Systems", *MIS Quarterly*, (1978, September), pp. 43-51.
- [12] Lee, C. S. and Mao, C. K., "A Discussion on the Software Development Activities, Methodology, and Environments of taiwan," *Proceedings of National Computer Symposium*, (1987, December), pp. 187-196.
- [13] Leitheiser, R. L., "Computer Support for Knowledge Workers: A Review of Laboratory Experiments", *Data Base*, (1986, Spring), pp. 17-45.
- [14] Lo, T. D., *MIS and Decision Making*, 3rd Ed., Taipei, Song-Kong Computer Publishing Co., (1987).
- [15] Lu, M. T., Hsieh, C. C., Pan, C. C. and Farrell, C., "Strategies for Decision Support Systems Implementation in Taiwan", *Proceedings of the International Conference on Comparative Management*, (1988, May), pp. 259-264.
- [16] Lucas, H. C. Jr., "Performance and the Use of an Information System", *Management Science*, (1975, April), pp. 980-919.
- [17] Lucas, H. C. Jr., "Empirical Evidence for a Descriptive Model of Implementation", *MIS Quarterly*, (1978, June), pp. 27-41.
- [18] Maish, A. M., "A User's Behavior Toward MIS", *MIS Quarterly*, (1979, March), pp. 39-52.
- [19] Mason, R. O. and Mitroff, I. I., "A Program for Research in MIS", *Management Science*, (1973, January), pp. 475-485.
- [20] Motivalla, J. and Pheny, F. Y. K., "Decision Effectiveness and Information Use: Effects of Cognitive Style", *Proceedings of the Third International Conference on Information Systems*, (1982), pp. 137-149.
- [21] Neidleman, L. D., "Computer Usage by Small and Medium Sized European Firms: An Empirical Study", *Information and Management*, (1979, May), pp. 17-23.
- [22] Nolan, R. L., "Managing the Crises in Data Processing", *Harvard Business Review*, (1979, March-April), pp. 115-126.
- [23] Poppel, H. L., "Who Needs the Office of the Future?", *Harvard Business*

- Review*, (1982, Nov.-Dec.), pp. 146-155.
- [24] Robey, D., "User Attitudes and Management Information Systems Use", *Academy of Management Journal*, (1979), pp. 527-538.
 - [25] Rockart, J. F. and Flannery, I., "The Management of End User Computing", *Communications of the ACM*, (1983, October), pp. 776-784.
 - [26] Sanders, G. L. and Courtney, J. F., "A Field Study of Organizational Factors Influencing DSS Success", *MIS Quarterly*, (1985, March), pp. 77-93.
 - [27] Schewe, C. D., "The Management Information System User: An Exploratory Behavior Analysis", *Academy of Management Journal*, (1976, December), pp. 577-579.
 - [28] Schultz, R. L. and Slevin, D. P., "Implementation and Organization Validity: An Empirical Investigation", *Operations Research and Management Science*, Schultz and Slevin (Eds.), American Elsevier Company, New York. (1974).
 - [29] Schoeder, R. G. and Benbasat, I., "An Experimental Evaluation of the Relationship of Uncertainty in the Environment to Information Used by Decision Makers", *Decision Science*, (1975, July), pp. 556-576.
 - [30] Swanson, E. B., "Management Information Systems: Appreciation and Involvement", *Management Science*, (1974), pp. 178-188.
 - [31] Swanson, E. B., "Measuring User Attitudes in MIS Research: A Review", *Omega*, (1982), pp. 157-165.
 - [32] Thorne, J. F., "Gauging Worth of System Reports", *Data Management*, (1977), pp. 44-48.
 - [33] Vazsonyi, A., "The Rise and Decline of a Mainframe: A Progress Report", *Interface*, (1981, February), pp. 31-35.
 - [34] Weber, H. and Tiemeyer, E., "Teaching Information Systems to Small Business Management", *Information and Management*, (1981, December), pp. 297-303.

台大管理論叢

國立台灣大學管理學院

第一卷，第一期，中國民國七十九年五月

國內大型企業使用決策支援系統 之決定因素

謝 清 佳

摘 要

本論文採實證研究以調查影響國內大型企業採用決策支援系統(Decision Support System)的因素。所調查的 92 家企業。超過三分之二的廠商，其規模如下：員工人數超過 300 人，年營業額超過新臺幣 10 億，其使用電腦的年數超過四年。本論文主要發現顯示技術可用性(technology availability)，訓練計劃(training program)，決策者的認知(awareness of decision makers)，電腦作業年數(the age of computer operation)，與正式化的 MIS 規劃(formal MIS planning)等五個因素與企業是否採用決策支援系統有正向的關聯。