The Influence of Organizational Factors on CASE Technology Adoption

JAMES T.C. TENG

UNIVERSITY OF SOUTH CAROLINA

ANTHONY NELSON

UNIVERSITY OF MISSOURI-ST. LOUIS

ABSTRACT

The adoption and implementation of IT in organizations has been studied from an innovation-theoretic perspective in recent years. In this study, the adoption of CASE (Computer Aided Software Engineering) by 253 systems development groups was examined. A number of organizational factors were hypothesized to have associations with the propensity of CASE adoption behavior. These hypothesized associations received strong support for departmental size, and modest support for centralization and formalization. The influence of structural overlays such as venture groups was partially supported. The factor that had the strongest association with CASE adoption propensity was the existence of a champion who enthusiastically promoted the innovation. These findings attest to the viability of the innovation-theoretic research tradition for CASE technology. Several implications for IS practice are also discussed. Venture groups can be used to compensate for the stifling impact of centralization and formalization or CASE adoption. Without a champion who campaigns for and promotes CASE, the technology may never be adopted.

INTRODUCTION

The development of application systems is one of the most critical functions of an IS organization, yet the development process is often fraught with difficulties [Ball & Lawrence, 1984]. Over the years, many structured methods and tools [Necco, Gordon, & Tsai, 1987] have been prescribed to help alleviate the problems. Currently, the CASE (Computer-Aided Software Engineering) movement seeks to combine the discipline of structured methodology and the power of computer-aided tools for documentation, analysis, and coordination [Henderson & Cooprider, 1990]. Software professionals perceive CASE to be beneficial [Norman & Nunamaker, 1989], and its usage is increasing [Jones, M. & Arnett, K., 1993]. A recent study has empirically demonstrated impressive productivity gains as a result of implementing integrated CASE tools in a major investment bank [Banker & Kauffman, 1991].

While it is not difficult to demonstrate the technical benefits of a new method or technique, the process of adopting and implementing new information technology (IT) in the organizational context is far more difficult. In particular, adopting and implementing IT for actual systems development has not been very successful [Fichman & Kemerer, 1993; Sumner & Sitek, 1986; Yourdon, 1986].

Innovation diffusion theory provides a general explanation for the way IT is adopted and implemented within an organization [Cooper & Zmud, 1990]. The objective of the study is to examine the factors which influence the adoption of CASE technology in organizations from an innovation-theoretic perspective. More specifically, the intent of this study is to examine the impact of organizational factors such as size, centralization, and formalization on the organization's propensity to adopt CASE.

Aside from conceptual and theoretical contributions, this line of research has practical significance as well. As the pace of technological change in IS continues to accelerate, the management of innovation becomes critical to the success of the IS function [Neiderman et al., 1991; Brancheau & Wetherbe, 1987]. The long-range goal of this research is to provide theory-based guidelines for planning and managing the adoption of CASE technology. This paper is a step in the direction to accomplish that goal.

Significant Prior Research

A number of IS researchers [Zmud & Cox, 1979; Bouldin, 1989; Orlikowski, 1989; Tyre & Orlikowski, 1993] have studied the implementation of new IS development methods. Orlikowski [1989], for example, has described conflicts between various groups within a systems development organization in using the CASE tools.

In recent years the innovation-theoretic perspective on the process of IT adoption and implementation has taken hold within the IS field [McFarlan & McKenney, 1983; Kwon & Zmud, 1987]. A number of empirical studies on the adoption of IT, such as DSS [Sanders & Courtney, 1985], telecommunications technologies [Grover & Goslar, 1993; Runge, 1985], data base management systems [Grover & Teng, 1992], spreadsheet software [Brancheau & Wetherbe, 1990], computers in foreign countries [Yavas, et al., 1992], interorganizational systems [Grover, 1993], and end-user computers [Bretschneider and Wittmer, 1993; Raho, Belohlav, & Fiedler, 1987; Henderson & Treacy, 1986; Munroe et al., 1987; Brown & Bostrom, 1989] have been reported. Zmud [1982] is one of the first IS researchers to treat this process of adoption and implementation as an organizational innovation phenomenon and apply innovation theories to study the adoption of modern software practices such as structured methods for systems development [Zmud, 1982; 1983]. In his study of the diffusion of modern software practices, Zmud [1982] related innovation behaviors to factors such as innovation phases (initiation, adoption, and implementation), type of innovation (technical versus administrative), and compatibility of the innovation. In developing the innovation-theoretic perspective on IS implementation, Zmud has examined the influence of centralization and formalization on the diffusion of innovative IS practices [Zmud, 1982], the effectiveness of various information channels (e.g., libraries, seminars, consultants, etc.) in facilitating the adoption process [Zmud, 1983], and the applicability of the "push-pull" theory in understanding the process [Zmud, 1984].

Since Zmud's work there has been increasing interest in a new IS practice (i.e., CASE technology). Although the adoption, implementation, and diffusion of IS practices has been studied, information is lacking regarding CASE technology. The focus of this paper, however, is not on the implementation and diffusion of CASE technology. Rather, we are concerned with the CASE technology adoption process, which precedes the implementation stage [Zmud, 1982].

Research Model

Adoption, which is a process occurring over time, includes acquiring knowledge of an innovation; reaching a decision to adopt or reject; and finally the implementation of this decision [Rogers, 1983]. The process involves information gathering and attitude formation, which influence the adoption decision, and finally the procurement of the innovation. Using the adoption process as described by Rogers [1983], the dependent variable for this research is the propensity to adopt CASE technology as an innovation by the organization (i.e., CASE adoption propensity). CASE adoption propensity includes stages such as whether an organization has attempted to collect information about CASE;

FIGURE 1

General Model

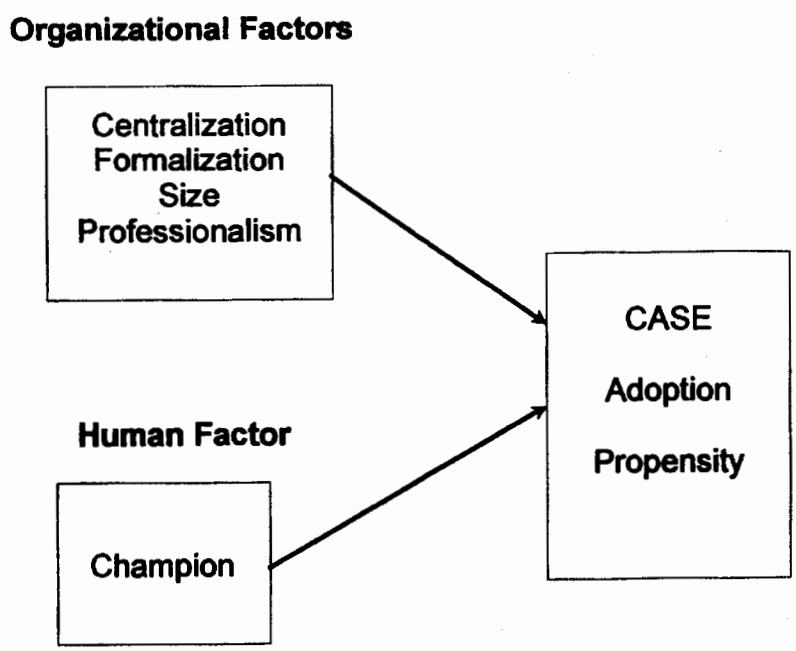
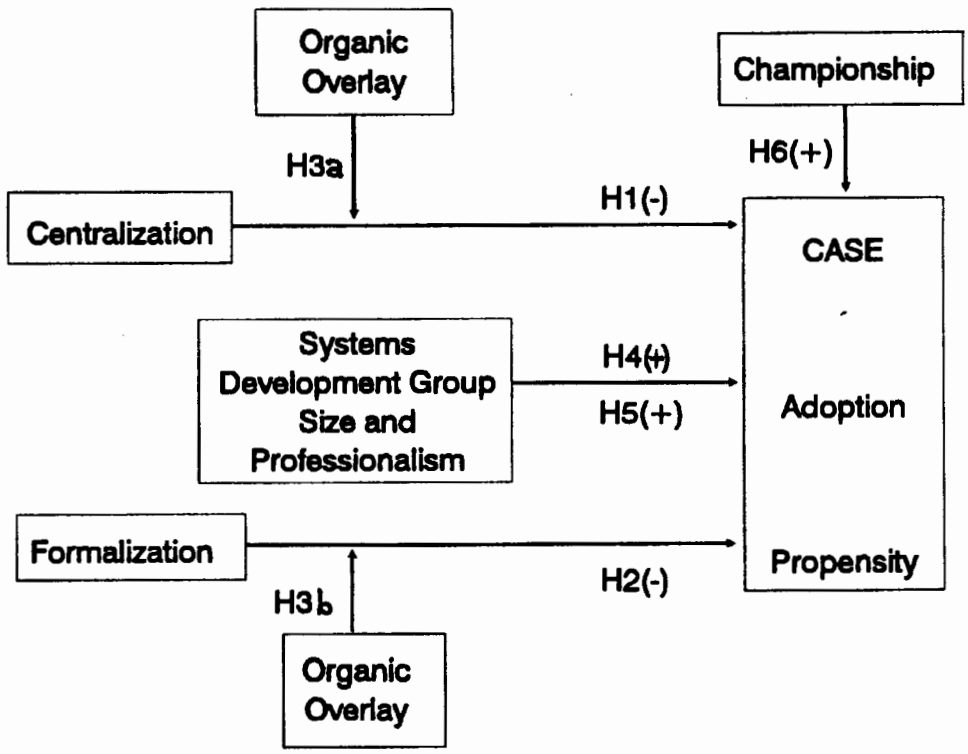


FIGURE 2

Research Model



whether or not it has decided to acquire CASE tools; and whether or not the organization is only experimenting with CASE, or if it has begun to use CASE on "live" development projects. For example, the adoption process for many organizations may be at the stage of collecting information about CASE products, while for others it may have progressed to the point of experimenting with CASE. Still yet, other organizations may be at the stage of using CASE on real systems.

As depicted in Figure 1, two types of organizational factors related to the adoption of innovation are included. The first pertains to the characteristics of the organization and includes such factors as centralization, formalization, size, and professionalism [Zmud, 1982]. The second is related directly to the human actor involved in the process, i.e., the role of a champion who enthusiastically promotes the new CASE technology [Beath, 1991].

The various relationships between the independent variables and the dependent variable indicated in the research model are depicted in Figure 2.

The directions of the hypothesized relationships are represented by arrows. The plus/minus signs indicate whether positive or negative relationships are postulated by these hypotheses. The rationale for each hypothesis in the model is presented in the following subsections.

The Influence of Centralization and Formalization

One of the oldest and most intuitively appealing notions in innovation literature has to do with the idea that organic organizations, i.e., those organizations that are decentralized, have flexible work rules, and encourage lateral communications between departments, can be expected to foster a higher level of individual initiative and innovative 'behavior than mechanistic organizations [Burns and Stalker, 1961]. Two organizational attributes often used by researchers to operationalize the organic vs. mechanistic structural dichotomy are centralization and formalization [Zmud, 1982].

As centralization and formalization seem to hinder the innovative energy which permeates an "organic" organization, one would expect them to negatively affect the innovation process. Several studies do indeed show this pattern. Aiken and Hage [1971] reported that higher levels of centralization and formalization have negative effects on innovation adoption. Daft [1978] also found that low formalization and decentralization facilitates technical innovation. Other

researchers, on the other hand, have found that one particular aspect of innovation, the implementation of innovation, may be more easily enforced if the organization is more centralized and formalized [Corwin, 1972; Rogers and Shoemaker, 1971]. As our study is focused on the adoption, rather than the implementation phase of innovation the following two hypotheses are put forth based on prior research:

H1: Centralization in systems development organizations will be negatively associated with CASE adoption propensity.

H2: Formalization in systems development organizations will be negatively associated with CASE adoption propensity.

Structural Overlay

A very promising and interesting development in innovation theory is the concept of structural overlay [Pierce & Delbecq, 1977]. The innovative potential of mechanistic organizations may be enhanced by instituting an "organic overlay" such as venture teams and brainstorming groups to induce more creativity in problem solving and decision making in the organization [Daft & Steers, 1986]. In a study of innovation in systems development practices, Zmud [1982] found evidence supporting the overlay notion: the use of venture groups (organic overlay) compensate for the dysfunctional impact of mechanistic organizations. Based on these theories and research evidence, we hypothesize that:

H3a: The presence of organic overlays will enhance CASE adoption propensity within mechanistic (centralized) systems development organizations.

H3b: The presence of organic overlays will enhance CASE adoption propensity within mechanistic (formalized) systems development organizations.

Professionalism and Organizational Size

In addition to centralization and formalization, which are the main variables focused on in this research, previous studies have demonstrated the positive effects of other organizational variables such as size [Mohr, 1969; Rothwell, 1978; Blau & McKinley, 1979; Zmud, 1982] and degree of professionalism [Becker, 1970; Zmud, 1982] on innovative behavior. Utterback [1974] argues that larger organizations are more innovative because of their access to slack resources and capacity to absorb greater risk. This argument seems to be particularly applicable in larger systems groups which can allocate needed resources to investigate and experiment with the new CASE technology without substantially cutting back existing workload. Similarly, the professionalism notion appears to be especially helpful since many professional societies in EDP/MIS offer training seminars on new methods and techniques which may precipitate innovation. We therefore hypothesize that:

H4: The size of the systems development group will be positively associated with CASE adoption propensity.

H5: The degree of professionalism in the system development group will be positively associated with CASE adoption propensity.

The Influence of Innovation Champions

While factors such as decentralization and professionalism may provide favorable environments for innovation, the impetus for the actual innovative actions generally comes from individual initiatives [Beath & Ives, 1988].

In a study of innovative use of telecommunication for competitive advantages, Runge [1985] found that in the overwhelming majority (83%) of the cases he studied, the project champion, someone who enthusiastically promoted the new idea and secured resources for its implementation, was regarded as the key enabler of project success. The role of champion in innovation, according to the results of many studies, is critical to the adoption as well as its successful implementation [Madigue & Zirger, 1984; Van De Ven, 1986]. In the context of this study, we put forth the following hypothesis:

H6: Organizations where a CASE champion exists will exhibit higher CASE adoption propensity than organizations without a champion.

Research Methodology

Since the hypotheses to be tested are based on established theories, a survey methodology was deemed appropriate. Critical to the research objective was the need to have different levels (i.e., low to high) of CASE innovation behaviors among the sample. To capture a "variety" of CASE adoption behaviors as dictated by the research objectives, we needed firms currently using CASE in development projects, those who have not yet considered CASE, as well as others that were actively evaluating it. Thus, the survey sample was drawn from both CASE users as well as the general population of IS development groups.

Four CASE vendors agreed to participate by furnishing their customer lists. In addition, random samples were taken from firms listed in the Compact Disclosure database which is based on filings with the Securities and Exchange Commission (SEC) by publicly listed companies. The questionnaire was developed and subsequently revised to improve its clarity and content on the basis of pilot tests with the heads of five development groups in local firms. Out of a total mailing of 1054 questionnaires, 253 usable responses were received representing a response rate of 24 percent.

Profile of Respondents

As can be seen in Table 1, the respondents came from a wide variety of industries, with financial services and manufacturing being the two largest groups. To ensure that the appropriate person would fill out the questionnaire, we asked the respondents to indicate their job title. To our satisfaction, the largest group was IS manager (24%), followed by manager of systems development (22%), CIO or V.P. of Information Systems (11.8%), project leader (10.2%), senior systems analyst (6.1%), and others (25.9%).

TABLE 1

Distribution of Respondents by Industry

Industry	Frequency	Percentage
Finance/Insurance/Real Estate	51	20
Manufacturing	62	24
Wholesale/Retail/Trade	16	6
Education	5	2
Energy	5	2
Government	32	13
Transportation	10	4
EDP Service/Software	6	2
Utilities	39	16
Health care	1	1
Other	26	10
Total	253	100.0

Measures for Research Variables

In an extensive meta-analysis of research on innovation adoption and implementation, Tornatzky and Klein [1982] concluded that a majority of studies in this area had failed to use appropriate measures for adoption and implementation as dependent variables. As proper identification and formulation of dependent variables are critical to the validity of an innovation study, the dependent variable for this study was carefully defined to capture a rich spectrum of different levels of adoption. The respondents were requested to indicate their status concerning the application of CASE technology in systems development according to the following five levels of adoption:

1. have never tried to collect information about CASE and have not considered its use in systems development;
2. have collected information about CASE and considered its use in systems development, but have not yet decided to acquire CASE tools;
3. have decided to acquire CASE tools;
4. have acquired CASE tools and are currently experimenting with it;
5. have gone beyond experimentation and have begun to use CASE in real development projects.

As shown in Table 2, the respondents were spread across the five categories. More than one-third of the respondents are in the most advanced stage. On the other hand, we also have more than one-third (40%) of the respondents in the beginning 2 stages who have not yet adopted CASE technology.

TABLE 2

Intensity of CASE Innovation

Intensity	Frequency	Percentage
1. Has never considered CASE	28	11%
2. Has considered CASE but not yet decided to adopt it	74	29%
3. Has decided to acquire CASE	16	2%
4. Is experimenting with CASE	57	23%
5. Is using CASE in real projects	87	35%
Total	252	100.0

The measure for centralization of decision making in systems development groups was adopted from Zmud [1982]. Six types of systems development responsibilities were included: project tracking & control, assignment of personnel to projects, selecting design methods, selecting programming methods, selecting documentation methods, and approval of requirement changes. For each of these tasks, a centralization score of 1 was assigned if the respondent indicated that the task was performed by a programmer or analyst. A score of 2, 3, or 4 was assigned when the respondent indicated that the task was performed by a project manager, a software development manager, or the IS department manager, respectively. The centralization score is taken as the average of the 6 items, and thus had a potential minimum of 1 and a maximum of 4. Approximately seventy percent of the respondents' scores were between 2 and 3. Furthermore, the average centralization score for the sample was 2.64, with a standard deviation of .52. This indicates that in general, the systems development responsibilities were performed by the project manager and the software development manager. Cronbach's alpha for the scale was 0.62 which, according to Nunally [1978], indicates a satisfactory degree of reliability for the measure. The formalization

measure focused on the extent at which processes and procedures specific to systems development are practiced. The following four items were used to measure formalization:

1. In managing development projects, formal procedures and standards are followed in activities such as cost/size estimating, scheduling, milestone tracking, and status reviews by senior management.
2. Formal procedures are used in tracking requirements changes and changes.
3. Formal procedures are followed in controlling design changes, gathering statistics on design errors, and tracking (to closure) errors, and tracking (to closure) errors found in design reviews.
4. A documented methodology is enforced for analysis, design, and design review.

For each of these items, the respondent was to check one of five possible responses: 1) not practiced at all; 2) very loosely practiced; 3) loosely practiced; 4) strictly practiced; and 5) very strictly practiced. Based on the average of the four items, which were used to measure formalization, a mean response of 2.61 was obtained. This means that formal systems development practice was not strictly adhered to by the development groups included in the sample. Cronbach's alpha was also calculated and the result (alpha = 0.89) indicates a high degree of reliability for the measure.

To determine if an organic overlay was present, we asked the respondent whether there existed a formal "venture group" who monitors and brings new developments to the attention of the systems development unit. The identification of an organic overlay was also done in this fashion in an earlier study by Zmud [1982].

Organizational size was measured as the natural logarithm of the number of professionals such as analysts, programmers, and managers (excluding clerks) in the systems development group. The natural logarithm was used to make the variance more uniform. The professionalism scale was based on the average of four ratios representing the proportions of employees: 1) having a bachelor's degree, 2) having a master's or higher degree, 3) belonging to EDP or IS professional associations (e.g., ACM, DPMA, ASM, etc.) that are dedicated to the diffusion of innovative professional practices, and 4) actively participating in these associations' activities. These combined items represent a comprehensive assessment of the organization's/department's ability to learn about new IT and stay up-to-date with the latest IT. For our sample, the average ratio is 0.46, indicating a reasonably satisfactory level of professionalism among the respondents. The scale also has a sufficiently high Cronbach's alpha at a level of 0.68. The measures for size and professionalism were adopted from Zmud [1982]. To ascertain the existence of a CASE champion in the organization, we asked the following yes/no question: please indicate whether there is one individual who enthusiastically championed the use of CASE in systems development. If the answer was yes, the respondent was asked to indicate the position that this person holds.

Study Results

Table 3 shows the results of stepwise regression analysis to test hypotheses H1-H6. Hypotheses H1, H2, H3b, and H4, and H6 were supported.

TABLE 3

Stepwise Regression Results of Testing Hypotheses H1–H6

Variables entered in Stepwise Regression Equation:

1. Champion (H6)
2. Size (H4)
3. Centralization (H1)
4. Formalization x organic overlay (H3b)

Multiple R	.58
R Square	.34
F	29.50**

Variables	**T**
Champion	5.8**
Size	5.4**
Formalization x organic overlay	–4.1**
Centralization	–2.1*

(* $p<.05$ ** $p<.000$)

Overall, the independent variables explain approximately 34% of the variance in CASE adoption propensity. All of the variables were entered into the regression equation except professionalism (H5) and the "centralization x organic overlay" (H3a) interaction term. The presence of the interaction term "formalization x organic overlay" implies that "formalization" is an important element in the equation (Sincich, 1994, p. 484; Grienpentrog et al., 1982). As a result of this interaction term being entered, the hypotheses regarding the impact of formalization (H2) and the moderating influence of organic overlay (H3b) were supported. This suggests the potential contribution of the venture group in bringing innovative concepts to the attention of systems development specialists. Further investigation of the influence of a champion for CASE on adoption revealed the importance of having a CASE supporter. Of the 246 responding organizations, 134 indicated the existence of a champion for CASE and 112 reported otherwise. Among the champions, most (67.2%) hold influential positions in the organization at the levels of Chief Information Officer, senior manager, or middle manager. This fits the role requirements of the champion whose

efforts to promote an innovative new idea would not seem credible if he or she is low in the organizational hierarchy and unable to project an aura of authority and muster the necessary resources for the innovation. The average CASE adoption propensity for the group with champions (N=139) is 4.04, and 2.58 for the group without champions (N=101). The results of ANOVA indicate that the difference between the two groups is significant at $p = 0.00$ ($F=74.79$). Therefore, we accept Hypothesis H7 and conclude that the existence of a champion is strongly associated with higher CASE adoption propensity.

Discussion of Findings

This current study's objective was to understand the factors influencing the tendency to adopt CASE technology among systems development organizations. In particular, the research sought to determine whether organizational factors, such as centralization, formalization, size, and professionalism were associated with CASE adoption propensity. Furthermore, the research attempted to examine the relationship between the existence or absence of a CASE champion and adoption propensity. The supported hypotheses are depicted in the final research model in Figure 3. First, it was found that size of the development group was highly correlated with its propensity to adopt CASE technology. This result confirms a large body of innovation research which has repeatedly demonstrated that larger organizations tend to have higher innovative potential [Mohr, 1969; Rothwell, 1978; Zmud, 1982; Blau & McKinley, 1979; Pierce & Delbecq, 1977]. In the context of systems development organizations, this phenomena may be due to the considerable time, manpower, and financial resources required to experiment and successfully adopt new methods and technology. Larger development groups apparently have more resources to launch such expensive and risky endeavors.

The study revealed interesting results concerning the structural characteristics of the systems development groups. The results showed that centralization of decision making and formalization of methods and procedures within the systems development unit are negatively associated with the propensity to adopt CASE technology. Thus, we may conclude that the centralization of decision making authority and the rigid formality in systems development practices will, to some extent, impede CASE adoption. The high level of bureaucracy, which usually accompanies centralization and formalization, tends to stifle or stop the adoption process. On the other hand, moving towards a democratic power structure in a systems development group seems to make the group more receptive toward CASE technology innovation. As responsibility becomes more decentralized, new ideas are generated and circulated among various staff members [Hage & Dewar, 1973]. While decentralization and fewer formal procedures give individuals at lower levels increased power, ownership, and autonomy over their work, they might be more willing to consider, experiment with, and use new information technology.

The result concerning the decisive role of a champion in actively promoting CASE and mobilizing resources needed to adopt the new technology is significant. The finding strongly affirmed the results of previous studies concerning the powerful influence of champions on the innovation process in general [Van De Ven, 1986] and innovation within the IS context in particular [Beath & Ives, 1988; Runge, 1985].

The IS field is characterized by perpetual changes and new methods and technologies constantly appearing to increase competitive pressures. In such a dynamic environment, organizational approaches to enhance the adoption potential of an IS organization must be thoroughly understood. This study sheds light on a particular technology (i.e., CASE) and the factors which inhibit/promote its adoption.

Limitations of the Study and Future Research

The limitations of this study need to be noted. A longitudinal analysis which would represent a "moving 'picture" of the firms, would be better suited to investigate the various stages of the adoption process. A longitudinal study could be performed to track and describe the attitudinal changes towards CASE that occur during the adoption process period and to describe how the factors, such as championship, formalization, centralization, etc., are associated with the changes which occur. However, a longitudinal study is difficult to perform for a large sample of firms, which allows for generalizability. This research has employed a cross-sectional analysis which represents a "snapshot" of one point in time for each of the large sample of firms. A major assumption is that the data collected from the large sample of firms represents the various stages of the adoption process.

Since this research was an initial step to determine key factors which influenced CASE adoption, only a limited set of independent variables such as formalization and centralization were investigated. However, there are many other variables which could be investigated such as the relative advantage and compatibility of the technology [Kwon & Zmud, 1987]. Therefore we suggest that future research investigate the relationship between CASE technology innovation and the other predictor variables.

This research has a "pro-innovation" bias since it does not examine firms that rejected CASE after investigating and/or adopting it. Therefore, the results can not be generalized to firms that have rejected CASE.

Furthermore, this research investigated the factors that affected CASE adoption. Practically, if CASE is not fully implemented after being adopted it is of no value to an

organization. Although adoption is an important innovation phase, future research should address the factors influencing CASE implementation.

Implications and Conclusion

There are several implications for IS practitioners. First, it appears that centralization and formalization tend to stifle innovations within IS organizations. IS managers and project leaders should be cognizant of this and seek to compensate for it. One way to accomplish this is to encourage open communication and positively reinforce innovative ideas and behaviors. In addition, "organic overlay" units in the form of venture teams or brainstorming groups may be considered to provide more stable and reliable channels for innovative ideas. Another finding which is very significant for CASE adoption involves the pivotal role of a champion in innovation. It is important to note that organizational factors such as centralization and formalization, while indicating a certain favorable or unfavorable environment, exert only an indirect influence on IS innovation. The direct and immediate impetus to innovate almost always comes from human actions. Without the active persuasion, promotion and campaigning from a powerful high-ranking officer on behalf of the cause, the potential to adopt CASE technology within an organization may never be energized and forever remain latent. It is, therefore, vital to support the efforts of the champion. Various avenues for providing this support, according to the research of Beath [1991], include helping the champion to fathom the organization's approach to change with respect to IT, making uncharged staff time available, and legitimizing the champion's claims about the technology

REFERENCES

[1] Aiken, M., and Hage, J. "The Organic Organization and Innovation," *Sociology,* 5 (1971), 63-82.

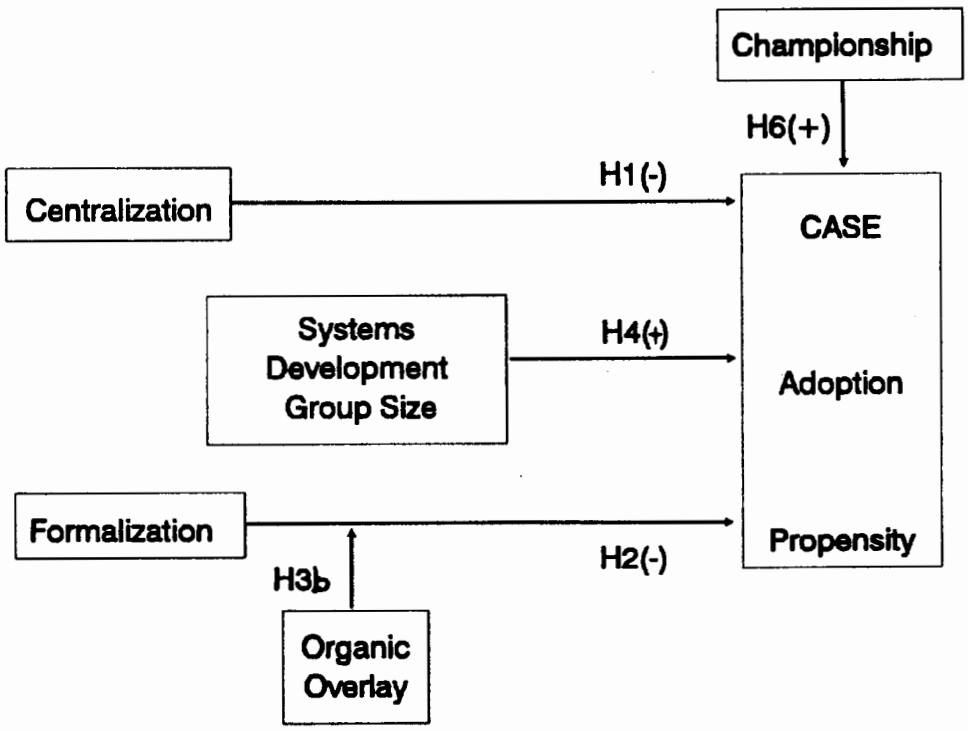
[2] Arnold, H. J., "Moderator Variables: A Classification of Conceptual, Analytic, and Psychometric Issues," *Organizational Behavior and Human Performance,* Vol. 29, 1982, pp. 143-174.

[3] Ball, S. R. and Lawerence, M. L., "Systems Development: Finding the Right Path," *ICP Data Processing Management,* Vol. 9, No. 1, Spring, 1984.

[4] Banker, R. D. and Kauffman, R. J., "Reuse and Productivity in Integrated Computer-Aided Software Engineering: an Empirical Study," *MIS Quarterly,* Vol. 15,

FIGURE 3

Final Model



No. 3, Sept. 1991, pp.375-402.

[5] Beath, C. M., "Supporting the Information Technology Champion," *MIS Quarterly*, Vol. 15, No. 3, Sept. 1991, pp.355-372.

[6] Beath, C. M. and Ives, B., "The Information Technology Champion: Aiding and Abetting, Care and Feeling," *Proceedings of the Hawaii International Conference on Systems Science*, 1988, pp. 115-123.

[7] Becker, M. H., "Sociometric Location and Innovativeness: Reformulation and Extension of the Diffusion Model," Bouldin, B. *Agents of Change: Managing the Introduction of Automated Tools.* Yourdon Press, 1989.

[8] Blau, J. R. and McKinley, W., "Ideas, Complexity and Innovation," *Administrative Science Quarterly*, Vol. 24, 1979, pp. 200-219.

[9] Brancheau, J. and Wetherbe, J. "Key Issues in Information Systems Management," *MIS Quarterly*, Vol 11, n1, March, 1987, pp. 23-45.

[10] Brancheau, J. and Wetherbe, J. "The Adoption of Spreadsheet Software: Testing Innovation Diffusion Theory in the Context of End-User Computing," *Information Systems Research*, v1, n2, 1990, 115-143.

[11] Bretscheider, S. and Wittmer, D. "Organizational Adoption of Microcomputer Technology: The Role of Sector," *Information Systems Research*, v4, n1, 1993, 88-108

[12] Brown, C. and Bostrom, R. "Effective Management of End-user Computing," *Journal of Management Information Systems*, 1989.

[13] Burns, T., and Stalker, G. M. *The Management of Innovation.* Tavistock, London, 1961.

[14] Cooper, R. and Zmud, R. "IT Implementation Research: A Technological Diffusion Approach," *Management Science*, v36, n2, Feb, 1990, 123-139.

[15] Corwin, R. G. "Strategies for organizational innovation: an empirical comparison," *American Sociological Review*, 37 (1972),

[16] Daft, R. L. "A dual-core model of organization innovation.,"*Academy of Management Journal*, 21, 2 (1978), 193-210.

[17] Daft, R. L., and Steers, R. M. *Organizations: a micro/macro approach.* Scott, Foresman & Company, 1986.

[18] Daft, R. L., and Wiginton, J. C. "Language and Organization," *Academy of Management Review*, 4 (1979), 179-191.

[19] Griepentrog, G., Ryan, M. and Smith, D. "Linear Transformations of Polynomial Regression Models," *The American Statistician*, v36, n3, part 1, 1982, pp.171-174.

[20] Grover, V. "An Empirically Derived Model for the Adoption of Customer-based Interorganizational Systems," *Decision Sciences*, v24, n3, 1993, 603-640.

[21] Grover, V. and Goslar, M., "The Initiation, Adoption, and Implementation of Telecommunications Technologies in U.S. Organizations," *Journal of Management Information Systems*, V10, n1, 1993, 141-163.

[22] Grover, V. and Teng, J., "An Examination of DBMS Adoption and Success in American Organizations," *Information and Management*, v23, n5, 1992, 239-248.

[23] Hage, J. and Dewar, R., "Elite Values Versus Organizational Structure in Predicting Innovation," *Administrative Science Quarterly*, Vol. 18, 1973, pp. 279-290.

[24] Henderson, J. and Cooprider, J. "Dimensions of IS Planning and Design Aids: A Functional Model of CASE Technology", *Information Systems Research*, Vol. 1, No. 3, Sept. 1990, pp. 227-254.

[25] Henderson, J. and Treacy, M. "Managing End-user Computing for Competitive Advantage," *Sloan Management Review*, Vol 28, n2, 1986, pp. 3-14

[26] Jones, M. and Arnett, K., "Current Practices in Management Information Systems," *Information and Management*, Vol, 24, 1993, pp. 61-69.

[27] Fichman, R. and Kemerer, C., "Adoption of Software Engineering Process Innovations: The Case of Object Orientation," *Sloan Management Review*, Winter, 1993, 7-22.

[28] Kimberly, J. R. "Managerial innovation." In Nystrom, P. C. and Starbuck, W. H. (eds.) *Handbook of organizational design*, Oxford University Press, London, 1981, 84-104.

[29] Kwon, T. H. and Zmud, R. W., "Unifying the Fragmented Models of Information Systems Implementation," in *Critical Issues in Information Systems Research*, John Wiley and Sons Ltd, 1987.

[30] Maidique, M. A. and Zirger, B. J., "A Study of Success and Failure in Product Innovation: The Case of The U.S. Electronics Industry," *IEEE Transactions on Engineering Management*, November, 1984, pp. 192-203.

[31] Mohr, L., "Determinants of Innovations in Organizations," *American Political Science Review*, 63 (1969), 111-126.

[32] McFarland, F. W. and Mckenney, J. L., "The Information Archipelago — Plotting a Course", *Harvard Busines Review*, Vol. 61, No. 1, January-February 1983, pp. 145-156.

[33] Moore, G. C. and Benbasat, I., "Development of an Instrument to Measure the Perceptions of Adopting an Information Technology Innovation," *Information Systems Research*, Vol. 2, No. 3, Sept. 1991, pp. 192-222.

[34] Munro, M., Huff, S. and Moore, G. "Expansion and Control of End-user Computing," *Journal of Management Information Systems*, 1987

[35] Norman, R. and Nunamaker, J. "CASE Productivity

Perceptions of Software Engineering Professionals," *Communications of the ACM,* Vol. 32, No. 9, 1989, pp. 1102-1108.

[36] Necco, C., Gordon, C., and Tsai, N., "Systems Analysis and Design: Current Practices," *MIS Quarterly,* Vol. 11 No. 4, December 1987, pp. 461-478.

[37] Neiderman, F., Brancheau, J, and Wetherbe, J., "IS Management Issues for the 1990's," *MIS Quarterly,* Vol 16, n4, December, 1991, pp. 475-500.

[38] Nunally, J. C., *Psychometric Theory.* McGraw Hill, New York, 1978.

[39] Orlikowski, W., "Division Among the Ranks: The Social Implications of CASE Tools for System Developers," *Proceedings of the Tenth International Conference on Information Systems,* Boston, MA., December, 1989, pp. 199-210.

[40] Pierce, J. L., and Delbecq, A. L. "Organizational structure, individual attributes, and innovation," *Academy of Management Review,* 2 (1977), 27-37.

[41] Raho, L, Belohlav, J. and Fiedler, K., "Assimilating New Technology into the Organization: an Assessment of McFarlan and McKenney's Model," *MIS Quarterly,* Vol. 11, No. 1, March 1987, pp. 46-57.

[42] Rogers, E. M. *Diffusion of Innovations.* Free Press, New York, 1983.

[43] Rogers, E. M., and Shoemaker, F. F. *Communication of innovation.* Free Press, New York, 1971.

[44] Rothwell, R., "Small and Median-Sized Manufacturing Firms and Technological Innovations," *Management Decision,* 16 (1978), 362-370.

[45] Runge, D. A. *Using Telecommunication for Competitive Advantage.* Unpublished doctoral dissertation, Oxford University, England, 1985.

[46] Sanders, G. and Courtney, J., "A Field Study of Organizational Factors Influencing DSS Success," *MIS Quarterly,* Vol. 9, No. 1, March 1985, pp. 77-93.

[47] Sumner, M. and Sitek, J., "Are Structured Methods for Systems Analysis and Design Being Used?" *Journal of Systems Management,* Vol. 37, 1986, pp. 18-23.

[48] Tornatzky, L. G., and Klein, K. G., "Innovation Characteristics and Innovation Adoption-Implementation: A Meta-Analysis of Findings," *IEEE Transactions on Engineering Management,* February, 1982, pp. 28-45.

[49] Tyre, M. and Orlikowski, W., "Exploiting Opportunities for Technological Improvement in Organizations," *Sloan Management Review,* Fall, 1993, 13-26

[50] Utterback, J. M., "Innovation in Industry and the Diffusion of Technology," *Science,* 183 (1974), 620-626.

[51] Van De Ven, A. H., "Central Problems in the Management of Innovation," *Management Science,* 32(5), May 1986, 590-607.

[52] Yavas, U., Lugmani, M., and Uuraeshi, Z., "Facilitating Adoption of Information Technology in a Developing Country," *Information and Management,* v23, n2, 1992, 75-82.

[53] Yourdon, E., "Whatever Happened to Structured Analysis?" *Datamation,* June, 1986, pp. 133-138

[54] Zaltman, G., Duncan, R. and Holbek, J. *Innovation and Organizations.* John Wiley & Sons, New York, 1973.

[55] Zmud, R. and Cox, J., "The Implementation Process: A Change Approach," *MIS Quarterly,* Vol. 3, No. 2, June 1979, pp. 35-43.

[56] Zmud, R. W., "An Examination of 'Push Pull' Theory Applied to Process Innovation in Knowledge Work," *Management Science,* Vol. 30, No. 6, June 1984, pp. 727-738.

[57] Zmud, R. W., "The Effectiveness of Information Channels in Facilitating Innovation Within Software Development Groups," *MIS Quarterly,* June 1983, pp. 43-58.

[58] Zmud, R. W. "Diffusion of modern software practices: impact of centralization and formalization," *Management Science,* Vol. 28, No. 12, December 1982, pp. 1421-1431.

ABOUT THE AUTHORS

James T.C. Teng *is an Associate Professor at the College of Business Administration, University of South Carolina. He earned his Master of Science degree in mathematics from the University of Illinois at Urbana-Champagne, and his Ph.D. from the University of Minnesota. Dr. Teng's research and consulting interests are in the area of information resource management, decision support systems, and the management of process and organizational change. He has published over forty articles in journals such as* Journal of MIS, Decision Sciences, Information and Management, California Management Review, INFOR, Data Base, European Journal of IS, Information Systems Journal, IEEE Transactions in Engineering Management, *and others. In 1992 he received the Outstanding Contribution Award from the Institute of Decision Sciences.*

Anthony C. Nelson *is an Assistant Professor at the University of South Florida in Tampa/St. Petersburg. Dr. Nelson obtained his Ph.D. and Masters in Business Administration from the University of Pittsburgh's Katz Graduate School of Business and a B.S. degree in business management from North Carolina A & T State University. He has been employed as a Business Analyst, Senior Systems Analyst, and Project Manager for several large manufacturing and banking firms. Dr. Nelson's teaching, research, and consulting interests are in the areas of IS strategy, systems analysis and design, the impact of CASE technology, and the management of IS personnel. Dr. Nelson is the author of papers in journals such as* Interfaces, Information and Management, *and* The Journal of Information Technology Management.