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THE EFFECTS OF ORGANIZATION'S LEVEL OF INFORMATION SYSTEM EVOLUTION ON THE RELATIONSHIP BETWEEN INFLUENCE FACTORS AND ACCOUNTING INFORMATION SYSTEMS PERFORMANCE

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This paper presents the results of a survey questionnaire used to investigate the effects of organization's level of IS evolution on the relationship between influence factors and AIS performance. This study focused on user involvement, user capability, management support, organization size and formalization of IS development as influence factors and on user AIS satisfaction and user system usage as surrogates of AIS performance.

This research considers the level of IS evolution of a company which is determined using stage hypothesis model as a moderating variable that affects the relationship between influence factors and AIS performance. The IS evolution stages were grouped together into prior and posterior stages and the questionnaire prepared for this study was constructed to measures the overall work environment and is to be completed by the manager of the IS department (or equivalent).

A total of forty-five completed questionnaires was received and the main findings of this study indicated that (1) user involvement for the success of AIS is more important in posterior stage of IS, and (2) in general, the benchmark variables in the stage hypothesis model which were used to measure the organization's level of IS evolution, failed to classify firms into a stage. Another interesting finding suggested that the stage of growth, which was determined, based on data processing organization and user awareness benchmarks had similar effects on influence factors. Therefore, these benchmarks perhaps still appropriate to be used to determine the level of IS evolution of a company.

Keywords: AIS satisfaction; benchmark variables; formalization of IS development; management support; organization size; stage hypothesis; user capability; user involvement; user system usage

Data availability: data will be provided for interested readers.

Introduction

Many researchers have tried to identify the factors that influence the performance of information systems (IS). Results have highlighted the direct effects of factors such as user involvement in system development, user training and education, top management support, technical capability of IS personnel, IS steering committees, organizational size, location of IS department, and formalization of system development on the successful implementation and performance of IS. Some results, however, have been inconclusive and contradictory. The reason for these inconsistencies is the implementation factors that researchers have ignored the effects of moderating or intervening variable such as the complexity or sophistication of systems or the maturity of IS.

This research considers the level of IS evolution of a company which is determined using stage hypothesis model as a moderating variable that indirectly affects the relationship between influence factors and AIS performance. In this study AIS performance is measured based on two surrogates: user AIS satisfaction and user system usage. The reason to investigate the performance of AIS is this system is often the most widely used and the largest of the information subsystem in a business organization. In some organizations the AIS is the only formally designated information system and is thus, in effect, the management information system.

The objectives of this study are twofold. *First* is to investigate the relationships between influence factors and AIS performance under the level of IS evolution and *second* is to suggest some managerial implications of these findings for the successful implementation of AIS.

Previous Research

The Stage Hypothesis

Many researchers have investigated the evolution and management of organization data processing. One would expect that after so many years of experience, organizational data processing would not still be a problem. Unfortunately, there is evidence that such is not the case: organizations still have MIS planning problems (McFarlan and McKenney 1983) and are often unable to apply their experience to new technologies (Raghunathan and Raghunathan 1988). Software development and quality are still major problems (Yaverbaum and Nosek 1992).

Among the proposals for explaining the evolution and management of organizational data processing is the stage hypothesis (Gibson and Nolan 1974; Nolan 1979; Nolan 1982). In this model, an organization goes through a sequence of stages, from initiation to maturity. Gibson and Nolan (1974) suggest a set of benchmark variable for assessing the stage of an organization.

Nolan's first version of four stages of growth model (1973) includes *initiation, contagion, control* and *integration.* Using the assumption that the stages capture the management tasks of control, organization, and planning, Nolan (1973) summarized the implications of the model as follows: control is lax in *Stages I* and *II*; reactionary and overdone in *Stage III*; and refined and effective in *Stage IV*. In 1979, the four stage growth theory was expanded to six stages of growth. Nolan (1979) essentially maintained stages one, two, and four, but the third stage was divided into three stages resulting in six distinct stages: *initiation, contagion, control, inte-*

Table 1. **Benchmarks of the Six Stages**

Stages Benchmarks Administration	Stage 1 Initiation	Stage 2 Contagion	Stage 3 Control	Stage 4 Integration	Stage 5 Data	Stage 6 Maturity
DP expenditure Benchmark	Tracks rate of sales growth	Exceeds rate of sales growth	Is less than rate of sales growth	Exceeds rate of sales growth	Is less than rate of sales growth	Tracks rate of sales growth
Technology Benchmark	100% batch processing	80% batch processing	70% batch processing	50% batch and remote job entry processing	20% batch and remote job entry processing	10% batch and remote job entry p rocessing
		20% remote job entry processing	15% database processing 10% inquiry processing	40% database and data communications processing	60% database and data communications processing	60% database and data communications processing
			5% time-sharing processing	5% personal computing	5% personal computing	5% personal computing
				5% minicomputer and microcomputer processing	15% minicomputer and microcomputer processing	25% minicomputer and microcomputer processing
Application portfolio Benchmark	Functional cost reduction applications	Proliferation	Upgrade documentation and restructuring of existing applications	Retrofitting existing applications using database technology	Organization integration of applications	Application integration "mirroring" information flows
DP organization benchmark	Specialization for technological learning	User-oriented programmers	Middle management	Establish computer utility and user account teams	Data administration	Data resource management
DP planning and control benchmark	Lax	More lax	Formalized planning and control	Tailored planning and control systems	Shared data and common systems	Data resources strategic planning
User awareness benchmark	"Hands off"	Superficially enthusiastic	Arbitrarily held accountable	Accountability learning	Effectively accountable	Acceptance of join user and data processing accountability

Adapted from Nolan (1979)

gration, *data administration*, and *maturity*. A necessary prerequisite to applying transition strategies from one stage to the next is ascertaining the existing stage. According to Nolan (1979), this may be done by applying benchmarks to the organization. These benchmarks concern (a) the rate of expenditure, (b) the technological configuration, (c) the applications portfolio, (d) the DP organization, (e) DP planning and control, and (f) user awareness characteristics. The benchmarks for the six stages are summarized in Table 1.

Effect of Information Systems Evolution Level

IS evolution stages can be grouped into Prior Stage which includes *Stage 1*, Initiation; *Stage 2*, Contagion; and *Stage 3*, Contro l; and Posterior Stage which includes *Stages 4*, Integration; *Stage 5*, Data Administration; and *Stage 6*, Maturity (Nolan 1979; Drury 1983). Cheney and Dickson (1982) have found that IS performance is influenced by the evolution level of IS. However, Raymond (1985) and Montazemi (1988) have suggested no relationship between IS performance and IS maturity as measured by the duration of IS operation. Mahmood and Becker (1986) also have found that the individual IS maturity variables were weakly related to user satisfaction variables.

In the study of Raymond (1985), it was suggested that IS maturity is significantly associated with all the other influence factors such as user involvement and management support. He proposed that IS maturity may have an influence on the performance of IS through its association with the influence factors. Similarly, Nolan (1973, 1979) suggested that critical management problems or critical success factors are different according to the degree of evolution. Hence, according to the level of IS evolution, the influence factors are considered differently in the degree of importance and each influence factor has a different impact on the performance of IS. In addition, Choe (1996) suggested that user training and education and formalization of system development have more of an effect on AIS performance in the prior stage, while user involvement and organization size were positively greater in the posterior stage.

User Satisfaction

In two empirical studies on implementation success, Ginzberg (1981 a, b) chose user satisfaction as his dependent variable. In one of those studies (1981a), he adopted both usage and user satisfaction measures. Several other information system researchers have also suggested user satisfaction as a success measure for their empirical information system researches (Ein-Dor and Segev 1978; Hamilton and Chervany 1981). These researchers have found user satisfaction as especially appropriate when a *specific* information system was involved. The key issue is *whose* satisfaction should be measured. User satisfaction is also recommended as an appropriate success measure in experimental information research (Jarvenpaa et al.1985) and for researching the effectiveness of group decision support systems (Cherveny and Sanders 1986).

System Usage

The use of an information system has often been the MIS success measure of choice in MIS empirical research (Zmud 1979). The broad concept of use can be considered or measured from several perspectives. It is clear that actual use, as a measure of information system success, only makes sense for voluntary or discretionary users as opposed to captive users

(Lucas 1978; Welke and Kinsynski 1980). Recognising this, Maish (1979) chose voluntary use of computer terminals and voluntary requests for additional reports as his measures of information system success. Similarly, Kim and Lee (1986) measured voluntariness of use as part of their measure of success. More recently, Choe (1996) employed system usage as a surrogate to measure AIS performance. Another issue concerning use of an information system is "use by whom?" (Huysmans 1970).

User Involvement in IS Development

Studies by Maish (1979), Schewe (1976), Swanson (1974), Lucas (1981), and King and Rodriquez (1978) examined the relationship between user involvement and system usage. Of the six studies, only the study by Swanson (1974) reported significant results (at a .10 level), finding user estimate of "a priori involvement" to be related to "inquiry involvement." King and Rodriquez (1978) found that user participation affected the "nature" of usage but not the amount. Lucas (1981) reports mixed results for the relationship between involvement and usage. Recent studies by Choe (1996), which also examined the relationship between user involvement and system usage found significant positive relationship between these variables.

User Training and Education Program

Bronsema and Keen (1983) discussed implementation education as a vehicle for change and suggested that the success of any information system implementation effort increase substantially if there is a strong commitment to education. Brady (1967) suggested that lack of education is a major reason for the lack of MIS utilization. In addition, Dickson et al. (1980) implicitly stated in their findings that IS-related education/training affects the acceptance and usage of IS technologies throughout the organization. Cheney et al. (1986) explored the effectiveness of end-user computing following a training program and found that it increased productivity and resulted in a high degree of satisfaction with the program. More recently, study of Choe (1996) indicated that the system usage was greater in organizations that have training and education programs on AIS. Hence, the performance of AIS can be increased with user training and education.

Capability of IS Personnel

Average education or experience levels of IS group members can be used to measure the capability of information system personnel (Ives et al. 1983). Technical capability of IS personnel has a major influence on the information requirements analysis and the design of IS (Huff and Munro 1985; McFarlan and McKenney 1983). Bruwer (1984) also suggested that the performance of IS is related to the technical quality or the design quality of the system, which is the responsibility of system personnel. Choe (1996) found positive relationship between the capability of AIS personnel (measured using the level of computer experience) and system usage but found insignificant relationship between the capability of AIS personnel and user satisfaction.

Organization Size

Ein-Dor and Segev (1978) found that organizational size had special importance because, as an uncontrollable variable, it had major impact on the resource availability, and lead-time for planning and

implementation of CBIS projects. Although Raymond (1985) did not find any significant association between organizational size (i.e., number of employee) and end-user satisfaction or systems utilization, there seems to be some association between organizational context variables and CBIS environment. In addition, it is still plausible to expect that the greater human, technological, and financial resources, generally available to larger organizations, will allow them to be more sophisticated and successful in their use of information systems (Mykytyn 1988).

Top Management Support

Top management is responsible for providing general guidance for the information system activity. The extent of support given by top management to the organizational information system could become a very important factor in determining the success of all information system-related activities (Lucas 1981; Raghunathan and Raghunathan 1988). Farced and Cheney (1982) argued the importance of top management involvement and input must be considered by the MIS professionals as critical to the success of MIS activities. The rationale is without management support and input; a company wide commitment to MIS will not exist. This lack of commitment will be significantly detrimental in terms of an MIS master plan as well as the availability of adequate budget and resources.

IS Development Formalization

Organizations tend to formalize their behavior to reduce variability, and ultimately to manage, predict, and control it effectively. One prime motive for doing so is to coordinate activities (Barki and Hartwick 1994). Other studies demonstrated that the formalisation of system development influence the successful implementation of IS (Lee and Kim 1992; Thayer et al. 1981). An organization tends to formalize IS development because it is needed to enhance communication and coordination between systems developers and users, or among developers of specific systems. Thayer et al. (1981) demonstrated that computer professionals believe that "using or enforcing (existing) standard, procedures, and documentation" will solve problems associated with software engineering.

IS Steering Committee

The IS steering committee has been suggested as one such integrative mechanism. This committee is intended to bring a broad perspective to focus on systems issues (Drury 1985). Its use as an IS management tool has been widely advocated in the systems literature. It has been recommended as a solution to the problem of linking users and data processing personnel and it serves as a source of information for management on the progress and plans of data processing (Maish 1979). It has also been recognized as one of the most efficient avenues for improving IS planning (Doll 1985; Doll and Torkzadeh 1988; Drury 1985; Nolan 1979). Despite the diversity among organizations in the form and functions of these committees, these committees have been viewed, in their direction-setting role, as an effective way of getting top management involvement in IS planning (McFarlan and McKenney 1983; Maish 1979; Nolan 1979), ensuring the fit of information systems with corporate strategy (King and Rodriquez 1978), and changing the attitudes of users towards data processing and of DP personnel towards users (Iavari 1985).

Location of IS Department

Gibson and Nolan (1974) proposed that in the initiation stage it makes economic sense to locate the EDP unit in the department where it is first applied–very frequently, in accounting–and to hold that department responsible for a smooth introduction and a sound control of costs and benefits. However, the department where the computer will first be used may not be the best location for the EDP facility later on. Ein-Dor and Segev (1982), after analyzing data and case studies, also proposed that the most common practice seems to have been to establish information units at the area needing the initial applications. As a result, there is a wide distribution of initial locations. Choe (1996) empirically investigated the difference of AIS performance among companies which have independent-AIS-department and which run AIS within another department. He found no difference in AIS performance among these companies either in prior or posterior stage.

Research Method

Instrument Development

Questionnaire prepared for this study was constructed to measure the overall work environment and is to be completed by the manager of the IS department (or equivalent). The questionnaire surveyed the evolution level of companies' IS. Even though empirical support of Nolan's stage model was mixed and somewhat discouraging (Drury 1983; Lucas and Sutton 1977), it was used to measure the evolution or maturity level of IS in this study. This model is the best known model of evolution related to organization information system and has been cited extensively as the major statement about the growth of information systems in organizations. Gregoire and Lustman (1993), however, suggested that expenditure benchmark is the most inadequate benchmark. Therefore, it was excluded and the remaining five benchmarks were used in this study.

IS managers (or equivalent) were asked to determine the growth stage of their organizational data processing based on five selected benchmarks (see Table 1). Differ from study of Choe (1996), which measured each benchmark on a six-point ordinal scale, this study measures each benchmark by offering managers with six choices. Each choice consistent with one of the development stages for each benchmark. In order to test the theory of whether the stages are consistent, require using them exactly, otherwise to reinterpret will really have meant that the theory of stages is not being tested at all.

Subject Selection

The important criterion for subject selection was the existence of a manager of IS (or equivalent) in a company. Therefore, companies which have manager of IS (or equivalent) were selected and used as subjects. Research questionnaires were sent in one package, with the questionnaires of Soegiharto (2001) study to 351 companies. The package consisted of two parts of questionnaires. *The first part* surveyed the direct relationship between influence factors and the AIS performance which had been discussed in Soegiharto (2001) and *the second part*, which is discussed in this study, considers the level of IS evolution of a company as a moderating variable that indirectly affects the relationship between influence factors and AIS performance. A total of 45 complete packages of questionnaires, which consisted of the first and the second part questionnaires, were received. This repre-

sents a response rate of 12.82 percent of the 351 firms in the sample. This response is relatively low compared to the information systems survey.

Hypotheses Development

The objective of this study is to investigate the relationships between influence factors and AIS performance under the level of IS evolution. To explain the relationship between the variables in this study more clearly and explicitly, the research model is depicted graphically in Figure 1.

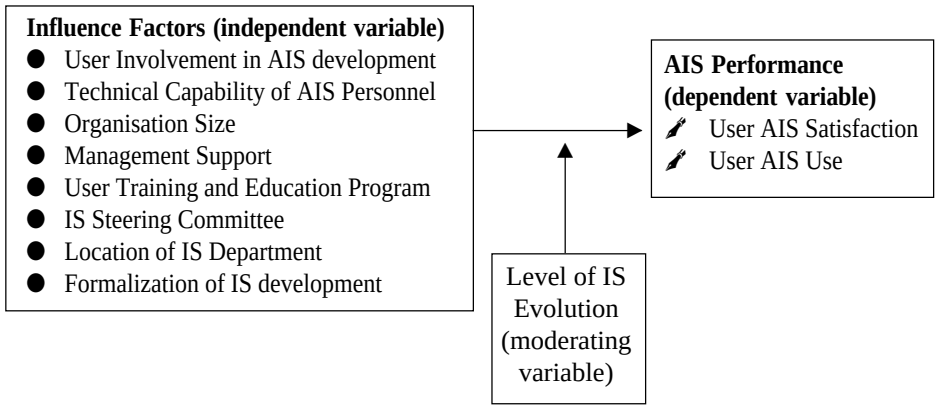
User involvement in the development permits the system to be constructed so as to provide the best fit between the IS characteristics and the requirements of organization or user (Hirschheim 1985) and it can improve system design quality by constructing the system to fit the various needs of the organization (Tait and Vessey 1988). As the IS matures, the developed systems are more complex or sophisticated and the number of related user departments increases (Amstutz 1968; Nolan 1979). User involvement in development is required more as the system becomes more complex or sophisticated (Anderson 1985; Kim and Lee 1986; Tait and Vessey 1988). Therefore, user involvement is more important for the success of IS as the evolution level of IS rises (Ein-Dor and Segev 1982; Mahmood and Becker 1986). Based on these arguments, hypothesis 1 is stated as follows:

H_1: *The influence of user involvement in AIS development on AIS performance tends to be positively greater in the posterior evolution stage of IS.*

Technical capability of IS personnel has a major influence on the information requirements analysis and the design of IS. Bruwer (1984) suggested that the performance of IS is related to the technical quality or the design quality of the system, which is the responsibility of system personnel. Technical capability is required in prior and posterior stage (Benbasat et al. 1980). To study the effect of capability of AIS personnel on the performance of AIS under the level of IS evolution, hypothesis 2 is stated as follows:

H_2: *Technical capability of AIS personnel has equal influence on AIS performance in prior and posterior stages.*

Figure 1. **Research Model**



Many researchers have proposed that organization size has an influence on system performance (Ein-Dor and Segev 1978; Raymond 1990). They also suggested that the reason why system implementation is successful in large organizations is the sufficient funding or resource support of the larger organizations. Although sufficient resources are needed in the expansion stage, the required funds increase dramatically in the posterior stage when the database and the telecommunication systems are introduced (Nolan 1979). Hence, the influence of organization size on system performance will be greater in the posterior stage when the system sophistication and the needed resources radically increase. Hypothesis 3 is stated as follows:

H_3: *The influence of organization size on AIS performance tends to be positively greater in the posterior evolution stage of IS.*

Cerullo (1980) proposed that top management support involves defining information and processing requirements and reviewing programs and plans for the information system effort. Doll (1985) also suggested that top management support ensures offering funds, setting policies and goals, system development planning, and deciding development priorities. Of these functions, particularly, fund support and goal setting are important.

In the prior stage, sufficient fund support is required for the adoption and the expansion of IS. However, in the posterior stage, it is more critical to set system objectives and goals that are fitted to the organizational goals (Nolan 1973; Nolan 1979). Hence, top management support has an equal influence on the performance of IS in both stages, prior and posterior. Hypothesis 4 is stated as follows:

H_4: *Top management support has equal influence on the AlS performance in both stages, prior and posterior.*

Lee and Kim (1992) empirically tested the claim that in the initial stage of IS evolution the formalization of system development has a greater influence on the performance of IS, since in the initial stage learning and experience of system personnel would be lower. Nolan (1979) also suggested that, in the prior stage, documentation and programming of system development processes are more critical for successful implementation. Hence, it is likely that the influence of formalization on the performance of IS will be greater in the prior stage. Hypothesis 5 is stated as follows:

H_5: *The influence of the formalization of information system development on AIS performance tends to be positively greater in the prior evolution stage of IS.*

Many researchers have suggested that user training and education have an impact on system performance (e.g., Montazemi 1988; Mykytyn 1988; Yaverbaum and Nosek 1992). Though user training and education are necessary in both stages, they are more necessary for user acceptance and understanding in the initial stage when the application systems are first introduced (Cash and McLeod 1985; Nolan 1979). Nolan (1979) also suggested that early training and education are inevitable. Hence, it is likely that the influence of user training and education on system performance will be greater in the prior stage. Hypothesis 6 is stated as follows:

H_6: *The influence of user training and education on AIS performance tends to be positively greater in the prior evolution stage of IS.*

Several researchers reported similar functions of steering committees, such as defining objectives of IS, resolving conflicts concerning user needs, discussing problems arising from IS development and operation, approving data processing capital expenditures, and reviewing documentation for IS (Drury 1985; Ein-Dor and Segev 1978; Raghunathan and Raghunathan 1989). These functions are required more in the later evolution stage when the information systems are decentralized and the strategic thrusts of organization increase (Nolan 1973; Nolan 1982). Nolan (1982) also proposed that the role of steering committees is more important in the posterior stage for efficient resource allocation. Hence, the influence of steering committees on the performance of IS will be greater in the posterior stage. Hypothesis 7 is stated as follows:

H_7: *The influence of steering committees on AIS performance tends to be positively greater in the posterior evolution stage of IS.*

In the initial stage, the IS unit locates itself within other departments. However, as the IS matures, the IS unit eventually becomes autonomous (Ein-Dor and Segev 1978; Gibson and Nolan 1974). The location of an IS unit within a specific department inhibits and delays application outside the department. Hence, as the IS unit expands, the IS unit should become independent for company wide coordination and information processing. Based on these arguments it is assumed that the influence of IS unit location on the performance of AIS will be greater in the posterior stage. Hypothesis 8 is stated as follows:

H_8: *The influence of the location of the IS department on the AIS performance tends to be positively greater in the posterior evolution stage of IS.*

Data Analysis and Results

The results of this study based on the analysis of the data obtained from this study and the related data from the study of Soegiharto (2001). Both studies were conducted at the same occasion in 1997. Data of this study is regarding the evolution level of information systems and data from the study of Soegiharto (2001) is about the influence factors and the performance of AIS. Both data were obtained from the same companies.

The Relationships Between Influence Factors and AIS Performance Under the Level of Information System Evolution

Using Nolan's hypothesis model (1979), the managers of IS departments (or equivalent) were asked to determine the stage of their organizational IS growth. In this study, five benchmarks were used to measure the stage of IS growth. It is expected that the managers' responses for all benchmarks agree with or close to one of the six stages proposed in the model. Of 45 usable responses, however, there were only two companies that showed their stage of IS growth consistent with one of the stages, that is the initiation stage. To determine the stage of IS growth of the other 43 companies, data must be examined.

To examine the data, the chi-square (X^2) test was used because it is a classification test requiring only an ordinal scale. This test also has the advantage of being applied to the entire structure simultaneously. Since several independent chi-square tests were conducted, it may be considered that the data are contained in a matrix as appears in Table 1. The cells within each column should be equal under

the hypothesis that all benchmark variables will be consistent as defined by Nolan. The chi-square statistical test requires the comparison of the actual cell sizes within each column with an expected cell size. The hypothesis that all benchmark variables would classify the same stages, was not accepted when tested at the .95 levels with a sample of 45 organizations. The lowest $X^2 = 237.84$ was obtained with an overall test of the column average tested against the column cells. The critical $X^2 = 30.14$ for the sample and therefore the hypothesis is rejected. In general, the benchmark variables as a group, failed to classify firms into stage. This result agreed with the study of Drury (1983) and Discenza and Sanders (1985).

In this study, each benchmark as individual was used to determine the stage or the level of IS evolution of companies. Several studies used only one of the benchmarks to determine the level of IS evolution (Lucas and Sutton 1977; Ein-Dor and Segev 1982). As the consequence of using each benchmark separately, evolution level based on technological benchmark, for example, can be different from evolution level based on application portfolio benchmark. This procedure allows the author to assess which benchmarks generating similar effects on the relationship between influence factors and AIS performance.

Moderated Regression Analysis (MRA)

The effects of the level of IS evolution on the relationships between influence factors and AIS performance were tested. Two basic analysis methods to empirically test these effects are subgroup analysis and moderated regression analysis (MRA). MRA is differentiated from subgroup analysis because MRA maintains the integrity of a sample (Sharma et al. 1981).

In applying MRA in terms of one predictor variable, three regression equations were formulated as follows:

(1) $y = a + b1 \,.\, x$;
(2) $y = a + b1 \,.\, x + b2 \,.\, z$;
(3) $y = a + b1 \,.\, x + b2 \,.\, z + b3 \,.\, x \,.\, z$;

where

y = the AIS performance (user AIS satisfaction or AIS usage),
b = the regression coefficient,
x = an influence factor (predictor variable),
z = the level of IS evolution, and
$x \,.\, z$ = the interaction of x and z.

Following Sharma et al. (1981), three regression analyses were performed in number order. If equations 2 and 3 are not significantly different (i.e., $b3 = 0$; $b2 \neq 0$), z is an independent predictor variable. For z to be a pure moderator, equations 1 and 2 should not be different but should be different from equation 3 (i.e., $b2 = 0$; $b3 \neq 0$). For z to be classified as a quasi- moderator, equation l, 2, and 3 should be different from each other (i.e., $b2 \neq 0$; $b3 \neq 0$) (Sharma et al. 1981).

Effects of Level of IS Evolution on the Relationships between Influence Factors and User AIS Satisfaction

The eight influence factors were tested separately with each stage of each benchmark as the level of IS evolution. In the regression analyses, user training and education program, IS steering committee, and location of the IS unit were entered in the equation as dummy variables because they were measured on a nominal scale. Based on equation 1, 2, and 3, three regression analyses in each influence factor and under different benchmarks were run.

The results of regression analyses for user AIS satisfaction under each benchmark as the level of IS evolution are summarized as follows:

1. The level of technological and DP planning and control evolutions are not related to the user satisfaction (*b2=0*) and none of the interaction terms is significant (*b3=0*).
2. The level of application portfolio evolution is not related to the user satisfaction (*b2=0*) and all of the interaction terms are insignificant (*b3=0*), except in IS steering committee (*b3 • 0; p=0.0041*).
3. The level of DP organization evolution is not related to the user satisfaction (*b2=0*), except in IS steering committee (*b2 • 0; p=0.0157*). All interaction terms are not significant (*b3=0),* except in user involvement and personnel capability (*b3 • 0; p=0.0088; p=0.0098*).
4. The level of user awareness evolution is not related to the user satisfaction (*b2=0*) and all the interaction terms are insignificant (*b3=0*), except in personnel capability (*b3 • 0; p=0.0186*).

Overall, the results of regression analyses for user satisfaction under the level of IS evolution correspond to the results of Choe's study (1996) which found most interaction terms were not significant.

Effects of Level of IS Evolution on the Relationships between Influence Factors and User System Usage

The results of regression analyses for user system usage under each benchmark as the level of IS evolution are summarized as follows:

1. The level of technological, application portfolio, and DP planning and control evolutions are not related to the system usage (*b2=0*) and none of the interaction terms is significant (*b3=0*).
2. The level of DP organization evolution is not related to the system usage (*b2=0*) and all the interaction terms are insignificant (*b2=0*), except in management support (*b3 • 0; p=0.0053*).
3. The level of user awareness evolution is not related to the system usage (*b2=0*), except in user information satisfaction and management support (*b2 • 0; p= 0.0195; p= 0.0486*) and none of the interaction terms is significant (*b3= 0*).

User satisfaction is included as an independent variable since it affects system usage (Baroudi et al. 1986). Again, the results of regression analyses for system usage under the level of IS evolution correspond to the results of Choe's (1996) study which demonstrated that most interaction terms were not significant. Therefore, it is clear that the results of MRA are not satisfactory.

The differences in the relationships between influence factors and AIS performance according to the level of IS evolution may not be significant because of too many groups, that is, levels of IS evolution. Sharma et al. (1981) argued if the result of MRA is unsatisfactory and the variable is theoretically serving as a moderator, subgroup analysis can be used.

Subgroup Analysis

For the subgroup analysis, the observations of evolution level were divided into two groups. Companies which stand in *Stage I* (initiation), *Stage II* (contagion) and *Stage III* (control) belong to prior stage and the others which stand in *Stage IV* (integration), *Stage V* (administration) and *Stage VI* (maturity) belong to posterior stage. In each group, Person Product-Moment correlation analysis and Mann-Whitney *U*-Tests were performed.

Hypotheses 1 to 5

The results of Pearson Product-Moment correlation analysis indicated that results regarding management support agreed with Choe's study (1996), which found negative correlation between management support and AIS performance in prior stage and found positive correlation between those in posterior stage. For personnel capability, the results contradicted the findings in Choe's study, which found positive correlations between personnel capability and AIS performance in prior stage. For organization size, the results also disagreed with Choe's study, which found positive relationship between organization size and user satisfaction in both stages and found positive relationship between organization size and system usage only in posterior stage.

Compared to the other three benchmarks used in determining the level of IS evolution, the DP organization and user awareness benchmarks generated relatively similar effects on the relationship between influence factors and AIS performance. It suggests that the use of these two benchmarks in determining companies' IS evolution level may be still appropriate. Results of these two benchmarks are as follows: (1) the influence of user involvement on AIS performance tends to be positively greater in the posterior stage of IS, (2) the influence of technical capability of IS personnel on AIS performance tends to be positively greater in posterior stage, (3) organization size has relatively equal influence on the AIS performance in both prior and posterior stages, (4) the influence of management support on AIS performance tends to be positively greater in posterior stage, and (5) the influence of formalization of IS department on AIS performance tends to be negatively greater in prior stage.

The first result supports hypothesis 1 and is in line with the study of Anderson (1985), Kim and Lee (1986), and Tait and Vessey (1988). User involvement in AIS development is required more as the system becomes more complex or sophisticated. Therefore, user involvement is more important for the success of IS as the evolution level of IS raises. The other findings, however, do not support *hypotheses 2, 3, 4* and *5*.

The second result suggests that in more complex and sophisticated IS more capable AIS personnel is required so that the system available can be utilized effectively and efficiently. The fourth result indicated that, apparently, management tends to consider setting system objectives and goals function as more critical than fund support function. Therefore, the influence of management support on AIS performance tends to be positively greater in posterior stage.

Hypotheses 6 to 8

The results of Mann-Whitney *U*-Test indicated that of the five benchmarks used in determining the level of IS evolution, none of them results in conclusive picture regarding the effect of the presence or absence of user training and education programs and steering committees and the effect of the independence or dependence of IS location on AIS performance. Therefore, these results do not support hypotheses 6, 7, and 8.

Other Findings Based On Correlation Analysis

The significant ($p<.05$) results of correlation analysis in prior and posterior stages revealed other interesting findings that might be explored in future research. In the prior stage, management support is positively related to the formalization of

IS development. Therefore, management support is important in the prior stage to establish more formal IS development. The results also indicated that generally formalization of IS development positively related to the personnel capability in the prior stage. Of the five benchmarks used to measure the level of a company IS evolution; only technology benchmark did not show the relationship between these variables. It suggests that in more formalized IS development circumstance, higher degree of AIS personnel capability is needed to systematically document the task in the process of IS.

Organization size is related to formalization of IS development in the prior stage. Positive relationship of these variables was indicated by four benchmarks used in determining the level of IS evolution. In posterior stage these variables are positively related under all benchmarks. Fisher *z* statistics were used to determine whether the correlation coefficients of both groups represent population having different true correlations with respect to the evolution level (Nachmias and Nachmias 1981). The standard *z* for formalization of IS development was .42 and it was not significant at the 5 percent level. Hence, it is assumed that the association of organization size with formalization of IS development is the same in both stages. Another finding indicated that in posterior stage generally personnel capability is positively related to user involvement. The positive relationships between these variables arise under technological, DP organization and user awareness benchmarks. In prior stage, the positive relationship between these two variables only appears under application portfolio and DP planning and control benchmarks. Since the three relationships in posterior stage and the two relationships in prior stage emerge under different benchmarks, it is difficult to draw a conclusion whether the more capable AIS personnel which more involve in IS development is more important in prior or posterior stage.

Management support and formalization of IS development generally related to user involvement in the posterior stage. Therefore, in the posterior stage, higher degree of management support is needed to stimulate the user to more involve in IS development. Similarly, the higher the degree of formalization of IS development the more the user involved in IS development.

The other two significant results are the relationships between personnel capability and organization size and between personnel capability and management support. However, the positive correlation of *the first relationship* only exists under user awareness and application portfolio benchmarks and is in the prior stage; *the second relationship* only exists under application portfolio evolution and is in the posterior stage. Therefore, it is inconceivable to draw a conclusion from these results.

Again, it can be concluded that application portfolio, user awareness, data processing planning and control, and data processing organization benchmarks generated similar results. Consequently, these four benchmarks may be still valid compared to the technological benchmark to measure the level of IS evolution of an organization.

Other Findings Based On Mann-Whitney U-Test

The results of Mann-Whitney *U*-Test also revealed other interesting findings that might be explored in future research. Generally, in the prior stage, the formalization of IS development tends to be higher when a user training and education

program is introduced. Similarly, formalization of IS development also tends to be higher when a steering committee is introduced and the location of IS department is independent. In posterior stage, however, the existence or nonexistence of a user training and education program and a steering committee and the independence or the dependence of IS department location have no impact on the formalization of IS department. Hence, in prior stage, it is more important to introduce a user training and education program and a steering committee and place an IS department in an independent location to attain higher degree of formalization.

In both prior and posterior stages, the size of organizations that introduce steering committees tends to be larger than those who do not introduce it. The availability of resource in larger organizations and the complexity of their structure and process of IS might be the reasons that drive organizations to establish steering committees.

In prior stage, companies, which place, IS departments in independent location tend to have higher degree of management support. Consequently, it is more significant in prior stage to place IS departments in independent location in order to gain higher degree of management support for the success of AIS. Similarly, companies which have independent IS department location tend to be large in size. Conversely, in posterior stage there is no difference in organization size and management support for the companies, which have IS departments located independently or within another department.

This study also found that in the posterior stage companies, which do not have steering committees, tend to have more capable AIS personnel compared to those which have ones. In prior stage, however, there is no significant difference in personnel capability for companies, which do have or do not have steering committees. Results suggest that, in posterior stage, when a company has more capable AIS personnel the presence of a steering committee will be superfluous while for a company, which has less capable personnel, the presence of the committee will be useful.

Table 2. **Mann-Whitney U-Test for the Difference in Influence Factors under Five Benchmarks**

Influence Factors	Benchmarks			
	Technological	**Application Portfolio**	**DP Organization**	**User Awareness**
Formalization of IS Development	Mean Rank Prior: 14.16 (n=18) Post: 27.08 (n=24) z= -3.4327 2-Tailed P = .0006	Mean Rank Prior: 17.79 (n=28) Post: 28.93 (n=14) z= -.2802 2-Tailed P = .0052	Mean Rank Prior: 16.33 (n=18) Post: 25.38 (n=24) z= -2.3824 2-Tailed P = .0172	Mean Rank Prior: 16.00 (n=19) Post: 26.04 (n=23) z= -2.6617 2-Tailed P = .0078
Management Support			Mean Rank Prior: 15.64 (n=18) Post: 25.90 (n=24) z= -2.6821 2-Tailed P = .0073	Mean Rank Prior: 17.11 (n=19) Post: 25.13 (n=23) z= -2.1106 2-Tailed P = .0348

The differences in tested influence factors are only significant under one or two benchmarks while under the other benchmarks the differences are not significant. Based on the above findings, it is obvious that none of the benchmarks used to determine the level of IS evolution yield comparable effects. Therefore, overall, it is not possible to conclude that one benchmark is more appropriate than the other benchmarks.

The Difference of Influence Factors in Prior and Posterior Stage

As can be seen in Table 2, organization which stand in posterior stage tend to have more formalized IS development procedures. Of five benchmarks used to determine the level of IS evolution, only DP planning and control benchmark indicate inconsistent results. Similarly, organizations which stand in posterior stage tend to have higher degree of management support. However, only two benchmarks indicate the consistent results, they are DP organization and user awareness benchmarks. The results of the other benchmarks are not significant. In this case, DP organization and user awareness benchmarks tend to produce similar effect.

Discussion and Conclusion

Results of this study indicated that the effects of the level of IS evolution on the relationship between influence factors and AIS performance, either analyzed using moderated regression analysis or subgroup analysis, were disappointing. The possible explanation for these disappointing results is that benchmarks, which were used in the model, failed to classify firms into a stage. Results of the study indicated that while the benchmark variables change across the stage of development, they are inconsistent with each other and generally change at different rates. Thus, the stages of growth model could not be validated using the entire set of benchmarks. Some benchmark variables indicate higher stages earlier, and other indicate higher stages later than the stage development structure suggests. The failure of these benchmarks to classify firms into a stage may be caused by two methodological problems, the use of questionnaires and the necessity to interpret the variables of the benchmark, and/or the benchmarks themselves are no longer appropriate or valid to be used to determine the level of IS evolution of a company.

In testing hypotheses one to five, the results of subgroup analysis indicated that DP organization and user awareness benchmarks generated relatively similar effects on the relationship between influence factors and AIS performance. In testing hypotheses six to eight, the results of subgroup analysis exhibited that DP organization benchmark resulted in more conclusive pictures regarding the effects of the presence or absence of user training and education programs and the effect of the existence or nonexistence steering committees and the effect of the independence or dependence of IS department location on AIS performance. From the other analyses, the application portfolio, user awareness, DP planning and control and DP organization benchmarks resulted in similar effects on the relationship among influence factors. Finally, another result of analysis indicated that the stage of growth, which was determined based on DP organization and user awareness benchmarks had similar effects on influence factors. Based on these findings, DP organization and user awareness benchmarks are perhaps still appropriate to be used to determine the level of IS evolution of a company.

One of the effects of the IS evolution level which was determined using DP organization and user awareness benchmarks on the relationship between influence factors and AIS performance is that the influence of user involvement on AIS performance tends to be positively greater in the posterior stage of IS. This finding was in line with the research conducted by Choe (1996), Ein-Dor and Segev (1982), and Mahmood and Becker (1986) which found user involvement are more important for the success of IS as the evolution level of IS rises and correspondingly it supported hypothesis 1.

Of eight hypotheses proposed in this study only one were supported. This little support is likely due to the limitation of the study. With any study involving the use of a questionnaire, problems may arise in eliciting truthful answers from respondents. In addition, since the focus of this study is confined to AIS, the results might be peculiar to AIS. There are various types of information system according to the organizational function and activity and various types AIS. If the focus is to be changed, different results may be obtained. Future research should be more specific about the AIS, which will be addressed.

Most of the results in this study were insignificant. These insignificant results may be the outcome of lack of control over the research setting. Future research requires rigorous attention to methodology. It is suggested to conduct longitudinal studies to track a series of organizations as they move over time, experience technology, user educational needs, and other changes.

As discussed above, Nolan's stage hypothesis model failed to classify firms into a stage. Therefore, it is not possible to measure the level of IS evolution of a company based on the five benchmarks in the model. For future study, an accurate conceptual and measurement tool for evolution level should be developed. It may be more appropriate to consider the nature of information technology infrastructures such as the extent of PCS/workstations, LANs, EDI, and client server.

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Appendix

Information Systems (IS) Evolution

Direction:

For each statement presented, please circle one of the six alternatives available for each question that best represents the state of Information Systems (Data Processing) in your company. If the alternative you have chosen only partly represents the state of Information Systems (Data Processing) in your company, please detail the exact nature of the systems in the space available at the bottom of each question.

1. The Data Processing (DP) in my company is:
   a. 100% batch processing
   b. 80% batch processing; and 20% remote job entry processing
   c. 70% batch processing, 15% data base processing, 10% inquiry processing; and 5% time-sharing processing.
   d. 50% batch and remote job entry processing, 40% data base and data communications processing, 5% personal computing; and 5% minicomputer and microcomputer processing
   e. 20% batch and remote job entry processing, 60% data base and data communications processing, 5% personal computing; and 15% minicomputer and microcomputer processing.
   f. 10% batch and remote job entry processing, 60% data base and data communications processing, 5% personal computing; and 25% minicomputer and microcomputer processing.

The Data Processing (DP) in my company are:

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2. The computer applications in my company are focused on:
   a. Functional cost reduction applications (cost savings).
   b. Proliferation of applications in all functional areas
   c. Upgrading documentation and restructuring of existing applications
   d. Retrofitting existing applications using data base technology
   e. Organisation integration of applications
   f. Application integration “mirroring” information flows

The computer applications in my company are focused on:

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.....

.....

3. The staffing emphasis in my company is designed to create an IS department suitable for:
   a. technological learning
   b. user-oriented programmers
   c. middle management
   d. establishing computer utility and user account teams
   e. data administration
   f. data resource management

The staffing emphasis in my company is designed to create an IS department suitable for:
.....
.....
.....

4. The Data Processing (DP) planning and control in my company is:
   a. Informal
   b. Semi formalised
   c. Formalised planning and control
   d. Tailored planning and control systems
   e. Shared data and common systems
   f. Data resource strategic planning

The Data Processing (DP) planing and control in my company is:
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.....
.....

5. The user awareness (attitude) of the Data Processing (DP) in my company is:
   a. "Hands off": anxiety over implications
   b. Superficially enthusiastic: insufficient involvement in applications design
   c. Arbitrarily held accountable.
   d. Accountability learning.
   e. Effectively accountable.
   f. Acceptance of joint user and data processing accountability

The user awareness (attitude) regarding the Data Processing (DP) in my company is:
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