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Measuring Performance of Information Systems in Evolving Computing Environments: An Empirical Investigation

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Abstract
This study empirically tests the relationship between the structure of various information systems (IS) and several different measures of their performance. The taxonomy of IS structure is based on the degree of centralization of IS-related activities (development, operation, and administration of IS), integration of processing, and centralization of computer processing (hardware configuration). By using a multi-step cluster analysis, both the membership and number of groups are derived from the responses of 137 firms. Four IS structures are identified: (1) centralized (centralized IS activities, moderate integration, centralized processing); (2) decentralized (decentralized IS activities, low integration, decentralized processing); (3) centralized cooperative (centralized IS activities, high integration, centralized processing); and, (4) distributed cooperative computing (decentralized IS activities, high integration, decentralized processing). Different sets of IS success measures are perceived important in the firms with different IS structure. Among DeLone and McLean's six measures, system quality is perceived as the most important measure in centralized computing, information quality is perceived as the most important measure in centralized cooperative computing, and organizational quality is perceived as the most important one in distributed cooperative computing. This result supports the need for a comprehensive framework including contingency factors for measuring performance of IS as suggested in several previous studies. Development of such a framework is of critical importance to both academic and management practitioners.

Keywords: IS structure, organizational structure, cluster analysis, measurers of IS performance

1. Introduction

Implementation of information technology is a source of increasing cost and concern to management. In a recent survey done by the Gartner Group, average capital spent on IT is 28 percent of the capital budget with some systems spending as much as 80 percent. The average percentage of the capital budget spent on operating the system is 2.8 percent and is expected to increase to 4 percent by 2001 and more than 5 percent by 2003 (Turisco, 2000). These rapidly increasing and tremendous amounts of capital requirements have led senior managements to expect a tighter link between IT expenditure and business performance. Many senior managers are dissatisfied with their capability for evaluating the impact of IS on organizational performance.

More research is needed because the value of IS expenditures cannot be properly assessed (Ballantine et al., 1996; Clark, 1992; Coe, 1996; DeLone and McLean, 1992; Ishman, 1996; Jurison, 1996; Louadi, 1998; Myers et al., 1997; Saunders and Jones, 1992). Empirical studies have presented mixed or even conflicting results (Jurison, 1996). While some divergence can be attributed to a lack of methodological rigor or the ad-hoc nature of the evaluation process, carefully designed studies have produced inconsistent results. Based on Jurison (1996), there are three possible explanations that may be at work:

- Inconsistently defined or measured dependent variable because, in part, there is also a lack of agreement on what constitutes a dependent variable (DeLone and McLean, 1992);
- No explicit recognition of the intervening effect of time (Jurison, 1996); and,
- The complex interactions between technology and its organizational users in the implementation process make it difficult to make comparisons and develop a consistent theory (Louadi, 1998).

To overcome these limitations of current IS research, several researchers have suggested using multidimensional and interrelated measures of IS evaluation and have presented contingency models for selecting appropriate measures. This study adopts the rationale of DeLone and McLean's contingency model (1992), which is that no single measure is intrinsically better than others and that the choice of a success measure depends on the objective of the study, the organizational context, and the characteristics of IS.

In terms of the direct influence on IS performance, the research focus is placed on those characteristics of the IS which support an organization's objectives, goals, and strategies. Several factors such as IS structure, IS strategy, end-user computing, outsourcing, and IS investments are used as IS context variables in the previous studies. IS structure is one of the most widely used variables in that it is affected by the various organizational attributes (Ahituv, 1980; Ahituv et al., 1989; Choe, 1996; Ein-Dor and Segev, 1982; Fiedler et al., 1996; Louadi, 1998).

Developing or altering the structure of IS facilitates the organization's acquisition, analysis, and provision of information. These activities are organized and performed in different ways in different IS structures. Therefore, the way to assess the performance of information systems is placed on different factors. For example, while fast response can be one of the most important factors in the highly centralized transaction processing system of a bank, the improvement of a user's job performance can have priority over other factors in the distributed decision support system of a retailing company.

The objective of this study is to examine the relationship between IS structure and appropriate measures of IS evaluation. To find the appropriate measures for different IS structures, we attempt to categorize IS structure with three IS characteristics: level of centralization of IS activities; degree of IS integration, hardware configuration. The steps are specifically: (1) identifying the characteristics and number of alternative IS structures; and, (2) describing and testing anticipated relationships between IT structure and the appropriate measures of IS performance. This study, through the responses of 137 Korean IS managers, develops a taxonomy of IS structure and explores its relationship to IS performance measure. The first section reviews the measures of IS performance. Next, the classification techniques and IS structural typologies are reviewed. This review then forms the basis for the methodology used to derive the IS structure of the surveyed corporations. A series of research hypotheses then follows with a discussion of the anticipated relationship between IS structure and performance measure. A discussion of the research methodology, measurement, and taxonomy validation comes after this. The paper concludes with a review of the results and a discussion of the study's implications.

2. Literature Review

2.1 The measures of IS performance

The approaches and methodologies for measuring IS performance are as varied as the number of papers or authors. In a chronological view, the early works appearing in the 1970s concentrate on considerations of efficiency and the introduction of multiple assessment measures (Davis and Olson, 1985; Brovits and Neuman, 1979). For example, Brovits and Neuman (1979) describe several indices of IS performance: capacity, response time, throughput rate, overhead percentage, software time measures, reliability measures, system utilization measures, raw speed, and availability.

The measurement focus then shifts from efficiency to effectiveness; doing the right thing rather than doing the thing right. This means that the organizational objectives are pursued in addition to the IS department's objectives. The effectiveness of IS function is about the impact of the information provided in helping users do their jobs. Efficiency, on the other hand, is concerned with system availability and performance over efforts (e. g. money, time, and so on).

In the 1980s or 1990s, many other researchers introduced the idea of various measures of system effectiveness and different viewpoints such as user satisfaction, workgroup's decision making, and strategic impacts on organization (Davis and Olson, 1985; Mitra and Chaya, 1996; Scott, 1995; Scudder and Kucic, 1991). This paper reviews the various measures of IS assessment on the basis of the studies of DeLone and McLean (1992), Saunders and Jones (1992), and Myers et al.(1997).

DeLone and McLean (1992) create an IS success model and suggest the systematic combination of individual measures from IS success categories to create a comprehensive measurement instrument. The model is an attempt to reflect the interdependent, process nature of IS success. In other words, it is a description of the relationships of the six IS success dimensions. They contend that:

SYSTEM QUALITY and INFORMATION QUALITY singularly and jointly affect both USE and USER SATISFACTION. Additionally, the amount of USE can affect the degree of USER SATISFACTION – positively or negatively – as well as the reverse being true. USE and USER SATISFACTION are direct antecedents of INDIVIDUAL IMPACT; and lastly, this IMPACT on individual performance should eventually have some ORGANIZATIONAL IMPACT (pp. 83-87).

This model seems to be the most comprehensive IS assessment model so far. To verify the model's validity empirically, Seddon and Kiew (1994) test the model through a structural equation model (SEM) and publish the results supporting DeLone and McLean's Model.
They also suggest the consideration of contingency variables in selecting and combining the individual measures from the IS success dimensions; the organizational strategy, structure, size, and environment of the organization; the technology; and the task and individual characteristics of the system. Several researchers follow the interrelationship model and

contingency considerations suggested by DeLone and McLean, and expand them with slight modifications (Ballantine et al., 1996; Coe, 1996; Ishman, 1996; Scott, 1995).

In the same year, Saunders and Jones (1992) also had a similar idea for the selection of IS success measures. However, they place more emphasis on how measures should be selected from the multiple dimensions of the IS function. They conduct a Delphi study that examines how IS function performance dimensions are ranked in importance by IS executives, how the IS executives measure performance in each dimension, and the value they place on the measures. According to the results, the IS function's impact on strategic direction, the integration of the IS function planning with corporate planning, the quality of information outputs, and the IS function's contribution to organizational financial performance are highly ranked in terms of importance. Contradictorily, the measures used in these dimensions tend to be weak, or surrogate and the measures of operational efficiency such as response time and system availability are more highly valued. The authors suggest that this contradiction may be due to the fact that IS operational efficiency has been stressed for years while IS impact on strategic direction is a fairly new dimension and measures are still being developed. As the IS function matures, measures likely change from a structured focus on operational efficiency and user satisfaction to a more unstructured concern for IS impact on strategic direction.

Myers et al. (1997) combine the dimensions of IS success proposed by DeLone and McLean (1992) and the contingency framework developed by Saunders and Jones (1992). Figure 1 summarizes their resulting model. It is called the comprehensive models and it represents, with a few changes, the middle ground of the two studies. They add two additional dimensions of IS success such as service quality and workgroup impact. They also adopt a large number of variables about external environment and organizational environment as contingency theories generally propose. However, more focused research with narrower viewpoints is needed.

2.2 Information System Structure

There have been increasingly more types of possible IS structures as information technology has advanced. The advances in hardware and software have expanded the pool of alternatives in deciding the IS structure (Gibson and Nolan, 1974; Hodgkinson, 1992; Kanter, 1983; Leifer 1988). Centralized computing is characterized by isolated processors that are accessed either directly or through the use of dumb terminals. The business operations are carried out using a centralized processor, database, and repository of application programs. The less expensive and the more powerful IT emerges, the more authority end-users gain in their computer applications. Decentralized computing can be viewed as a network between the central processing unit and isolated islands, where the central unit maintains control. Then computer networks is developed to interact directly between the islands without the aid of a central processor, forming a distributed computing environment (Fiedler et al., 1996, Ahituv et al. 1989; Leifer, 1988).

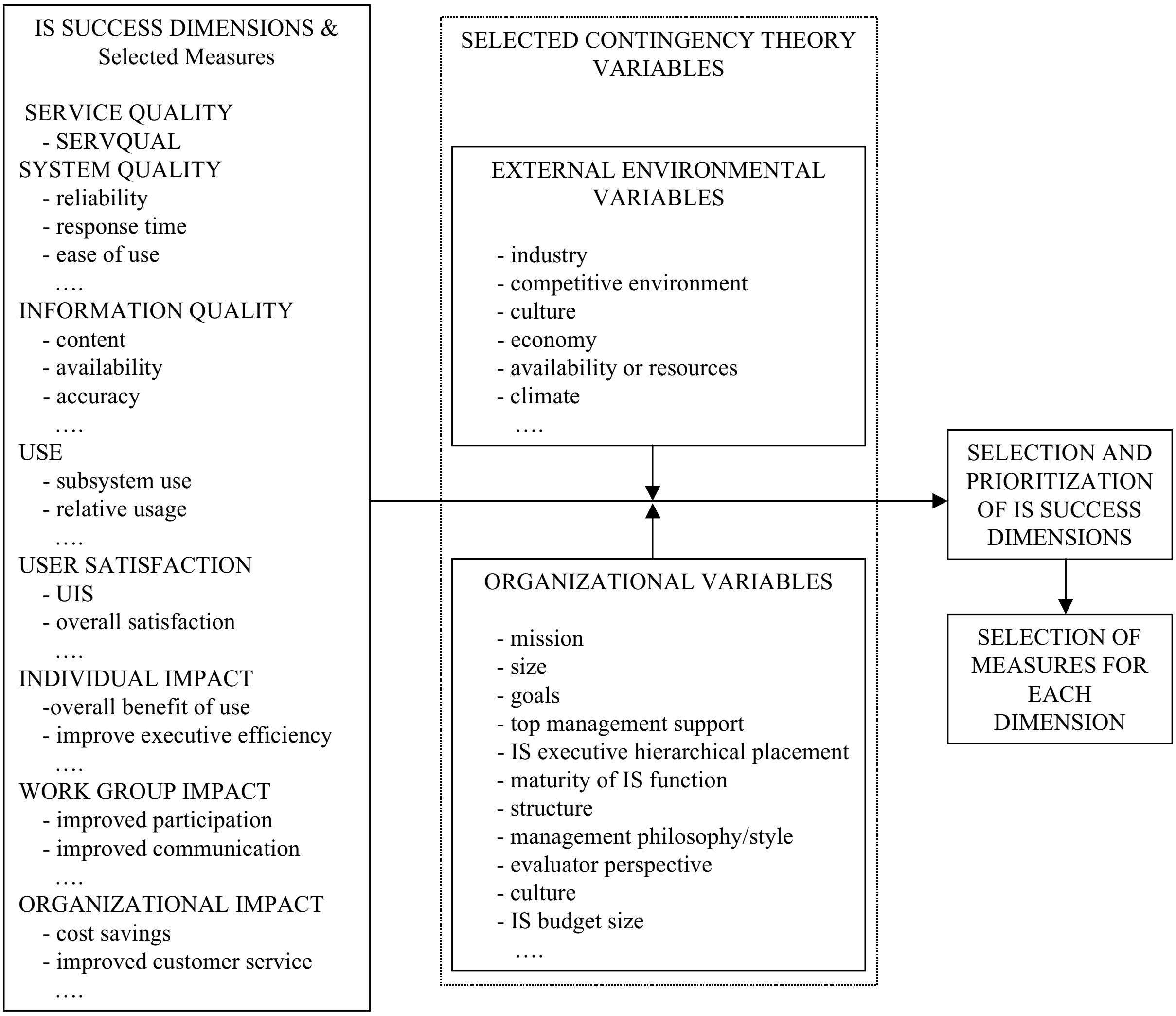

Figure 1. IS Assessment Selection Model of Myers et. al. (1997)

In the 1990s, the most important issue in information technology seems to be the “networking”, which led Oracle’s CEO, Larry Ellison, to say “Network is computing!” Companies network their computers, creating decentralized computing and distributed computing environments (Hodgkinson, 1992; Fiedler et al. 1996). The advancement in computer-based telecommunication, processing, and data storage, such as ISDN, LAN and database management systems (DBMS), has created a client-server computing structure, with shared access to dispersed data and applications. Fiedler et al. (1996) classified this type of IS structure as cooperative computing.

Table 1. Information System Structure Typologies (based on Fiedler et al. 1996)

Category	Processing decentralization	Network connectivity	Shared data and applications	Description
Centralized computing	Low	Low	N/A	A central isolated processor
Decentralized computing	High	Low	N/A	A number of isolated processors

Hub-and-spoke computing	Low	High	N/A	A centralized processor with networked connections
Distributed computing	High	High	N/A	A number of networked processors
Centralized Cooperative computing	Low	High	High	Centralized computing with high resource sharing
Distributed cooperative computing	High	High	High	Decentralized computing with high resource sharing

Several researchers present the various typologies based on three dimensions such as the degree of processing decentralization, network connectivity, and resource sharing (Ahituv et al., 1989; Fiedler et al. 1996; Leifer, 1988; Louadi, 1998). Ahituv et al. (1989) create a typology dividing IS structure into centralized systems with a central isolated processor, distributed systems with a number of networked processors, and decentralized systems with isolated processors. Similarly, Leifer (1988) presents a typology of centralized systems with a isolated and dumb terminals, stand-alone systems of dispersed isolated computers, decentralized systems of networked peer computers, and hub-and-spoke computing systems designed around a centralized processor with networked connections. On the basis of these studies, Fiedler et al. (1996) propose a new emphasis on resource sharing. They pay additional attention to the impact of the new technologies (e.g., high-speed processors, LAN, and DBMSs) on computing environments. The ability of computers to share data and application programs is used as a third dimension to derive IS structural taxonomy. These classification schemes and typologies are summarized in Table 1 with a little revision to the summary of Fiedler et al. (1996).

3. Research Model & Hypothesis

This paper adopts the taxonomy of Fiedler et al. (1996) (i.e. centralized, decentralized, centralized cooperative, and distributed cooperative computing) to derive the taxonomy of IS structure in Korea. As they identify, IS structure evolves from centralized to cooperative computing via decentralized computing. It can be said that the decentralized computing is more evolved than centralized computing and that cooperative computing is more evolved than decentralized computing in the same way. Saunders and Jones (1992) propose that as the IS function matures, the measurement focus shifts from operational efficiency and user satisfaction to a more unstructured concern for IS impact on strategic direction. As noted, the objective of this study is to identify the empirical relationship between the prioritization or adoption of IS performance dimensions and IS structure. Based on Fiedler et al. (1996) and Saunders and Jones (1992), the research question of this paper can be expressed as the following simple and basic proposition.

Proposition 0. The IS performance dimensions that are perceived to be appropriate differ in different IS structural typologies.

In DeLone and McLean's six dimensions of IS success, system quality is about the operational efficiency of information system itself (i. e., reliability, response time, ease of use, usefulness, flexibility, accessibility, etc). User satisfaction is probably the most widely used single measure of IS success in both academic research and field practice. These two are direct and structured measures that can be more widely used in relatively immature computing environments (Saunders and Jones, 1992; Yutha and Eining, 1995).

Proposition 1. Direct measures (system quality and user satisfaction) are perceived to be more appropriate in centralized computing.

On the other hand, individual impact and especially organizational impact cannot be measured in a direct and temporary manner. They are often too unstructured to identify and explain because those impact-oriented measures seldom isolate the performance of IS from that of other factors. Therefore, they are considered more important and are adopted more often in more evolved and mature computing environments. This rationale can be expressed as the following proposition.

Proposition 2. Impact-oriented measures (individual impact and organizational impact) are perceived to be more appropriate in cooperative computing environment.

In the next chapter, the operationalization of variables is discussed.

4. Operationalization of variables

4.1 IS performance measures

Table 2. Operationalization of IS success measures

<table>
<tr><th>Dimension</th><th>Operationalized Measures</th><th>Value</th></tr>
<tr><td>System quality</td><td>- Operational efficiency of IS function
- Responsiveness of hardware & software
- Downtime of information system
- Internal control
a. System availability
b. Confidentiality</td><td rowspan="6">Two five-point-scales of importance and usage are measured for each item.

1) From Never Important (1) to Very Important (5),

2) From Not Used (1) to Very Frequently Used (5).</td></tr>
<tr><td>Information quality</td><td>- Accuracy of information
- Timeliness of information
- Completeness of information</td></tr>
<tr><td>Information use</td><td>- Frequency of use
- Voluntary usage</td></tr>
<tr><td>User satisfaction</td><td>- User/management attitudes about IS function
- Perceived utility of system</td></tr>
<tr><td>Individual impact</td><td>- User's understandability of the decision context
- Decision making productivity
- User's job performance</td></tr>
<tr><td>Organizational impacts</td><td>- IS impacts on goal achievement
- IS contribution to organizational financial performance.</td></tr>
</table>

All dependent variables – system quality, information quality, information usage, user satisfaction, individual impact, and organizational impact – are measured in five-point scales of importance. The subjects are asked to rate the importance of evaluation criteria on a five-point scale (one is "not important" and five is "very important") for each system structure.

4.2 IS Structural Typology

The operationalized constructs and their measurement scales of IS structural variables are presented in Table 3. Each of the four variables has its own operationalized items with different scales.

Table 3. Operationalization of Dimensions of IS structure

Dimension	Operationalized Measures	Value
Degree of MIS Centralization (Ein-Dor and Segev, 1982; Ahituv et al. 1989)	- Responsibility central MIS dept. in system administration and operation activity (4 items) . Responsibility of MIS dept. in IS planning . Responsibility of MIS dept. in IS capacity . Responsibility of MIS dept. in IS resourcing . Responsibility of MIS dept. in IS control - Responsibility central MIS dept. in system development activity (3 items) . Responsibility of MIS dept. in IS analysis . Responsibility of MIS dept. in IS design . Responsibility of MIS dept. in IS justification and selection	from decentralized (1) to centralized(5), (5 point scale)
Hardware Deployment (Ahituv et al. 1989, Leifer, 1988; Fiedler et al. 1996)	- Distribution of CPU and connectivity of network (1 item) . Centralized system: mainframe with dumb terminals . Distributed system: central host linked with smart terminals, many to one communications . Decentralized: linked independent terminals or processors, many to many communications	from centralized (1) to decentralized(5), (5 point scale)
Degree of MIS Integration (Fiedler et al. 1996; Ein-Dor and Segev, 1982)	- Degree of two types of integration (2 items) . Parallel Integration of data from different areas of the organization by means of a database . Vertical Integration of models where the output of one model becomes an input to another	from never integrated (1) to completely integrated (5), (5 point scale)

5. Research Methodology

5.1 Sampling

The research method used to test the hypotheses in this study was a mail survey of Korean companies having Management Information Systems (MIS) departments. Initially, 1014 companies were selected. This group is composed of profit seeking organizations that have more than one person in their MIS department.

Most of them are listed firms that generally have relatively matured or sophisticated information system. But the size of the firms differ, which makes the role of MIS department vary from simple operations to administration or planning of IS. The target respondent is the chief of the MIS department whether he (she) is an executive, middle-ranked manager, or low-level manager.

The response rate was low in that the returned questionnaires number 154. This, however, is large enough to perform statistical tests. In testing the two propositions, the unit of analysis was the overall MIS of the organization. Thus, MIS structural features and IS success measures are measured with respect to the overall information system.

We delete 17 cases from 154 firms because they have missing values, the number of their IS employees is under 5, and/or the percentage of the IS budget is extremely low. The remaining 137 cases are used to test the hypotheses.

5.2 Data Analysis

5.2.1 Reliability/Validity Studies

Table 4. Factor Analysis/Discriminant Validity Check

Indicator Items	System Quality	Infor. Quality	Infor. Use	User Satis'n	Individual Impact	Org'l Impact
SQ1	.5991					
SQ2	.7050					
SQ3	.6837					
SQ4	.8039					
SQ5	.7959					
IQ1		.7543				
IQ2		.7605				
IQ3		.8112				
IU1			.8544			
IU2			.8012			
US1				.7175		
US2				.7909		
II1					.5810	
II2					.5558	
II3					.4624	
OI1						.7280
OI2						.7566
Eigen Value	13.380	8.168	2.542	2.032	1.747	1.531
Cum Variance	35.7 %	49.5%	54.8%	60.4%	65.8%	68.6%

Note) SQ: System Quality, IQ: Information Quality, IU: Information Use, US: User Satisfaction, II: Individual Impact, OI: Organizational Impact

An exploratory factor analysis using principal components factor analysis with varimax rotation is performed to identify the unidimensionality/convergent validity of each predefined multi-item construct. A joint factor analysis (using all the indicator items of all the antecedent variables) employing the same factor extraction and rotation approach is employed to determine discriminant validity. Table 4 summarizes the results of the analysis.
As can be seen in Table 5, reliability is evaluated by assessing the internal consistency of the indicator items representing each construct using Cronbach's alpha.

Table 5. Reliability Check for Variables

Category	Variable	No. of items	Alpha	Adjusted Alpha	Deleted Items
Importance of IS Success Measure	SQ	5	.7773	-	None
	IQ	3	.7435	-	None
	IU	2	.8001	-	None
	US	2	.5956	-	None
	II	3	.8409	-	None
	OI	2	.7542	-	None
Usage of IS Success Measure	SQ	5	.6672	-	None
	IQ	3	.8016	-	None
	IU	2	.7491	-	None
	US	2	.7509	-	None
	II	3	.8121	-	None
	OI	2	.7540	-	None
IS Structure	Degree of Centralization	From 7 to 5	.5099	.9012	2 items deleted. i. Responsibility of MIS dept. in IS planning ii. Responsibility of MIS dept. in IS control
	Degree of Integration	2	*.2563**	-	1 item deleted. i. Vertical Integration of models

Note) SQ: System Quality, IQ: Information Quality, IU: Information Use, US: User Satisfaction, II: Individual Impact, OI: Organizational Impact

* Degree of integration is measured with only one item, parallel integration of data.

5.2.2 IS Structural Taxonomy

SPSS 8.0 for Windows is used to perform cluster analysis. The first step in cluster analysis is to determine the number of clusters (i.e. types of IS structure). Four groups suggested by Fiedler et al. (1996) are included.

The Ward Method of agglomerative hierarchical cluster analysis is used for empirically determining the number of groups. This method determines the distance between two clusters as the sum of squares between the clusters summed over all variables, which minimizes the total within-group sum of squares. By adding one cluster to another, a coefficient of squared Euclidean distance between the two combined cases is calculated and recorded. The value of the coefficient determines whether they can be combined into one cluster or not (Bailey, 1994). The coefficient in this study is large enough to lend support to the four typologies suggested by Fiedler et al. (1996).

To supplement the limitation (subjectivity) of hierarchical cluster analysis, the steps for validation and examination of the stability of the chosen clusters need to be explicated. The first step is multivariate analysis of variance to determine that the four clusters are significantly different from each other. The observed F statistic of each group reveals differences significant at the 0.01 level. The second step to gain further confidence is nonhierarchical cluster analysis or K-means clusters (Bailey, 1994). During nonhierarchical cluster analysis which starts with four clusters and centers resulting from during the hierarchical cluster analysis, all the cases are directed to fall within a set distance to each of the defined group centers. The analysis of variance for these groups produced an F statistic that shows differences at the 0.01 of significant level. The final step is another nonhierarchical analysis with designation of four groups, but with starting cluster centers that are independent of the hierarchical analysis and maximize the distance between groups. The F statistic from the analysis of variance reveals differences significant at the 0.01 level. None of the group centers varied significantly across the cluster analysis at a significant level of 5 percent. The combination of the validity and stability analysis allows for increased confidence in the derived IS structural taxonomy. Table 6 shows variable means related to each of the four IS structure types that the cluster analysis produce. F-values and significance levels associated with the test of equality of variable means across the four groups are shown in the last column.

Table 6. Cluster Analysis of Information System Structures

IS structural scheme	**Cluster**				**F value**
	Centralized	Decentralized	Centralized cooperative	Distributed cooperative	
Hardware decentralization	1.02	3.21	2.38	3.02	125.4***
IS activity centralization	3.17	1.64	3.05	2.15	109.3***
IS integration (inter-departmental data dependence)	2.79	1.24	3.12	3.17	121.3***
Number of cases	39	22	39	37	

Cluster groups derived from K-means procedure using Cluster analysis of SPSS.
F-values: Test of significant differences across Cluster Groups using one-way ANOVA.
***$p < 0.01$; **$p < 0.05$; *$p < 0.1$.

As can be seen from Table 6, cluster one (centralized computing), relative to other clusters, represents a group of firms with a moderately high inter-departmental data dependence (degree of integration), a high centralization of IS activities, and a low dispersion of IS hardware resources. Just the opposite characteristics are depicted by firms in cluster two (decentralized computing). This cluster represents a group of firms with a low to moderate inter-departmental data dependency, a low centralization of IS activities, and a high dispersion of IS hardware resources. Cluster three firms (centralized cooperative computing) display a high level of inter-departmental data dependence, a high degree of centralization of IS activities, a moderately low degree of hardware resource dispersion. Cluster four (distributed cooperative computing) exhibits a high level of inter-departmental data dependence, a low degree of centralization of IS activities, and a high degree of hardware resource dispersion.

6. Test of Propositions

The anticipated propositions are that the prioritization and adoption of IS performance measures would differ in each of the derived taxonomies of IS structure. The results of ANOVA test are summarized in Table 7.

As can be seen from Table 7, the results appear to partially uphold the central proposition of the study. The F-tests indicate that the group means of these four clusters are significantly different on the prioritization and adoption of IS performance dimensions. Firms with centralized computing appear to focus on system quality, information quality, and user satisfaction. The firms with decentralized computing also emphasize information quality, system quality, and user satisfaction. The mean ratings on these measures (maximum score of 5.0) represent high levels of importance in measurement of IS performance. In the firms with centralized cooperative computing, organizational impact, system quality, and information quality are considered important. Finally, the firms with distributed cooperative computing consider organizational impact, individual impact, and information quality as important measures. Furthermore, each of system quality and user satisfaction appears to score the highest rating in the group of centralized computing, which supports proposition 1. The F value in the first (fourth) row exhibits that the importance of system quality (user satisfaction) measure is perceived in different groups at statistically different levels. Both individual impact and organizational impact appear to score the highest rating in distributed cooperative computing, which also upholds proposition 2.

The corresponding F-values are significant enough to explain the difference of scores between groups. The results indicate that there are major differences of prioritized and adopted measures of IS performance between the firms in different clusters. In the next section, the analyses on the findings and the underlying rationale producing these results follow.

7. Discussion and Implications

The cluster analysis technique proved to be useful in deriving distinct and meaningful clusters from data. Cluster one represents firms with moderate to high inter-departmental data dependence. The IS organization within these firms is characterized by high centralization of both operational and strategic IS decisions. These organizations have also managed to retain and concentrate practically all of the IS resources such as hardware, software, data, telecommunications, and personnel at their central site. While this configuration allows for greater control over IS resources and ensures hardware and software compatibility across the organization, it is difficult to respond to and adapt the local needs.

On the other hand, organizations represented by cluster two have low inter-departmental data dependence and most of their resources are distributed to local sites. These organizations have further decentralized authority to make operational and strategic IS decisions to lower levels of management. This configuration permits greater adaptability and faster response to local needs that are essential for firms that operate in distinctly different product/market domains where inter-departmental data dependencies are relatively low. These two groups represent the IS typologies placed in the earlier stages of IS structural evolution. As expected, the direct measures such as system quality and user satisfaction are prioritized and adopted. Most of the firms in those stages seldom, if ever, have comprehensive frameworks for assessing the indirect influence of IS.

Table 7. The prioritized and adopted IS measures in four IS structural types: One-way ANOVA across four cluster groups

IS performance measures	Centralized (Group 1)	Decentralized (Group 2)	Centralized Cooperative (Group 3)	Distributed cooperative (Group 4)	F	Duncan Range Test (Significant contrast values)
System quality	4.063	3.870	3.731	3.379	2.187*	1-2*; 1-3*; 1-4**
Information quality	3.715	4.002	3.658	3.675	1.304	1-2*; 2-3**; 2-3**
Information Use	3.264	3.058	2.886	2.741	1.094	1-3**; 1-4**
User satisfaction	3.625	3.531	3.227	3.243	1.021	1-3*; 1-4*; 2-3*
Individual impact	2.646	3.213	3.167	3.773	2.448**	1-2*; 1-3*; 1-4***;2-4**, 3-4***
Organizational impact	3.079	3.250	3.714	4.279	3.248***	1-3***; 1-4***; 2-3**; 2-4***; 3-4**
Number of cases	39	22	39	37		

***$p < 0.01$; **$p < 0.05$; *$p < 0.1$.

The group three and group four clusters have a distinctively high level of IS resource sharing which can be represented as client-server computing systems composed of powerful and cost-effective workstations and LANs. Technological changes have encouraged organizations to migrate to the distributed environments. In these relatively evolved IS environments, the frameworks for assessing the indirect influence of IS are already in place.

Prioritized and adopted IS performance measures differ in the four types of IS structure. This implies that IS managers in firms with different IS structures focus on different aspects of the role of IS (Clark, 1992; Floyd and Zahra, 1996; Hodgkinson, 1992). It seems to be always true that "what to measure is what to manage" and that "what is to be seen is what is to be known." As Saunders and Jones (1992) state, IS maturity may impact on the relevance and usefulness of various measures to the IS manager.

8. Conclusion

The taxonomy of IS structure is based on the degree of centralization of IS-related activities (development, operation, and administration of IS), integration of processing, and centralization of computer processing (hardware configuration). By using a multi-step cluster analysis, both the membership and number of groups are derived from the responses of 137 firms. Four IS structures are identified: (1) centralized (centralized IS activities, moderate integration, centralized processing); (2) decentralized (decentralized IS activities, low integration, decentralized processing); (3) centralized cooperative (centralized IS activities, high integration, centralized processing); and, (4) distributed cooperative computing (decentralized IS activities, high integration, decentralized processing).

This study employs an ANOVA analysis to test the empirical relationship between the structure of various information systems (IS) and several different measures of their performance. Different sets of IS success measures are perceived important in the firms with different IS structures. Among DeLone and McLean's six measures, system quality is perceived as the most important measure in centralized computing, information quality is perceived as the most important measure in centralized cooperative computing, and organizational quality is perceived as the most important one in distributed cooperative computing.

Rapid changes occurring in the information systems area often require study of the problems and issues for which a well-established theory or conceptual model does not exist. The encouraging results of this study indicate that the concept of fit is useful for studying complex and messy organizational issues such as IS performance evaluation.

It may be necessary to fine-tune the analysis by a more extensive study of specific industries/environments. The effects of additional factors are not included (e.g., size, industry type) in this study. For example, it is possible that concerns of system quality (e.g., response time or downtime) may be more important in service industries such as banking and insurance than manufacturing companies with multiple plant sites (Hodgkinson, 1992). Further research needs to be conducted across different environmental settings to validate the existence of fit among the IS factors and the prioritized and adopted IS performance measures. Furthermore, besides the three IS factors (centralization of IS activities, dispersion of hardware resources, and inter-departmental data dependence), a number of other relevant factors may exist, such as overall organizational structure, leadership style/culture, role of IS, and constraints imposed by the migration/evolution path of the distributed environment.

9. Limitations

Due to limited resources, the study is restricted to only three independent variables. Other variables, as noted in the previous section, may be important. In order to attain a high level of responses, only one respondent of each organization is solicited. Perhaps, the solicitation of multiple viewpoints might have led to different findings. This is an area of future research. Finally, the prioritization and adoption of IS performance dimensions are operationalized and constructed to five point Likert-type scales of perceived importance and usage of each measure. The difference of individual perception can cause measurement error through biased response.

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