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The Relationship Between Information System Planning Sophistication and Information System Success: An Empirical Assessment*

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ABSTRACT

Literature on information systems (IS) planning implicitly assumes that a sophisticated IS planning process leads to greater IS success. This paper questions the exclusive reliance on this traditional belief. Instead, because IS planning requires significant organizational resources, prior IS success is essential to convince top management of the importance of IS planning sophistication. Therefore, IS success may influence IS planning sophistication. Several theoretical arguments are advanced in support of this explanation.

Data from a survey of 236 academic institutions are used to empirically assess the two alternative directions of the relationship between IS planning sophistication and IS success. Four structural models including the alternative causal directions are evaluated. Two of these models are supported. Together, they imply that for a high level of IS planning sophistication, either the previous ISs should have been successful or the organization should possess advanced information technology capabilities. Thus, empirical results suggest that the explanation presented here (i.e., IS success facilitates IS planning sophistication) provides an equally good alternative to the more traditional explanation (i.e., IS planning sophistication facilitates IS success).

Subject Areas: Information Systems Planning, Management Information Systems, Structural Equation Models, and Survey Research/Design.

INTRODUCTION

Practitioners as well as researchers have consistently considered information systems (IS) planning as a very important topic (Branchaeu, Janz, & Wetherbe, 1996). The widespread recognition of the strategic potential of IS and concerns about the sustainability of competitive advantage have caused increasing attention to IS

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planning. This paper focuses on one important issue in this area: the nature of the relationship between an organization's IS planning sophistication and IS success.

Conceptual and empirical research suggesting a positive relationship between IS planning sophistication and IS success (Henderson & Sifonis, 1988; Lederer & Sethi, 1996; McFarlan, 1971; McLean & Soden, 1977) has stimulated numerous recommendations for increasing IS planning sophistication, including educating top management about information technology and its strategic potential, and seeking greater IS participation in business planning (Lederer & Mendelow, 1988). It is assumed that such efforts towards increasing IS planning sophistication lead to greater IS success. In contrast, this paper suggests that an organization's IS success influences the degree of IS planning sophistication. Several theoretical arguments are offered in support of this expected relationship. For example, sophisticated IS planning requires significant organizational resources (McFarlan). Therefore, efforts to increase IS planning sophistication can be much more effective if the IS group has built a high level of credibility by developing successful ISs in the past (Doll & Ahmed, 1983).

Data from a survey of 236 large academic institutions constitutes the empirical basis for this paper. This focus on large academic institutions controlled for the industry context, enabled construction of questionnaire items that can be easily understood by respondents, and enhanced the meaningfulness of responses. The focus on academic institutions in particular was motivated by several factors. Academic institutions are considered to be knowledge and information intensive (Green & Gilbert, 1988; McLaughlin, McLaughlin, & Howard, 1987), which increases the likelihood that the issues addressed are important to the respondents. Academic institutions have made significant investments in information technology capability, especially since the advent of microcomputers. Only about 2% of the overall university budget was allocated to information technology until the early 1980s, but this figure soared to nearly 5% in 1988 (Hawkins, 1988). It is, therefore, not surprising that researchers of academic institutions have emphasized the need for sophisticated IS planning (Day, 1987). Finally, there is substantial prior research on academic institutions, which facilitated the development of the measures of various research constructs.

The theoretical background for the paper is developed in the next section. Both sides of the argument—(1) IS planning sophistication affects IS success, and (2) IS success affects IS planning sophistication—are examined. This is followed by a description of the data collection process. The subsequent two sections describe the data analysis approach and the results. Finally, in discussion, the paper's implications are examined and some of its limitations are acknowledged.

THEORETICAL DEVELOPMENT

The theoretical foundation for the paper is developed in this section. The first subsection provides an overview of the research model, following which the relationships between organizational integration and IS planning sophistication, and between information technology capability and IS planning sophistication, are examined. Finally, the last three subsections of this section describe the relationship, first at an overall level, then using the traditional perspective (i.e., IS planning sophistication affects IS success), and lastly using the alternative perspective (i.e., IS success affects IS planning sophistication.)

Overview of the Research Model

Figure 1 presents the research model underlying the paper. It depicts the focus on four research constructs—IS planning sophistication, IS success, organizational integration, and information technology capability. The first two of these constructs were essential considering the research objective: to examine the alternative directions of the relationship between IS planning sophistication and IS success. The other two constructs—organizational integration and information technology capability—are key attributes of the organizational and technological environments, respectively, in which IS planning is performed. There is strong prior evidence for the effects of these two constructs on IS planning sophistication and IS success as discussed later.

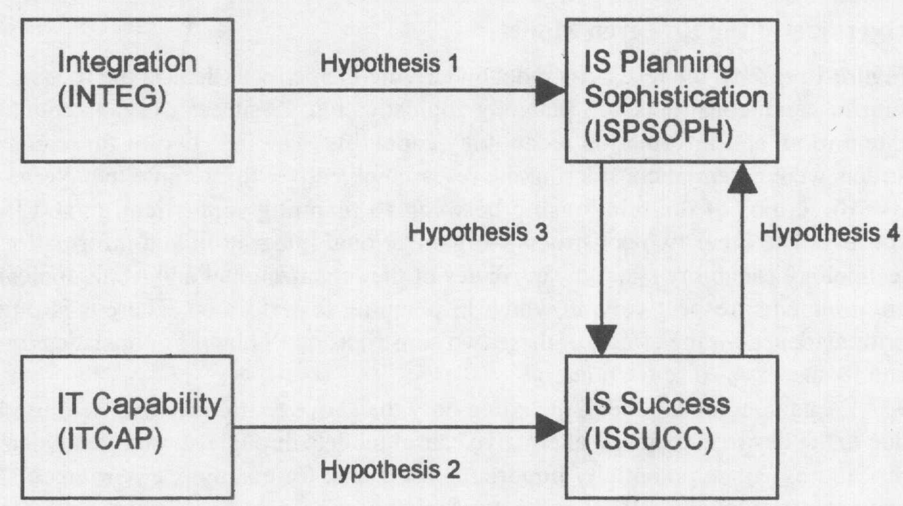
A parsimonious model, including only the above four constructs, was used due to the desire to examine alternative causal models through rigorous analytical procedures. Some potentially important constructs, for example, environmental uncertainty (Duncan, 1972) and information technology management climate (Boynton, Zmud, & Jacobs, 1994), were excluded. They would have exponentially increased the complexity of analysis and necessitated much larger sample sizes, due to two major reasons. First, most such additional constructs directly relate to more than one of the four constructs included in the study. For example, information technology management climate may be related to IS success as well as to IS planning sophistication. Second, for some of these additional relationships, either direction can be justified. For example, environmental uncertainty may reduce IS planning sophistication by increasing the problems encountered, and a low level of IS planning sophistication may increase environmental uncertainty. Thus, the use of a parsimonious research model enhanced the internal validity of the study but sacrificed generalizability, which might have resulted from a larger set of constructs.

In addition, some other constructs, such as information technology-management-process-effectiveness (Boynton et al., 1994) and IS maturity (Saarinen & Saaksjarvi, 1992), were not included due to another reason as well: their high level of conceptual overlap with IS planning sophistication. For example, information technology-management-process-effectiveness conceptually overlaps with IS planning sophistication because information technology management includes strategic IS planning (Boynton et al., 1994).

IS Planning Sophistication and Organizational Integration

The value of IS planning has been recognized for a long time, but much of the initial focus was on operational issues. Blumenthal (1969) considered the objectives of IS planning "to encompass the review of proposed systems in terms of the criteria designed to minimize the number of systems, to broaden their scope, and to place them in the proper sequence for development" (p. 13). Likewise, Ein-Dor and Segev (1978) conceptualized IS planning as including "the development strategy, the purpose of the system, priorities for choosing system functions, system functions (applications), function goals, function requirements, documentation"

Figure 1: The research model.



(pp. 1631, 1633). Thus, despite the recognition of the need for "establishing computer planning objectives on the basis of corporate goals" (Kriebel, 1968, p. 12), the early IS planning literature concentrated on application development portfolio (McFarlan, 1971).

More recently, the need to align the IS strategy to the business strategy has been recognized (King, 1978; Pyburn, 1983) and the performance implications of such alignment have been empirically demonstrated (Chan & Huff, 1993; Sabherwal & Kirs, 1994). The earlier work on this alignment focused on aligning IS strategy to business strategy. However, discussions of the strategic potential of IS have been accompanied by the recognition that IS strategy can also impact business strategy (Galliers, 1987; Jarvenpaa & Ives, 1990; Porter & Millar, 1985). It has also been recognized that the IS planning process can impact the business planning process, in addition to its supportive or reactive role (Galliers; Henderson & Sifonis, 1988). It is clear that as information technology's contributions to organizations have progressed from the eras of data processing and management information systems to the current "strategic" era (Ward, Griffiths, & Whitmore, 1990), the normative expectations from the IS planning process have evolved from the specification and prioritization of future systems to supporting and shaping the corporate business plans (Ein-Dor & Segev, 1978; Galliers).

An organization's IS planning sophistication may be defined as the extent to which its IS planning process helps create opportunities for information systems to make a strategic contribution in the organization. There are two broad dimensions of IS planning sophistication: IS planning behaviors and knowledge overlaps. The "strategic" IS era has necessitated drastic changes in the IS planning process along both these dimensions. The recommended IS planning behavior is one in which the top managers participate actively (Doll, 1985; Galliers, 1987; Hann & Weber, 1996; Sabherwal & King, 1994), which explicitly considers the organization's business plans (Cash, McFarlan, McKenney, & Vitale, 1988; King, 1978), and which is more formalized (Earl, 1993; Sabherwal & King, 1992). Such IS planning behavior is associated with greater knowledge overlaps among business and IS managers, with the IS managers being more aware of the long-term business plans (Lederer & Mendelow, 1989; Lederer & Sethi, 1996; Ward et al., 1990), and the top managers possessing greater knowledge about information technology and its potential business impact (Johnston & Carrico, 1988). Moreover, the IS planning behavior may be considered as both influencing and depending on knowledge overlaps. For example, greater top management participation in IS planning may increase knowledge overlaps but greater knowledge overlaps are likely to stimulate more top management participation in IS planning. Recognizing that IS planning behavior and knowledge overlaps influence each other and represent aspects of IS planning sophistication, both these dimensions were incorporated. Thus, in organizations with sophisticated IS planning, both top management and IS executives are knowledgeable about business objectives and information technology, and participate in IS planning.

The above attributes of sophisticated IS planning, such as top management participating in IS planning and the IS managers being involved in business planning, are more likely when the organization is highly integrated (Premkumar & King, 1994). Organizational integration is "the quality of the state of collaboration that exists among departments that are required to achieve unity of effort by the demands of the environment" (Lawrence & Lorsch, 1967, p. 11). Integration is achieved through such mechanisms as task forces, interdepartmental committees, and liaison personnel to coordinate the activities of interdependent departments (Galbraith, 1977). These integrative mechanisms promote interaction that can help in reconciling divergent perspectives and developing unified plans and strategies (Miller, 1987). They may also enhance IS managers' awareness of business, while simultaneously increasing the participation of top managers in the IS planning process (Premkumar & King, 1994).

> H1: An increase in the level of organizational integration leads to an increase in the level of IS planning sophistication.

IS Success and Information Technology Capability

In prior IS planning research, the effectiveness of IS planning has sometimes been assessed in terms of benefits of the IS planning process (e.g., improved top management support), but more commonly in terms of the overall success of the organization's information systems (Raghunathan & King, 1988). The success of information systems in organizations has been characterized in the IS literature in many different ways. For example, DeLone and McLean (1992) classified these measures into system quality, information quality, use, user satisfaction, individual impact, and organizational impact. In IS planning studies, IS success has appropriately been viewed at the organizational rather than an individual system level (Raghunathan & King). This focus on the organizational level implies consideration of IS success in terms of the contribution of IS products rather than the quality of the IS development process (Saarinen & Saaksjarvi, 1992). An organization's IS success is therefore considered as information systems' overall contribution to the organizational success, including such aspects as distinguishing the organization, improving its efficiency, and providing it a competitive advantage (Premkumar & King, 1994).

IS success has been linked to the organization's information technology capability, or the extent to which the technologies needed for manipulation, storage, and communication of information are available within the organization (Sabherwal & Kirs, 1994). It is similar to "information processing capacity" (Galbraith, 1977), but focuses on information technologies, that is, computer and communication hardware and software, while information processing capacity also includes such structural mechanisms as teams and committees. Information technology capability can help enhance the amount and richness of an organization's information processing (Daft & Lengel, 1986; Galbraith, 1977). As a consequence, a high level of information technology capability may directly lead to greater IS success. Conversely, an organization with a low level of information technology capability would be likely to have low IS success.

H2: An increase in an organization's information technology capability leads to an increase in the level of IS success.

Association Between IS Planning Sophistication and IS Success

Several authors have implicitly or explicitly proposed that IS planning sophistication and IS success are interrelated (Boynton & Zmud, 1987; Ein-Dor & Segev, 1978; McFarlan, 1971; Vitale, Ives, & Beath, 1986). Over time, several empirical studies have found evidence of a positive association between IS planning sophistication and IS success. A study of 36 companies found 16 of 18 successful users of IS to have formal IS plans (Long, 1983). Another study found that companies with integrated business and IS plans financially outperformed companies without such integrated plans by a factor of six to one (Ball, 1982). A study of companies that are successful, along with unsuccessful users of information technology, found the vision and strategy of the CEOs of the successful companies to include the use of information technology (Harris & Katz, 1991). Doll (1985) found firms with successful ISs to be about three times as likely to have written overall plans for IS development. Moreover, Raghunathan and King (1988), who distinguished between systems planning and strategic IS planning, found user satisfaction to be positively associated with the extent of systems planning but not with the extent of strategic IS planning. These results may reflect the limitation of user satisfaction as a measure of IS success, especially in the strategic context.

In addition to the arguments made for the effect of IS planning sophistication on IS success, a logical argument can also be built for the effect being from IS success to IS planning sophistication. However, in previous examinations of the relationship between IS planning sophistication and IS success, it is generally implied that the direction of the effect is from IS planning sophistication to IS success, and the possibility of the reverse effect—from IS success to IS planning sophistication—is largely ignored. There has been no empirical investigation of the two alternative possibilities. For example, Raghunathan and Raghunathan (1994) argued that IS planning capability predicts IS planning success and found this causal direction to be supported by their empirical data, but they did not examine whether the reverse relationship is also supported by their empirical data. The rationale for each of these two directions of the relationship is examined next, with the rationale for the traditional perspective (IS planning sophistication affects IS success) being considered first and then the rationale for the alternative perspective offered in this paper (IS success affects IS planning sophistication).

The Traditional Perspective: IS Planning Sophistication Affects IS Success

At a very basic level, sophisticated IS planning may be expected to lead to greater IS success if that is considered to be the very objective of IS planning (McFarlan, 1971). In fact, IS success and IS planning effectiveness are sometimes considered to be the same. Premkumar and King (1994) included better IS investment decisions, greater exploitation of IS for competitive advantage, increased user satisfaction, and better control over IS resources among the measures of IS planning effectiveness. If a distinction is not made between the effectiveness of the IS planning process and the success of the ISs, then the argument that sophisticated IS planning leads to greater IS planning effectiveness (or to greater IS success) is tautological. However, even if the conceptual distinction between IS planning effectiveness and IS success is preserved (Saarinen & Saaksjarvi, 1992), sophisticated IS planning may be argued to lead to IS success because more successful IS development is one of the objectives of IS planning. For example, Raghunathan and Raghunathan (1994) included improvement in short-term and long-term IS performance, improvement in decision making, and increase in user satisfaction among the objectives of the IS planning process.

Three broad explanations may be advanced for the effect of IS planning sophistication on IS success. First, more sophisticated IS planning may increase the convergence between IS and line managers on the kinds of systems to be developed (Lind & Zmud, 1991), and enable more synergistic integration of information technology and business knowledge (Boynton et al., 1994). This convergence may, in turn, improve the identification and development of strategic IS applications (Reich & Benbasat, 1990). Consequently, sophisticated IS planning may facilitate rational IS investments (Ein-Dor & Segev, 1978; Henderson & Sifonis, 1988), while unsophisticated IS planning may cause expensive IS resources to be wasted (Lederer & Sethi, 1988). Furthermore, organizations with sophisticated IS planning may take a more long-term perspective when identifying strategic systems (Sabherwal & Tsoumpas, 1993).

> Organizations that consistently apply technology in these ways do not gain such capabilities by chance. Rather, these capabilities are developed over periods of time in which technology has been tightly integrated into the organization's core business activities and strategic planning. It is unlikely that either of these events can occur without effective planning processes. (Boynton & Zmud, 1987, p. 59).

Second, more sophisticated IS planning would enhance IS success due to greater ability to implement IS plans (Premkumar & King, 1994). The involvement of business and IS executives in IS planning would improve anticipation of future changes and enhance ability to deal with surprises (Raghunathan & Raghunathan, 1994), and enable systems to be developed at reduced costs (Blumenthal, 1969; Gourman, 1990). The formal IS plan may provide a useful reference to guide actions when circumstances change during IS development (Tully, 1985).

Finally, greater IS planning sophistication would lead to greater involvement of line managers in IS activities. This would generate greater support and resources for IS projects and, consequently, enable more successful IS development. Top management involvement in IS planning may also help in securing necessary resources and reducing problems during IS development (Johnston & Carrico, 1988).

> H3: An increase in the level of IS planning sophistication leads to an increase in the level of IS success.

An Alternative Perspective: IS Success Affects IS Planning Sophistication

For the IS field as a whole, the increasing frequency of strategic IS applications may have led to increased top management awareness of information technology, greater top management participation in IS planning, and greater IS participation in business planning (Pyburn, 1983). Galliers (1987) commented on the change in the nature of IS planning from 1977 to 1987:

> Given that information systems planning is considered . . . a corporate responsibility and that increasing attention is being given to the strategic role that information systems and technology can play, it seemed likely that more recent surveys would indicate greater involvement on the part of managers and corporate planners. (p. 245)

Four broad reasons may be advanced for expecting greater IS success to lead to more sophisticated IS planning within a specific organization as well (Galliers, 1987; Sullivan, 1985). First, IS success may affect IS planning sophistication by influencing the expectations from future systems. If prior systems have not been successful, IS planning may be conducted in an unsophisticated fashion, with less top management participation than appropriate, due to the belief that it is costly and time consuming (Lomax, 1982; Pyburn, 1983). In contrast, prior IS success may alleviate the perception that IS planning is a resource drain and facilitate the allocation of greater organizational resources for IS planning and development (Premkumar & King, 1994; Raghunathan & Raghunathan, 1990).

> Firms that use IS for strategic purposes automatically improve the quality of the planning process to support that role, and firms that plan to use IS primarily for support purposes do not have a very good quality planning process. (Premkumar & King, 1992, p. 118)

Another consequence of IS success is greater involvement of IS executives in business planning due to the recognition of information technology's strategic potential. One common problem in IS planning is that IS managers cannot align the IS plans to the business plans because they do not know the business plans (Powell, 1992; Vitale et al., 1986). IS managers' ignorance of the business plans is attributed to the business plans' being closely guarded (Powell, 1992) and IS managers being excluded from business planning (Lederer & Mendelow, 1988). Perceptions that the ISs are highly successful may help address these problems (Vitale et al.).

Third, IS success may also lead to greater involvement of IS executives in strategic business planning by increasing the credibility of the IS group (Doll & Ahmed, 1983). CEOs who have witnessed successful IS projects in their organizations are likely to have excellent relationships with their chief information officers (Feeny, Edwards, & Simpson, 1992). Conversely, if an organization's IS group exhibits a pattern of poor performance, the credibility of the IS group may suffer (Doll & Ahmed, 1983). Consequently, top management may become disenchanted with information technology, may see no reason to share the business plans with the IS managers or to involve IS managers in business planning, and may exhibit little interest in the IS planning process. Thus, poor IS performance may cause reduction in IS planning sophistication.

> Credibility problems reduce the status and influence of the systems staff. This loss of status and influence may create further difficulties in gaining management cooperation, responsiveness, and involvement, and in securing funding for necessary hardware. Management becomes less willing to work with systems personnel and less willing to automate. (Doll & Ahmed, p. 21)

Finally, prior IS success would help users and line managers to better understand the potential for future IS applications (Jarvenpaa & Ives, 1991). Using the knowledge they have gained from previous systems, these individuals would be able to make a greater contribution to IS planning (Boynton et al., 1994). The theory of absorptive capacity (Boynton et al.; Cohen & Levinthal, 1990) also suggests that the prior IT-related knowledge enables improved relationships and exchanges between line managers and IS managers (Henderson, 1990; Rockart, 1988; Zmud, Boynton, & Jacobs, 1987).

H4: An increase in the level of IS success leads to an increase in the level of IS planning sophistication.

DATA COLLECTION

A large sample size was needed to test the research hypotheses using a structural equation model. A questionnaire survey was therefore appropriate for data collection. The Appendix provides all the measures. The survey was mailed to the vice presidents of academic affairs of the 650 largest (in student enrollment) four-year institutions of higher learning in the U.S. Two-year institutions were excluded as they might serve specialized functions and may therefore have different general objectives than four-year institutions. A total of 244 usable responses (37.5% response rate) were received. Respondents had the option of including identifying information, and 216 (88.5%) identified themselves. After listwise deletion, 236 responses were used for analysis.

Table 1 summarizes the characteristics of the respondent institutions. As may be seen from this table, the respondents were quite senior. The institutions ranged widely in size: 43 institutions had 20,000 or more students while 63 had less than 5,000.

Nonresponse Analysis

A number of tests were performed to examine differences between the respondents and the nonrespondents. One set of tests compared the 216 known respondents

Table 1: The respondents.

Respondent Characteristics	Frequency
Titles	
Senior Vice President, Vice President, Provost, Vice Provost, Chancellor, Vice Chancellor	110
Director, Executive Director	44
Associate/Assistant Vice President, Associate/Assistant Provost, Associate/Assistant Vice Provost	39
Others	23
Missing	28
Institutional Control	
Public	171
Private	73
Total Student Enrollment	
20,000 or more	43
10,000 - 19,999	54
5,000 - 9,999	68
Less than 5,000	63
Missing	16
Highest Degree Offered	
Doctorate	108
Masters	120
Undergraduate	16

with 50 randomly selected nonrespondents in terms of seven attributes of academic institutions. These seven attributes—total student enrollment, student-faculty ratio, average SAT score (verbal), average SAT score (mathematics), Gourman's ratings (undergraduate), Gourman's ratings (graduate), and Barron's ratings—were obtained from secondary sources (Barron's Educational Series, 1990; Gourman, 1990). Differences between respondents and nonrespondents were not significant for any of the comparisons ($p \leq .05$). The second set of tests for assessing nonresponse bias compared the four research variables across time-dated waves of respondents (Armstrong & Overton, 1977). The first 100 respondents were classified as "early" and the last 100 respondents as "late," with the middle 44 responses being excluded to enable a more distinct separation between the two groups. Neither of these four t-tests comparing the two groups was significant ($p \leq .05$).

Measures

The Appendix provides the operationalizations of all the research variables. The measures of organizational integration and information technology capability were derived from their more general measures using the literature on academic institutions. Organizational integration was measured using nine items (Miller, 1987; Miller & Friesen, 1982; Vijayasarathy & Sabherwal, 1994). Early theoretical work on integration (Thompson, 1967) led to its operationalization by Miller and Friesen in terms of eight questions, including three items on the use of integrative mechanisms and five on cross-functional discussions on different kinds of decisions. Later, Miller measured "liaison devices" using a similar measure, but with one overall item on interdepartmental interaction. More recently, Vijayasarathy and Sabherwal used a seven-item measure of organizational integration, including three items on integrative mechanisms, three on cross-functional discussions on different kinds of decisions, and an overall item. A nine-item measure based on Miller and Friesen, and Vijayasarathy and Sabherwal was used, but with slight modifications to adapt the measure to academic institutions. For example, the item on interdepartmental committees was replaced with two items, one on institution-wide committees and one on interacademic unit committees.

Information technology capability was measured using 17 items obtained from a review of the literature on information technology use in academic institutions (Baldridge & Tierney, 1979; Baschich, Kaye, & Lefrere, 1986; Green, 1988; Hawkins, 1988; Kissler, 1988; Warren, 1987). Examples of key information technology capabilities for academic institutions include communication devices for access of remote databases (Hawkins, 1988; Kerr & Hiltz, 1982), videoconferencing for student-faculty interaction (Baschich et al., 1986), computer-aided instruction (Baschich et al.; Self, 1985), and computer-aided curriculum design (Baschich et al.; Hawkins; Kontos, 1984).

IS planning sophistication was measured using five items, derived from the literature on IS planning (Galliers, 1987; Lederer & Mendelow, 1989; Raghunathan & King, 1988; Vitale et al., 1986). Lederer and Mendelow (1989) offered four broad suggestions for improving the coordination of IS plans with business plans, namely: encourage business management participation in IS planning, rely on business management's planning process, participate in business management's planning process, and establish an IS plan. Three items—top management participation in IS planning, IS managers' knowledge of business plans, and their participation in business planning—were included to represent the first three of the above suggestions. The other two items measured two areas of concern regarding IS planning, namely top management knowledge of information technology and formalization of the IS planning process (Galliers; Raghunathan & King; Vitale et al.). The five items together assess both behavioral and knowledge-overlap dimensions of IS planning sophistication.

Finally, IS success was measured using five items based on the literature on academic institutions and strategic information technology utilization (Reich & Benbasat, 1990). Because the focus of this study was on the impact of information technology on the organization rather than on certain individuals, organization-level measure of IS success was needed (DeLone & McLean, 1992). The measure used here was based on Reich and Benbasat (1990), who identified a number of measures of IS success, including reduction in costs, improvement in image within the industry, and increases in customer satisfaction. Recognizing that their measure was specific for customer-oriented strategic systems, and considering this paper's focus on academic institutions, a five-item measure was developed. Of these, four items measure the use of IS to support Porter's (Porter & Millar, 1985) generic strategies of differentiation (the extent to which information technology has helped the institution to (a) distinguish itself from competitors and (b) enhance its reputation), and low cost (the extent to which information technology has helped the institution to (c) reduce administrative costs, and (d) improve internal efficiency). The fifth item is a broader one, assessing the extent to which information technology has helped the institution to become more successful overall. Table 2 provides the number of items used, means, standard deviations, and inter-item reliabilities (standardized alphas) for each construct.

Validation of Measures

Reliabilities

The interitem reliabilities (standardized Cronbach's alpha) of all measures were satisfactory. All four reliabilities exceeded 0.75, being 0.78, 0.88, 0.88, and 0.84 for integration, information technology capability, IS planning sophistication, and IS success, respectively.

Further Validation of the Measures for IS Planning Sophistication and IS Success

H3 and H4 propose that IS planning sophistication and IS success affect each other. Before testing these hypotheses and the overall research model, the measures of these two constructs were further validated by assessing their unidimensionality and discriminant validity. The interrater reliability of the IS success measure was also assessed.

To assess the unidimensionality of IS planning sophistication and IS success, the composite measure reliability (ρ_c) of these two constructs was computed using the following formula (Venkatraman & Ramanujam, 1987):

$$\rho_c = \left[\sum_{i=1}^{i=n} \lambda_i\right]^2 \text{var}(A) \Big/ \left[\left(\sum_{i=1}^{i=n} \lambda_i\right)^2 \text{var}(A) + \sum \text{Error Variance}\right],$$

where

ρ_c = composite reliability of measurement,

n = number of indicators (five each for ISPSOPH and ISSUCC);

λ_i = the factor loading relating indicator i to the underlying theoretical dimension, and

var(A) = the variance of the dimension (A) explained by the indicators.

Thus, ρ_c represents the ratio of trait variance to the sum of trait and error variances. The ρ_c values for ISPSOPH and ISSUCC were 0.88 and 0.91, respectively, as shown in Table 2, indicating that the trait variance explains a large proportion of the variance in measurement.

Table 2: The research variables.[1]

Variable	Number of Items	Mean	Standard Deviation	Reliability (Standardized alpha)	ρ_c
Integration (INTEG)	9	5.01	0.82	0.78	–
IT Capability (ITCAP)	17	3.87	0.89	0.88	–
IS Planning Sophistication (ISPSOPH)	5	4.78	1.25	0.88	0.88
IS Success (ISSUCC)	5	4.20	1.18	0.84	0.91

[1]Number of valid observations (with listwise deletion) = 236.

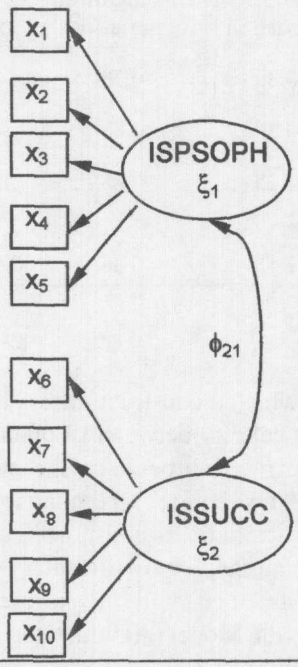
Discriminant validity refers to the degree to which a construct differs from other related constructs. In this case, discriminant validity between IS planning sophistication and IS success is evident if the correlation between these two dimensions (ϕ_{21}) is significantly lower than unity. This requires a comparison of model A, wherein ϕ_{21} is kept free, with model B, wherein ϕ_{21} is constrained to be equal to 1.0. Figure 2 provides the results for these models. A significant χ^2 difference value ($\chi^2_d = 6.63; p \leq .01$) shows that the Model (B) with the correlation between the two constructs set at 1.0 underperforms the Model (A) with the correlation kept free, thus indicating discriminant validity.

To assess the interrater reliability of IS success, a short questionnaire was mailed to the 216 identifiable institutions two months after the initial mailing, with instructions that it be completed by a different senior administrator. Ninety-three (43.1%) responses were received, 22 of which were discarded because the first round respondent had completed the second questionnaire also. The other 71 responses were used. The interrater reliability was assessed using a similar procedure as that used to assess discriminant validity for IS planning sophistication and IS success. Two models were compared, including one with the correlation between the measures obtained from the two respondents (ϕ_{21}) kept free, and the other with ϕ_{21} fixed at 1.0. For the unconstrained model, χ^2 was 32.64, with 22 degrees of freedom, whereas for the constrained ($\phi_{21} = 1.0$) model, χ^2 was 34.89, with 23 degrees of freedom. The χ^2 difference value ($\chi^2_d = 2.25$; $df = 1$) was not significant even at the 0.10 level, indicating that unconstraining ϕ_{21} does not improve the model fit compared to keeping ϕ_{21} fixed at 1.0. This support for the model with the correlation between the two respondents' assessments of IS success set at 1.0 demonstrates the interrater reliability of the IS success measure.

DATA ANALYSIS

Data analysis was conducted using structural equation modeling, implemented through LISREL, due to the following reasons. LISREL allows the joint specification and estimation of the measurement and specification models as a system of structural equations. It thus avoids the confounding of measurement and structural

Figure 2: Assessing the independence of ISP sophistication and ISP success.[1]



A. Unconstrained Model (ϕ_{21} set free)[2]

$\chi^2 = 56.37$
$df = 27$
$p = 0.001$

ML estimate of $\phi_{21} = 0.60$

B. Constrained Model ($\phi_{21} = 1.0$)

$\chi^2 = 63.00$
$df = 28$
$p = 0.0001$
$\chi_d^2 = 63.00 - 56.37 = 6.63$

χ_d^2 is significant at $p \leq 0.01$, thus supporting Model A.

[1] The symbols x_1, x_2, etc., have been used here and in Figure 3 according to the conventions used in LISREL modeling. It may be noted that ξ_1 and ξ_2 in this figure are the same as η_1 and η_2, respectively, in Figure 3. Similarly, $x_1, x_2 \ldots x_{10}$ are the same as $y_1, y_2 \ldots y_{10}$, respectively, in Figure 3.

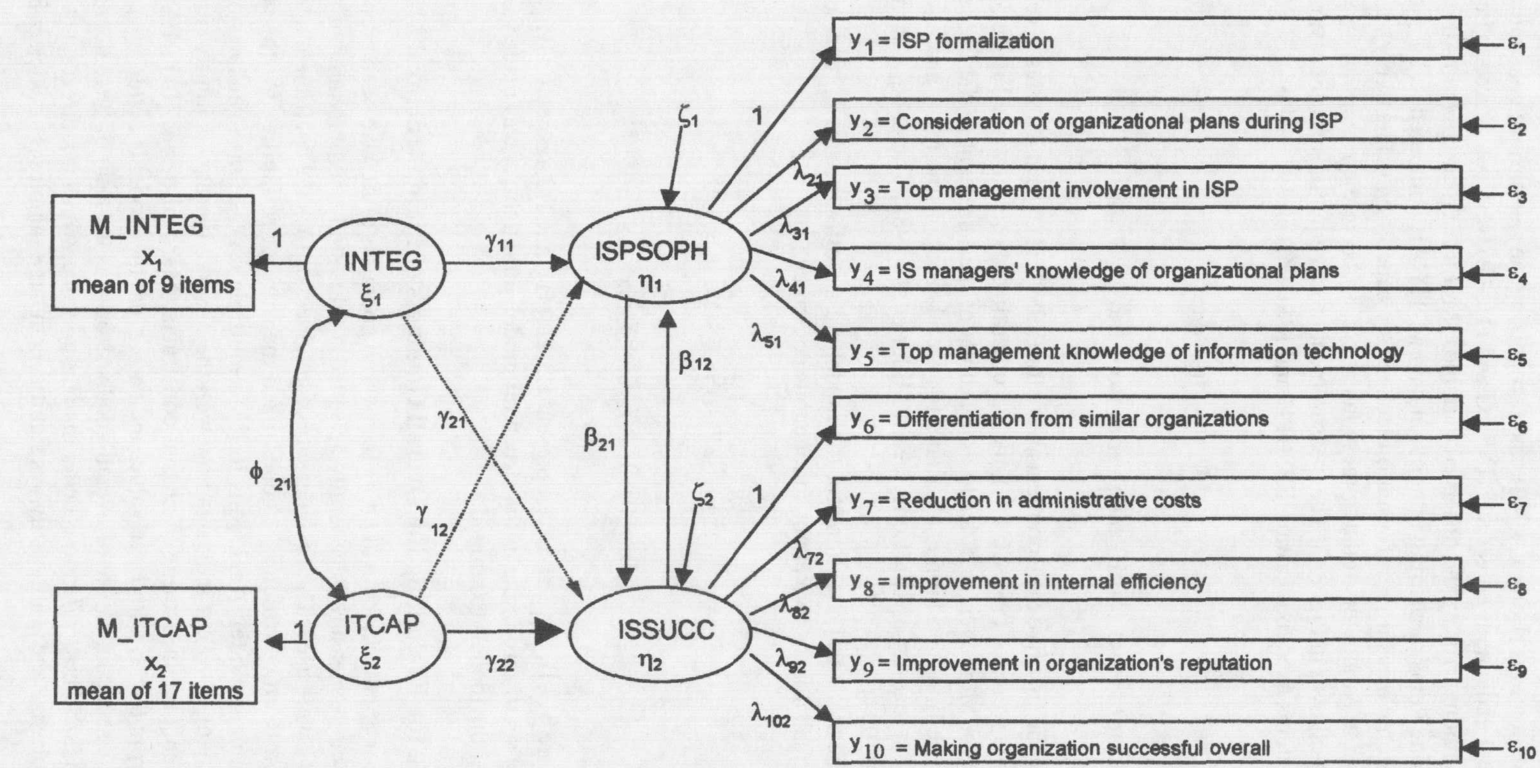
[2] To prevent this figure from becoming further complicated, the λs for the arrows to various indicators have not been shown in any of the three models. To assign a scale to the latent variables, λs for x_1, and x_6 were set to 1 in Models A and B.

parameters (Jöreskog & Sörbom, 1988) and is particularly appropriate for nonexperimental data (Bagozzi, 1977; Miller, Dröge, & Toulouse, 1988). Structural modeling algorithms such as LISREL also enable the overall goodness of a proposed model to be checked, and facilitate testing alternatives to the original model (Chin & Newsted, 1995; Ein-Dor & Segev, 1978). Such tests provide insights into the direction of influence between research constructs (Judge & Ferris, 1993), and were considered useful in assessing the alternative directions of the relationship between IS planning sophistication and IS success.

The Models

The full LISREL model for this study is given in Figure 3. The η latent endogenous variables were IS planning sophistication (ISPSOPH) and IS success (ISSUCC), and the ξ latent exogenous variables were integration (INTEG) and information technology capability (ITCAP).

Figure 3: The structural equation model.



Note: Only the solid arrows were included in the hypothesized model. The dotted arrows (γ_{12} and γ_{21}) are shown only for completeness.

Following prior practice (Marcoulides & Hick, 1993; Miller et al., 1988) and recommendations (Lomax, 1982), and recognizing the sample size constraints, the two latent exogenous constructs (INTEG and ITCAP) were considered to be measured without error by the observed variables (M_INTEG, computed as the mean of the nine items measuring integration, and M_ITCAP, computed as the mean of the 17 items measuring information technology capability, respectively). Consequently, the parameters relating these latent constructs to their measures were set to 1.0, as shown in Figure 3. The measurement model equations for the *y* variables (the 10 items used to measure ISPSOPH and ISSUCC) are:

$$\psi_i = \lambda_{ij}\,\eta_j + e_i,$$

where *i* varies from 1 to 10 and *j* varies from 1 to 2.

Because the first five measurements were for ISPSOPH (η_1), and the last five measurements were for ISSUCC (η_2), the λs other than those shown in Figure 3 were set to zero. Moreover, in order to assign units of measurement to the latent constructs, the first measurement variable for each latent construct (λ_{11} and λ_{62}) was assigned a loading of 1.0 (Long, 1983; Miller et al., 1988; Tharenou, Latimer, & Conroy, 1994).

The structural equations for the model are as follows, with ζs representing the residuals for the two latent endogenous constructs:

$$\eta_1 = \beta_{12}\eta_2 + \gamma_{11}\xi_1 + \gamma_{12}\xi_2 + \zeta_1$$

$$\eta_2 = \beta_{21}\eta_1 + \gamma_{21}\xi_1 + \gamma_{22}\xi_2 + \zeta_2.$$

Here β_{21}, β_{12}, γ_{11}, and γ_{22} represent H3, H4, H1, and H2, respectively. γ_{12} and γ_{21} were set to zero in the initial structural model, although γ_{12} was made variable in one of the models examined.

Criteria for Evaluating the Overall Goodness of Fit of Structural Models

A number of criteria for evaluating the overall goodness of fit have been proposed, and no single measure is generally accepted. In this study, six measures of goodness of fit were used. The first measure of goodness of fit is the coefficient of determination (COD), which is a generalized measure of reliability for the whole measurement model. Analogous to R^2 in multiple regressions (Venkatraman & Ramanujam, 1987), it indicates how well the observed variables jointly serve as instruments for measuring the latent constructs (Marcoulides & Hick, 1993). It varies from 0 to 1, with large values indicating that the model is better.

The second measure of overall goodness of fit is the ratio of χ^2 to degrees of freedom (*df*). The χ^2/df ratio is better than the χ^2 value, which is a direct function of the sample size and is almost always significant in large samples (Hartwick & Barki, 1994; Jöreskog, 1978). The χ^2/df ratio should be less than 3.0 (Carmines & McIver, 1981) or less than 2.0 in a more restrictive sense (Premkumar & King, 1994).

The next two indices are goodness of fit index (GFI) and GFI adjusted for degrees of freedom (adjusted goodness of fit index or AGFI). They measure how much of the variances and covariances the model jointly accounts for and are relatively robust against normality. A rule of thumb is that GFI and AGFI should be 0.90 or greater (Venkatraman & Ramanujam, 1987).

The fifth index of fit, root mean square residual (RMR), is a measure of the average difference between the elements in the sample and hypothesized covariance matrices. Lower values of RMR indicate better fit, and a value below 0.10 is considered desirable (Premkumar & King, 1994).

The sixth index, Bentler and Bonnet's (1980) fit index (BBI), indicates the practical significance of the model in explaining the data. The rule of thumb for this index is that it should be greater than 0.90. It is calculated as follows:

$$\text{BBI} = (F_0 - F_k) / F_0,$$

where

F_0 = χ^2 value for a null model specifying mutual independence among indicators,

F_k = χ^2 value for the specific model.

Criteria for Evaluating Specific Paths of Structural Models

Specific paths in structural models were evaluated using two statistics. First, the *t*-values associated with each included path (i.e., each path that was not fixed at 0 or 1) were examined (Hartwick & Barki, 1994). Paths with nonsignificant ($p \leq .05$) *t*-values should be dropped.

Second, the modification indices for each fixed, or constrained, path were examined. The modification index for a constrained path indicates the predicted decrease in χ^2 if the constraint for that path is relaxed (Jöreskog, 1978). Therefore, if one or more paths have large modification indices, then the reestimation of the model after relaxing the constraints for those paths (i.e., including the parameters for those paths in the model as variables instead of fixing them at 0 or 1) would lead to improvement in the overall model.

Together, *t*-statistics and modification indices are useful in modifying the original model and moving toward a model that better fits the empirical data. Such modifications of the structural model should, however, be made only if they can be justified on theoretical grounds (Marcoulides & Hick, 1993).

RESULTS

Four structural models, shown in Table 3, were tested using the above criteria. In order to test the research hypotheses and assess the directionality of the relationship between ISPSOPH and ISSUCC, four models were tested: Model 1, which

Table 3: The results of model testing.[a]

	The Model		Results for the Overall Model								Results for Specific Links	
	Free Parameters[b]	Fixed Parameters	CD[c]	χ^2	*df*	χ^2/df	GFI	AGFI	RMSR	BBI	Nonsignificant *t*s or Large MIs	ML Estimators
Model 1	γ_{11} γ_{22} β_{12} β_{21}	$\gamma_{12} = 0$	0.567	63.18	41	1.54	0.954	0.913	0.080	0.959	*t* for β_{21} is 1.17	$\gamma_{11} = 0.47$ $\gamma_{22} = 0.79$ $\beta_{12} = 0.45$ $\beta_{21} = 0.15$
Model 2	γ_{11} γ_{22} β_{12}	$\beta_{21} = 0$ $\gamma_{12} = 0$	0.493	64.30	42	1.53	0.953	0.913	0.082	0.959	none	$\gamma_{11} = 0.45$ $\gamma_{22} = 0.88$ $\beta_{12} = 0.50$
Model 3	γ_{11} γ_{22} β_{21}	$\beta_{12} = 0$ $\gamma_{12} = 0$	0.442	92.11	42	2.19	0.939	0.887	0.146	0.941	MI (ITCAP -> ISPSOPH) = 26.68 MI (ISSUCC -> ISPSOPH) = 25.95	$\gamma_{11} = 0.68$ $\gamma_{22} = 0.57$ $\beta_{21} = 0.54$
Model 4	γ_{11} γ_{12} γ_{22} β_{21}	$\beta_{12} = 0$	0.469	62.96	41	1.54	0.955	0.914	0.078	0.959	none	$\gamma_{11} = 0.49$ $\gamma_{22} = 0.52$ $\gamma_{12} = 0.43$ $\beta_{21} = 0.58$

[a] The four models are given in the order in which they were tested. Models 2 and 4 were both acceptable, while Models 1 and 3 were not.
[b] These parameters define the model, and are identified in Figure 2.
[c] CD refers to Coefficient of Determination, *df* refers to degrees of freedom, GFI to Goodness of Fit Indicator, AGFI to Adjusted Goodness of Fit Indicator, BBI to Bentler and Bonnet's (1980) Incremental Fit Index, and RMSR to Root Mean Square Residual.

includes the four paths implied in the research hypotheses; Model 2, which excludes the path from ISPSOPH to ISSUCC but includes the path from ISSUCC to ISPSOPH and the other two paths; Model 3, which excludes the path from ISSUCC to ISPSOPH but includes the path from ISPSOPH to ISSUCC and the other two paths; and Model 4, which includes all the paths included in Model 3, but includes an additional path from ITCAP to ISPSOPH.

The results of testing the four models are summarized in Table 3. It should be noted that the sample size in this study (236, following listwise deletion of cases) is adequate for all the four models tested, as the ratio of sample size to the number of parameters estimated was 6.38 for Models 1 and 4 and 6.56 for Models 2 and 3, which exceeds the ratio of 5.0 recommended by Bentler (1985).

The coefficient of determination for Model 1 was quite high (0.57) and the χ^2/df ratio was below 2.0. GFI, AGFI, and BBI all exceeded 0.90 and RMR was below 0.10. Thus, this model seemed satisfactory at an overall level. However, the *t*-value for the path from ISPSOPH to ISSUCC was not significant at the .05 level. Therefore, it was necessary to examine whether Model 2, obtained from Model 1 by excluding this path, fits the data better.

The coefficient of determination for Model 2 was sufficiently high, although it was lower than in Model 1 due to the exclusion of the path from ISPSOPH to ISSUCC. For Model 2 also, the χ^2/df ratio was below 2.0, GFI, AGFI, and BBI all exceeded 0.90, and RMR was below 0.10. Moreover, all the *t*-values were significant at the .05 level and none of the modification indices exceeded 5.0. Thus, Model 2 was satisfactory at the overall level as well as in terms of the specific structural paths.

Model 3, which included the path from ISPSOPH to ISSUCC but excluded the path from ISSUCC to ISPSOPH, was examined next. This model had a lower coefficient of determination than Models 1 and 2. Although GFI and BBI exceeded 0.90, AGFI was below 0.90. The χ^2/df ratio was above 2.0 and RMR was very high (0.15). Thus, at an overall level, this model appeared to be less satisfactory than Models 1 and 2. In addition, two of the modification indices, namely for the paths from ITCAP to ISPSOPH and from ISSUCC from ISPSOPH, were very high. Model 3 was thus unacceptable, and Model 4, including the additional path from ITCAP to ISPSOPH, was examined.

Like Model 2, Model 4 seemed satisfactory in terms of the overall model as well as the various specific paths. The coefficient of determination was quite high, the χ^2/df ratio was below 2.0, GFI, AGFI, and BBI all exceeded 0.90, and RMR was below 0.10. Examining the specific paths, the *t*-values for all the included paths were significant at the .05 level and the modification indices for all the paths excluded from the model were below 5.0.

Thus, Models 2 and 4 were both satisfactory in all respects, but Models 1 and 3 were not acceptable. Moreover, statistically there is very little difference between Models 2 and 4, and they both seem to represent the empirical data equally well.

DISCUSSION

The findings of this study must be viewed in the light of its limitations. However, the study has several implications for practice and research. The implications for practice are described next. The subsequent subsection identifies some of the limitations of the study. This section, and the paper, concludes with some implications for future research.

Implications for Practice

A central theme in the IS planning literature is that organizations should make their IS planning processes more sophisticated because that would lead to greater IS success. At the same time, the tasks involved in making IS planning more sophisticated—for example, obtaining greater top management participation in the process or convincing top management to involve senior IS managers in business planning—are believed to be quite difficult. This creates a situation in which low IS success is attributed to poor IS planning processes and efforts are made to convince top managers to take the actions necessary to enhance IS planning sophistication, but such efforts encounter little success, and the low levels of IS planning sophistication and IS success continue.

In an effort to address this problematic situation, this paper has argued that a high level of IS success is necessary for IS managers to persuade the top management to take the actions required to increase IS planning sophistication. Several theoretical reasons have been offered to support this argument. That Model 2 was supported provides some empirical evidence for this argument. In addition, even though Model 4, which was also supported, does not include the link from IS success to IS planning sophistication, it includes the link from information technology capability to IS planning sophistication. Together, the two supported models imply that for an organization's IS planning process to be highly sophisticated, either the previous ISs should have been highly successful (Model 2) or the organization should possess advanced information technology capabilities (Model 4).

This paper provides three general lessons for practitioners. First, it shows that even if the level of IS planning sophistication is low, IS managers should concentrate on increasing the level of IS success. The onus is upon the IS managers to advance information technology capabilities and develop successful systems, despite top management participation being lower than desired. Instead of focusing their attention on trying to convince top management to take the actions necessary to increase IS planning sophistication, IS managers should take the actions necessary to build successful systems, and thereby build a good track record and credibility for the IS group. Once the organization has developed information technology capabilities and successful systems, IS planning sophistication would increase, as the previous track record and credibility would alleviate the difficulties currently encountered in IS planning. Previous IS success and information technology capabilities may also be expected to improve the information technology management climate which, in turn, enhances the overall quality of the IS management process (Boynton et al., 1994). Consequently, top managers would acquire greater knowledge of information technology and participate more in IS planning, inputs from IS managers would be more actively sought during business planning, and IS managers would become better informed about the business plans. Greater information technology capabilities would also lead to more formal IS planning processes, as has been previously argued (Pyburn, 1983).

Second, the paper (specifically, Model 4) provides some support for the argument that more sophisticated IS planning leads to greater IS success. Along with the link from information technology capability to IS planning sophistication, this suggests that if IS managers strive to build advanced information technology capabilities in their organizations, IS planning sophistication would increase, which in turn, would lead to more successful ISs.

Third, the paper shows the importance of organizational integration. Integration was found to facilitate IS planning sophistication, which implies that in organizations where the IS planning process is unsophisticated, IS managers should, in addition to trying to develop more advanced information technology capabilities and systems, examine the level of integration in the organization. Where the level of organizational integration is low, IS managers should make efforts to increase integration by, for example, introducing steering committees and task forces, creating liaison roles, and promoting frequent meetings. Efforts to build such integrative mechanisms may also help enhance the level of IS planning sophistication.

Limitations

The results of this study must be treated with caution due to some inherent limitations. First, the study focused on academic institutions. Although this enhanced the study's internal validity by minimizing the differences in information intensity (Johnston & Carrico, 1988), it limited the generalizability of the findings, especially because academic institutions differ from business organizations in several ways. They depend on government and private donors for financial support, are often more decentralized in their organization structure than business organizations, and their various units are commonly located in a relatively small geographical location. Partly due to these differences, the way in which information technology is utilized and managed in academic institutions is also often very different from that in business organizations. Therefore, further research is needed to examine whether this paper's findings on the bi-directional relationship between IS planning sophistication and IS success can be extended to business organizations. The analytical approach employed here should be useful in replicating the research in other industry contexts.

Second, this study used single-respondent perceptual measures of various constructs. The use of single respondents helped in obtaining the necessary response rate, but the results would have been stronger if multiple respondents had been used to measure the research constructs. The results may also have been viewed with greater confidence if information technology success could have been assessed using an objective measure.

Third, this study was cross sectional and static in nature. If the study had been conducted longitudinally, it would have increased the ability to assess the temporal ordering of the research constructs. To be more specific, IS success may have been found to temporally precede increase in IS planning sophistication, which may then lead to further IS success. Furthermore, the effects included in the models may take time to occur. For example, increased IT capability may be followed by increased IS success only when the organization maintains, and benefits from, this high level of IT capability for some time. This study could not assess the nature of such time lags due to its cross-sectional nature.

Fourth, organizational integration and information technology capability were considered as antecedent variables affecting IS planning sophistication and IS success. To prevent the analysis from being overwhelmingly complex, models in which these constructs were affected by IS planning sophistication and IS success were not considered. Future research, especially longitudinal studies, may examine these possibilities as well.

Finally, the findings should be viewed with caution due to the exclusion of potentially important variables. Although the study indicates the level of IS success to depend on the IS planning sophistication and the organization's IT capability, other variables, such as the implementation of the IS plans and the utilization of IT capability, might also influence IS success.

Implications for Research

Three conditions are considered necessary to establish causality (Cohen & Levinthal, 1990). First, the two variables should be mutually correlated. This seems to be true in case of the relationship between IS planning sophistication and IS success, as previous research has found these variables to be positively correlated (Doll, 1985; McKinsey & Company, 1988; Raghunathan & Raghunathan, 1994). This study also found a high positive correlation between IS planning sophistication and IS success.

The second condition for causality is that there should be no other plausible alternative explanations. It is in this area that this paper has made a significant contribution. Previous research (e.g., Raghunathan & King, 1988) has implicitly or explicitly assumed that IS planning sophistication affects IS success but ignored the alternative explanation for the association between these constructs, namely that IS success may affect IS planning sophistication. This alternative explanation has been explicated in this paper. Some theoretical basis has been laid for the argument that IS success may affect IS planning sophistication. Empirically, the results show that two alternative models (Models 2 and 4) provide equally good explanations for the positive association between IS planning sophistication and IS success. In addition to the more traditional explanation (IS planning sophistication affects IS success, captured by Model 4), the alternative explanation proposed here (IS success affects IS planning sophistication, represented by Model 2) also found empirical support.

The third condition for establishing causality is temporal antecedence—the cause should precede the effect. To satisfy this condition, a longitudinal research design is necessary, which has not been used either in prior research on the relationship between IS planning sophistication and IS success or in this study. Therefore, it cannot be concluded if the association between IS planning sophistication and IS success is best captured by the traditional explanation, the alternative presented here, or some combination of these two explanations.

To achieve the third condition for causality, further research should take a longitudinal approach in examining the dynamics of the relationship between IS planning sophistication and IS success. This may be done using multiple questionnaire surveys at periodic intervals or through longitudinal case studies. Such studies should also provide further insights into the roles of information technology capability and integration in this relationship.

As indicated earlier, future research may also build on this paper's findings through replications in other industry contexts, by using multiple respondents, and by using objective measures of information technology success. In addition, further research is needed to examine other factors, such as the size of the organization and industry information intensity, which may moderate the relationship between IS planning sophistication and IS success.

In summary, this paper has questioned the exclusive reliance on the traditional explanation for the relationship between IS planning sophistication and IS success (IS planning sophistication leads to greater IS success). Another explanation (IS success leads to IS planning sophistication) has been offered, and four theoretical arguments in support of this explanation have been provided. Moreover, it has been empirically shown that this explanation provides an equally good alternative as the more traditional explanation. The support for this alternative perspective may reflect the increase in absorptive capacity resulting from prior information technology capabilities and IS success (Boynton et al., 1994; Cook & Campbell, 1979). Thus, in conjunction with some prior research (Boynton et al., 1994; Lind & Zmud, 1991; Porter & Millar, 1985; Zmud et al., 1987), this study shows the value of viewing IS success as a precursor of IS planning sophistication. [Received: January 10, 1997. Accepted: February 18, 1998.]

REFERENCES

Armstrong, J. S., & Overton, T. S. (1977). Estimating nonresponse bias in mail surveys. *Journal of Marketing Research, 14*, 396-402.

Bagozzi, R. (1977). Structural equation models in experimental research. *Journal of Marketing Research, 14*, 209-226.

Baldridge, J. V., & Tierney, M. L. (1979). *New approaches to management*. Washington, DC: Jossey-Bass.

Ball, L. (1982). MIS strategic planning: You can be the captain of the ship. *Infosystems,* (May), 33-38.

Barron's Educational Series. (1990). *Barron's profiles of American colleges* (17th ed.). New York: Barron's Educational Series.

Baschich, P., Kaye, A., & Lefrere, P. (1986). New information technologies for education and training: A brief survey. In P. I. Zorkoczy (Ed.), *Oxford surveys in information technology* (Vol. 3). Oxford, UK: Oxford University Press.

Bentler, P. M. (1985). *Theory and implementation of EQS: A structural equations program*. Los Angeles, CA: BMDP Statistical Software.

Bentler, P. M., & Bonett, D. G. (1980). Significance tests and goodness of fit in the analysis of covariance structures. *Psychological Bulletin, 88*, 588-626.

Blumenthal, S. C. (1969). *Management information systems: A framework for planning and development*. Englewood Cliffs, NJ: Prentice Hall.

Boynton, A. C., & Zmud, R. W. (1987). Information technology planning in the 1990's: Directions for practice and research. *MIS Quarterly, 11*(1), 59-75.

Boynton, A. C., Zmud, R. W., & Jacobs, G. C. (1994). The influence of IT management practice on IT use in large organizations. *MIS Quarterly, 18*(3), 299-318.

Branchaeu, J. C., Janz, B. D., & Wetherbe, J. C. (1996). Key issues in information systems management: 1994-95 Delphi results. *MIS Quarterly, 20*(2), 225-242.

Carmines, E. G., & McIver, S. P. (1981). Analyzing models with unobserved variables: Analysis of covariance structures. In G. W. Bohrnstedt & E. F. Borgatta (Eds.), *Social measurement: Current issues*. Beverly Hills, CA: Sage Publications.

Cash, J. I., Jr., McFarlan, F. W., McKenney, J. L., & Vitale, M. R. (1988). *Corporate information systems management: Text and cases.* Homewood, IL: Irwin.

Chan, Y. E., & Huff, S. L. (1993). Investigating information systems strategic alignment. In J. I. DeGross, R. P. Bastrom, & D. Robey (Eds.), *Proceedings of the Fourteenth International Conference on Information Systems*, Orlando, Florida, 346-364.

Chin, W. W., & Newsted, P. R. (1995). The importance of specification in causal modeling: The case of end-user computing satisfaction. *Information Systems Research*, *6*(1), 73-81.

Cohen, W. M., & Levinthal, D. A. (1990). Absorptive capacity: A new perspective on learning and innovation. *Administrative Science Quarterly*, *35*(1), 128-152.

Cook, T. P., & Campbell, D. T. (1979). The design and conduct of quasi-experiments and true experiments in field settings. In M. Dunette (Ed.), *The handbook of industrial and organizational psychology.* Chicago, IL: Rand McNally.

Daft, R. L., & Lengel, R. H. (1986). Organizational information requirements, media richness, and structural design. *Management Science*, *32*(3), 554-571.

Day, J. (1987). Developing office and information center components. *New Directions for Institutional Research, 58* (Fall), 15-28.

DeLone, W. H., & McLean, E. R. (1992). Information systems success: The quest for the dependent variable. *Information Systems Research*, *3*(1), 60-95.

Doll, W. J. (1985). Avenues for top management involvement in successful MIS development. *MIS Quarterly*, *9*(1), 17-35.

Doll, W. J., & Ahmed, M. U. (1983). Diagnosing and treating the credibility syndrome. *MIS Quarterly*, *7*(3), 21-32.

Duncan, R. B. (1972). Characteristics of organizational environments and perceived environmental uncertainty. *Administrative Science Quarterly*, *17*(3), 313-327.

Earl, M. J. (1993). Experiences in strategic information systems planning. *MIS Quarterly*, *17*(1), 1-24.

Ein-Dor, P., & Segev, E. (1978). Strategic planning for management information systems. *Management Science*, *24*(15), 1631-1641.

Feeney, D. F., Edwards, B., & Simpson, K. (1992). Understanding the CEO/CIO relationship. In J. I. DeGross, J. D. Becker, & J. J. Elam (Eds.), *Proceedings of the Thirteenth International Conference on Information Systems,* Dallas, Texas, 119-126.

Galbraith, J. (1977). *Organization design.* Reading, MA: Addison-Wesley.

Galliers, R. D. (1987). Information systems planning in the United Kingdom and Australia—A comparison of current practice. In P. I. Zorkoczy (Ed.), *Oxford surveys in information technology* (Vol. 4). Oxford, UK: Oxford University Press.

Gourman, J. (1990). *The Gourman report: A rating of undergraduate and graduate programs in American and international universities.* Los Angeles, CA: National Educational Standards.

Green, K. C. (1988). The new administrative computing. *New Directions for Higher Education, 62,* 5-10.

Green, K. C., & Gilbert, S. W. (1988). Editorial notes. *New Directions for Higher Education, 62,* 1-2.

Hann, J., & Weber, R. (1996). Information systems planning: A model and empirical tests. *Management Science, 42*(7), 1043-1064.

Harris, S. E., & Katz, J. L. (1991). Organizational performance and information technology investment intensity in the information technology industry. *Organization Science, 2*(3), 263-295.

Hartwick, J., & Barki, H. (1994). Explaining the role of user participation in information system use. *Management Science, 40*(4), 440-465.

Hawkins, B. L. (1988). Administrative and organizational issues in campus computing. *New Directions for Higher Education, 62,* 13-27.

Henderson, J. C. (1990). Plugging into strategic partnerships: The critical IS connection. *Sloan Management Review, 31*(3), 7-18.

Henderson, J. C., & Sifonis, J. G. (1988). The value of strategic IS planning: Understanding consistency, validity, and IS markets. *MIS Quarterly, 12*(2), 187-200.

Jarvenpaa, S. L., & Ives, B. (1990). Information technology and corporate strategy: A view from the top. *Information Systems Research, 1*(4), 352-376.

Jarvenpaa, S. L., & Ives, B. (1991). Executive involvement and participation in the management of information technology. *MIS Quarterly, 15*(2), 205-228.

Johnston, H. R., & Carrico, S. R. (1988). Developing capabilities to use information strategically. *MIS Quarterly, 12*(1), 37-50.

Jöreskog, K. G. (1978). Structural analysis of covariance and correlation matrices. *Psychometrika, 43,* 443-487.

Jöreskog, K. G., & Sörbom, D. (1989). LISREL 7: A guide to the program and applications. Chicago, IL: SPSS Inc.

Judge, T. A., & Ferris, G. R. (1993). Social context of performance evaluation decisions. *Academy of Management Journal, 36*(1), 80-105.

Kerr, E., & Hiltz, S. (1982). *Computer-mediated communication systems: Status and evaluation*. New York: Academic Press.

King, W. R. (1978). Strategic planning for management information systems. *MIS Quarterly, 2*(1), 27-37.

Kissler, G. R. (1988). A new role for deans in computing. *New Directions for Higher Education, 62* (Summer), 47-55.

Kontos, G. (1984). Instructional computing: In search of better methods for the production of CAL Lessons. *Journal of Educational Technology Systems, 13*(1), 3-14.

Kriebel, C. H. (1968). The strategic dimension of computer systems planning. *Long Range Planning, 1*(1), 7-12.

Lawrence, P. R., & Lorsch, J. (1967). *Organization and environment*. Boston, MA: Harvard University Press.

Lederer, A. L., & Mendelow, A. L. (1988). Convincing top management of the strategic potential of information systems. *MIS Quarterly, 12*(4), 525-544.

Lederer, A. L., & Mendelow, A. L. (1989). Coordination of information systems plans with business plans. *Journal of MIS, 6*(2), 5-19.

Lederer, A. L., & Sethi, V. (1988). The implementation of strategic information systems planning methodologies. *MIS Quarterly, 12*(3), 445-461.

Lederer, A. L., & Sethi, V. (1996). Key prescriptions for strategic information systems planning. *Journal of MIS, 13*(1), 35-62.

Lind, M. R., & Zmud, R. W. (1991). The influence of a convergence in understanding between technology providers and users on information technology innovativeness. *Organization Science, 2*(2), 195-217.

Lomax, R. G. (1982). A guide to LISREL-type structural equation modeling. *Behavior Research Methods & Instrumentation, 14*(1), 1-8.

Long, J. S. (1983). *Confirmatory factor analysis: A preface to LISREL*. Newbury Park, CA: Sage Publications.

Marcoulides, G. A., & Heck, R. H. (1993). Organizational culture and performance: Proposing and testing a model. *Organization Science, 4*(2), 209-225.

McFarlan, F. W. (1971). Problems in planning the information system. *Harvard Business Review, 49* (March-April), 75-89.

McKinsey & Company, Inc. (1968). Unlocking the computer's profit potential. *The McKinsey Quarterly*, (Fall), 17-31.

McLaughlin, G. W., McLaughlin, J. S., & Howard, R. D. (1987). Decision support in the information age. *New Directions for Institutional Research, 55* (Fall), 81-92.

McLean, E. R., & Soden, J. V. (1977). *Strategic planning for MIS*. New York: John Wiley.

Miller, D. (1987). Strategy making and structure: Analysis and implications for performance. *Academy of Management Journal, 30*(1), 7-32.

Miller, D., Dröge, C., & Toulouse, J. (1988). Strategic process and content as mediators between organizational context and structure. *Academy of Management Journal, 31*(3), 554-569.

Miller, D., & Friesen, P. H. (1982). Innovation in conservative and entrepreneurial firms: Two models of strategic momentum. *Strategic Management Journal, 3*, 1-25.

Porter, M. E., & Millar, V. E. (1985). How information gives you competitive advantage. *Harvard Business Review, 63*(4), 149-160.

Powell, P. (1992). Information technology and business strategy: A synthesis of the case for reverse causality. *Proceedings of the Thirteenth International Conference on Information Systems*, Dallas, TX, 71-80.

Premkumar, G., & King, W. R. (1994). Organizational characteristics and information systems planning: An empirical study. *Information Systems Research, 5*(2), 75-109.

Pyburn, P. J. (1983). Linking the MIS plan with corporate strategy: An exploratory study. *MIS Quarterly, 7*(2), 1-14.

Raghunathan, B., & Raghunathan, T. S. (1990). Planning implications of information systems strategic grid: An empirical investigation. *Decision Sciences, 21*(2), 287-300.

Raghunathan, B., & Raghunathan, T. S. (1994). Adaptation of a planning system success model to information systems planning. *Information Systems Research, 5*(3), 326-340.

Raghunathan, T. S., & King, W. R. (1988). The impact of information systems planning on the organization. *OMEGA, 16*(2), 85-93.

Reich, B. H., & Benbasat, I. (1990). An empirical investigation of factors influencing the success of customer-oriented strategic systems. *Information Systems Research, 1*(3), 325-349.

Rockart, J. F. (1988). The line takes the leadership—IS management in a wired society. *Sloan Management Review, 29*(4), 57-68.

Saarinen, T., & Saaksjarvi, M. (1992). Process and product success in information systems development. *Journal of Strategic Information Systems, 1*(5), 266-277.

Sabherwal, R., & King, W. R. (1992). Decision processes for developing strategic applications of information systems: A contingency approach. *Decision Sciences, 23*(4), 917-943.

Sabherwal, R., & Kirs, P. (1994). The alignment between organizational critical success factors and information technology capability in academic institutions. *Decision Sciences, 25*(2), 301-330.

Sabherwal, R., & Tsoumpas, P. (1993). The development of strategic information systems: Some case studies and research proposals. *European Journal of Information Systems, 2*(4), 240-259.

Self, J. A. (1985). Perspective on intelligent computer-assisted learning. *Journal of Computer-Assisted Learning, 1*(2), 159-166.

Sullivan, C. H. (1985). Systems planning in the information age. *Sloan Management Review*, *26*, 3-11.

Tharenou, P., Latimer, S., & Conroy, D. (1994). How do you make it to the top? An examination of influences on women's and men's managerial advancement. *Academy of Management Journal*, *37*(4), 899-931.

Thompson, J. D. (1967). *Organizations in action*. New York: McGraw-Hill.

Tully, C. J. (1985). Toward a conceptual framework for systems methodologies. In D. Teichroew & G. David (Eds.), *System description methodologies*. Amsterdam, Netherlands: North Holland.

Venkatraman, N., & Ramanujam, V. (1987). Planning system success: A conceptualization and an operational model. *Management Science*, *33*(6), 687-705.

Vijayasarathy, L., & Sabherwal, R. (1994). Organizational integration and the use of telecommunication technologies for internal links: An empirical investigation. *Journal of High Technology Management Research*, *5*(1), 77-99.

Vitale, M. R., Ives, B., & Beath, C. M. (1986). Linking information technology and corporate strategy: An organizational view. *Proceedings of the Seventh International Conference on Information Systems*, San Diego, CA, 265-276.

Ward, J., Griffiths, P., & Whitmore, P. (1990). *Strategic planning for information systems*. New York: John Wiley.

Warren, S. (1987). Academic computing: The challenges ahead. *New Directions for Institutional Research*, *55* (Fall), 29-42.

Zmud, R. W., Boynton, A. C., & Jacobs, G. C. (1987). An examination of managerial strategies for increasing information technology penetration in organizations. *Proceedings of the Eighth International Conference on Information Systems*, Pittsburgh, PA, 24-44.

APPENDIX: MEASURES OF THE RESEARCH VARIABLES

Information Technology Capability was measured as the mean of the 17 items given below, preceded by the statement: "Please indicate *the extent to which the following information technology applications are found in your institution.*"

	Not Much						Extensively
1. Electronic mail services between students	1	2	3	4	5	6	7
2. Electronic mail services between students and faculty (e.g., submission and evaluation of student assignments)	1	2	3	4	5	6	7
3. Electronic mail for administrative communiques	1	2	3	4	5	6	7
4. Computer conferencing for seminars on specific topics	1	2	3	4	5	6	7

	Not Much						Extensively
5. Computer conferencing for group preparation of documents (e.g., student projects, course newsletters, etc.)	1	2	3	4	5	6	7
6. Databases for course-related purposes	1	2	3	4	5	6	7
7. Databases for administrative purposes	1	2	3	4	5	6	7
8. Communications devices for access of remote databases	1	2	3	4	5	6	7
9. Computer-aided library searches	1	2	3	4	5	6	7
10. Computer labs for student instruction	1	2	3	4	5	6	7
11. Computer facilities for student projects	1	2	3	4	5	6	7
12. Advanced computer facilities (e.g., graphics) for students	1	2	3	4	5	6	7
13. Separate computer facilities for faculty	1	2	3	4	5	6	7
14. Personal computers for individual faculty/administrators	1	2	3	4	5	6	7
15. Computer-aided instruction (e.g., on-line tutorials)	1	2	3	4	5	6	7
16. Computer-aided curriculum design	1	2	3	4	5	6	7
17. Teleconferencing (audio/video) for student-faculty interaction	1	2	3	4	5	6	7

Integration was measured as the mean of the nine items given below, which were preceded by the following statement: "The following questions are intended to *identify the manner in which decisions are made in your institution.* Please circle the number that best corresponds to how these decisions are made."

1. In assuring the compatibility of decisions among different academic units, to what extent are the following "integrative mechanisms" used?

	Not at All						Extensively
a. Institution-wide committees (e.g., Library, Tenure Committees) to establish institutional policy	1	2	3	4	5	6	7
b. Interacademic unit committees set up to promote ongoing decision making among units	1	2	3	4	5	6	7

	Not at All						Extensively
c. Task forces temporarily set up to facilitate interacademic unit collaboration on specific projects	1	2	3	4	5	6	7
d. Liaison personnel who coordinate the efforts of several academic units for a specific purpose	1	2	3	4	5	6	7

2. For each of the following decision types, *to what extent does the top level of the university rely on participative decision making, or inter-area discussions in which several academic units contribute*?

	Rarely						Frequently
a. Planning for future operating policies (i.e., strategic planning)	1	2	3	4	5	6	7
b. Investment in long-term projects (e.g., buildings, technical infrastructure)	1	2	3	4	5	6	7
c. New programs and courses	1	2	3	4	5	6	7

	Not at All						Extensively
3. To what extent is there interaction among various academic units in institutional decision making?	1	2	3	4	5	6	7
4. To what extent do individual employees contribute to decision making within specific areas?	1	2	3	4	5	6	7

IS planning sophistication was measured as the mean of five items, all measured using 7-point scales, shown below. The items were preceded by the instruction: "The questions in this part attempt to *identify your academic institution's management of its information systems.*"

	Very Informal						Very Formal
1. How formalized is the information systems planning at your institution?	1	2	3	4	5	6	7

	Not Much						Extensively
2. To what extent does information systems planning take the institution's future plans into account?	1	2	3	4	5	6	7
3. How involved is the institution's top management in the information systems planning process?	1	2	3	4	5	6	7

	Uninformed						Well Informed
4. How informed are your information system managers about the institution's long-term plans?	1	2	3	4	5	6	7
5. How informed is the institution's top management about information technology?	1	2	3	4	5	6	7

Information Systems Success was measured as the mean of the five items given below. The items were preceded by the following statement: "Please indicate *the extent to which information systems has helped your institution* in the following areas:"

	Not Much						Extensively
1. Distinguishing your institution from similar institutions	1	2	3	4	5	6	7
2. Reducing administrative costs	1	2	3	4	5	6	7
3. Improving the efficiency of internal operations	1	2	3	4	5	6	7
4. Enhancing the institution's reputation	1	2	3	4	5	6	7
5. Making the institution successful overall	1	2	3	4	5	6	7

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