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THE CONTRIBUTION OF SHARED KNOWLEDGE TO IS GROUP PERFORMANCE

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ABSTRACT

A major issue facing managers of Information Systems organizations is the increasing pressure to demonstrate the business value of the firm's investment in information technology. The working relationship between the IS group and other diverse organizational groups can have a major contribution to increasing IS performance. This paper explores the concept of shared knowledge between IS groups and their line customers as a contributor to IS performance. Shared knowledge is achieved through the mechanisms of mutual trust and influence between these groups. The relationship of mutual trust, influence, and shared knowledge with IS performance is tested empirically using path analysis in a study of eighty-six IS organizations. The results of this study show that shared knowledge mediates the relationship between IS performance and trust and influence and that increasing levels of shared knowledge between IS and line groups leads to increased IS performance. Recommendations are given for ways managers can develop mutual trust and influence between these diverse groups, and therefore achieve higher levels of shared knowledge and IS performance.

1. INTRODUCTION

A major issue facing managers of Information Systems (IS) organizations is the increasing pressure to demonstrate the business value of the firm's investment in information technology (IT). The opportunity for IS groups to be the driving force behind business transformation has never been greater (Davenport and Short 1990; Hammer 1990), yet internal and external competitive pressures (e.g., outsourcing) are threatening the form and the very existence of the internal IS function (Dearden 1987; Loh and Venkatraman 1992). The value of the investment in IT has remained frequently untapped and largely unseen in most organizations. To take full advantage of the opportunities facilitated by IT, senior managers must integrate the management of IT into the various business departments and functions of the firm (McFarlan, McKenney, and Pyburn 1983; Henderson and Venkatraman 1993). Improving the relationship between IS and line managers has frequently been suggested as a way to meet this challenge (Elam 1988; Rockart and Short 1991; Boynton, Jacobs and Zmud 1992).

The IS group's ability to effectively work with diverse functional groups can be a major factor in both IS and organizational performance (Keen 1988; Henderson 1990; Rockart and Short 1991). This research addresses the following key questions about building IS-line relationships.

1. What factors build on the strengths of organizational diversity rather than emphasize weaknesses?

2. What can IS and line managers do to develop these mechanisms and improve IS performance delivered to its customers?

This paper develops the concept of *shared knowledge* between IS and line organizations as a key contributor to IS group performance. The building of trust and influence between diverse groups is presented as an important mechanism for achieving cross-functional shared knowledge.

As the business environment becomes more turbulent and time dependent, organizational productivity often depends on an in-depth knowledge of technologies, processes, and people — both in and across diverse functional areas (Nonkana and Johansson 1985; Badaracco 1991). The interdependence among functional groups becomes especially critical in complex environments (Thompson 1967; Pfeffer and Salancik 1978; Weick 1982; Schrage 1990). Mutual knowledge bases between functional groups provide a potential bridge to organizational productivity (Krauss and

Fussell 1990). This is particularly true in the case of information systems groups and the line groups they support.

What is unique about shared knowledge between IS groups and their customers? Information systems groups are constantly involved in technology transfer processes to line organizations (Cooper and Zmud 1990; Williams and Gibson 1990). A primary responsibility of IS groups is to deliver information technology based on requirements of the line organization. The need to operate from a common knowledge base begins in the requirements phase of system development (Ewers and Vessey 1981), but continues through maintenance, support, and eventual deactivation or replacement of the technology (Henderson and Treacy 1986; Jordan and Macheskey 1990). A shared knowledge of both this process and the information technology in question supports and enhances the transfer of IT from IS to its customer base. Through this shared knowledge base, barriers to understanding and acceptance between IS and the line are removed (Churchman and Schainblatt 1965; Krauss and Fussell 1990) and both groups increase their ability to work toward a common goal.

This paper uses an organizational behavior perspective to propose factors which lead to shared knowledge between functional groups within an organization. Section 2 conceptualizes shared knowledge by drawing on concepts of organizational and functional knowledge. Section 3 then identifies two key determinants of shared knowledge — trust and influence — and proposes a model of shared knowledge between IS and line groups. A field study for testing the model is described in section 4, and section 5 presents a path analysis of the study data to validate the model. Finally, conclusions and future research directions from this work are discussed in section 6.

2. SHARED KNOWLEDGE

Conventional wisdom is that managerial communication is important. Peters and Waterman (1982) exhort managers to "manage by walking around" and stress informal communication as the means by which organizations function (Sinetar 1988). Of course, communication by itself is not enough. The sharing of knowledge is a different process than managerial communication (Sherif and Sherif 1953; Schrage 1990). Shared knowledge goes beyond the basic informational level (Swanson 1974; Keen 1988). Churchman and Schainblatt (1965, p. B-82) illustrate the need for this deeper form of interaction: "One can brief a reluctant manager endlessly without accomplishing anything, unless one comes to realize his hidden resistances and strives to bring them up to consciousness in some way."

A first step in going beyond the informational briefing stage of the IS-line relationship is to build a common language. Such a shared language can facilitate knowledge transfer as well as create a positive social influence process (Pondy 1978). IS and line managers must develop an appreciation and understanding of the other's environment rather than merely sharing information and translating technical and procedural terms (Swanson 1974; Henderson 1990; Cooprider 1990). That is, communication is only a means to and facilitator of shared knowledge (Bostrom 1989). We define **shared knowledge** as *an understanding or appreciation among IS and line managers for the technologies and processes which affect their mutual performance.* Keen (1988, p. 52) maintains that "the relationship between IS and business managers has to be one of mutual understanding — not of the details of each other's activities, knowledge and skill bases, but of the other's needs, constraints, and contribution to an organizational venture partnership." Simply communicating facts is not sufficient. A deeper level of knowledge must be shared to achieve mutual understanding.

Badaracco (1991, p. 81) describes organizational knowledge as embedded knowledge, which is defined as "knowledge which resides primarily in specialized relationships among individuals and groups and in the particular norms, attitudes, information flows, and ways of making decisions that shape their dealings with each other." A lack of this organizational and cross-functional knowledge may result in losses of IS performance (Kaiser and Srinivasan 1982). As boundary lines between organizational functions become vaporous (Davenport and Short 1990; Rockart and Short 1991), managers struggle to keep themselves informed about the technologies, processes, and people which fall outside their primary functional area yet contribute to their success. IS groups impact nearly every functional group in the information intensive organization, yet Lucas (1984) maintains that functional users of information systems have very little understanding of what is involved in the analysis and design of information systems. This lack of knowledge can lead to missed opportunities for line managers to contribute domain knowledge at critical points in the design process.

Conversely, IS managers are frequently consumed with keeping pace with rapidly changing technologies and IT processes and are frequently far removed from the business functions which their systems support (Kaiser and Srinivasan 1982). They often seek information about the technologies and methods of other functional operations only in response to the IS requirements for a specific support or design request. The day-to-day problems and opportunities of these supported operations are often unfamiliar to them (Henderson 1990). IS and line managers often speak

different technical and procedural languages (Keen 1988), and as a result they feel disaffected from one another (Tushman and Romanelli 1983). The operational needs and constraints presented from one side can be perceived as unreasonable demands and a lack of cooperation from the other. The commonality of organizational goals is often lost due to a lack of understanding of each others' realities.

When faced with information that is not consistent with their own reality, human beings experience internal conflict, which Festinger (1957) labels cognitive dissonance. The way line managers articulate their IS design or support needs may be foreign and inconsistent with the terminology and methods the IS group uses and understands (Keen 1980, 1988). While line managers may try to conceptualize and describe the business requirements of an information system, their counterparts in IS may attempt to translate without sufficient domain knowledge to accurately interpret the message and, hence, the actual requirements (Boland 1978; Guinan 1988; Bostrom 1989). The IS manager experiences an inconsistency between his or her own functional knowledge and the interpreted line requirements. This can lead to a feeling of alienation from both the line manager and the process of determining information system requirements. This phenomenon is often a two-way street, with line personnel also lacking in knowledge and understanding of the language, technologies, and methods of the IS group (Lucas 1984).

By understanding what motivates members of groups to seek knowledge and reduce inconsistency, it is possible to identify the mechanisms which facilitate the sharing of knowledge between functional groups. Ancona (1990) found that the external interactions of groups have patterns similar to the internal patterns of members of the group. In this case, when individual members of the IS group find inconsistencies between their knowledge and that of their counterparts in the line group, the group itself displays these inconsistencies. As the knowledge base, expectations, and realities of each group become more distant from that of the other, lack of cooperation and intergroup conflicts begin to appear (Sherif 1962). What Sherif, Sherif and Nebergall (1965) describe as the in-group/out-group phenomenon occurs, which can exhibit itself as an "us against them" group attitude (Bettenhausen 1991). The attainment of organizational goals and mutual productivity becomes an almost impossible task in the face of this organizational intergroup conflict. The absence of a shared reality between groups is a critical factor in these dysfunctional group dynamics.

We hypothesize that shared knowledge between information systems groups and their line customers will have a positive impact on the performance of the IS group.

Hypothesis I. Shared knowledge between information systems groups and their line customers, as perceived by the IS organization, lead to improved IS group performance.

Shared knowledge is conceptualized as the level of understanding that the IS and line groups have for each other's work environment (problems, tasks, roles, etc.) and the level of appreciation (Swanson 1974) that the groups have for each other's accomplishments. Swanson defines appreciation as a manifold of beliefs regarding the object(s) appreciated, implying that appreciation reflects a deep level of understanding of the referent context. As discussed above, as IS organizations increase their feelings of understanding of their line customers, their disaffection with these customers will decrease, their appreciation of the complexities of the line environment will increase, and their performance will increase.

Having introduced the concept of shared knowledge as a contributor to IS performance, we next consider its antecedents in order to more completely understand this relationship. The following section examines trust and influence as determinants of shared knowledge.

3. ANTECEDENTS OF SHARED KNOWLEDGE

Trust. Trust has a major impact in relationships between organizational groups. Zucker (1986) defines trust as "a set of expectations shared by all those in an exchange." Bradach and Eccles (1989) maintain that trust is an expectation that alleviates the fear that one's exchange partner will act opportunistically. Repeated intergroup exchange communications build trust, leading to increased communications and the eventual sharing of knowledge (Anderson and Narus 1990). Moorman, Zaltman and Deshpande 1992), in a study of the relationship between marketing research providers and users, find that trust is a facilitating factor of other relationship processes such as quality of interactions and involvement levels. By alleviating the fear of the unexpected and facilitating interactions and involvement, trust encourages a climate conducive to the sharing of knowledge.

Sherif and Sherif (1953) maintain that by repeatedly working together to obtain mutual goals, groups develop a mutual trust. By sharing expectations and reducing individual dissonance-inducing fears among group members, mutual trust brings groups closer together. Empirical evidence of this phenomenon is demonstrated in a series of controlled studies of camping groups in which competing teams develop trust relationships — *followed* by a sharing of knowledge on solving a common problem (Sherif 1966).

Although it may also seem reasonable that sharing knowledge might lead to trust, Sherif's work demonstrates that repeated episodes of joint effort and communication leads to trust, which *then* leads to the sharing of methods and ideas. Trust — developed through repeated communication — is demonstrated to be different from and a determinant of shared knowledge.

In interviews with executives, Henderson (1990) found that mutual trust leads to an increased ability of IS and line groups to work together. This investment of trust between different organizational groups can be viewed as a leap of cognitive faith and understanding (Lewis and Weigert 1985). The increases in mutual understanding brought on by mutual trust result in shared knowledge between groups. We thus hypothesize that mutual trust is a determinant of shared knowledge.

> **Hypothesis II:** The perception of increased levels of mutual trust between the IS and line groups lead to increased levels of shared knowledge between these groups.

Mutual trust is conceptualized as the expectation shared by the IS and line groups that they will meet their commitments to each other. Through a commitment to work toward joint goals built through repeated periods of communication, mutual trust leads to increased shared knowledge between the groups in the long term.

Influence. Organizational groups engaged in joint work are often dependent upon each other for the achievement of goals (Sherif 1962). One of the consequences of this dependence is the creation of influence relationships (Anderson and Narus 1990). The ability of a group to accomplish its goals can be limited by its ability to influence other groups in the organization (Pfeffer and Salancik 1978; Kanter 1983). Festinger (1957) found that social communication and social influence processes are interwoven with the processes of knowledge creation and dissonance reduction. By seeking social support for ideas, individuals and groups seek to either influence others into accepting these ideas or to be influenced by others' ideas and attitudes. Churchman and Schainblatt (1965) see this influence process as *necessary* for achieving mutual understanding between groups. Through this social influence mechanism, cognitive elements are exchanged between groups — leading to shared knowledge.

Boyle et al. (1992) find that the frequency of information exchange between buyer-seller groups is positively related to the level of group influence. The sharing of knowledge is not limited to simple information exchange, but is related to the *influence* developed between groups as a result of more frequent and in-depth communication. By depending on each other for the joint accomplishment of goals, expectations, needs, and knowledge are shared across groups. We therefore hypothesize that:

> **Hypothesis III:** The perception of increased levels of mutual influence between IS and line groups leads to increased levels of shared knowledge between these groups.

Mutual influence is conceptualized as the ability of groups to affect the key policies and decisions of each other. These influence processes result in increased levels of appreciation and understanding of each others' work environment and accomplishments through mutual policy making and decision making, leading again to shared knowledge.

Figure 1 presents the completed model of shared knowledge. This model illustrates two important aspects of shared knowledge. First, mutual trust and influence are presented as antecedents of shared knowledge. Second, shared knowledge is presented as a mediating variable between mutual trust and influence — leading to IS group performance.

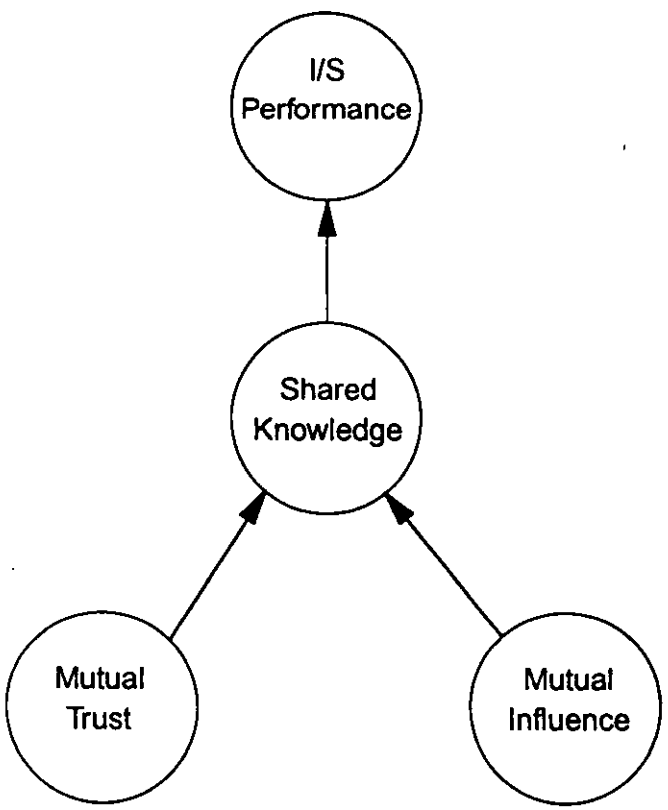

Figure 1. A Model of Shared Knowledge

Table 1. Study Participants by Organization

Company	Industry Type	Number of I/S Orgs. Identified	Number of I/S Orgs. Participating
A	Pharmaceuticals	10	4
B	Insurance	13	0
C	Oil & Gas	37	26
D	Consumer Goods	5	2
E	Computer Manufacturing	33	25
F	Insurance	17	17
G	Automotive	17	12
Totals:		132	86 (65%)

Communication is a common element of mutual trust and influence. The establishment of a history of communications in the context of quality interactions impacts trust, while the frequency of these communications in the context of social mechanisms leads to influence. In the discussion of shared knowledge, we stated that communication is only a means to and a facilitator of shared knowledge. That is, repeated and frequent communications contribute to IS performance through the development of mutual trust and influence leading to shared knowledge. As IS and line groups move beyond simple communications to understanding and appreciating the expectations, realities, and methods of each other, the benefits of these dynamics are seen in IS group performance. In this way, shared knowledge acts as a mediating variable between mutual trust and influence and IS performance.

Both Festinger (1957) and Sherif (1966) attribute a mutual appreciation of and attractiveness toward another group or individual as an integral component of shared cognition. Sherif (1966) found in a series of experiments on competing groups that contact between groups was not in itself sufficient to motivate the groups to achieve common goals. Only through repeated cooperation between groups is trust developed, and this trust leads to an increased seeking of information about the other group — resulting in shared knowledge being desired and built. This sharing of knowledge is needed for groups to achieve superordinate goals which are beneficial to both groups. Sherif's (1966) experiments reinforce the role of shared knowledge as a mediating variable in the relationship between trust and performance. Similarly, Churchman and Schainblatt (1965) maintain that (1) influence is necessary to achieve mutual understanding between groups and (2) successful implementation of projects presuppose that the involved parties have attained some level of mutual understanding. Thus, influence leads to shared knowledge — which precurses performance.

> **Hypothesis IV:** Shared knowledge acts as a mediating variable between mutual trust and influence and IS performance.

Using this model of the contribution of shared knowledge to IS performance, section 4 discusses the research design and section 5 presents the analysis for a test of this model and the four hypotheses presented above.

4. RESEARCH DESIGN

Data to test the model and hypotheses were drawn from a cross-sectional field study of 132 IS departments and their line customers in seven firms (Cooprider 1990). Each of the seven participating firms are Fortune-100 size organizations in North America. The level of analysis of the study is the IS organization, since the intent of the study is to explain the behavior and attitudes of the IS organization rather than those of individuals. Participating organizations were asked, therefore, to identify distinct IS organizations (i.e., IS units with a specific management structure in place) serving a single client organization. In addition, each question in the questionnaire was customized to include the names of the specific IS organization and its corresponding line client.

While it would have been ideal for the sake of external validity to randomly choose companies, partnerships, and

individuals to participate, it was not possible in the study. In the data collection, all companies agreeing to participate were included — a convenience sample. Because of this, there is a possible selection bias that cannot be entirely discounted. Table 1 describes the industries and number of IS organizations studied for each of the companies participating in the study. The nature of the sample selection process focused on maintaining internal validity, since the broad range of organization and industry types made it unlikely that unmonitored explanations would cause effects in all of the target organizations. However, since there was not a random sampling of respondents (for example, two companies accounted for 59% of the participating IS organizations), the generalizability of the results across all firms is necessarily limited due to the possibility of selection bias.

Study respondents were chosen based on a key-informant methodology (Phillips and Bagozzi 1986). Measurement of organizational characteristics requires research methods different from those used for measuring the characteristics of individuals (Seidler 1974), and a key-informant methodology is a frequently adopted approach. Key informants in this case are members of IS organizations who work closely with line organization customers. For each IS organization, at least three individuals — including a range of management levels — were asked to complete the measurement instrument.

The principal research instrument for this study asked a series of questions about characteristics of the IS-line relationship. These characteristics were evaluated by determining a consensus of the respondents from each IS organization. Such an approach assumes equal reliability among informants, which is unlikely to be completely justified in practice since some informants may be more knowledgeable, less biased, etc. (Seidler 1974). However, there was no reason to suspect a systematic bias among respondents, and it was felt that combining responses would provide measures containing less unique variance since aggregated values would be less affected by idiosyncratic responses of specific individuals. The mean and standard deviation across all individual respondents for each indicator in the study are listed in the appendix.

Construct Measurement. The study was conducted in two phases (Cooprider 1990). In phase one, measures and collection instruments were developed. The first step in the measurement development process was to identify an initial set of measurement items as candidates for later use in the construct scales. First, candidate indicators were derived from published research articles that discussed or attempted to measure similar constructs. Second, candidate indicators were generated from a content analysis of a series of twenty-eight interviews with executives managing organizational "partnership-style" relationships (Henderson 1990). It was critical for the indicators generated to be meaningful for (1) the constructs of interest, (2) the specific IS context, and (3) each of the organizations to be studied. Therefore, from the candidate indicators, a pilot questionnaire was created and tested using two to six managers from five organizations (not participating in phase two of the study). Following the completion of this pilot instrument, each respondent was debriefed to determine if any questions were confusing and if the terminology used related in a meaningful way to the concepts they were intended to measure. All evidence from the pilot studies and executive interviews suggested that these indicators tapped the respondents' view of the theoretical constructs.

Two types of measures are used to assess the organizational characteristics of shared knowledge, trust, and influence. The first type is a **general** measure. Each informant is asked to assess the overall level of interaction for a specific characteristic of a particular relationship. For example, one question might ask respondents to evaluate "the level of appreciation that the IS organization and the line organization have for each other's accomplishments." The second type of measure is a **multiplicative** or interaction measure. Each informant is asked to assess separately the role of IS and the line for each characteristic. For example, the questionnaire might contain the following two questions: "the level of appreciation that the line organization has for the accomplishments of the IS organization" and "the level of appreciation that the IS organization has for the accomplishments of the line organization." Using the conceptualization of fit as interaction (Venkatraman 1989), we operationalize this measure as "IS Role * Line Role," multiplying the two responses together. The actual indicators for each construct appear in the appendix.

There are a number of advantages to this measurement scheme. The two types of measures (general and multiplicative) can be thought of as different methods, from a Campbell and Fiske (1959) perspective. Using measures in this way provides a stronger test of the validity of the measurement scheme than would be possible if only one type of measure were used for each indicator. That is, the extent to which these two kinds of indicators agree provides a much stronger test of validity than would be possible if only one or the other type of indicator were used. Further, using both types of measures balances possible threats to validity inherent in either type alone. For example, the general assessments require a complex set of summarizations and interpretations by respondents, leading to potential error due to the large cognitive burden such assessments place on key informants (Silk and Kalwani 1982). The questions used for the multiplicative assessment, however,

are very specific about the role and characteristic of interest, placing a much smaller cognitive burden on respondents. Similarly, the operationalization of the multiplicative indicators as "IS Role * Line Role" is one of several possible operationalizations of interaction (Venkatraman 1989). The general questions, on the other hand, are *direct* assessments of the fit relationship in question. To the extent that these two very different types of indicators show convergent and discriminant validity in their measurement of the constructs in question, we can have a higher level of confidence about the validity of the measures.

The dependent variable — IS group performance — was collected from "stakeholders" in each firm, usually senior IS or functional management. There are many reasons for using this approach. First, a large body of literature exists that highlights the substantial problems involved in measuring IS performance (ICIT Research Team #2 1988; Kemerer 1989). It is typically not possible to find objective (e.g., accounting) measures that can be gathered and used consistently across a range of organizations such as those participating in this study. Venkatraman and Ramanujam (1987) suggest that perceptual assessments of performance provided by knowledgeable managers have a high level of convergence with objective performance measures. We therefore conclude that using managerial ratings is a suitable method for gathering performance data for this study. It should be noted, however, that such an approach is not without its weaknesses. Our specific operationalization, for example, includes indicators of system quality and efficiency. There are clearly other indicators that might represent other aspects of IS performance (e.g., effectiveness). Future studies should clearly explore a broader conceptualization and operationalization of IS performance (DeLone and McLean 1992).

Participating firms were each asked to select two stakeholders to fill out a measurement instrument to assess IS performance. These stakeholders were required to be knowledgeable about the performance of the IS organization in its relationship with its line customer. To prevent a common method bias, the chosen stakeholders could not have filled out the original relationship questionnaire. Altogether, as shown in Table 1, questionnaires were received from team members and stakeholders for 86 of the 132 identified IS organizations (65%).

The Appendix provides Chronbach's alpha for each of the four constructs measured in the study. All alphas are well above the acceptable range for empirical studies of this type (Nunnally 1967), with the smallest being .84. We therefore conclude that the measures are reliable. To assess convergent and discriminant validity, we show the correlation matrix for all ten indicators in Table 2. This matrix shows all correlations within constructs to be higher than any correlations across constructs, implying convergent and discriminant validity of the constructs (Campbell and Fiske 1959).

5. DATA ANALYSIS

The model of shared knowledge displayed in Figure 1 is tested empirically using path analysis. Path analysis was chosen as the analytic technique in this study due to its ability to assess causal relationships (Wright 1971; Kerlinger and Pedhazur 1973). It is a regression-based technique which permits the testing of causal models using cross-sectional data (Baroudi 1985). Normalized path coefficients (betas) are used to determine the strength and direction of causal paths or relations. These betas represent the fraction of the standard deviation of the dependent variable for which the independent or mediating variable is responsible (Kerlinger and Pedhazur 1973).

In order to assess the validity of our model of shared knowledge, we test a series of alternative path models. The first model is our theoretical model of shared knowledge, and it appears in Figure 2.

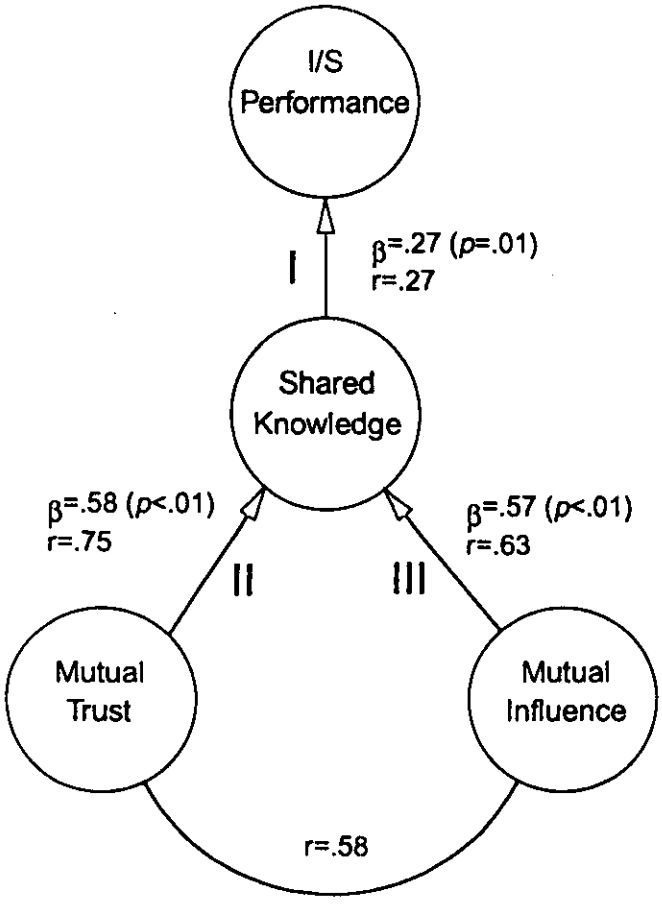

Figure 2. The Shared Knowledge Model
R^2 = .63, F = 101.34, p < .01

Table 2. MTMM Correlation Matrix for Construct Indicators

	Trust1	Trust2	Influence 1	Influence 2	Influence 3	Shared Know.1	Shared Know.2	Shared Know.3	I/S Perform. 1	I/S Perform. 2
Trust1	1.00	0.78	0.41	0.32	0.32	0.43	0.62	0.55	0.31	0.13
Trust2	0.78	1.00	0.62	0.58	0.51	0.59	0.72	0.68	0.23	0.14
Infl.1	0.41	0.62	1.00	0.69	0.71	0.61	0.62	0.63	0.07	-0.06
Infl.2	0.32	0.58	0.69	1.00	0.79	0.57	0.63	0.50	0.23	0.17
Infl3	0.32	0.51	0.71	0.79	1.00	0.59	0.58	0.44	0.22	0.21
SK1	0.43	0.59	0.61	0.57	0.59	1.00	0.81	0.73	0.14	0.11
SK2	0.62	0.72	0.62	0.63	0.58	0.81	1.00	0.79	0.30	0.23
SK3	0.55	0.68	0.63	0.50	0.44	0.73	0.79	1.00	0.30	0.21
ISPerf1	0.31	0.23	0.07	0.23	0.22	0.14	0.30	0.30	1.00	0.80
ISPerf2	0.13	0.14	-0.06	0.17	0.21	0.11	0.23	0.21	0.80	1.00

To assess the Figure 2 model, we perform a hierarchical regression; first examining the relationship between shared knowledge and performance, and then between shared knowledge and trust and influence. Figure 2 shows the results of this analysis, with all betas large and statistically significant — supporting the proposed model. Specifically, Hypotheses I through III are directly supported by the significance of paths I, II, and III, respectively.

We next evaluate a series of alternate models to attempt to further validate the model shown in Figure 2 (Blalock 1971). Specifically, in order to test Hypothesis IV (shared knowledge as a mediating variable), three alternate models are tested. The first two alternates (A and B) each eliminate one of the independent variables, trust or influence, and treat shared knowledge as an independent rather than a mediating variable. These two models and the results of their assessment are shown in Figures 3 and 4, respectively.

For both of these models, neither determinant (trust or influence) was significantly related to IS performance, providing support for Hypothesis IV's contention that mutual trust and influence do not have a direct effect on performance but rather only an effect through the mediation of shared knowledge. As a final test of Hypothesis IV, we regress IS performance on trust, influence, and shared knowledge as a group — as shown in Figure 5. The results of this assessment eliminate the potential paths between trust and performance and influence and performance (since they are non-significant) (Kerlinger and Pedhazur 1973). In addition, the regression's F-statistic is not significant, and comparing this with the results of the Figure 2 model also supports Hypothesis IV, implying further that shared knowledge acts as a mediating variable between mutual trust and influence and IS performance.

A final confirmatory test of the Figure 2 model is performed by reconstructing the original correlation coefficients between variables (Kerlinger and Pedhazur 1973; Baroudi 1985). Any discrepancies between the original correlation coefficients and the reconstructed coefficients greater than .05 is seen as reason to reject the causal path model. Correlations are reconstructed by adding the direct and indirect effects of the path using the following equations:

$$r_{mt,sk} = \beta_{sk,mt} + \beta_{sk,mi} * r_{mt,mi}$$
$$r_{mi,sk} = \beta_{sk,mi} + \beta_{sk,mt} * r_{mt,mi}$$
$$r_{sk,isp} = \beta_{sp,mt} * r_{mt,sk} + \beta_{isp,mi} * r_{mi,sk} + \beta_{isp,sk}$$

where $r_{a,b}$ is the correlation between a and b, $\beta_{a,b}$ is the beta for the direct path between a and b, *sk* is shared knowledge, *mt* is mutual trust, *mi* is mutual influence, and *isp* is IS performance. Table 3 shows the results of solving these equations.

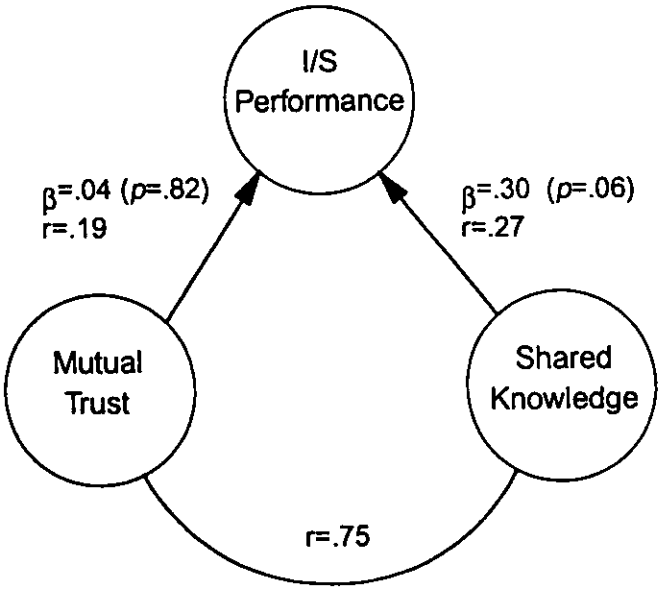

Figure 3. Alternative Model A: Trust and Shared Knowledge as Independent Variables
R^2 = .07, F = 3.75, p = .03

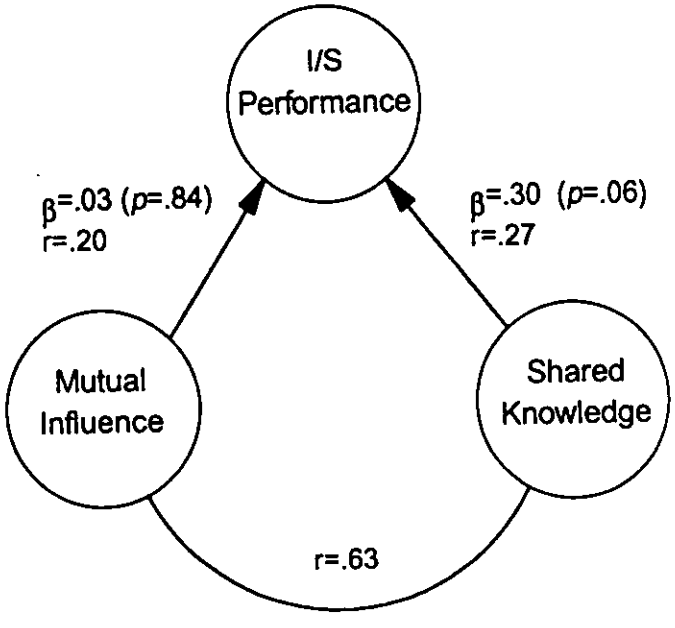

Figure 4. Alternative Model B: Influence and Shared Knowledge as Independent Variables
R^2 = .07, F = 3.75, p = .03

Since the differences between the reconstructed correlations and the original correlations is in all cases less than .05, the model passes the test of reconstructed correlations.

6. DISCUSSION OF RESULTS

The path analysis of the previous section shows our proposed model to best describe the causal relationships between mutual trust, influence, shared knowledge, and IS group performance. The insignificant beta values obtained when removing either mutual trust or mutual influence from the model indicates that both variables are necessary to achieve shared knowledge. Alternative models A and B eliminate the possibility that either of these variables, along with shared knowledge, has a direct effect on IS performance, supporting Hypothesis IV. The role of shared knowledge as a mediating variable is supported by comparing the Figure 5 model with our proposed (Figure 2) model. Low and insignificant betas in Figure 5 confirm that the original "trimmed" model (one which does not include all possible paths) explains the most causality among the variables. The analysis further supports Hypotheses I through III that mutual trust and influence are not direct causal antecedents of IS performance, but rather act through shared knowledge.

In summary, the path analysis supports Hypotheses I through IV and the proposed shared knowledge model. The results indicate that mutual trust and influence between IS groups and their line customers lead to increased levels of shared knowledge. This shared knowledge, in turn, is a positive contributor to IS group performance.

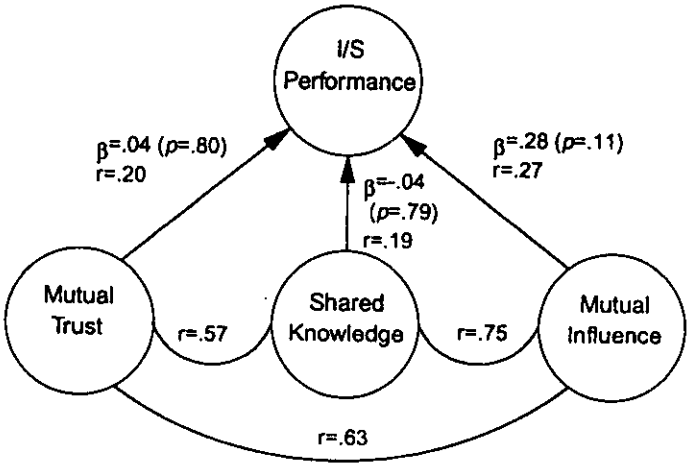

Figure 5. Alternative Model C: Influence, Trust and Shared Knowledge as Independent Variables
R^2 = .07, F = 2.50, p = .06

Table 3. Reconstructed Correlations for Path Model

Path	Original Correlation	Reconstructed Correlation	Difference	Direct Effect	Indirect Effect
SK → P	0.27	0.27	0.00	0.27	0.00
T → SK	0.75	0.77	0.02	0.58	0.19
I → SK	0.63	0.63	0.00	0.30	0.33

7. CONCLUSIONS AND FUTURE RESEARCH

This model of the contribution of shared knowledge to IS group performance has implications for both researchers and managers. We propose that IS and line groups have the opportunity to develop mutual trust and influence through repeated periods of communication, social interaction and goal attainment. These attributes lead to the groups' increased attractiveness to each other and an increase in shared information regarding problems, processes, and opportunities. This sharing of information leads to the sharing of technical and organizational knowledge. When shared knowledge occurs, the IS and line obtain a more complete understanding and appreciation of each others' reality. Shared knowledge plays a mediating role in the achievement of IS group performance through the mechanisms of trust and influence.

Shared knowledge positively relates to the performance of the IS organization. This research contributes to an overall conceptual understanding of the nature and importance of knowledge as an organizational performance mechanism. From a theoretical perspective, these results imply that information exchange by itself is not sufficient for knowledge sharing. This distinction raises additional questions about the nature of cognitive elements which are utilized in achieving IS performance. By identifying trust and influence as determinants of shared knowledge, the relationship between the IS and line groups is characterized as a complex interaction of social and cognitive elements.

This study examines a large sample of IS-line relationships in a range of firms. While the measurements used have demonstrated statistical, convergent, and discriminant validity, issues of concern remain. Although stakeholder assessments of performance have been found to have a high level of convergence with objective measures (Ventkatraman and Ramanujam 1987), it is clear we have taken a relatively narrow approach to IS performance. As was mentioned earlier, future studies in this area should include a more comprehensive conceptualization and operationalization of IS performance which better reflects its multidimensional nature (Delone and McLean 1992). In addition, the data presented are cross-sectional. The development of mutual trust and influence leading to shared knowledge is an ongoing phenomenon. These constructs were measured at a static point in time rather than as they develop, thus losing some richness of explanatory power. An ethnographic study of shared knowledge between diverse organizational groups would be an alternative method of capturing this richness.

From a managerial perspective, the identification of mutual trust and influence between IS and line groups as determinants of shared knowledge implies the need to provide opportunities for these qualities to be developed. By defining shared knowledge as an understanding or appreciation among cross-functional managers for the technologies and processes which affect their mutual performance, it is not implied that the groups need to be able to perform each other's jobs. However, IS and line managers should be provided opportunities to socially interact and communicate about their work. Henderson (1990) suggests such activities as joint training on interdependent tasks, joint planning sessions, and formation of cross-functional teams to provide such opportunities. These activities can lead to improved IS group performance by providing a greater understanding and appreciation of the constraints and environment of each group. The increased shared knowledge between groups is attained through repeated and frequent interactions over time, which build mutual trust and influence.

Future research indicated by this study includes looking at changes in trust, influence, and shared knowledge levels over time and the relationship of those changes to IS performance. These variables should also be studied with respect to their impact on the performance of the *line* group as well as IS. Finally, the model can be used as a theoretical lens to examine similar organizational relationships. An example of such a relationship might be that of R&D and manufacturing groups. It is hoped that the model of shared knowledge provided here will provide insight to managers in a variety of organizational contexts in the future.

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APPENDIX

CONSTRUCT MEASUREMENT

A. CHARACTERISTICS OF INDEPENDENT AND MEDIATING VARIABLES TAKEN FROM RELATIONSHIP QUESTIONNAIRE GIVEN TO IS ORGANIZATIONS

Please characterize the general working relationship that *currently exists* between the [IS organization] and the [line/functional organization].

Note: Items in brackets were customized to reflect the exact names of the participating organizations and functional groups.

Scale used to measure constructs:

1	2	3	4	5	6	7
Extremely Weak	Weak	Moderately Weak	About Average	Moderately Strong	Strong	Extremely Strong

SHARED KNOWLEDGE (Cronbach's Alpha = .91)

Shared Knowledge Indicator 1: Multiplicative Assessment:
The product of the responses for the following:
1. The level of understanding of the [line organization] for the work environment (problems, tasks, roles, etc.) of the [IS organization] is: *(mean=3.70, s.d.=1.47).*
2. The level of understanding of the [IS organization] for the work environment (problems, tasks, roles, etc.) of the [line organization] is: *(mean=4.38, s.d.=1.37).*

Shared Knowledge Indicator 2: Multiplicative Assessment:
The product of responses for the following:
1. The level of appreciation that the [line organization] has for the accomplishments of the [IS organization] is: *(mean=4.16, s.d.=1.55).*
2. The level of appreciation that the [IS organization] has for the accomplishments of the [line organization] is: *(mean=4.30, s.d.=1.31).*

Shared Knowledge Indicator 3: General Assessment:
The level of appreciation that the [IS organization] and the [line organization] have for each other's accomplishments is: *(mean=4.40, s.d.=1.35).*

MUTUAL TRUST (Cronbach's Alpha = .84)

Mutual Trust Indicator 1: General Assessment:
The level of trust that exists between the [IS organization] and the [line organization] is: *(mean=4.58, s.d.=1.40).*

Mutual Trust Indicator 2: Calculated Assessment:
The product of the responses for the following:
1. The reputation of the [line organization] for meeting its commitments to the [IS organization] is: *(mean=4.11, s.d.=1.33).*
2. The reputation of the [IS organization] for meeting its commitments to the [line organization] is: *(mean=4.83, s.d.=1.39).*

MUTUAL INFLUENCE (Cronbach's Alpha = .90)

Mutual Influence Indicator 1: General Assessment of Interaction:
The average of responses for the following:

1. In general, the level of influence that members of the [IS organization] and the [line organization] have on each other's key decisions and policies is: *(mean=4.27, s.d.=1.31).*
2. In general, the ability of members of the [IS organization] and the [line organization] to affect each other's key decisions and policies is: *(mean=4.55, s.d.=1.25).*

Mutual Influence Indicator 2: Calculated Assessment of Interaction:
The product of responses for the following:

1. In general, the level of influence that members of the [line organization] have on key decisions and policies of the [IS organization] is: *(mean=4.58, s.d.=1.48).*
2. In general, the level of influence that members of the [IS organization] have on key decisions and policies of the [line organization] is: *(mean=3.64, s.d.=1.45).*

Mutual Influence Indicator 3: Calculated Assessment of Interaction:
The product of responses for the following:

1. In general, the ability of members of the [line organization] to affect key policies and decisions of the [IS organization] is: *(mean=4.46, s.d.=1.47).*
2. In general, the ability of members of the [IS organization] to affect key policies and decisions of the [line organization] is: *(mean=3.64, s.d.=1.46).*

B. THE DEPENDENT VARIABLE: TAKEN FROM PERFORMANCE QUESTIONNAIRE GIVEN TO ORGANIZATIONAL STAKEHOLDERS

The following questions ask you to compare the [IS organization] to other such IS organization units. In relation to other comparable units you have observed, how does the [IS organization] rate on the following?

Note: Items in brackets were customized to reflect the exact names of the participating organizations and functional groups.

Scale used to measure constructs:

1	2	3	4	5	6	7
Non-Existent	Very Weak	Weak	About Average	Strong	Very Strong	Extremely Strong

IS PERFORMANCE (Cronbach's Alpha = .89)

IS Performance Indicator 1: General Assessment:
In general, the quality of the work produced for the [line organization] by the [IS organization] is: *(mean=5.09, s.d.=0.98).*

IS Performance Indicator 2: General Assessment:
In general, the efficiency of the [IS organization] in performing its work for the [line organization] is: *(mean=4.82, s.d.=1.05).*