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Mechanisms for the Development of Shared Mental Models between the CIO and the Top Management Team

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MECHANISMS FOR THE DEVELOPMENT OF SHARED MENTAL MODELS BETWEEN THE CIO AND THE TOP MANAGEMENT TEAM

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Abstract

Extant research has documented that the relationship between the chief information officer and the management team (TMT) has been troubled. An often cited contributing factor to this has been the gap in understanding between the CIO and the TMT. The objective of this study is to examine the development of shared mental models (SMMs) between the CIO and TMT about the role of information systems in the organization. A SMM is conceptualized as a multidimensional construct spanning the dimensions of shared language and shared understanding. The study posits that knowledge exchange mechanisms and relational similarity between the CIO and TMT are key antecedents to the development of SMMs. SMMs between the CIO and TMT are expected to guide the strategic orientation of the organization and may influence strategic alignment and organizational outcomes. The model was tested via a field survey of 382 CIOs using structural equation modeling. Results show that relational similarity and formal mechanisms of knowledge exchange (e.g., formal CIO membership in the TMT, CIO hierarchical level, and formal educational mechanisms by the CIO) are important to the development of SMMs. Contrary to expectations, social informal mechanisms of knowledge exchange and physical proximity were not significantly related to SMMs. Given the undeniable importance of developing a shared view of the role of IS in the organization by senior executives, such research has important theoretical and practical implications.

Keywords: Chief information officer, information systems, top management team, knowledge exchange, shared understanding, relational similarity

Motivation and Objectives

Despite recognition of information systems as a key enabler of business strategy and despite significant investments in IS, many organizations have found themselves unable to apply IS effectively (Armstrong and Sambamurthy 1999; Brynjolfsson and Hitt 1996; Feeny and Willcocks 1998; Sambamurthy and Zmud 1994). Among various other reasons, extant academic and practitioner research recognizes the gap in understanding between chief information officers and the top management team (TMT) as a major obstacle to IS effectiveness and IS strategic alignment. This gap encompasses both the CIO's often limited understanding of business and strategic issues (Feeny et al. 1992; Wang 1994), as well as the CEO's and TMT's often limited understanding of information systems capabilities (Armstrong and Sambamurthy 1999; Gupta 1991).

The practitioner press describes this issue with headlines such as "CIOs Not Up to Snuff as Active Business Leaders" (Wilder 1992), "Chasm Closer: the CIO/CEO Gap Still Dogs Information Systems" (King 1995), and "Hatred: An Update (on) CIO-CEO Relationships" (Klug 1996). As a result, the reputation and performance evaluations of CIOs have suffered. For instance, CIO positions have been recently filled with candidates from business backgrounds twice as often as with candidates with computer backgrounds (Karimi and Gupta 1996). In addition, there is a higher than average corporate dismissal rate and shorter tenure for IS leaders compared with other top executives (Karimi and Gupta 1996), generally attributed to conflict with the CEO and other

TMT members (Gupta 1991). In this research, we propose the development of shared mental models (SMMs) about the role of IS in the organization as a key endeavor in bridging the gap in understanding between CIOs and TMT members and propose antecedents that promote their development. Nelson and Cooprider (1996) found that shared knowledge (achieved via mutual trust and influence) between IS groups and their line customers contributed to IS performance. This study explores issues similar to those of Nelson and Cooprider; however, we extend the concept of shared knowledge to that of a multidimensional construct of CIO–TMT SMMs. In addition, this study examines antecedents that specifically promote the development of SMMs between the CIO and TMT. The thesis is that specific knowledge exchange mechanisms within the organization and relational similarity between the CIO and TMT are important factors that contribute to the development of SMMs.

Theoretical Background

Figure 1 presents the conceptual model for the study, which establishes two primary antecedents to SMMs: (1) knowledge exchange mechanisms and (2) relational similarity.

Shared Mental Models

SMMs have been defined in various contexts in the literature as shown in Table 1.

In this study, we integrate the existing SMM definitions and define SMMs as *shared beliefs and **understandings** of the role of IS in the organization along with a shared common **language** with its own vocabulary of nuances* based on Madhaven and Grover (1998). This definition suggests two different dimensions of SMMs: (1) shared language (Denzau and North 1994; Feeny et al. 1992; Lederer and Mendelow 1987, 1988; Madhavan and Grover 1998; Nelson and Cooprider 1996) and (2) shared understanding of the role of IS in the organization (Armstrong and Sambamurthy 1999; Feeny et al. 1992; Gupta 1991; Kim 1993; Madhavan and Grover 1998; Marks et al. 200;2 Mohammed et al. 2000; Peterson et al. 2000). A *shared language* is necessary to facilitate communication and SMM building (e.g., the CIO can communicate in business terms rather than in "technolingo"). This shared language is a necessary but not sufficient condition for the development of a *shared understanding* about the role of IS in the organization. We posit that it is through this multidimensional SMM between the CIO and TMT that IS strategic alignment in the organization can be achieved. Based on review of the literature, knowledge exchange mechanisms and relational similarity emerge as key antecedents to SMMs[1] (Madhavan and Grover 1998; Mohammed et al. 2000; Nelson and Cooprider 1996; Armstrong and Sambamurthy 1999; Webber, Chen et al. 2000; Richards 2001; Marks et al. 2002; Swaab et al. 2002).

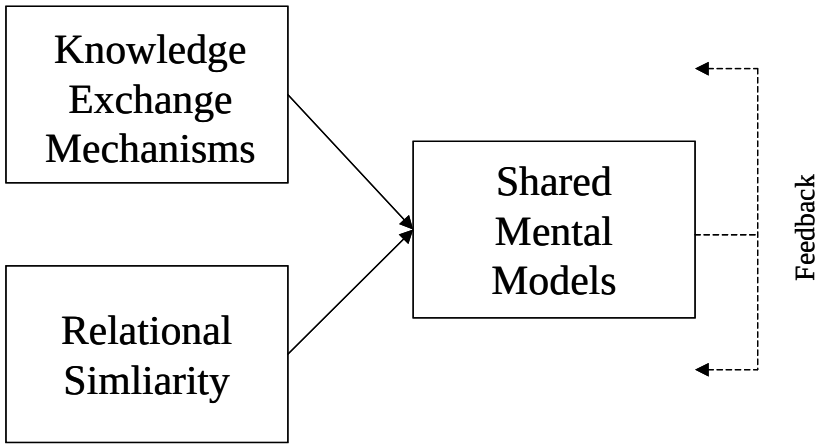

Figure 1. Conceptual Model

[1]Heretofore the term SMMs refers to the shared mental models between the CIO and TMT on the role of IS in the organization.

Table 1. Select Definitions of Shared Mental Models

Study	Definition
Cannon-Bowers et al. (1993)	SMMs are viewed as organized knowledge structures that include objects, situations, and events, and the relationships between them.
Kim (1993)	SMMs include shared values, culture, myths, standard operating procedures, and beliefs.
Madhavan and Grover (1998)	SMMs represent often unconscious assumptions about the way the world works, along with a shared common language, with its own vocabulary of nuances and taken-for-granted understandings, and a shared organizational memory.
Mathieu and Goodwin (2000)	SMMs are mechanisms whereby humans generate descriptions of system purpose and form, explanations of system functioning and observed system states, and predictions of future system states.
Mohammed et al. (2000)	SMMs refer to an organizational understanding or mental representation of knowledge about key elements of the team's environment.
Peterson et al. (2000)	SMMs are the member's common models of the group structure, process, and task.

Knowledge Exchange Mechanisms

SMMs are facilitated through communication and knowledge that is exchanged among key members of the organization (Rasker and Post 2000; Swaab et al. 2002). The CIO–TMT incongruence in the understanding of the role of IS in the organization has been attributed to lack of strategic IS knowledge on behalf of the TMT on one hand and limited business knowledge by the CIO on the other (Armstrong and Sambamurthy 1999; Chan and Huff 1993; Feeny et al. 1992; Gupta 1991; Wang 1994). Knowledge exchange mechanisms allow for the transfer of business and strategic IS knowledge to create a shared understanding between the organization's key strategic decision makers. IS executives must understand top management objectives to enable effective IS deployment in the organization (Lederer and Mendelow 1987). This is further enhanced when the TMT understands IS capabilities and capitalizes on these to enable, support, or shape the organization's business strategy. The literature on knowledge exchange mechanisms suggests that rich communication media allow for the transfer of knowledge between the CIO and TMT and consequently facilitate the development of SMMs (Armstrong and Sambamurthy 1999; Smaltz 1999). Knowledge exchange mechanisms comprise: (1) aystems of knowing and (2) CIO educational mechanisms.

Systems of Knowing

Systems of knowing refer to organizational structures that allow for communication and knowledge exchange between the CIO and TMT (Armstrong and Sambamurthy 1999). We propose three dimensions of systems of knowing: (1) *structural systems of knowing* (e.g., the hierarchical position of the CIO and participation of the CIO within the TMT), which are formal structural arrangements that allow for formal interactions between the CIO and the TMT (Armstrong 1995); (2) *physical systems of knowing* (e.g., organizational proximity of CIO–TMT office locations) that allow physical access to those with whom one wishes to exchange and integrate knowledge (Nahapiet and Ghoshal 1998) and afford the CIO greater opportunity to engage in rich face-to-face communication with the TMT; and (3) *social systems of knowing* (e.g., informal interactions between the CIO and TMT) that reflect the informal interactions between the CIO and TMT and expand knowledge exchange opportunities beyond what formal and physical systems will allow. Each of these systems facilitates frequent communication and knowledge exchanges between the CIO and TMT and thereby influences SMM development.

CIO Educational Mechanisms

CIO educational mechanisms provide an additional mechanism for the transfer of knowledge to the TMT and consequently the development of SMMs by the CIO proactively creating opportunities for the TMT to learn about IS (Enns et al. 2003; Lederer and Mendelow 1988; Martin et al. 1995; Pervan 1998; Rifkin and Kurtzman 2002; Rockart 1982; Smaltz 1999). CIO educational mechanisms are important knowledge exchange mechanisms that specifically address the TMT's limited understanding of IS strategic capabilities. While the CIO likely educates the TMT on IS capabilities through many interaction opportunities created

by the three systems of knowing, CIO educational mechanisms capture formal proactive educational efforts such as seminars and retreats put forth by the CIO.

Relational Similarity

Relational similarity is defined as the similarity of background (demographic and experiential) characteristics between the CIO and TMT. Based on the similarity-attraction paradigm, which suggests that individuals tend to be attracted to those more similar to themselves (Byrne 1971), relational similarity (Tsui and O'Reilly 1989; Young and Buchholtz 2002) suggests that similarity of demographic and experiential characteristics leads to more frequent interaction, liking, and similar mental models. Thus, we posit that relational similarity between the CIO and TMT will influence the development of SMMs. As individuals become more acquainted, the effect of demographic similarity declines (Harrison and Price 1998); therefore, we assess CIO–TMT relational similarity based on experiential similarity.

Research Model and Hypotheses

The research model for the study is presented in Figure 2 and definitions of key constructs of the study in Table 2. As Figure 2 shows, there are three primary antecedents to the development of SMMs: (1) systems of knowing (structural, physical, and social systems), (2) CIO educational mechanisms, and (3) relational similarity. Systems of knowing and CIO educational mechanisms are posited to directly influence SMMs. Relational similarity of the CIO and TMT is posited to influence SMMs directly and indirectly through systems of knowing.

Systems of Knowing and SMMs

Structural Systems of Knowing and SMMs

Structural systems of knowing include formal knowledge exchange mechanisms that are critical in the development of SMMs. Specifically, they include the hierarchical level of the CIO and the degree of participation and interaction of the CIO with the TMT. The hierarchical level of the CIO in the organization provides the CIO with greater opportunities for engagement and rich

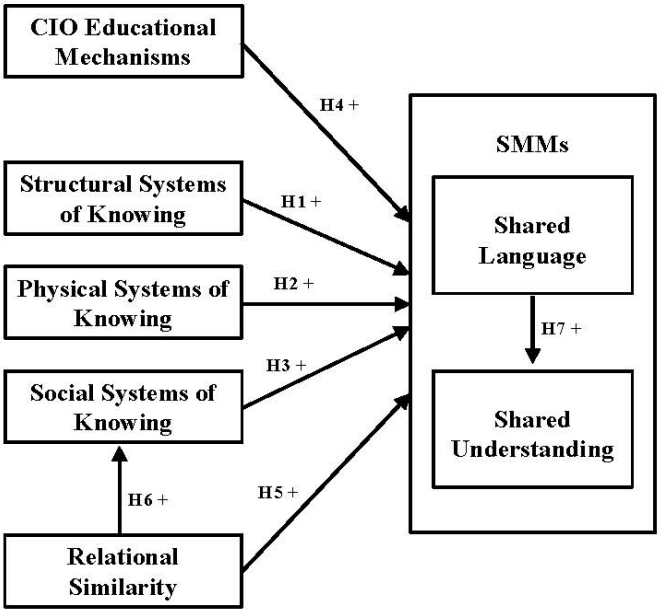

Figure 2. Research Model

Table 2. Definitions of Key Constructs

Construct	Definition
Systems of Knowing	Structures of interaction among team members for sharing their perspectives, pooling of knowledge, and development of shared understanding (Nahapiet and Ghoshal 1998). Three dimensions of systems of knowing: (1) structural, (2) physical, and (3) social.
Structural Systems of Knowing	Potential *formal* avenues available to the senior leadership team to develop rich channels of interaction on strategic business and IS issues (Armstrong and Sambamurthy 1999).
Physical Systems of Knowing	Physical proximity of the CIO and TMT offices that allow the CIO greater opportunity to engage in rich face-to-face communication with the TMT (Monge et al. 1985).
Social Systems of Knowing	Potential *informal* avenues available to the senior leadership team to develop rich channels of interaction on strategic business and IS issues (Armstrong and Sambamurthy 1999).
CIO Educational Mechanisms	Formal mechanisms through which the CIO educates the TMT on the capabilities of IS to support corporate strategy.
Relational Similarity	The similarity of the CIO and TMT with respect to common experiences and interests (Young and Buchholtz 2002).
Shared Mental Model	The degree to which the CIO and TMT have a shared language and a shared understanding.
Shared Language	The degree to which the CIO and TMT use similar terminology during communication.
Shared Understanding	The degree to which the CIO and TMT have a shared understanding of the role of IS in the organization.

communication with the TMT and thereby allows for greater understanding of organizational goals (Smaltz 1999; Watson 1990). The degree to which the CIO participates in the TMT also provides a structure in the organization that can influence opportunities for the CIO to communicate with the TMT, consensus of business knowledge between the CIO and TMT, success of the CIO within the organization, increased understanding of the organization's business, access to the TMT's vision for the organization, and the development of SMMs with the TMT (Armstrong and Sambamurthy 1999; Earl and Feeny 1994; Feeny et al. 1992; Lederer and Mendelow 1987; Rockart et al. 1996). Thus,

Hypothesis 1: *Structural systems of knowing will promote the development of SMMs (shared language and shared understanding) between the CIO and TMT.*

Physical Systems of Knowing and SMMs

Physical systems of knowing are defined as two or more people being in the same location where there is both the opportunity and the psychological obligation for face-to-face communication (Monge et al. 1985). The physical proximity of the CIO to the TMT provides the CIO with greater advantage for messages of high equivocality (which require face-to-face interaction) to enable an exchange of information that can lead to a common perspective for ambiguous issues (Daft et al. 1987; Watson 1990) such as those pertaining to strategy. Thus, organizational proximity is a formal structure that can influence communication and knowledge exchange between the CIO and TMT (Cross et al. 2002; Monge et al. 1985) and allow these executives to discover each other's common attitudes (Monge et al. 1985; Newcomb 1961). The CIO who is in close proximity to the CEO is likely to have a more accurate perception of the TMT's objectives and have a greater understanding of organizational goals (Brass 1984; Watson 1990). Therefore, greater opportunity for engagements due to organizational proximity allows for greater degree of knowledge exchange and development of SMMs. Thus,

Hypothesis 2: *Physical systems of knowing will promote the development of SMMs (shared language and shared understanding) between the CIO and TMT.*

Social Systems of Knowing and SMMs

In addition to interactions facilitated by structural and physical systems of knowing, social systems of knowing are expected to influence SMMs between the CIO and TMT. Informal interactions are expected to facilitate the ease and frequent flow of

communication among team members (Smith et al. 1994), allow for rich communication processes that drive knowledge transfer in organizations (Alavi and Leidner 2001), create opportunities to exchange ideas and improve understanding (Armstrong 1995; Lederer and Burky 1988; Watson 1990), and create SMMs between individuals (Denzau and North 1994). Communication has been described as a facilitator of gradual convergence of meanings and opinions about situations and as a facilitator of shared knowledge, which must be expressed in a common language of both groups (Johnson and Lederer 2003; Nelson and Cooprider 1996). Further, interaction and networking of the CIO with top management have been shown to form a shared understanding between the participants (Armstrong and Sambamurthy 1999) and to provide the CIO with a greater understanding of the goals of the firm (Madhavan and Grover 1998). Thus,

Hypothesis 3: *Social systems of knowing will promote the development of SMMs (shared language and shared understanding) between the CIO and TMT.*

CIO Educational Mechanisms and SMMs

The CIO will need to take a proactive stance on promoting a shared understanding of IS within the organization through educating the TMT on the capabilities of IS as they relate to business strategy to avoid a disconnect between IS and business goals (Gupta 1991; Lederer and Mendelow 1987). Formal education (in the form of seminars and retreats) should facilitate an understanding of IS capabilities and aid TMT members in communicating their objectives vis-à-vis these capabilities, thereby facilitating the development of SMMs (Lederer and Mendelow 1987; Markides 1997), thus,

Hypothesis 4: *CIO educational mechanisms will lead to the development of SMMs (shared language and shared understanding) between the CIO and TMT.*

Relational Similarity and SMMs

Individuals with similar experiences, interests, and cultural backgrounds are shown to have more similar attitudes and perceptions, a similar understanding, values, and beliefs, as well as convergent mental models (Denzau and North 1994; Hodgkinson and Johnson 1994; Markides 1997; Tsui and O'Reilly 1989; Young and Buchholtz 2002). Common experiences and interests are primary factors in the development of a common language, mutual understanding, and SMMs between individuals (Denzau and North 1994; Hodgkinson and Johnson 1994; Madhavan and Grover 1998; Markides 1997; Vandenbosch and Higgins 1995). Therefore, the more similar the CIO–TMT characteristics, the more likely the development of SMMs, thus,

Hypothesis 5: *Relational similarity between the CIO and TMT will lead to a higher level of CIO–TMT SMM development (shared language and shared understanding).*

Relational Similarity and Social Systems of Knowing

Based on prior research in relational demography and through the application of the similarity attraction paradigm, it is posited that relational similarity between the CIO and TMT facilitates social systems of knowing. Informal interactions between the CIO and TMT will be facilitated by relational similarity since individuals are more likely to communicate and socialize with those who have greater commonalities (Tsui and O'Reilly 1989; Young and Buchholtz 2002).

Hypothesis 6: *Relational similarity between the CIO and TMT will lead social systems of knowing (increased networking) between the CIO and TMT.*

Shared Language and Shared Understanding

The creation of a shared understanding is unlikely without the existence of a common shared language used to exchange knowledge and communicate meaning (Nahapiet and Ghoshal 1998). Thus, a shared language between the CIO and TMT is expected to contribute to the development of a CIO–TMT shared understanding:

Hypothesis 7: *Shared language between the CIO and TMT will lead to a shared understanding between the CIO and TMT regarding the role of IS in the organization.*

Research Methodology and Findings

The research methodology employs a combination of qualitative interviews with a field survey of CIOs. Six semi-structured interviews with CIOs from different organizations were conducted to gain a richer understanding of the research phenomenon, assess the face validity of the research model, and develop instruments for constructs identified in the research model. The interviews started with open-ended questions to inquire about the antecedents of CIO–TMT SMMs. In the latter portion of the interview, the interviewees were asked more specific questions with regard to the relationship of constructs within the research model. Reponses from the CIOs to the open-ended questions emphasized the need for knowledge exchange mechanisms to allow for a shared understanding between the CIO and TMT and mentioned each of the following as essential in the development of this understanding: formal interactions between the CIO and TMT (hierarchical position of the CIO and TMT participation), CIO–TMT organizational proximity, networking between the CIO and TMT, and educational mechanisms by the CIO. Thus, the findings from the interviews provide evidence as to the face validity of the research model.

A survey was developed to test the hypotheses. Since the study focuses on the development of SMMs between CIOs and members of the TMT, organizations that have a member of the IS functional area in an executive position form the population for the study. The survey instrument involves a number of items that were modified from previously validated instruments in order to fit the current context as presented in Table 3.

All research variables were measured using multi-item scales with the exception of relational demography, which was measured with a single-item. The items included in the CIO survey are presented in Appendix A. A pilot study was not conducted because our population is difficult to reach and it would potentially limit the number of responses that could be used as data for the research study. However, the survey was validated in a two-step process: (1) the survey was pretested via a panel of experts to assess content validity amd (2) an instrument item sorting exercise was conducted to qualitatively evaluate the discriminant validity of each of the measured constructs. A total of 382 of 2,691 CIO surveys were completed and returned for a response rate of 14.2 percent. Table 4 shows sample characteristics of the respondents.

Table 3. Construct Item Sources

Relational Similarity (Young and Buchholtz 2002; CIO Interviews): CIO–TMT common interests/experiences.
CIO Educational Mechanisms (CIO Interviews): Ed1A (organize seminars); Ed1B (organize retreats); Ed5 (manage IS expectations); Ed6 (provide realistic IS expectations). (Smaltz 1999) Ed2 (emerging IT); Ed3 (TMT computer literacy); Ed4 (IS capabilities).
Structural Systems of Knowing (Armstrong and Sambamurthy 1999; Smaltz 1999): StrSK1 (TMT participation); StrSK2 (formal interactions with TMT); StrSK3 (CIO reporting level).
Physical Systems of Knowing (Watson 1990; CIO Interviews): PhySK1 (CIO/CEO); PhySK2 (CIO–TMT).
Social Systems of Knowing (Armstrong and Sambamurthy 1999; Smaltz 1999): SocSK1 (informal contact); SocSK2 (socialize); SocSK3 (informal exchanges).
Shared Language (CIO Interviews): SL1ave (common language); SL2T (use business terminology); SL3T (avoid using IS jargon).
Shared Understanding (Boynton et al. 1994; CIO Interviews): SU1ave (role of IS in the organization); SU2ave (IS as a competitive weapon); SU3ave (increase productivity); SU4ave (IS investments).

Table 4. Sample Characteristics

	Mean	Std. Dev.	Missing
Age (years)	48.6	8.0	4
Organizational Tenure (years)	7.4	6.7	0
Positional Tenure (years)	4.3	3.8	0
Gender	Male: 302; Female: 80		0

Data Analysis

Hypotheses were tested using structural equation modeling (SEM) techniques. SEM allows simultaneous testing of all relationships in the research model (Chin 1998a). Since the constructs in the research model employ both formative and reflective indicators, for which more well-known SEM tools such as LISREL are not well suited (Chin 1998b), PLS Graph was employed. The psychometric properties of all scales were first assessed within the context of the structural model through confirmatory factor analysis. These results are presented next followed by results of the structural model.

Results

Measurement Model

The psychometric properties of the scales are assessed in terms of item loadings, discriminant validity, and internal consistency. Item loadings and internal consistencies greater than .70 are considered acceptable (Fornell and Larcker 1981). As can be seen from the confirmatory factor analysis (CFA) results in Table 5 and composite reliability scores (Werts et al. 1974) in Table 6, scales used in the study largely meet these guidelines. These guidelines for item loading are relevant only for constructs that are modeled as reflective. The dependent variables in this study (shared language and shared understanding) and physical systems of knowing, social systems of knowing, and relational similarity are modeled as reflective. However, the other antecedents to SMMs (CIO educational mechanisms and structural systems of knowing) are modeled as formative. As the research model was developed, we determined that CIO educational mechanisms and structural systems of knowing are formatively modeled constructs based on the following conditions established by Jarvis et al. (2003): (1) the indicators are viewed as defining characteristics of the construct, (2) changes in the indicators are expected to cause changes in the construct, (3) changes in the construct are not expected to cause changes in the indicators, (4) eliminating an indicator may alter the conceptual domain of the construct, and (5) a change in the value of one of the indicators is not necessarily expected to be associated with a change in all of the other indicators.

For all reflectively modeled constructs, all items except for one item in shared language (SL3) exhibit high loadings (greater than 0.70) on their respective constructs. Furthermore, all constructs in the model exhibit good internal consistency as evidenced by their composite reliability scores. To assess discriminant validity (Chin 1998b), (1) indicators should load more strongly on their corresponding construct than on other constructs in the model and (2) the square root of the average variance extracted should be larger than inter-construct correlations.

Table 5. Results of Confirmatory Factor Analysis

Reflective Indicators	SU	SL	Phys SK	Social SK	Rel Sim	Educ Mech	Struct SK
SU1 (role of IS in our organization)	0.859	0.426	0.053	0.176	0.205	0.459	0.332
SU2 (role of IS as a competitive weapon)	0.867	0.394	0.137	0.223	0.295	0.402	0.387
SU3 (how IS can increase productivity)	0.870	0.394	0.081	0.209	0.252	0.417	0.365
SU4 (prioritization of IS investments)	0.798	0.454	0.049	0.140	0.280	0.356	0.302
SL1 (common language)	0.578	0.878	0.112	0.200	0.263	0.395	0.306
SL2 (use business terminology)	0.200	0.730	0.004	0.134	0.171	0.333	0.196
SL3 (avoid using IS jargon)	0.115	0.561	0.002	0.043	0.101	0.258	0.130
PhysSK1 (CIO/CEO physical proximity)	0.100	0.052	0.949	0.180	0.076	0.079	0.247
PhysSK2 (CIO–TMT physical proximity)	0.081	0.092	0.960	0.251	0.079	0.115	0.297
SocSK1 (TMT informal contact)	0.266	0.208	0.215	0.785	0.141	0.332	0.464
SocSK2 (TMT socialization)	0.215	0.227	0.163	0.796	0.370	0.312	0.375
SocSK3 (TMT informal exchanges)	0.219	0.186	0.236	0.801	0.206	0.334	0.483
RelSim* (common experiences/interests)	0.408	0.384	0.119	0.276	1.000	0.362	0.222

*Note: Relational similarity was measured by a single-item

Table 6. Inter-Construct Correlations

	Reliability (# of items)	SU	SL	Educ Mech	Structural SK	Physical SK	Social SK	RelSim
SU	0.910 (4)	0.846						
SL	0.771 (3)	0.490	0.878					
Educ Mech	0.833 (7)	0.482	0.450	0.732				
Structural SK	0.732 (3)	0.409	0.309	0.373	0.658			
Physical SK	0.951 (2)	0.094	0.077	0.102	0.285	0.952		
Social SK	0.836 (3)	0.291	0.264	0.408	0.543	0.250	0.793	
RelSim	N/A (1)	0.408	0.384	0.362	0.222	0.119	0.370	1.000

Composite Reliability = $\rho c = (\Sigma\lambda_i)^2 / [(\Sigma\lambda_i)^2 + \Sigma_i var(\varepsilon_i)]$, where λ_i is the component loading to an indicator and $_i var(\varepsilon e_i) = 1 - \lambda_i^2$

The shaded numbers on the leading diagonal are the square root of the variance shared between the constructs and their measures. Off diagonal elements are the correlations among constructs. For discriminant validity, diagonal elements should be larger than off-diagonal elements.

As can be seen by the CFA results, all indicators load more highly on their own construct than on other constructs. Furthermore, as shown by comparing the inter-construct correlations and AVE (shaded leading diagonal) in Table 6, all constructs share more variance with their indicators than with other constructs. Thus, these results point to the discriminant validity of the constructs in the model.

Structural Model

CIO demographic characteristics such as a respondent's organizational tenure, tenure as the organization's CIO, and gender were included in the analysis as controls. As none of the controls were significant, they were dropped from the model. We present the results of the structural model in Figure 3 and weights for the formative constructs' indicators in Table 7.

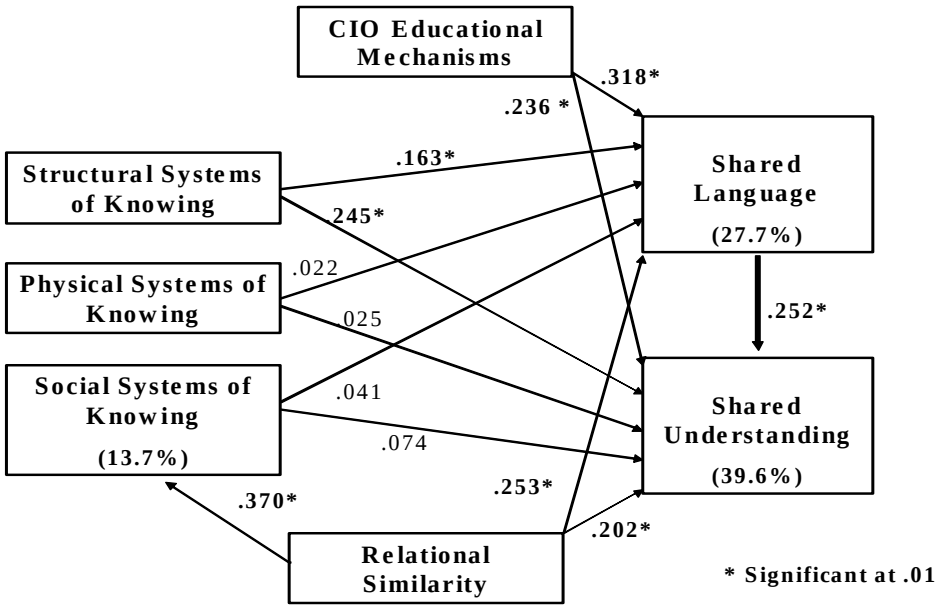

Figure 3. PLS Results

Table 7. PLS Weights

Construct	Weight		Construct	Weight
CIO Educational Mechanisms			***Structural Systems of Knowing***	
Ed1A (organize Seminars for TMT)	.04		StrSK1 (TMT participation)	.83*
Ed1B (organize Retreats for TMT)	.24*		StrSK2 (formal interactions with TMT)	.33*
Ed2 (provide insight on emerging IT)	.27*		StrSK3 (CIO reporting level)	-.03
Ed3 (assist TMT computer literacy)	.14			
Ed4 (educate TMT regarding IS capabilities)	.16			
Ed5 (manage TMT's IS expectations)	.34*			
Ed6 (provide realistic IS expectations to TMT)	.26*			

* Significant at .01

The PLS results show that three of the five antecedents were significant predictors of shared language and shared understanding: CIO educational mechanisms, structural systems of knowing, and relational similarity. These three constructs together predominantly explain 27.7 percent of the variance in shared CIO–TMT language. These same three antecedents together with shared CIO–TMT language predominantly explain 39.6 percent of the variance in a shared CIO–TMT understanding. Shared language contributed to an increase in explained variance in shared understanding over and above that explained by the key antecedents alone. Physical and social systems of knowing were not significant predictors of either shared language or shared understanding between the CIO and TMT. Further, relational similarity had a strong effect on social systems of knowing, explaining 13.7 percent of its variance.

As is evident from Figure 3, PLS results provide support for hypotheses 1a and 1b, which posited that structural systems of knowing would lead to a CIO–TMT shared language and shared understanding, respectively. Specifically, participation in the TMT and formal interactions with the TMT (but not reporting level of the CIO) were significant formal structural mechanisms. Hypotheses 2a and 2b, which posited that physical systems of knowing would respectively lead to shared language and understanding, were not supported. In addition, hypothesis 3a and 3b, which posited that social systems of knowing would respectively lead to shared language and understanding, were not supported. Hypotheses 4a and 4b were supported: CIO educational mechanisms are significant predictors of both shared language (H4a) and understanding (H4b). Specifically, the following educational mechanisms proved significant: organizing TMT retreats to increase IS knowledge, providing insight to TMT members on emerging information technologies, managing TMT expectations, and providing realistic expectations regarding the capabilities of IS. Hypotheses 5a and 5b were supported: relational similarity between the CIO and TMT is a significant predictor of both shared language (H5a) and understanding (H5b). Hypothesis 6, relational similarity between the CIO and TMT and social systems of knowing, is also strongly supported. Furthermore, supporting H7, shared language has a significant effect on shared understanding of the role of IS in the organization. Table 8 summarizes these results.

Table 8. Summary of Hypothesis Tests

Hypothesis	Support
H1a: Structural Systems of Knowing → Shared Language	**Yes**
H1b: Structural Systems of Knowing → Shared Understanding	**Yes**
H2a: Physical Systems of Knowing → Shared Language	No
H2b: Physical Systems of Knowing → Shared Understanding	No
H3a: Social Systems of Knowing → Shared Language	No
H3b: Social Systems of Knowing → Shared Understanding	No
H4a: CIO Educational Mechanisms → Shared Language	**Yes**
H4b: CIO Educational Mechanisms → Shared Understanding	**Yes**
H5a: Relational Similarity → Shared Language	**Yes**
H5b: Relational Similarity → Shared Understanding	**Yes**
H6: Relational Similarity → Social Systems of Knowing	**Yes**
H7: Shared Language → Shared Understanding	**Yes**

Implications and Conclusions

This research was motivated by evidence suggesting that a gap in understanding between the CIO and members of the TMT has a detrimental effect on IS strategic alignment. To this end, we developed a theoretical model that identifies key antecedents to a shared perspective between the CIO and the top management team, termed the *shared mental model*. We have operationalized the SMM as a multidimensional construct and tested the resulting model via a field study of CIOs.

From the perspective of both academics and practitioners, several rich and important implications follow. First, our results support the concept of SMMs as a multidimensional construct comprising both a shared language and a shared understanding that hold a *common* set of antecedents (structural systems of knowing, CIO educational mechanisms, and relational similarity). In addition, our results support the important role shared language plays in creating a shared understanding. Thus, CIOs can proactively create a shared language and facilitate the creation of a shared understanding by focusing on communicating in business terms and avoiding technical jargon.

Second, the significant predictors of SMMs provide important levers to CIOs and top management to foster shared mental models. Perhaps surprisingly and contrary to expectations, formal mechanisms (structural systems of knowledge and CIO educational mechanisms) were salient in creating shared mental models while informal networking mechanisms were not. The leadership of the organization can control the level of participation of the CIO in the TMT and frequency of formal interactions. Based on our findings, the senior leadership should engineer the structure of the organization so that the CIO is a formal TMT member and take measures to increase formal interactions between the CIO and TMT. The TMT can also establish the educational role of the CIO as a key part of the CIO job description to provide greater support for this role. In addition, the CIO should strongly promote CIO educational mechanisms as an effective means to build a shared understanding with the TMT and to be perceived as an effective leader by the TMT. Two of the seven formative indicators for CIO educational mechanisms (organize seminars and retreats) may reflect the CIO's role as an administrator, while the remaining five indicators may reflect the CIO's role as a visionary. Future research should further examine how these distinct mechanisms influence SMMs. The educational mechanisms construct is focused on activities of the CIO designed to educate other members of the TMT with regard to the capabilities of IS. Business knowledge is expected to be exchanged from the TMT to the CIO through systems of knowing rather than via formal educational mechanisms. However, future studies should examine formal TMT educational mechanisms as a potential antecedent to CIO–TMT SMMs.

Relational similarity was found to significantly influence SMMs (both shared language and shared understanding). From a human resources perspective, relational similarity provides important implications. The organization can select a CIO based on similarity with the TMT or develop programs to allow the CIO to develop experience in certain areas where there is a gap in background or experiential similarity. Our findings may also extend beyond the CIO–TMT relationship and may be relevant to other areas of executive development. Future research should include additional measures to better assess demographic and experiential characteristics of both the CIO and TMT members and should also investigate further implications of relational similarity such as the rate of CIO–TMT convergence and decision making quality.

Contrary to our hypotheses, physical systems of knowing and social systems of knowing did not significantly influence SMMs. The physical proximity of the CIO to the TMT may not be important due to the virtual world that allows executives to communicate via other means even though new electronic means of communication are not as rich as face-to-face communication enabled by the physical proximity of individuals. The TMT is defined in the survey as *the CEO and the highest-ranking senior executives in the organization*, which allows for a subjective interpretation of its meaning by the responding CIO when assessing physical proximity to the TMT. Therefore, to account for this potential issue, we operationalized physical systems of knowing as the physical proximity of the CIO to the CEO as well as to the majority TMT. These two indicators were found to be highly correlated (significant at 1 percent). Future research should examine which organizational executives the CIO considers to be formal members of the TMT to provide greater clarity.

Surprisingly, social systems of knowing did not significantly influence either shared language or shared understanding. This contradicts findings of previous research that indicated that social interaction was a critical perspective of the CIO–TMT relationship (Armstrong 1995; Armstrong and Sambamurthy 1999; Denzau and North 1994; Johnson and Lederer 2003; Lederer and Burky 1988;Nelson and Cooprider 1996; Watson 1990) but is consistent with findings by Smaltz (1999). Thus, our results suggest that the CIO should focus on formal mechanisms rather than focusing on engaging in social interaction with the TMT to build SMMs. However, informal interactions may be important in terms of building trusting relationships that may facilitate the development of SMMs.

Since the research model included both formatively modeled constructs and reflectively modeled constructs, the study used PLS to test the research hypotheses. However, PLS has several limitations. PLS is considered more appropriate for exploratory rather than confirmatory research (Chin 1995; Chin 1998b; Gefen et al. 2000) and tends to overestimate the measurement model and underestimate the structural model (Chin 1995; Chin 1998b). Therefore, PLS may not be as generalizable across samples as other structural modeling techniques such as LISREL, EQS, or AMOS. Future research should consider alternative methods of analysis to increase statistical rigor and generalizability of the results.

From a theoretical perspective, we have framed the phenomenon within the context of knowledge exchange mechanisms and have shown the relative efficacy of a set of such mechanisms. We believe that this is a useful lens that enables new theoretical perspectives on the sometimes rocky relationship between CIOs and members of the TMT. Clearly, other knowledge exchange mechanisms exist and can be examined in future research. In addition, characteristics of the CIO such as trust, credibility, communicative ability, and political savvy (Smaltz 1999) may be important antecedents or moderators to some of the relationships posited. Future research should also examine the creation of shared mental models from the TMT perspective or use matched pairs of CIOs and TMT members as respondents. Finally, the relationship between SMMs and possible consequents such as IS strategic alignment should be examined.

In conclusion, the overarching goal in this paper was to enrich our knowledge of how the CIO and TMT can develop a shared understanding with regard to the role of IS in the organization. We described a construct labeled as the *shared mental model*, which encompasses both a shared language and a shared CIO–TMT understanding. In addition, we empirically tested the relationship of SMMs with key antecedents. Our results show that formal mechanisms of knowledge exchange and relational similarity are important to the development of SMMs rather than informal mechanisms of knowledge exchange. Given the undeniable importance of developing a shared view of the role of IS in the organization by senior executives, such research has value for theory development as well as for practice. Several avenues for future work remain and we hope this study will stimulate others to extend this line of research further.

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Appendix A. CIO Questionnaire Items

Structural Systems of Knowing
1. Reporting levels between you and the CEO
2. Involvement with the Top Management Team (TMT)
3. I interact with TMT on a formal basis (e.g., official meetings, work-related phone calls, etc.)

Physical Systems of Knowing
1. Physical location of your office with respect to your CEO's office
2. Physical location of your office with respect to the majority of the TMT members' offices

Social Systems of Knowing
1. I have informal contact with TMT members
2. I socialize with the TMT members (e.g., social gatherings, golf, tennis, etc.)
3. I have informal exchanges with TMT members

CIO Educational Mechanisms
1. How often do you organize seminars for the TMT to increase their IS knowledge?
2. How often do you organize retreats for the TMT to increase their IS knowledge?
3. I provide insight to the TMT members on emerging information technologies
4. I assist the TMT members in improving their computer literacy
5. I educate the TMT members regarding the capabilities of IS
6. I work to manage the expectations of the TMT with regard to the capabilities of IS
7. I try to give TMT members realistic expectations about the capabilities of IS

Relational Similarity
1. TMT members and I share many common interests (sports, hobbies, cultural interests, etc.)

Shared Language
1. TMT members and I share a common language in our conversations
2. I primarily use business terminology when interacting with TMT members
3. I avoid using IS jargon when interacting with TMT members

Shared Understanding
1. TMT members and I have a shared understanding of the role of IS in our organization
2. TMT members and I have a shared view of the role of IS as a competitive weapon for our organization
3. TMT members and I have a shared understanding of how IS can be used to increase productivity of our organization's operations
4. TMT members and I have a common view regarding the prioritization of IS investments