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Boundary Spanning Competencies and Information System Development Project Success

Completed Research Paper

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Abstract

Information System Development (ISD) relies on cross-functional teams with distinct cultures and non-overlapping knowledge. Developing a shared understanding of the business needs and associated IS solutions by drawing upon these disparate knowledge sets is critical for project success. We adopt a “practice” view of system development, which emphasizes the relevance of knowledge boundaries between different communities in a system development process. We extend this perspective by testing the impact of different forms of boundary-spanning competencies and practices on ISD success. By analyzing 136 ISD projects in a global US automotive OEM, we show that the presence of boundary spanning roles, acculturative processes, and cross-domain knowledge and experience acquisition are significant factors positively affecting IS development success. We also demonstrate that facilitative boundary spanning roles - ambassador, coordinator, and scout - moderate the relationship between accumulated IS business domain knowledge and ISD success and that IS business competence is determined by acculturation among IS teams, and the technical competence of the IS team. This suggests that IS teams with low levels of business domain knowledge may be able to mitigate this deficit by exhibiting boundary spanning behaviors to enhance the flow of information across the knowledge boundaries.

Key words: Acculturation, Boundary Spanning roles, Competence, Confirmatory Factor Analysis, Exploratory Factor Analysis, Information System Development, Project Success, Quantitative, Structural Equation Modeling

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Introduction

Developing enterprise-class Information Systems (IS) is a complex undertaking that relies heavily on cross-functional teams (Cheney & Lyons, 1980; Sawyer, Guinan, & Coopriider, 2008). Practice-based theorizing in IS research, however, informs us that these functional teams have expertise that is borne of the experience with the particular activities associated with a given community of practice, and this knowledge is specific to the practices of that community, and is difficult to leverage across boundaries with other communities (Brown & Duguid 1991; Boland & Tenkasi 1995; Carlile 2004; Orlikowski 2002). Therefore there are inevitable issues with cross-boundary collaboration in information systems development practice (Sawyer et al 2008).

One persistently problematic boundary in the context of an information system development project is the one that arises between IS personnel and “business” personnel. IS developers understand the hardware and software elements of the system, whereas business personnel have a particular domain knowledge that is critical to the appropriate development and eventual use of the system. The resulting combined teams, by design, rarely have any members with completely overlapping knowledge sets, (Tesch, Sobol, Klein, & Jiang, 2009; Maruping, Venkatesh, & Agarwal, 2009). Furthermore, members come from different and distinct cultures, which tend to thicken the knowledge boundaries (Orlikowski, 2002). Yet, it is imperative that these teams traverse these knowledge boundaries and develop a shared understanding of the needs of the business and required IS solutions to succeed (Reich & Benbasat 2000).

A good deal of research has focused on the challenge of cross functional knowledge coordination by analyzing how distributed, cross-functional teams carry out successful projects (Blanton, Schambach & Trimmer, 1998; Bassellier & Benbasat, 2004). These studies indicate that that the ways in which these teams span the knowledge boundaries directly affect project success. These spanning mechanisms can take multiple forms: (1) creating boundary spanning roles (Sawyer et al 2008; Levina & Vaast 2005); (2) increasing the IS competence of business personnel (Bassellier et al 2001; Bassellier et al 2003); (3) increasing the business competence of IS personnel (Bassellier & Benbasat 2004); and (4) acculturating IS personnel into the business domain (Korzenny& Abravanel, 1998). While previous research has addressed the impact of several of these mechanisms separately for their effects on outcomes like IT-business relationships (Bassellier et al 2001; Bassellier et al 2003; Bassellier & Benbasat 2004; Sawyer et al 2008), no research so far has addressed how these forms of boundary spanning relate to one another, and how they affect distinct dimensions of project success (Espinosa et al 2006).

To address this lacuna, we formulate a model articulating functional relationships between boundary spanning forms and multiple dimensions of project success, including budget targets, scheduling goals, and participant satisfaction. To validate the model we survey 399 ISD project team members across 136 enterprise-level ISD projects at a large North American automotive OEM. Our findings indicate that boundary spanning significantly affects ISD success. This exhibited both the presence of integrative mechanisms reflecting behaviors related to the presence of boundary spanning roles (Ancona and Caldwell, 1991), as well as by acculturation that promotes sharing domain knowledge and experience among team members. Further, we find evidence that knowledge related competencies among IS and business personnel can have a substitutive relationship in affecting project success.

The remainder of the paper is organized as follows: first we review the relevant literature on boundary spanning and ISD project success. Then we present our theoretical model, detail hypotheses, and validate the measures and the model. Next, we discuss our findings and their significance. We conclude with a discussion of the implications for practice and research.

Boundary Spanning and ISD Project Success

Enterprise-class ISD relies on identifying and integrating diverse business knowledge within a chosen business domain, and combining it effectively with knowledge about appropriate IT solutions (Lyytinen, Rose, & Yoo,

2010). Thus, successful ISD demands- in addition to mobilizing high levels of IT knowledge and competence-intensive collaboration between IT and business personnel (Cheney & Lyons, 1980; Sawyer et al 2008). These groups participate in different communities-of-practice (Brown & Duguid, 1991, Bassellier et al 2003) with distinct practices, knowledge bases, and languages. Whilst IS personnel have highly specialized knowledge about the development and integration of IT, business people have hard-won knowledge about processes, practices and customers in their respective domains (Carlile 2004). Consequently, significant knowledge boundaries exist among these bodies of knowledge, and it is a non-trivial task to span the boundaries and integrate this knowledge (Boland & Tenkasi 1995). At the same time, the competencies enabling IS and business people to share and integrate this knowledge are among the most important factors associated with project success (Reich & Benbasat 2000). In order to traverse the knowledge boundaries, each group’s knowledge perspectives must be rendered accessible to the others, just as those others must make an effort to internalize other’s perspectives and integrate them (Boland & Tenkasi 1995). This continual mutual adaptation of relevant knowledge during ISD has been coined as “boundary spanning” (Baroudi, 1985; Orlikowski, 1991), and it has been shown to positively affect ISD success (Maruping et al 2009; Orlikowski 2002). Next we review research that addresses the competencies that drive ISD success, including different forms of boundary spanning and the level of technical competency of the team. We conclude this review with brief discussion of project success.

Boundary Spanning Competencies

There are four fundamental mechanisms that help ISD teams span knowledge boundaries. First, IS personnel can acquire and apply knowledge about the business domain. Second, business personnel can acquire and apply knowledge about information technology. Third, certain team members can enact roles that facilitate cross-boundary interaction, such as that of ambassador, coordinator, and scout. Fourth, the practices within teams can encourage the exchange of cultural norms and experience – a process of acculturation. See table 1 below for a summary. Next we will briefly address each mechanism.

Table 1. Boundary Spanning Mechanisms		
	<i>Definition</i>	<i>Source</i>
<i>IS-Business Competence</i>	The ability of IS people to acquire and apply business knowledge effectively in an ISD context.	Bassellier and Benbasat, 2004
<i>Business-IS Competence</i>	The ability of business people to acquire and apply IS knowledge effectively in an ISD context.	Bassellier, Benbasat, and Reich, 2003
<i>Integrative Boundary Spanning Roles</i>	The team’s ability to enact integrative boundary spanning roles of Ambassador, Coordinator, and Scout.	Ancona and Caldwell, 1991; Sawyer, Guinan, and Coopridger, 2008
<i>Acculturation</i>	The team’s ability to foster the exchange of cultural knowledge among diverse group members.	Dohrenwend and Smith, 1982; Orlikowski, 2002

IS-Business Competence relates to the ability, knowledge, and experience that IS practitioners have at hand to design, implement, and maintain information systems (Pawlowski, 2004; Lyytinen et al 2010). It covers dimensions beyond technical knowledge, including communication ability and organizational knowledge, or the IS personnel’s understanding of business. This competence has been shown to positively affect the intention on the part of the business to re-engage with the IT people (Bassellier & Benbasat 2004), and we posit that this also affects project success.

Business-IS Competence involves the increasing need for business personnel to become more familiar with IS knowledge, and thus be more willing to participate, champion, and lead ISD projects and to partner with IS people in solving their business problems (Bassellier et al 2001; Bassellier et al 2003). This competence comprises both the IS knowledge and IT-related experience that business personnel have at hand to effectively partner IS personnel. It includes dimensions of technical knowledge, and additional organizational knowledge related to managing and organizing ISD projects. A business manager’s IS competence has been seen to influence the project success, as IS savvy business managers are more likely to assume effective leadership (Rockart, Earl & Ross, 1996). In this context the higher levels of IS knowledge among business personnel provide the essential means to identify and integrate meaningfully non-overlapping knowledge bases (Bassellier & Benbasat, 2003; Nelson & Coopridger, 1996).

Integrative Boundary Spanning Roles relate to the way ISD project teams enact the institutionalized practices of common knowledge integrating roles. Through these roles, ISD project members enact well established scripts for organizing and coordinating knowledge flows at the borders among diverse communities, thus enabling effective knowledge sharing across these borders (Levina & Vaast 2005; Sawyer et al 2008). Ancona and Caldwell (1991) identify five boundary spanning roles: 1) ambassador, 2) coordinator, 3) scout, 4) guard, and 5) sentry. Boundary Spanners in these roles can 1) compensate for a lack of knowledge within the team by bringing that knowledge to the team from external sources, and 2) disseminate the knowledge in such a way as to bridge the existing knowledge gaps (Sawyer et al. 2008). While “guard” and “sentry” roles imply boundary work that filters and controls knowledge flows, the roles of ambassador, coordinator, and scout facilitate boundary spanning through *integrative* activities. In this study we are in particular interested in integrative boundary spanning roles. These are: 1) *ambassadors* who operate by advocating for certain positions with internal and external groups; 2) *coordinators* who ensure that information flows effectively between groups; and 3) *scouts* who seek out knowledge from external sources and bring them to the team. Collectively, these three roles actively facilitate effective knowledge flows across the boundaries. Conversely, *guards* control the release of information until the appropriate time, while *sentries* protect the teams from external interference, allowing them to process information appropriately. While these two non-integrative roles might be important to team outcomes, they cannot be considered competencies that enable teams span knowledge boundaries.

Acculturation is the final enacted boundary spanning form of ISD project teams that works to reconcile a variety of cultures that often clash in project contexts. Acculturation involves the exchange of cultural features through firsthand contact between the IS and the business personnel (Kottak, 2005). We claim that expansion of a shared understanding requires that the team members communicate frequently across distinct organizational cultures (Orlikowski, 2002) inviting constant alignment of language, values and beliefs. Here, culture is defined broadly as: “a set of cognitive and evaluative beliefs – beliefs about what is or what ought to be – that are shared by the members of a social system and transmitted to new members” (Miller-Loessi and Parker (2006:530), based on the work of House in 1981). These cultural features include not only cognitive beliefs, but also values and principles of language use, which both reflect an understanding of what is, and what should be (Miller-Loessi and Parker, 2006). We surmise that how effectively IS personnel can acquire their business knowledge is likely to be affected by the acculturative process taking place prior to and during the IS project. To this end we look at mechanisms that enable people to learn and understand “alien” culture of the business (or vice versa) by affecting the way in which the other culture is rendered understandable through cues shared at face-to-face contacts. Thus, acculturation measures the extent to which the IS personnel are in regular contact with business representatives (and vice versa), and the extent and frequency of their social networking across borders. The approach adopted here in capturing the extent of acculturation within project teams draws on two streams of research. First we adopt an anthropological framework developed by Korzenny & Abravanel (1998), which recognizes as drivers of acculturation traits like exposure to the new culture, exposure to culture of origin, alignment with values of the new culture, and depth of interpersonal network in the new culture as elements of acculturation. In addition, we enhance the construct of acculturation with the dimension of Language Usage per Basso, 1967.

Technical Competency: While not strictly a boundary spanning mechanism (with respect to IS-business knowledge boundaries), the technical competency of IS personnel is fundamental to ISD project success. Several studies have observed that technological competence forms a significant antecedent for successful IS implementation (Blanton, Schambach & Trimmer 1998; Tesch, Sobol, Klein, & Jiang 2009). We define **technical competence** as the ability to apply techniques and principles necessary to derive and document a sound IT solution - such as business data analysis, modularization, abstraction, or functional design, combined with the possession of specific organizational skills to coordinate design processes. Following Blanton, Schambach & Trimmer (1998) we also include interpersonal communication and leadership skills in this competence.

ISD Success

The project management literature defines Project Success as the extent to which the project meets its technical goals, remains within the budget, and is delivered in time (Jiang, Klein, & Pick, 2003; Procaccino & Verner, 2006). In addition other streams of IS research include the idea of meeting higher level organizational goal such as improving operational efficiency or effectiveness in ISD success (Procaccino & Verner 2006). These outcomes, however, are a somewhat difficult measure in the project context, as such measures are rarely agreed before ISD process, and many organizations lack the apparatus to measure such improvements (Sawyer et al 2008).

In defining ISD success we draw on DeLone and McLean (1992), who posit that IS success comprises of six dimensions: 1) System Quality, 2) Information Quality, 3) Information/System Use, 4) User Satisfaction, 5) Individual Impact, and 6) Organizational Impact. We will apply a modified DeLone and McLean’s framework by reducing IS success construct into three constructs that are applicable in evaluating project outcomes in the context of our study (see Table2): 1) system quality which reflects the technical system performance, accuracy, completeness etc., 2) satisfaction with system use, which represents the user’s reactions to the system; and 3) satisfaction with the development process, which is a reasonable surrogate for a measure of investment effectiveness (Saarinen 1996). These dimensions were selected for the following reasons. First, we are not interested in individual users directly. Therefore, individual impact related to system use is not measured. Second, we group system and information quality, into a single construct, System Quality as in practice most users have difficulty in separating them. Third, we submit to DeLone & McLean’s (2003) suggestion that information/system use and user satisfaction, when applied to an environment where little choice of system use is afforded to the users, may not be a useful construct. This construct is thus better re-purposed to measure satisfaction with the system environment, such as system support, launch and training support, and IS department relationships.

<i>Dimension</i>	<i>Definition</i>
<i>System Quality</i>	The required characteristics of the system that produces the information. Includes measures of performance, accuracy, reliability and completeness and the quality of the information such as its Accuracy, Completeness, Timeliness, and Meaningfulness
<i>Satisfaction with System Use</i>	Characteristics of the interaction of the user with the system, and by implication the information it manages. Includes measures of extent and nature of use.
<i>Satisfaction with Development Processes</i>	Represents the degree to which the business team is satisfied with the development process. Includes measures such as resource control, completeness of development, team member commitment.

Hypothesis development: Effects of Boundary Spanning on ISD Success

Overall, we posit that project success is influenced by the presence and level of boundary spanning mechanisms in ISD project teams in enterprise contexts (Figure 1). The model suggests that acculturation to the business by the IS members of the team, technical competence of IS members, and IS competence of business members are direct antecedents of system quality, satisfaction with system use, and development satisfaction. Accordingly we argue that the presence of integrative boundary spanning roles will moderate that impact of acculturation and business competence on quality and satisfaction. We will next articulate the hypotheses related to the impact of boundary spanning competencies on IS project success.

We posit after Blanton, Schambach and Trimmer (1998) and Bassellier & Benbasat (2004) that both the level of business and technical competence among IS members of the team influence positively system quality, satisfaction, and development satisfaction. Technical competence affects both the capability to determine requirements accurately and completely, and also the capability to implement systems with high quality. IS business competence affects the capability to link to critical domains of business managers knowledge and to understand their needs and to probe them effectively. This will result in better requirements leading to higher system quality, satisfaction with system use and development satisfaction. We finally expect that aspects of IS competence exhibited by the business members of the team positively influence System Quality, Satisfaction with System Use, and Development Satisfaction. This follows from the fact that harnessed with better IS knowledge users can express their needs better, can set up more realistic expectations of the system and its performance, and also can be more satisfied with the development process. Therefore we hypothesize:

- **H1:** *IS-Business Competence is positively related to System Quality, Satisfaction with System Use, and Development Satisfaction*
- **H2:** *IS-Technical Competence is positively related to System Quality, Satisfaction with System Use, and Development Satisfaction*
- **H3:** *Business-IS Competence is positively related to System Quality, Satisfaction with System Use, and Development Satisfaction.*

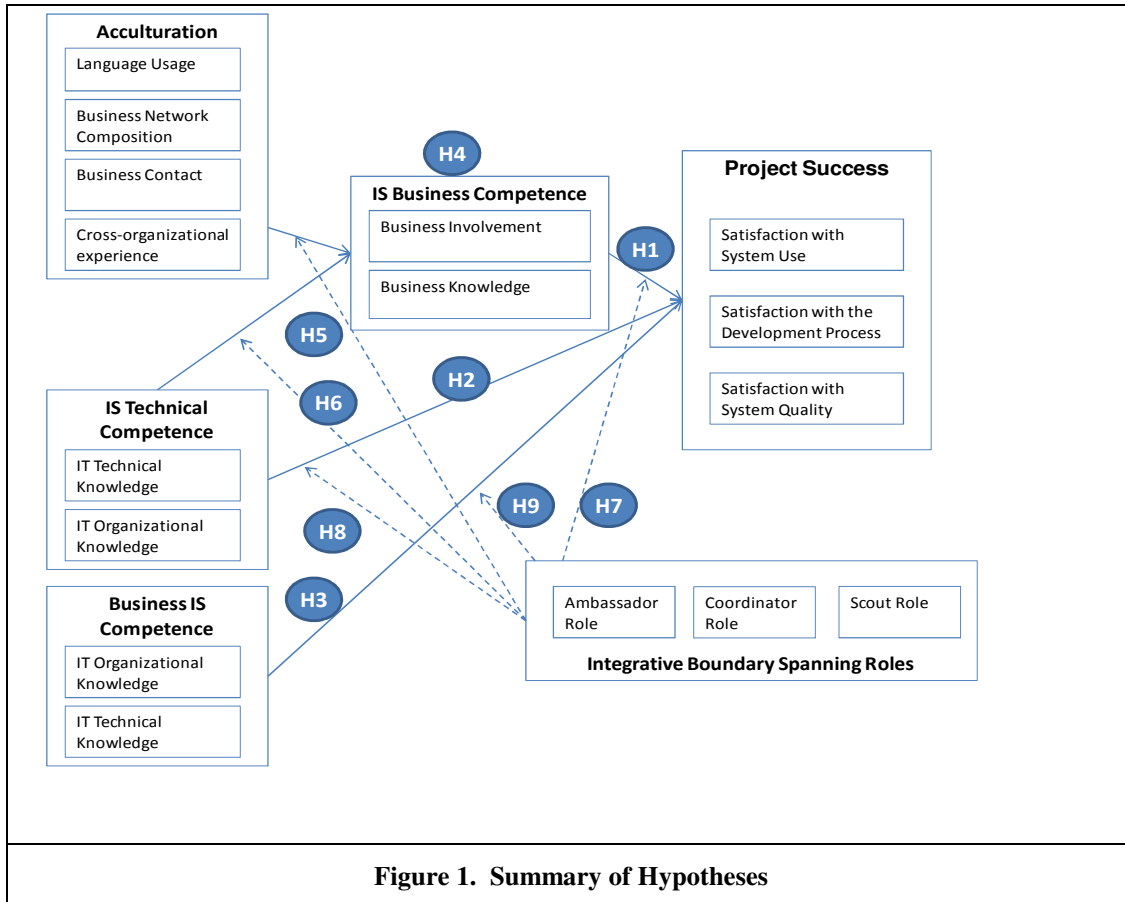


Figure 1. Summary of Hypotheses

The source of business knowledge for the IS members of the team is either knowledge already acquired by them, or it originates from the business organization during the development project. If this happens during the project, it is highly dependent on the level of acculturation by the team members. Therefore, we posit a positive mediated relationship between acculturation and project success: i.e. IS business competence fully mediates the relationship between acculturation and ISD success. Thus, the influence of the elements of acculturation such as strength of contact and network, use of language, and experience help create the shared business knowledge, as represented by the IS business competence. We hypothesize that this competence dynamic is caused by the acculturative process, where the individual level of acculturation improves due to the increased scope and intensity of contacts within the business domain (Korzenny & Abravanel, 1998). Thus, we hypothesize:

- **H4:** *IS-Business Competence fully mediates the positive effect of Acculturation on System Quality, Satisfaction with System Use, and Development Satisfaction.*

Guinan, Coopriker, and Faraj (1998) report a positive impact of the presence of boundary spanning roles on ISD team performance. They do not, however, articulate the causal mechanisms that boundary spanning roles play in affecting ISD success. We argue that this effect is not necessarily a direct effect. Boundary spanning roles alone do not drive project success, but instead they facilitate, or enable, other competencies to effectively drive success. While ambassadors, coordinators, and scouts might facilitate the active sharing of knowledge across boundaries that contributes to project success, these roles do not contribute to the development of better software *per se*. Therefore we conceive of these roles more as moderators that affect the nature of the direct effects of other competencies on

project success. There are two alternative hypotheses about these moderating effects. On the one hand, due to the complexity of the knowledge boundaries, integrative boundary spanning roles increase the effectiveness of other competencies and amplify their effects. On the other hand, perhaps the level to which these boundaries must be spanned is limited, and either direct competencies or integrative roles provide the requisite spanning, and would therefore have a substitutive effect. Either way, we expect moderation and accordingly hypothesize that:

- **H5:** *Integrative Boundary Spanning Role competencies moderate the effect of Acculturation on IS-Business Competence*
- **H6:** *Integrative Boundary Spanning Role competencies moderate the effect of IS-Technical Competence on IS-Business Competence*
- **H7:** *Integrative Boundary Spanning Role competencies moderate the effect of IS-Business Competence on System Quality, Satisfaction with System Use, and Development Satisfaction*
- **H8:** *Integrative Boundary Spanning Role competencies moderate the effect of IS-Technical Competence System Quality, Satisfaction with System Use, and Development Satisfaction*
- **H9:** *Integrative Boundary Spanning Role competencies moderate the effect of Business-IS Competence on System Quality, Satisfaction with System Use, and Development Satisfaction.*

Research Design & Method

To validate the hypothesized model we conducted a survey on the impact of boundary spanning mechanisms on ISD success. The sampling unit was a project team while the data was probed from multiple team members including IS designers, business professionals, and sponsors. The survey examined the level of project success as the function of the presence of social factors including acculturation, competence, and boundary spanning among studied project teams. Similar topics have been investigated in the past, but never in the context of explaining ISD success (Tiegland and Wasko, 2003; Bassellier, Benbasat, and Reich, 2003; Bassellier and Benbasat 2004; Sawyer, Coopriider, and Guinan, 2008).

Table 3. Survey Instrument		
<i>Construct</i>	<i>Dimensions</i>	<i>Source</i>
<i>Project Success</i>	Development Process (DP) System Use (SU) System Quality (SQ)	Saarinen 1996
<i>IS-Technical Competence</i>	IS Technical Knowledge (TK) IS Organizational Knowledge (OK)	Blanton, Schambach & Trimmer 1998
<i>IS-Business Competence</i>	Business Involvement (OV) Business Knowledge (GU)	Bessalier & Benbasat 2004; Blanton et al 1998
<i>Business-IS Competence</i>	Business's IS Organizational Knowledge (BO) Business's IS Technical Knowledge (BT)	Bassellier & Benbasat 2003
<i>Acculturation</i>	Language Usage (LU) Business Network Composition (BN) Business Contact (BC) Cross-organizational Experience (CE)	Korzenny & Abravanel 1998; Basso 1967
<i>Integrative Boundary Spanning Roles</i>	Ambassador Role (AM) Coordinator Role (CR) Scout Role (ST)	Sawyer, Guinan, & Coopriider 2008
<i>Controls</i>	Project Scope (PS) Project Type (NP) Nature of Innovation (PR) Business Domain (PD)	

Instrument development

We operationalized model constructs as shown in Figure 1 by adapting existing scales where possible (Table 3). We followed the scale development procedures suggested by DeVellis (2003). After reviewing and modifying the item pool obtained from the literature review, we formed an expert panel of six researchers whose scales we had used, or who had been involved in similar research, and obtained their feedback in two rounds of reviews. Five items were added as a result. We then used a think aloud protocol with a sample of six IS practitioners to refine the questions and to ensure that they were comprehensible, accurate, and offered a basis for clear judgments (Bolton, 1993). Based on these pre-tests three items were modified for improved comprehension and recall. We next pilot tested the scales by obtaining a sample of 35 IS practitioners, who did not participate in the final survey. The analysis of data showed normality (Kolmogorov-Smirnov significance > 0.05), adequate dimensionality (Kaiser-Meyer-Olkin > 0.5, Bartlett < 0.05), and item reliability (Cronbach's Alpha > 0.6) for all constructs. Exploratory Factor analysis based on theoretical groupings demonstrated communalities above 0.3 for all, but four items. Due to the small sample sizes of the pilot data the analysis was conducted for each construct separately. We did not make any changes to the survey instrument and the final questionnaire consisted of 121 items where all scales were defined as five point Likert-scales.

Data Collection

The data was collected from multiple participants of development teams in a major North American Automotive OEM. Respondents were identified and selected on the basis of their participation in development teams within the last three years. 181 projects were selected based on two criteria: (1) size – each of the projects involved at least 500 hours; and (2) access to the project lead (for a number of projects the lead had left the company and was not accessible for response). We identified three groups of respondents for different parts of the questionnaire: 1) IS Members of the teams, i.e. IS professionals in the teams; 2) IS sponsors, who controlled groups of projects, but were not involved with the teams; and 3) Business sponsors from the functional organization, who were responsible for providing overall direction and funding to the project, but were not involved on a day-to-day basis. IS team members were questioned for all constructs; business and IS sponsors rated Project Success constructs. Additionally business sponsors rated the IS competence of the business team members.

Data was collected over a twelve week period and 154 teams provided usable data resulting in an effective project level response rate of 86%. Overall 400 surveys were completed from these 154 teams with the following response rate: 275 (73% response) from IS team members, 73 (40% response) from IS sponsors, and 52 (28% response) from Business Sponsors. Sample demographics for the data are shown in Table 4. They demonstrate a good spread of sampled projects. Non-response bias threat was considered to be acceptable based on the similar demographics of the sampled and non-sampled teams, and the high rate of project level response (86%). No statistical differences were observed between the population sampled, and the population that responded. The sample data was analyzed using t-tests. No significant differences at the $p=0.05$ level were seen in the results of both early and late respondents nor with older or recent projects (those started in the first eighteen months of the cycle, and those started in the last eighteen months).

The responses were next aggregated first by each type of respondent; mean scores were calculated for each item for each construct at a team level from the IS team members. Then the mean score at the team level of the IS team members and the business sponsors was calculated for the business IS competence constructs, and then the mean score at the team level of the IS team members, the sponsors and the business managers was calculated for the success constructs. Missing sponsor data values were imputed from the project level aggregated team data. The imputation for the IS sponsor used the IS team values plus the average mean factor difference, which varied between 0.17 and 0.24. The imputation for the Business Sponsor used the team data with no adjustment. A paired t-test of each factor was conducted to validate this approach by setting $\alpha=0.05$. To further validate the data imputation for the missing values we assessed the invariance of the structural model to the data from the IS teams, and both sponsor groups (Fornell and Larcker, 1981). Differences were insignificant.

Measurement Model

The data was screened by visual assessment; missing values had been excluded as part of the on-line survey process. Surveys were assessed for flat lining, and removed where necessary. The data was checked for normality, multicollinearity, and homoscedascity using SPSS 16. Univariate and multivariate outliers were removed. Overall,

of 154 cases, 136 were used for final analysis. The measurement models were constructed using both the aggregated and the non-aggregated data. The large number of items and the use of aggregated values at the team level required that measurement models were developed for each factor, Acculturation, IS-Business Competence, Business-IS Competence, Integrative Boundary Spanning Roles, and Project Success, separately. For the non-aggregated data we could build larger measurement models, one for all the independent variables, and one for the dependent variables. Both approaches provided results that were not significantly different, yet allowed for some triangulation to validate the results of EFA.

Exploratory Factor Analysis (EFA) was conducted on the sampled maximal data set for each construct with principal axis factoring using Promax rotation with KMO > 0.5 and Bartlett < 0.05 for the data, using SPSS 16. Given the sample size of 275 (n=IS members of teams) responses and the large number of items (121) EFA was conducted first for the Independent variables of IS Competence and Acculturation, then for Business IS Competence (n=326), and then for the Dependent Variables (n=399). The EFA results demonstrated appropriate loading (>0.6), communalities (>0.4) and cross-loadings (<0.3) for the proposed factor structure and to yield the final item set. The final seven factors had acceptable reliability with Cronbach's Alpha > 0.7.

Table 4. factor Correlation Matrix

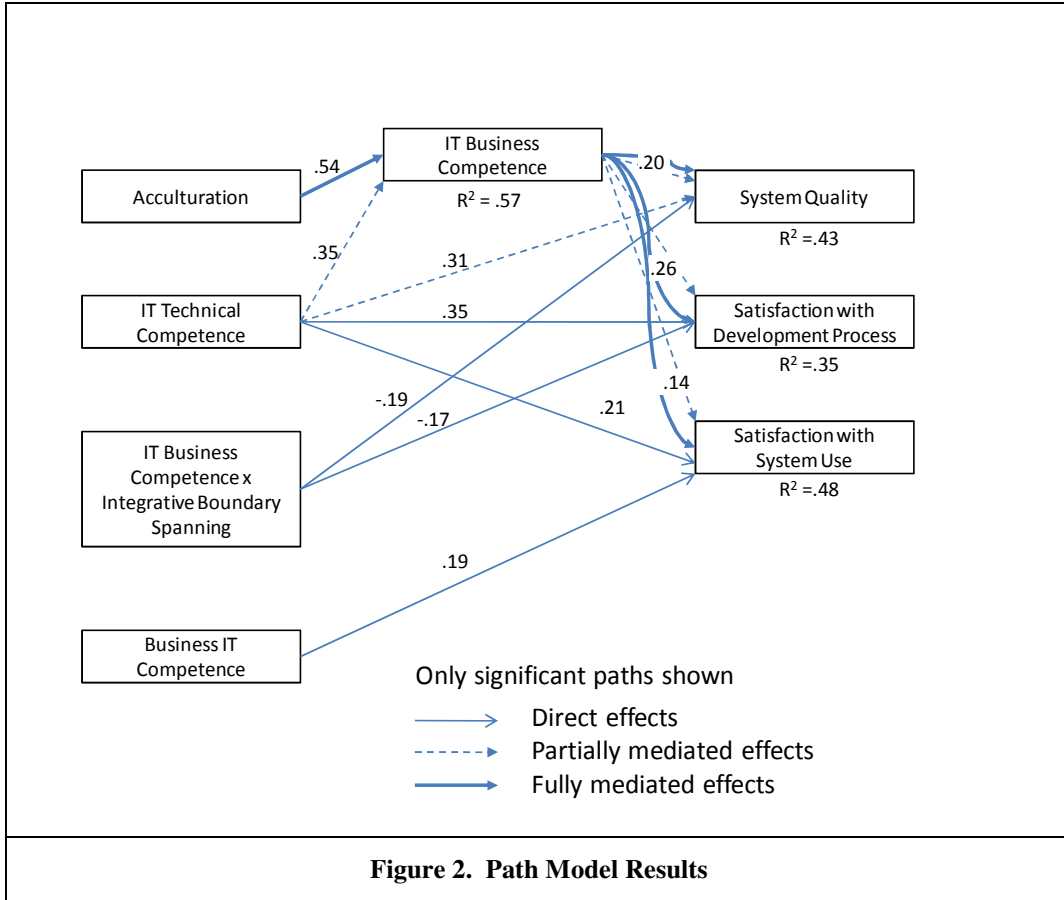
	mean	s.d.	Accult	ITBus	ITTech	BsCmp	BSInteg	DP	SQ
Acculturation	3.97	0.41							
IT-Business	4.05	0.41	-0.53						
IT-Technology	3.96	0.39	0.08	-0.26					
Business-IT Comp	3.63	0.49	-0.18	0.10	-0.27				
Integrative BS	3.99	0.34	-0.06	-0.21	-0.25	0.00			
Dev Process	4.18	0.42	-0.03	-0.14	-0.24	0.08	0.07		
Sys Quality	4.27	0.41	-0.05	0.05	-0.09	-0.04	-0.20	-0.38	
Sat Use	4.16	0.44	-0.03	-0.14	0.01	-0.24	0.05	-0.31	-0.19

Confirmatory Factor Analysis (CFA) was used (AMOS 16) to validate the initial factor structure using both aggregated (n=136) and non-aggregated (n=274) data. The non-aggregated data provided a larger sample, which permitted larger measurement models. These results were then confirmed with the aggregated data on smaller sections of the overall model. The factor loadings confirmed the theorized construct structure all factors have loading above 0.5 (Hulland, 1999) with no significant cross loadings. The overall fit of the two measurement models was reasonable, given the sample size and model complexity (Byrne 2001): Dependent Variable, CMIN/DF = 1.92, RMR = 0.013, CFI = 0.962, RMSEA = 0.083, n=136; Independent Variable, CMIN/DF = 3.1, RMR = 0.045, RMSEA = 0.088 n=274.

The reliability (composite reliability (CR) > 0.7) and convergent validity with AVE > 0.5 were good (Fornell and Larcker, 1981). Common method bias, while not expected to be a threat given the multi-source nature of the data, was assessed using the common marker approach (Podsakoff et al, 2003). It was found to be less than 0.1%.

Hypothesis Testing

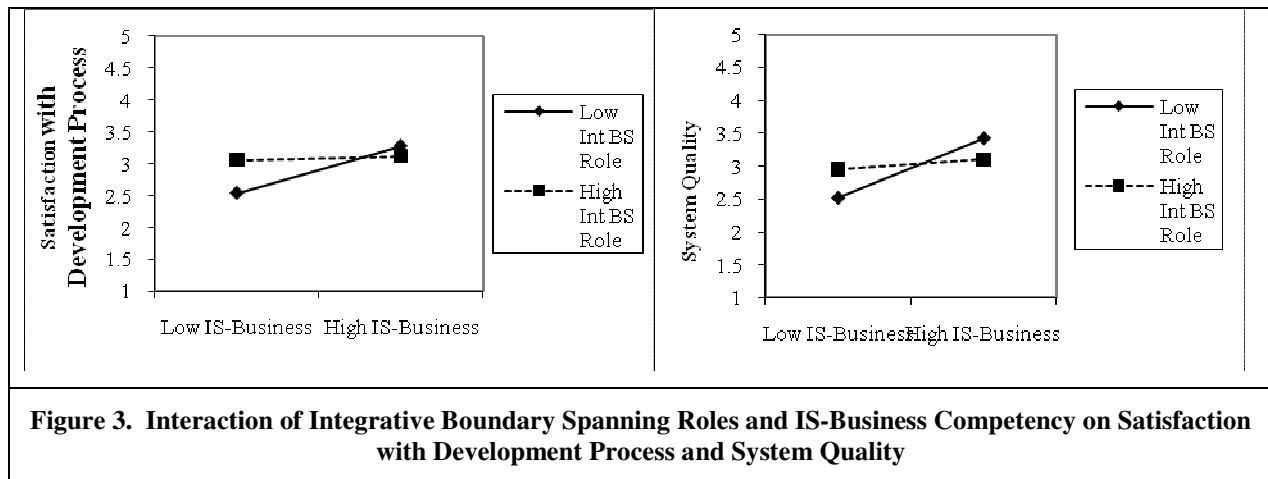
The seven factors were used to construct the structural model to test hypotheses H1-H9, including tests to detect for the presence of the hypothesized mediation, and moderation effects. We evaluated moderation (H5-H9) using interaction terms. Mediation hypotheses (H4) were tested following Baron and Kenny (1986) test. Following Preacher and Hayes, (2004) we carried out also bootstrapping test to confirm the significance of the observed mediation effects. Controls were added to the model using the variables Project Scope, Project Type, and Innovation Levels. The final structural model is shown in Figure 2(save the controls), and the detected significant effects are listed in Table 5, together with R² results derived from regression testing. The overall fit of the structural model was good, CMIN/DF = 1.67, RMR = 0.044, RMSEA = 0.071, (90% CI = 0.035 - .103, P CLOSE =0.146, n=136).



Construct Relationship			Estimate	t-statistic	P	R ²	Hypothesis
ISBus	<---	Accult	0.541	8.73	***	0.69	H4
ISBus	<---	ISTech	0.349	5.63	***	0.57	
DP	<---	ISBus	0.263	3.93	***	0.53	H1
SQ	<---	ISBus	0.199	2.37	0.018	0.43	H1
SU	<---	ISBus	0.136	1.85	0.064	0.48	H1
DP	<---	ISTech	0.35	4.40	***	0.56	H2
SQ	<---	ISTech	0.305	3.64	***	0.49	H2
SU	<---	ISTech	0.211	2.74	0.031	0.45	H2
SU	<---	BusComp	0.193	2.96	0.003	0.41	H3
DP	<---	ISBus x BSF	-0.19	-2.95	0.003		H7
SQ	<---	ISBus x BSF	-0.174	-2.86	0.004		H7
Controls							
SU	<---	PSize	-0.134	-2.04	0.042		
SU	<---	ProjType	-0.156	-2.12	0.034		
DP	<---	InfrArch	-0.149	-2.10	0.036		
DP	<---	Innov	-0.173	-2.26	0.024		
SQ	<---	Innov	-0.176	-2.176	0.03		

Findings

As hypothesized IS-Business Competence ($\beta_{ITB.DP} = 0.26$ $p < 0.001$, $R^2 = 0.53$, $\beta_{ITB.SQ} = 0.20$ $p = 0.018$, $R^2 = 0.43$, $\beta_{ITB.SU} = 0.14$ $p = 0.06$ $R^2 = 0.48$), and IS-Technical competence ($\beta_{ITT.DP} = 0.35$ $p < 0.001$, $R^2 = 0.56$, $\beta_{ITT.SQ} = 0.31$ $p < 0.001$, $R^2 = 0.49$, $\beta_{ITT.SU} = 0.21$ $p = 0.03$ $R^2 = 0.45$), had significant positive influence on all aspects of project success (**H1, H2 supported**). We did not find significant impact of Business-IS competence on System Quality or on Satisfaction with the Development Process (**H3 partially supported**), but there appears to be a significant positive impact on Satisfaction with System Use (**H3 partially supported** $\beta_{BC.SU} = 0.19$ $p = 0.003$ $R^2 = 0.41$). We suspect that this is the capability of the IS competent business members to focus better on those aspects of design that directly impact users. As hypothesized IS business competence was found to fully mediate the effect of acculturation on project success ($\beta_{ACC.DP} = 0.17$ $p = 0.003$, $\beta_{ACC.SQ} = 0.12$ $p = 0.071$, $\beta_{ACC.SU} = 0.21$ $p = 0.001$) (**H4 supported**).



In testing for the moderation effects we found mixed results. Many interaction terms had insignificant effects on the dependent variable in the context of the model. This is somewhat expected given the sample size and lack of power. However, still a number of significant interactions were identified (Figure 3), lending weak support for hypotheses involving moderation for the dependent variable (H7, H8, H9), while those involving moderation with the mediator were not supported (H5, H6). The interaction of IS-Business Competence and Integrative Boundary Spanning Roles had significant effects on System Quality (-.17, at $p < 0.05$) and Satisfaction with the Development Process (-0.19, at $p < 0.05$). These interactions as graphed in Figure 3 indicate that boundary spanning competencies have significant a substitutive effects: when the presence of integrative Boundary Spanning Roles is low, the relationships between IS-Business Competence and the dependent variables are significant and positive. When the presence of Integrative Boundary Spanning Roles is strong, this relationship is insignificant.

Discussion & Conclusion

This study is perhaps the first to explicitly link acculturation processes with IS business competence, and to examine the interplay between acculturation, boundary spanning roles, IS technical competence, IS business competence, and ISD success. In this regard our findings offer new insights into the management of IS development teams. We demonstrate that the presence of boundary spanning roles (ambassador, coordinator, and scout), is a significant factor affecting the success of IS development teams (Ancona and Caldwell 1991). In particular, integrative boundary spanning roles- ambassador, coordinator, and scout- help moderate the relationship of the accumulated IS business domain knowledge on project success. ISD teams with low levels of domain knowledge are able to mitigate this deficit by establishing strong boundary spanning behaviors that enhance the flow of information across the knowledge boundaries. Likewise, acculturative processes need to be put in place (e.g. constant team meetings, team building initiatives) so as to improve cross-domain knowledge sharing and experience. Finally, IS-Business Competence and IS-Technical Competence do, indeed, have significant direct effects on project success. Overall, our findings contribute to the literature in several ways. We extend theorizing about the role of IS business competence and its impact on project success. Prior research has applied significantly more limited measures of

acculturation with IS business competence. We were able to break these apart, and understand at more detailed level how acculturation drives the creation of business competence. Prior research has studied the role of IS business competence with regard to intentions of the business community to further engage their IS counterparts, but it has not to our knowledge been identified as a significant antecedent for project success. Another strength of this research is the large sample of involving varying types of global ISD teams, which enabled us to validate in a more generalized way a comprehensive set of knowledge based social factors affecting ISD success.

Practical Implications

The implications for practice are significant. They can be applied during all phases of the project life-cycle. Therefore, we will enumerate them in a chronological order. We demonstrate a significant relationship between IS business competence and project success - in particular, when the level of boundary spanning is low. Our primary recommendation then is for IS practicing managers to ensure that they build and maintain a steady supply of this valuable resource i.e. the IS professionals that are well versed in business knowledge while initiating the project. We also note that when level of boundary spanning is high, the value of business competent IS staff will be less critical. In contrast, when staffing projects, where IS practitioners are not familiar with the domain, erecting organizational roles and processes that will enhance boundary spanning roles, and educating team members in boundary spanning behaviors should be used to ensure that business knowledge can flow across boundaries.

A second set of recommendations concern how to orchestrate the development processes. Typical project management processes primarily measure in-cycle project execution, such as resource usage, meeting product delivery dates, etc. as to control execution risk. Few project management techniques focus on measuring the enabling social factors. Yet our research demonstrates that these explain more variance in project success. We recommend accordingly that IS managers need to establish in-process metrics that probe team competencies, and help adjust skills and roles as necessary throughout the project execution. This might take the form of training sessions, interventions with business experts, use of techniques that improve knowledge sharing etc.

Our final recommendation addresses the quality of the business relationships between IS personnel and their business partners. Ongoing interactions between IS practitioners and business representatives are essential to hone and maintain high levels of cross-functional business and IS knowledge. Outsourcing or off-shoring, especially of requirements, business process integration and so on, can be particularly detrimental to this competency building, as can high degrees of centralization of IS development. We recommend that IS managers critically evaluate which aspects of their software processes are sensitive to the impact of high degree of business knowledge and find appropriate counter-measures.

Limitations & Future Research

We recognize several limitations the study. First, measurement of satisfaction with system use with data from users, as opposed to sponsors, was not included in the study. We also recognize that the satisfaction with new capabilities is difficult to assess, as changes in the software, and user satisfaction over time is best captured through a longitudinal assessment. To mitigate against this threat we examined archival data on system satisfaction collected during yearly business assessment by the OEM, but it was not sufficient to permit an independent validation of the reported values. Second, the data was collected within a single, large global enterprise. The decision to do so was justified by the fact that we had access to *all* software development teams within that firm and these teams often had global reach. At the same time we could add controls for many elements that can confound the observed effects including incentives, development processes, competency levels, technological variation and so on. Future studies, however, should seek to generalize these results by sampling in other populations including governmental, non-profit, and other commercial sectors. Finally, we would need a larger sample size to increase the power and to detect better interaction effects.

Further work is needed to understand the role of the acculturation processes on business competence creation. Earlier qualitative research (Fisk, 2009) suggests that competence is built over a period of several years. Yet, a better understanding is needed of how this is effectively built, and deployed both during development projects, and other regular contacts between IS and their business partners. Neither did we distinguish specific IS roles during the research. Therefore further work is needed to identify which specific roles like business analysts, architects and so on who are most sensitive to the whims of the lack of business knowledge. However, as much of this business knowledge is tacit, and organizations engage in agile processes which blur the roles of IS specialists, we need to also

understand better how processes and roles interact, and potentially how different development methodologies such as agile/SCRUM operate.

Our research focused on the influence of knowledge related factors on project success. We believe that a further step is needed to further refine the relationships within this multi-dimensional construct. One additional area is to identify additional factors that can explain system quality when the level of boundary spanning is high. In this case the included social and technical competency factors accounted for only about a third of the variance. We hypothesize that the direct contribution of business domain knowledge within the team accounts for that, but other factors should be assessed as well.

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