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Acting as Translators between Consultants and Users in ERP Implementation: An Exploratory Study of Analysts' Boundary Spanning Expertise

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ABSTRACT

The collaboration between users and developers has been considered an important success factor for information system (IS) development. However, the new context of enterprise systems calls for further research in the collaboration of consultants and users when they work together to implement those commercial packages. This study introduces the concept of *boundary spanning expertise*, and examines how such expertise contributes to consultant-user collaboration during enterprise system implementations. Data analysis suggest that having overlapping knowledge, legitimate participation and interest in engaging two parties are only necessary conditions for a novice boundary spanner. To become an expert in boundary spanning, one should be able to probe and to challenge a status-quo when helping both parties overcome knowledge barriers. The study contributes to IS and project management theory by developing a domain-specific conceptualization of boundary spanning expertise. Findings of this study offer practical insights into staffing and managing cross-functional knowledge teams.

Keywords

ERP implementation, boundary spanning, expertise, analyst, project management

INTRODUCTION

In information system (IS) development projects, the collaboration between users and developers has been considered an important success factor. Prior studies in user participation suggest that users' involvement in design-related activities has a positive effect on design outcomes and IS success. The positive effect of user participation on system acceptance relies on users' psychological "buy-in" effect such as believing a new system is good, important and relevant to them (Barki and Hartwick, 1994). Moreover, it is contingent upon user participants' ability to influence development choices (Hunton and Beeler, 1997).

Implementation of enterprise systems, such as an enterprise resource planning (ERP) system, has presented a changing IS context. ERP systems are commercially developed software packages that embed standardized and integrated business processes, often referred to as "best practices" for an industry. The process of implementing such software packages can be viewed as a process of mapping and imposing those standardized processes onto the local environment of an adopting organization. Hence, the project focus has shifted from building customized applications in traditional IS development to adopting the built-in functionalities in ERP implementation (Davenport, 1998). Under these new circumstances, the "buy-in" explanations offered by traditional user participation theory become inadequate (Markus and Mao, 2004). User participation in ERP implementation does not necessarily lead to system success (Bagchi, Kanungo and Dasgupta, 2003). This missing linkage between user participation and ERP success calls for further research in the new context.

Viewing ERP implementation from knowledge perspective, prior studies have considered project participants' knowledge a significant and positive factor influencing ERP success. Extant studies have provided evidence to support the performance benefits of project participants' learning. On the one hand, client users' learning of ERP package has been found to be one critical factor for ERP implementation success (Haines and Goodhue, 2003; Ko, Kirsch and King, 2005). As an ERP package embeds those standardized business processes, it's essential for the adopting organizations to learn about those new businesses processes and their technical configurations from consultants. On the other hand, fitting a generic software package application into an adopting organization's local context requires consultants to understand the organization's information needs (Soh, Sia, Boh and Tang, 2003). To this end, extant research emphasizes consultants' learning about clients' business domains.

Although specialized knowledge and skills are valuable resources in knowledge-intensive teams, their mere presence in a team won't necessarily result in high-quality product. Different types of expertise need to be shared and coordinated in order to improve team performance (Faraj and Sproull, 2000). Similarly, bringing consultants' expertise and users' domain knowledge to an ERP design team does not necessarily lead to good design outcomes; the knowledge of both parties must be shared and applied to their joint work. Thus, having a translator between users and consultants becomes helpful to enhance their collaboration. In fact, Wagner and Piccoli (2007; p. 54) emphasized that to realized the benefits of user involvement, analysts should "develop the skills necessary to act as translators between those who do the work and those who design the software." Yet, we know little about the bridging roles in user-participated ERP implementation.

To answer the call for further research on user participation in ERP implementation (Bagchi *et al.,* 2003; Markus and Mao, 2004), this study intends to explore analysts' bridging activities across the boundary of users and of consultants. We consider these activities as boundary spanning practices, and define a practice as "a recurrent, materially bounded and situated action engaged in by members of a community" (Orlikowski, 2002; p. 256). In particular, this study will address two important questions: 1) what types of bridging practices emerge in user-participated IT projects? 2) What knowledge and skills are required to perform the bridging practices well?

Based on a case study of a multi-site ERP implementation, the paper reveals the relationships between analysts' bridging practices and cross-boundary knowledge barriers. In addition, this study suggests a variety of knowledge and skills, labeled as "boundary spanning expertise", that enable an analyst to play an effective bridging role between consultants and users in the same teams. Practical implications are offered on the development of the expertise and on the management of cross-functional knowledge teams.

The paper is organized as follows. First, it reviews theoretical background on expertise in IS development projects, and expertise in cross-functional product development. Then it describes the research method, including data collection, coding and analysis. Results are presented with supporting evidences from interviews and archived documents. Finally, the paper concludes with implications and direction for future research.

TOWARD A THEORY OF BOUDNARY SPANNING EXPERTISE

Expertise in Information System Development

IS research has emphasized developers' technical skills in information system development. For example, good programming skills are believed to improve software program quality (Brooks, 1995). Recently, IT industry begins to highlight an IS personnel's non-technical skills, such as communication and interpersonal skills. These non-technical skills enable an IS professional to understand users' business domain and to deliver effective solutions to IS use problems in organizations (Gallagher, Kaiser, Simon, Beath, and Goles, 2010). Thus, the variety of skills, technical and non-technical, constitutes an IS professional's expertise in information system development.

Moreover, studies in the information system field have also identified domain knowledge as a critical component of IS development expertise. For example, expertise of software operations support is built upon individuals' IS related knowledge and skills in hardware, software, system-specific and IT environment (Nelson, Nadkarni, Narayanan and Ghods, 2000). When performing information requirements tasks, an expert analyst is characterized by his strong problem-solving skills and breadth of knowledge with regard to the field of requirements collection and analysis (Schenk, Vitalari and Davis, 1998). Given the importance of domain for IS professionals, we take the domain-specific view of expertise in this study, and adopt the definition that an expert is someone displaying special skills or knowledge in a specific domain based on training or experience (Shanteau and Stewart, 1992).

Unlike those system analysts who interact directly with users in traditional IS development, analysts in an ERP implementation interact with two stakeholders, consultants and users, and facilitate their collaborations. On the one hand, the contextual specificity within an adopting organization makes it difficult for an off-the-shelf software package like ERP to be compatible with local business processes (Wagner and Newell, 2004). This challenges consultants to learn about clients' unique business domains. On the other hand, assimilation of those generic business practices embedded in an ERP package has become one big challenge to organizational end-users (Robey, Ross, Soh and Boudreau, 2002). This high degree of asymmetry of user and consultant's knowledge has been evidenced in prior ERP studies (e.g., Ko *et al*., 2005). Therefore, analysts in consultant-user teams find themselves at an important position to bridge those different stakeholders in the same project teams.

Cross-Functional Product Development and Boundary Spanners

Product development often draws expertise across different professional fields so as to develop innovative new products. For example, organizations that successfully engage engineers and marketing specialists in relating their practices of these fields are able to develop a knowledge-based competence in product development (Carlile, 2002; Dougherty, 1992). However, challenges arise in communicating and transforming different kinds of knowledge. A study of new product development across four functional areas (sales/marketing, design engineering, manufacturing engineering, and production) identified three types of knowledge boundaries that impacted the working across the four communities (Carlile, 2002). First they speak different languages and use different syntax, establishing a *syntactic knowledge boundary*. Second, they differ in their understanding and interpretation of meanings, which constitutes a *semantic knowledge boundary*. Last, the first two boundaries of knowledge and their mutual dependencies in joint task can cause negative consequences, representing a *pragmatic knowledge boundary*.

To improve communication and information processing across functional boundaries, prior research has suggested using boundary spanners as a bridge to link two groups. The boundary spanner is a third party with an overlapping knowledge between two communities, helping to establish a shared syntax and mutual understanding across the boundary. Brown and Duguid (1998) used the term of knowledge broker to describe people participating in multiple communities and facilitating the transfer of knowledge among them. Similarly, Wenger (1998; p. 109) highlighted the unique position of brokers "who provide connections between communities of practice,.**"** The conceptualization suggests that these boundary spanners are situated between two communities, engaging in activities to facilitate and coordinate the communication and information flows between the two communities. One example of spanning practice is translating, a process which involves framing the elements of one user group's view in terms of another's view (Pawlowski and Robey, 2004).

In ERP implementations, projects focus on identifying and resolving "*misalignments*", which are the differences between the standard capabilities offered by the commercial package and those information needs required by an adopting organization (Soh *et al*., 2003). As reflected in Figure 1, both consultants and users bring their own knowledge (about ERP system vs. business domains) to the project team. However, they need to exchange their respective knowledge when discussing and determining requirements decisions. It is very likely that they will experience various knowledge barriers during their joint work. Analysts are positioned between consultants and users to facilitate their collaboration.

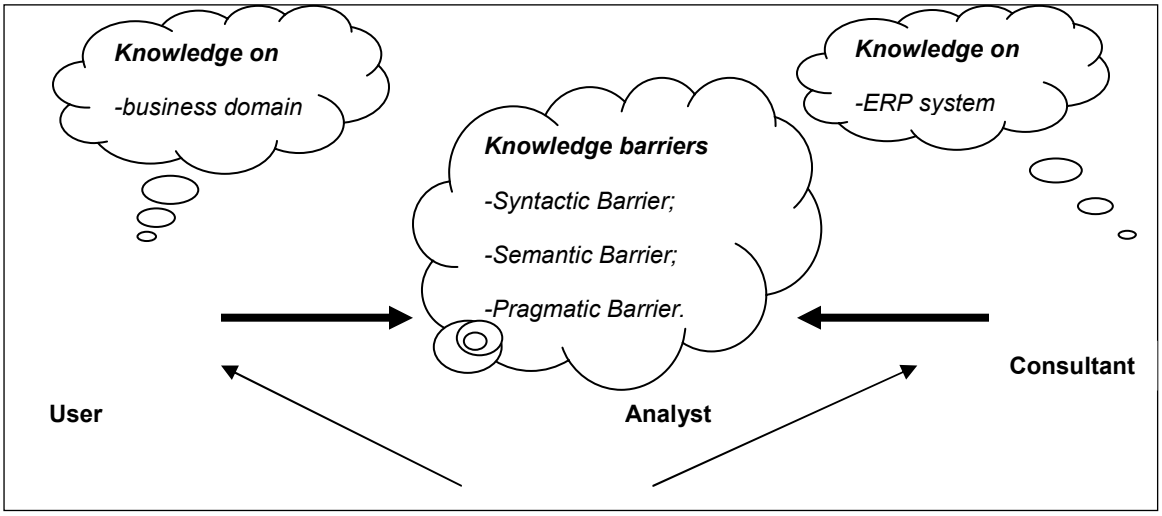

Figure 1. Conceptual Framework for Understanding Boundary Spanner Roles by Analysts

Figure 1 summarizes the conceptual framework of the study. Drawing upon the categorization of knowledge boundaries, this qualitative study focuses on identifying analysts' bridging activities and skills emergent in user-consultant collaboration.

RESEARCH METHOD

The objective of this study is to explore boundary spanning expertise and its applications in enterprise system implementation. ERP implementation is a complex process involving multiple stakeholders and integrating business processes of multiple groups. Given the complexity and magnitude of the enterprise system, it is appropriate to use case study methodology to investigate the "*how*" question (Yin, 1994). Additionally, Curtis and colleagues pointed out (1988; p.1269), "since large software systems are still generated by humans rather than machines, their creation must be analyzed as a behavioral process." This study used three data sources – observations, archived documents, and interviews to increase the reliability of the qualitative data and to strengthen the results. Details on the research site, data collection and analysis are presented below.

Research Site and Data Collection

GiantOrg (a pseudonym) is a large private enterprise located in the northeastern region of the United States. Under its enterprise umbrella are four institutions ---Hospital A, Hospital B, the University, and the College --- which employ about 40,000 employees in total. GiantOrg started a $200 million implementation project of an enterprise system SAP/R3 in 2003 and completed it in 2007. This study reported here focuses on the 12-month period between March 2004 and February 2005, spanning three project phases: requirements analysis, conceptual design and functional design.

Four functional teams were set up to implement four modules respectively from SAP/R3: Human Resources/Payroll (HR/Payroll), Finance, Supply Chain and Sponsored Projects. Under each functional team, there were multiple design teams, with each focusing on one specific business area. For example, the HR/Payroll functional team had five design teams, specializing in payroll, benefits management, personnel management, time management and organizational management respectively. Each team consisted of consultants, analysts, and user representatives (referred to as "users"). Both analysts and users were selected from the four institutions, but they differed in their job responsibilities and level of participation in the project. Analysts were mostly experienced managers hired to work in the project team as full-time staff, while users were mainly representatives carefully chosen from each business area to participate in the ERP requirements analysis and design.

Data was collected from three sources, including observations, interviews, and archival documents. First, the author spent eight hours a day on site to observe requirements sessions of four teams (Benefits, Organization Management, Payroll, and Internal Costing) under two modules (Finance and HR/Payroll), wrote field notes during the observations and supplemented the notes afterwards. The observations occurred in June and July of 2004 during requirements analysis and conceptual design, and in October of 2004 during functional design. In addition to the full-day observations, the author also sat in team meetings. Second, the author had access to electronic copies of teams' meeting notes and design documents. Last, the author conducted semi-structured interviews in November 2004 with members of two design teams, including analysts, consultants, and users. The author asked them open-ended questions about their experience with those requirements and design sessions and their evaluation of the analysts in the teams. In total, the author conducted 11 day-long observations and 9 interviews, and reviewed 40 archived documents. The different types and sources of data help improve the response coverage and reliability of the qualitative data (Yin, 1994).

Data Coding and Analysis

In compiling and analyzing data, the author followed Miles and Huberman's (1994) suggestions about using conceptual framework and research questions. Thus, the study started from the general research questions on the types of bridging practices and required skills to the refined questions of "What are the major types of knowledge barriers between consultants and users?", "How does an analyst help overcome the cross-boundary barriers?"

Data analysis was conducted iteratively between examination of data and development of theoretical interpretations. This practice enabled the author to discover categories and patterns in the data. When all observations and interviews were completed, the author did a more detailed coding of the qualitative data to reflect themes identified from prior literature and emerged from the initial analysis. Matrices were used to display and analyze field data (*refer to the sample matrix in the appendix*).

RESULTS

Stage 1: Analysts' Translation and Illustration Practices

GiantOrg's project management wanted to foster a knowledge transfer between consultants and GiantOrg's internal staff. Hence, they recruited experienced business managers to work full-time in the project time and user representatives from each functional team to participate in the requirements analysis and design. The project director explained in March 2004 that, "It (knowledge transfer) will be from consultants to internal staff, since the consultants have experience in health care and academic setting, and are expected to transfer the 'best practices' to the client users."

Consultants and users met for the first time at requirements sessions during June and July of 2004. During this period, each consultant-user design team held intensive 3-day or 4-day requirements sessions to share knowledge on current business processes (referred to as "AS-IS") at GiantOrg and on SAP capabilities. At this initial stage, both consultants and users openly admitted their lack of knowledge about the other domain. For example, consultants made the remarks at the beginning, "My role (at this requirements session) is to bring ERP functionality to you. I have little knowledge about GiantOrg's environment." On the other hand, users were selected to participate in the project based on their functional expertise. Therefore, when both met to discuss system requirements, it was users' first opportunity to learn about the SAP/R3 product.

At this initial stage, consultants and users were experiencing a syntactic barrier caused by jargons and terminologies from two different knowledge domains. As a result, analysts often performed the common practice of translating the SAP jargons and terminologies for users. For example, when presenting key features in SAP's Human Resource (HR) module, consultants used the term "Internal Orders" repeatedly, confusing users at the meeting. The analyst then made the translation that "Internal Orders" in SAP equals to "Internal Service Requests (ISR)", such as creating a new position at GiantOrg. To aid their translation activities, analysts also illustrated terms with examples and demos. For example, the analyst at a payroll wage deduction session used a demo to highlight the different tax consequences between loan and payroll advance. B*y* engaging in these translation and illustration activities, an analyst demonstrated his initial cross-boundary bridging expertise.

Stage 2: Analysts Helping Both Parties Develop a Shared Interpretation Scheme

Sometimes even when both parties thought they understood the definition of a terminology, they might interpret it differently, due to a specific organizational context. For example, when the organization management team was discussing two concepts, "Job" and "Position", users thought that they understood these two concepts, as they had been used interchangeably in GiantOrg. However, as soon as the consultant started to introduce the term of "one-to-many" relationship between "Job" and "Position", users got confused. To clarify users' confusion, the analysts at the meeting used an example of "Nurse" job in Emergency Room (ER) and in Intensive Care Unit (ICU) to explain why individually each is considered as "Position", and collectively they fall under the job category "Nurse".

As evidenced in the case above, users and consultants interpreted a terminology differently. Relying on context-specific examples which users could easily relate to, the analyst successfully assisted the users by clarifying their understanding of a SAP capability. Analysts adopted this practice, and explained that "It's important (for users) to understand what capability SAP has, not just 'SAP speak' (terminology)."

Different interpretations of a technical capability (semantic barrier) often became the source of users' frustrations during the requirements discussions. For example, at a Finance design team's requirements meeting, one user was asking the consultant for SAP's dynamic budgeting reports, but the consultant directed the user to SAP's Business Warehouse module for annual summary reports for budgeting comparison. The analyst realized that different interpretations of "Budgeting" might exist between the consultant and the user. Since the analyst understood that FM (Funds Management) module in SAP might be sufficient to meet the user's information needs, she requested the consultant to elaborate on SAP's FM capability for the users' benefit. This probing practice helped the consultant and the user to reach same interpretation about SAP's budgeting functionality. In this case, the analyst' cross-boundary expertise was enhanced by the ability to build a common interpretation scheme.

Analysts' effort to probe for further information and to build a common scheme was also evidenced at HR benefit management meeting during the functional design phase, when those approved "TO-BE" processes were mapped to SAP functionalities. Analysts were found helping consultants understand why "Option Nurse", temporary employees who work 20 hours per week, should be assigned to full-time category for benefits. That incident reflects an organizational idiosyncrasy in managing employee benefits.

Stage 3: Analysts Challenging Both Parties beyond Their Comfort Zones

Compared to the requirements discussions, analysts found it more challenging to facilitate design sessions, during which the consultant-user teams were discussing and determining the business processes to be supported by SAP ("TO-BE"). Users not only needed to decide a common business process across various business units, but also were expected to recommend a "custom-built" function or an adoption of SAP functionality.

Within the SAP system, design decisions made for one functional area (e.g., HR/Payroll) may affect the work flows under another area (e.g., Finance). For example, when HR's organization management team was discussing a HR module workflow related to grant-funded positions, the sponsored project team wanted to ensure that they had the ability to encumber grant dollars by position, and to move grant dollars easily from salaries to travel. Likewise, the finance team required the ability to move allocated dollars to a different position than the position originally planned. In this case, decisions made for Human Resource (HR) module would affect related business processes under finance and sponsored project team. Participants' lack of knowledge on the consequences of design decision may hinder their progress in making design recommendations.

One effective bridging practice by analysts during this phase was challenging users' assumptions, such as asking users "How" and "Why" questions about a current process, such as "Why are you doing it in that way?" "How would you like to see them (processes) come up in the new system?" By deliberately asking users "*why*" questions, analysts helped users uncover the pre-conditions of their existing business practices and discover more opportunities for business process improvement. For example, analysts' probing questions led users to reflect on their daily routines, and to become forward-thinking when making design recommendations. One user from the HR/Benefits team made the remark, "The process provides us a lot of opportunities for us to fix the problem, such as using automatic flags from SAP system for tracking time of part-timers."

This challenging practice also made consultants to reflect on the assumptions of SAP design features while helping consultants understand the localized context of a business process. For example, when discussing the list of reports on employee dependents' benefits, the analyst brought to the team's attention the two types of marriage partners --- spouse and same domestic partner --- differentiated in GiantOrg's Human resource policy, and challenged consultants if SAP functionality was sufficient to capture different tax consequences if these two types were combined as one dependent type. Under this circumstance, a pragmatic knowledge barrier arose in the consultant-user discussion. In overcoming the pragmatic barrier, the analyst needed to help both parties envision how a system feature would affect the organization's work practice post-implementation.

However, when an analyst lacked the knowledge and capability to challenge existing status quo and to portray the potential consequence of an issue, the pragmatic knowledge barrier remained intact. This was observed in one of the Payroll Wage Deduction meeting, when consultants and users had difficulty to reach a common understanding about flexible benefits refunding. As a result, the discussion of that issue was postponed.

DISCUSSION

This section will first discuss how analysts demonstrated their boundary spanning practices initially. Then, it examines how some analysts developed into an expert spanner while others remained as a novice.

Analysts' Initial Boundary Spanning Practice

The project management hired experienced managers internally to the position of "analysts", and specified in the job description that analysts facilitate the requirements analysis and design at the consultant-user design teams. Therefore, those analysts were aware of their expected role in connecting the two groups (consultants vs. users) during the requirements and design phase. Meanwhile, they were aware of one obvious challenge in performing the role: knowledge asymmetry between users and consultants. However, analysts' interpretation of "bridging" role seemed to be limited to the practice of "translation" and "interpretation". When asked about how to facilitate the sessions, one analyst explained, "I want to make sure that they (users) know what the consultants are saying. For example, "infotype" is the SAP terminology, but users may interpret it differently from consultants. …My job is to interpret the organizational business processes to the consultants."

In order to achieve this level of boundary spanning practice, analysts needed to be conversant in both languages. Analysts hired into the SAP project brought with them in-depth knowledge not only about their business functions (e.g., payroll, supply chain, or grant management) but also about this organization's culture. As one of consultants for HR/Payroll team explained, "We have domain experts in the team (e.g. John with 15 years at one organization, and Mary with 30 years at another); they have the experience and same background with the user participants, who can comfortably relate to John and Mary." After being hired, each analyst was provided several opportunities to learn about SAP, including SAP training offered by specialists from the software vendor SAP, having a consultant mentor, attending SAP training off-site. With overlapping knowledge in both business and SAP system, analysts were positioned advantageously between the two worlds of users and consultants.

As evidenced in this study, having overlapping knowledge of both parties' domains (SAP module vs. business functions) constitutes one necessary condition for analysts to play their "bridging" roles. A prior study on IT development and use (Levina and Vaast, 2005) echoed this message, and explained that boundary spanning "requires the development of, at the vest least, a peripheral understanding of each practice" (p.353). In addition, the analysts in this study were legitimate participants of the project and had invested interests in achieving good team performance. In short, analysts have developed the elementary ability to perform the basic boundary spanner role. This ability had been evidenced in their initial boundary spanning practices, such as translating SAP technical jargons and illustrating GiantOrg's existing business rules.

Became an Expert Boundary Spanner

However, it was not until the design phase where a boundary spanning expert became distinguished from a novice. Although analysts demonstrated their proficiency in helping consultants and users overcome syntactic and semantic knowledge barriers, it was an analyst's capability to challenge each party's assumptions and to analyze the potential consequences of a system design decision that promoted an analyst from a novice to an expert in boundary spanning.

Packaged ERP systems are commercially designed to fit generic rather than specific requirements, making them unlikely to be a perfect fit in any particular organization (Soh et al. 2003; Wagner and Newell 2004). Hence, when consultants and users worked together to identify business processes for one of the two options, e.g., adopting SAP standard functionality or custom-building an organization's unique process, they were expected to move away from their own domain and to embrace the new features from the other side. This appeared to be difficult for both stakeholders. To the analysts, users were "not forward thinking" or "not good at raising new requirements," while consultants just focused on introducing SAP system functionalities to GiantOrg's users.

One effective practice by analysts was to challenge each party's pre-assumptions about their own fields and to become forward-thinking. In one example, the finance analysts challenged the internal costing transfer procedure in SAP. In another example, the Benefits analyst questioned the SAP capability to differentiate same sex partner and tax consequence. In both cases, consultants and users were made to reflect on their own domain and to relate their own business process to that of the other party. To ensure that a design decision to adopt or custom-build was truly comprehended by participating users, analyst sought ways to portray a picture of a potential consequence of the design decision. For example, finance analyst explained to users the budgeting basis of accounting and the FM module in SAP, and concluded with a confirming question, "Is that what you wanted from the new system?"

Building Capabilities to Became an Expert Boundary Spanner

To become an expert in boundary spanning, analysts believed that they could benefit from their enhanced SAP knowledge, as one analyst explained, "One challenge is that I don't know SAP as I hope to know." One common message from the interviews with the analysts is that more and earlier SAP training would allow them to better explain to SAP functionalities to users, facilitating user-consultant discussions. Similarly, observation of requirements meetings shows that analysts who were confident in their SAP knowledge were more effective in their knowledge bridging practice. Another contributing factor to developing boundary spanning expertise lies in one's ability to learn from consultant-user interactions, and to apply their acquired knowledge to a new problem. Learning, the process of acquiring knowledge and developing skills, has been become critical to those knowledge workers' productivity. As Ellis (1965) explains, individuals' learning not only demonstrates the transfer of content knowledge (gained from working in previous unit) to a new unit of tasks, but also reflects their enhanced learning ability, or the ability to assimilate or process acquired information and knowledge to a new and different problem domain.

Overall, data analysis in this study shows that boundary spanning expertise is not only consisting of overlapping knowledge, legitimate role, and interest to relate one field to other (Levina and Vaast, 2005), but also related to domain-specific context and nature of problems (e.g., type of knowledge barriers). This is consistent with the findings of a prior study on software maintenance expertise (Nelson et al., 2000). As illustrated in the "Results" section, three types of knowledge barriers emerged during the project phases of requirements analysis and design, and the analysts applied different bridging practices accordingly. The practice of translating each others 'terms and viewpoints had been found helpful during the initial stage of requirements analysis when both users and consultants experienced *syntactic* knowledge barriers. When *semantic* barriers arose, analysts offered illustrative context-specific examples and contributed to the development of a shared interpretative scheme among users and consultants. Finally, when *pragmatic* barriers emerged, such as users or consultants were unaware of or ignorant of the potential consequences of adopting a new business process, an analyst challenged their assumptions, and relied on his knowledge about both domains to describe the potential impact of a new process on the implementing organization. An analyst's expertise in spanning the boundary is evidenced from his ability to adapt bridging practice to problems on hand, and to develop a learning ability as he made progress in boundary spanning.

IMPLICATIONS AND CONCLUSION

In summary, this qualitative case study used multiple data sources and examined the demonstration and development of boundary spanning expertise in user-participated project teams. Findings of this study make both theoretical and practical contributions to information system development and project management. Data analysis in this study show that expert boundary spanners distinguished themselves from novice in their breadth of knowledge overlapping two fields and their capability to challenge each field's status-quo. The findings enhance our understanding of boundary spanning in information system field (Levina and Vaast, 2005) by suggesting the different levels of expertise in boundary spanning.

As the study relied on data from one organization, the organizational context may impose constraints on the research findings, and potentially limit the generalizability of the results. A fruitful study in the future can use a large-scale survey instrument, incorporating the qualitative insights from this study. Limitations notwithstanding, this study used multiple data source and conducted in-depth data analysis to enhance our understanding of a domain-dependent phenomenon. Findings of this study can be applied to other cross-functional knowledge-intensive teams, such as consulting teams or new product design teams, when boundary spanners play an important role in coordinating diverse knowledge domains. Finding of this study also suggests that organizations should consider factors beyond functional knowledge and organizational tenure when recruiting a boundary spanner. In the long term, organizations should invest resources on developing their employees' learning and absorptive capacity (Ellis, 1965), enhancing the overall human capital of the firm.

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Appendix

Project Team / Topic	Knowledge Barrier	Illustration	Boundary Spanning Practice
Payroll/Wage Deduction (observation on 10/18/2004)	Syntactic	Payroll deduction codes for wage deductions	translating
	Semantic	Different tax consequence between loan and payroll advance	Illustrating and probing by analyst
	Pragmatic	Different approaches to treat Flexible benefits refund: negative deduction by hospital and positive contribution by the University. Confusions about how SAP will handle it as credit or employee contribution.	No boundary spanning; Analyst lack of knowledge about the workflow between payroll and benefits
HR/Benefits Management (observation on 10/25/2004)	Syntactic	Different definition of full-time employees across the four institutions	Translating
	Semantic barrier	Relationship between employee category (full-time vs. temporary) and eligibility for full-time benefits, e.g., option nurse who work 20 hours/per week, but enjoy full-time benefits rate.	Probing by analyst
	Pragmatic	Implication of combing "spouse" and "Same Sex Domestic Partner" under one dependent type in SAP. Different tax consequences	Challenging assumptions by analyst

Table 1. Sample Matrix of Knowledge Barriers and Boundary Spanning Practices