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ABSTRACT

This paper examines knowledge sharing in a cross-cultural context. We draw on a field study of a Jamaican-Indian software team to unpack how the system specification (spec) and formal coordination affected knowledge sharing and team performance. Our theoretical approach uses Polanyi's theory of knowledge as processes of sense reading and sense giving, and recent developments in boundary theory to unearth how differences and conflict adversely affected knowledge sharing. We found that during the software development process, the spec shifted from being a flexible boundary object to a rigid shared object, and this influenced the emerging dynamics of inter-occupational conflict. Our study also highlights how increased formal coordination adversely affected boundary permeability, which led to a decrease in knowledge sharing activity. We suggest that a process of *culturizing*, or politicization of cultural boundaries, was integral to the subsequent hardening of boundaries which significantly impaired the knowledge sharing process and consequently team performance.

Keywords:

Knowledge sharing, cross-cultural teams, boundary objects

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INTRODUCTION

The knowledge management literature has highlighted the important linkage between knowledge and competitive advantage at the firm level, yet there is less known about the relationship between knowledge sharing and software team performance, which earlier work identified as an important link (Walz et.al. 1993, Krant and Streeter 1995). In this vein, Faraj and Sproull (2000) have suggested that expertise, as specialized knowledge, is the most critical resource for software development teams, which must be coordinated to leverage its potential. Their study demonstrates a strong relationship between expertise coordination and team performance, which remains significant over and above administrative coordination focused on tangible and formal project management methodologies.

Given the recent trends for software teams to be working in a cross cultural environment, often using outsourcing or insourcing work strategies, there is also a growing need to examine knowledge sharing activity in a cross- cultural context (Holden 2001, Peltokorpi 2006). Our field study examines how a cross-cultural software team of Indian programmers and Jamaican analysts develop a general insurance system for a Jamaican financial conglomerate. We unpack the knowledge sharing processes, and the coordination of the team to understand the micro-processes of the conflict, which led to the breakdown of the team dynamics. We adopt a knowledge sharing focus (Osterlund and Carlile 2005) and draw on Polanyi's (1969) theoretical ideas of sense-giving and sense-reading to address our research question: 'How does the

specification and formal coordination practices affect knowledge sharing in culturally diverse software teams?'

Our research highlights that the balance and interaction between expertise and administrative coordination needs to be managed for effective team performance. For example, as project deadlines and Gantt charts were given increasing priority, the role of the software specification (spec) as a key artifact mediating relations between the different occupational groups (MIS analysts programmer developers) shifted from being a flexible boundary object to a rigid shared object. In this way our study adds to recent work on the dynamics of inter-occupational conflict emerging from the groups' use and representation of the spec as a workplace artifact (Bechky 2003). We examine how the inter-occupational dynamics affects, and is affected by, the changing ability of artifacts to act as boundary objects. This paper also contributes to the literature on knowledge sharing in cross-cultural teams by drawing on boundary theory (Lamont and Molnar 2002) to unearth how differences and conflict adversely affected knowledge sharing. Initially, knowledge sharing, facilitated by 'sense reading' and 'sense giving' processes (Polanyi 1969) and a permeable boundary, successfully bridged social boundaries. However, as formal coordination increased, knowledge sharing decreased and this adversely affecting boundary permeability. Hardening of the boundaries led to labeling and stereotyping and a vicious cycle of politicizing reduced knowledge sharing and team performance.

PERSPECTIVES ON COORDINATION AND KNOWLEDGE SHARING

In this section, we start by briefly reviewing the literature on coordination and knowledge sharing within software teams, which are becoming culturally more diverse in a global context.

We then discuss briefly the growing literature on knowledge sharing across boundaries at the organizational level. We conclude by draw on a processual, dynamic view of knowledge sharing processes, which recognizes boundary objects and the boundary work of software team members.

Coordination in Culturally Diverse Software Teams

Software development teams are difficult to coordinate and manage effectively (Levina 2005, Guinan et al 1998, Faraj and Sproull 2000). Faraj and Sproull (2000) argue that two types of coordination are needed to organize software development teams, namely, administrative coordination and expertise coordination. Administrative coordination (Kraut and Streeter 1995, Van de Ven et al 1976) involves the formal management and linking together of the different parts of the software development group to achieve explicitly recognized goals and collective tasks. This involves organizing formal structures, such as regular project meetings and milestone schedules, to ensure that resources are managed and routine outputs integrated. In their survey of 65 software projects, Kraut and Streeter (1995) also highlight the importance of informal mechanisms of coordination amongst project members of software teams in coping with technical and managerial problems.

Alongside administrative coordination, Faraj and Sproull (2000) argue that expertise coordination, defined as coordinating 'the special skills and knowledge that an individual brings to the team's tasks', needs to be considered separately and managed effectively in order to leverage the team's potential. They highlight that members' knowledgeability is the team's primary resource and suggest that managing intellectual dependencies and interactions is vital during the complex, non-routine intellectual tasks being performed during software development.

Their study demonstrates a strong relationship between expertise coordination and team performance.

Expertise coordination involving knowledge sharing in culturally diverse software teams becomes increasingly important as the complexity of software development grows (Levina 2005) and the cross-cultural diversity of software teams becomes more routine in a globalizing marketplace. The key focus of IS literature on cross cultural teams has highlighted national cultural differences (Barrett, Drummond, and Sahay 1996, Walsham 2002) as a key source of conflict that can negatively affect team performance. These studies have shown how knowledgeable actors in their practices draw on national and occupational culture, which may lead to contradiction and conflict (Walsham 2002). However, there is a need for further research on teams that focuses on knowledge sharing in a cross-cultural context (Holden 2001, Ford and Chan 2003).

The Role of Boundary Objects for Knowledge Sharing in Complex Organizations

We move from our discussion of knowledge and expertise coordination in software teams to the wider literature of knowledge sharing in complex organizations. In this literature, a particular recent focus has been on the role of boundary objects (Star and Greismer 1989) to address difficulties in the coordination and knowledge 'transfer' or 'transformation' across boundaries of different occupational communities (Carlile 2004, Bechky 2003). These challenges can develop for a number of reasons. Incompatible routine can result in problems of syntax (Carlile 2004). Alternatively, coordination challenges can arise due to differences in assumptions of occupational groups (Bechky 2003). Thirdly, coordination and knowledge sharing can be

difficult for political reasons. Occupational members invest in specific know-how and there is therefore a lot at stake for members when they engage in cross-boundary knowledge sharing. Boundary objects, defined as 'objects that are plastic enough to adapt to local needs and constraints of the several parties employing them, yet robust enough to maintain a common identity' (Star 1989 p 393), have the inherent flexibility needed to allow individuals to learn about each others' differences and dependencies as well as creating a 'common ground' (Bechky 2003). This facilitates a process of transforming localized knowledge into novel jointly produced knowledge that transcends each community's interests (Yanow 2003) and enables coordination of work across occupational boundaries.

A number of boundary objects have been studied (Briers and Chua 2001, Carlile 2002, Yakura 2002) adding to our understanding of distinctions amongst boundary objects. For example Briers and Chua (2001) distinguish between visionary boundary objects, which are conceptual in nature (eg organizational 'best practices') and ideal boundary objects, while Carlile (2002) and Bechky (2003) emphasize the importance of concrete boundary objects. Yakura (2002) in her analysis of timelines during the implementation of information systems gives a compelling analysis of how graphical representations of temporal units operates as a boundary object that remains abstract in use yet able to reconcile diverse temporal arrangements.

Recently, it has been pointed out that our concept of boundary objects has maintained a static approach to these objects, assuming a constant role and a relatively stable environment (Levina and Vaast 2005, Gal et al 2004). Going beyond a discussion about the properties of boundary objects, Levina and Vaast (2005) distinguish between 'designated boundary objects' and 'boundary objects in use' in examining how boundary objects emerge in practice during the

development of an information system. In other work, Gal and colleagues (2004), drawing on a 3 year interview based study of modeling technologies, highlight the importance of the interplay between social communities and identities with boundary objects. They argue that, in addition to serving as translation device to overcome informational differences, boundary objects are 'used as a resource to form social identities' (pp 196) in a relational process. We contribute to this dynamic understanding of boundary objects by investigating their role in the coordination and sharing of knowledge over time during software development in a culturally diverse team. As coordination practices change, the plasticity of the specification changes so that the boundary object becomes rigid, the boundaries are rendered less permeable, and the knowledge sharing more problematic. This led to increasing focus on the salient social identities and the more marked boundaries within the team, leading to 'culturizing' and further hampering knowledge sharing.

Conceptual Approach

Our theoretical perspective draws on Polanyi's (1968), 'tacit power' which undergirds the deep tacit knowledge held about the world which is 'the outcome of an individual's active shaping of experience' and draws from individual values and dispositions.

As developed by Polanyi, people derive meaning and communicate their understanding through tacit integration of multiple conflicting clues in processes of what he terms *sense-reading* and *sense-giving.* These involve attending from words or external events to what they mean through 'interiorized' delicate integrations (1968, p184). Polanyi illustrates these processes using the example of a person traveling in a novel country and reports about his trip in a letter to a friend. The traveller first develops an intelligent understanding of the sights, sounds, smells, and events.

Polanyi describes this as *reading* an interpretation of the experience, thus '*sense-reading*'. The traveler then *gives* sense to the experience by articulating a written account of its meaning. When the friend back home receives the letter, she needs to interpret this account to reproduce the reported experience, while drawing on her own knowledge of her friend and the country visited in another sequence of sense-reading.

Similarly, in IS development, analysts go through a sense-reading process in understanding client-user needs for an information system and then explicitly articulate this knowledge in a sense-giving process through writing a specification (spec). These processes repeat themselves when programmers then code a system from the spec. Those programmers who draw tacitly from different work practices and industry experiences will arrive at different interpretations of the spec's meaning. Thus a part of a programmer's knowledge is not just in the spec, but also in understanding how to use the spec in practice and involving users in system development. These components of tacit knowing are central to making the explicit knowledge encoded on the spec actionable (Walsham 2001) as tacit knowing lends meaning to explicit knowing and controls its uses (Polanyi 1968, pp156). It is also provides a basis for the interpretive flexibility of boundary objects and its ability to being plastic in use.

We draw on sense-reading and sense-giving to inform our study theoretically on the micro process of constructing and sharing knowledge as we examine the diverse ways that members of our ISD team viewed and engaged with the spec, a key boundary object in our study, over the course of the development process. As a coordinating element between diverse team members, and central to the development of team knowledgeability, the spec's dynamic role

within IS development, remains largely under-examined in understanding issues of knowledge sharing that may affect team performance. In our culturally diverse context, the changing focus on deadlines and temporal artifacts led to decreased boundary permeability and concomitant stereotyping of national and occupational groups. We develop the term 'culturizing' which politicizes the boundaries as *being* cross-cultural. This builds on Gal, Yoo and Boland's (2004) dynamic view of the role and use of boundary objects in technology development. Our study also has important implications for the coordination of expert knowledge particularly within a cross-cultural context.

RESEARCH METHODOLOGY

Data Collection

Case studies are the preferred research strategy for a process study when an in-depth understanding of phenomena in the IS field is needed (Klein and Myers 1999, Walsham 1995). We conducted a 2 yr longitudinal case study across three phases to examine the following question: How does the spec facilitate knowledge sharing and conflict in culturally diverse software teams?

In the first phase of the study, we focused on the macro level context of the global reinsurance crisis and the sectoral initiatives around geographical information systems (GIS) and hazard mapping between 1993-2000. We drew on a numbers of secondary sources collected from sectoral studies, trade journals and local newspapers. In addition, twelve interviews were held with the Insurance College of Jamaica, the regional housing and urban development office, and insurance companies leading sectoral GIS efforts.

Data collection at the organizational level started at the end of the first phase when access was negotiated through the chairman of JAMSURE. Our analysis of the initial set of interviews highlighted key themes concerning the challenges of the cross-cultural software team in developing the general insurance system. In total, forty two interviews were conducted over three phases with a wide range of participants: senior managers of JAMSURE and the software company GROUPIT; the general insurance company, GENSURE; and the life insurance company, LIFE; project managers and developers at GROUPIT and GENSURE; and users and managers of GENSURE who were the target users of the GENSYS system. Figure 1 presents a graphical representation of the different actors and entities and their interrelationships.

Detailed notes were taken of interviews rather than recording due to the cross-cultural sensitivity that persisted between Indians at GROUPIT and Jamaican staff across JAMSURE. Primary data sources supporting this interview data include textual data such as group strategy, IS strategy, mission statements, newsletters, and annual reports.

As a Jamaican, the field researcher was conscious and reflexive 'of the cultural self he brought into the field' (Denzin and Lincoln 1998 pp265). He therefore sought to limit researcher bias, and avoid 'being co-opted, going native, swallowing the agreed-upon or taken for granted version of local events' (Miles and Huberman 1994). For example, the prevailing adverse discourse by Jamaicans concerning cross-cultural differences was impressionable. He sought to minimize possible bias by getting feedback from a wide cross section of Jamaicans concerning this and other highly charged issues. He was also reflexive as to the role of Indian expatriates in

Jamaica by comparing and contrasting his own experience of working as a software development consultant in a foreign country. At the end of the fieldwork, the field researcher presented some preliminary findings and received feedback from the groups' management team.

Data Analysis

Open coding identified key issues that challenged the formation and ongoing development of the software team. Amongst others, key themes included cross cultural attitudes and differences, broader power relations within the team, and reduced levels of knowledge sharing between groups over time. A further step in the coding analysis was the identification of recurring themes from across these broad categories.

In a final step, we drew on different theoretical perspectives to think about the information (Langley 1999). Specifically, we drew initially on Giddens theory of change in late modernity and the coordination literature in IS development to enrichened our performative account of the change process and the macro-micro interdependencies, which were critical to the research setting. We also used theories of knowledge and practice from Polanyi (1969), and Orlikowski (2000) to deepen our understanding of the micro-processes of knowledge sharing in a cross-cultural context. A schematic of our thematic analysis is presented in Figure 2.

Throughout this process, we were conscious of the potential that researcher bias could have in influencing our analysis. The field researcher was able to deal with this bias somewhat by discussing transcripts of Indian managers with a seasoned Indian IS researcher who had studied software development in India and was very knowledgeable of issues concerning

hierarchy, work styles and the role of users. Further reflexivity was achieved in the data analysis through the researchers' subsequent research on global software outsourcing in Indian software houses.

CASE DESCRIPTION

In the 1980's and early 1990's, locally owned Jamaican insurance firms experienced rapid growth following deregulation of the general insurance industry. During this period, these firms enjoyed good profitability in a relatively stable industry context. The reinsurance crisis of the 1990's shook the local industry with reinsurers demanding new levels of detailed risk information across the island to facilitate variable pricing of risk.

One local insurance conglomerate, JAMSURE, had emerged as a dynamic and innovative player in the industry. Like other larger local companies, JAMSURE was a highly diversified financial group of 27 companies which had grown through acquisitions and had revenues of approx USD 400 M. Along with his chief financial officer and group human resource (HR) manager, the JAMSURE chairman personally oversaw the genesis of the new general insurance system (GENSYS), which was to be developed to meet reinsurers' changing information requirements.

Following an unsuccessful search for package software with the necessary functionality, the decision was made to develop a state-of-the-art system in-house. Top management had little faith in the competence or capabilities of GENSURE's MIS group to deliver. The Jamaican office of a Big Four consultancy firm, GLOBAL, was commissioned by the top management to work closely with JAMSURE's top management and a user group at GENSURE in developing

the functional specifications and initial design of GENSYS. During this interaction with GLOBAL, JAMSURE took the decision to in-source and establish their own for-profit software company, GROUPIT, which was expected to be responsible for all the groups' software development. This insourcing strategy met with top management approval, and was perceived to offer diversified growth needed for JAMSURE to reach their goals of being a Fortune 500 company to which they aspired.

Dr. Prava, and a number of other experienced software developers were hired from software houses in India to form the top management of GROUPIT. Dr. Prava, a former president of an Indian software house, had a strong technical background and a PhD in Operations Research from a top US university.

GROUPIT started the software development of GENSYS based on GLOBAL's spec. After a month, GROUPIT developers concluded that they were unable to build from the spec and requested a more detailed design. Short-term help was solicited from GLOBAL to extend the spec as 'details were residing in someone's head there'. However, a further attempt at system development reinforced the need for additional local general insurance expertise in order to write the code and build the system. A team from GENSURE's management information system (MIS) department was seconded to join GROUPIT. These included the MIS manager along with carefully selected staff who through technical skills testing demonstrated aptitude for professional software development.

Despite the circumstances of GENSURE's late involvement and their initial feelings of being excluded from the development effort, genuine excitement and enthusiasm grew across this culturally diverse team. Learning professional software development skills using state of the art system technology was very enticing for the Jamaican group as were the company's ambitions of marketing the software internationally. The spec was modified on occasion as reinsurers demanded new insurance requirements. The MIS staff also consulted occasionally with users to gain further clarification of program requirements. A culture of enthusiasm and knowledge sharing abounded with weekly awards for the most helpful member and project champion. There were positive reputation effects that gave hope to the project participants. In particular, a New Zealand insurance company short-listed GENSYS in an international search for a flexible reinsurance system and a large multi-national IT vendor entered into agreements to market the system globally.

However, after a few months, problems surfaced leading to conflict as deadlines tightened, with Jamaicans complaining of a highly competitive blame culture and resentment of rigid weekly project deadlines. Dr. Prava was perceived to be 'precise and very scientific', and relied heavily on his most talented technical Indian project manager both for his technical knowledge and deployment of project management methods. Such a focus on formal coordination practices and perceived lack of participation by Jamaicans plagued the development effort. User involvement became minimal and any feedback outside of the spec was noted but not incorporated in an attempt to meet the tight project deadlines and provide the 'contracted' deliverables. Development slowed to the point where Dr. Prava called a 'grievance meeting' to

unsuccessfully resolve team conflict. Conflict centered on interpretations of the spec and the role of users, as well as Dr. Prava's authoritative leadership style.

A change of leadership at GROUPIT occurred shortly after GENSYS was delivered, a year late, for attempted implementation within GENSURE. At the end of the research period, GENSYS had still not been successfully implemented despite significant redevelopment efforts.

CASE ANALYSIS

The case is analyzed in three distinct phases of the development process. The early phase highlights the role of the spec in knowledge sharing processes of software team development; the subsequent phase discusses the changing role of the spec as a boundary object in the middle of the scheduled project timetable, and the final phase of the project in which cross-cultural conflict adversely affected knowledge sharing.

The Role of the Spec in Knowledge Sharing Processes of Software Development

Following key technical decisions on the platform and architecture for state-of-the-art 4GL development, the Indian group started the process of interpreting the spec and using it to perform detailed design and development. These GROUPIT professionals drew on their knowledgeability to code GENSYS directly from GLOBAL's spec:

> They took GLOBAL's shell and spec and developed the system with little consultation of users, GLOBAL, or the GENSYS steering committee (Senior MIS developer)

After a month, however, their inability to code from the spec became apparent. The developers blamed this on the lack of detail in the spec:

> The GLOBAL specifications from which the reports were written were inadequate. The reports needed to be redesigned incorporating insurance knowledge and customized to GENSURE's operation (GENSURE MIS staff)

GLOBAL had developed the spec by consulting users and managers to clarify and understand JAMSURE's needs, whilst drawing on their experience to direct their efforts. In a series of *sense-reading* and *sense-giving* processes, the consultants had gradually developed an understanding of overall system needs according to the numerous and diverse accounts given. A core component of this knowledge they could give sense to in explicit form, and became articulated in the 'spec'. However, the deep tacit knowing that rendered the spec meaningful and actionable remained 'inside their heads' as a Jamaican developer later remarked. A manager of motor business at GENSURE who had been involved throughout the process reflected on the difficulties of the transition from GLOBAL to GROUPIT:

> GLOBAL leaving the system development process at the initial design stage complicated things a lot. All the knowledge GLOBAL had gained was lost…GROUPIT was to finish development but they were at the bottom of the learning curve, learning about general insurance, and had different interpretations as to what GLOBAL had done...GROUPIT could not develop a detailed design from the macro-level user requirements and initial design

A GLOBAL consultant who had been one of the original analysts was hired to further clarify and provide more detailed specifications. Despite these efforts, GROUPIT programmers, who lacked contextual knowledge of the insurance sector, user needs and local industry, were still unable to successfully design and code the GENSYS system from the revised spec.

> Lack of user involvement resulted in GENSYS being developed with holes due to a lack of basic insurance knowledge (GM Operations GENSURE)

Though the Indian developers were hired for their expert coding skills, they lacked tacit knowledge related to local industry practices to sense read meaningfully from the spec (cf Guinan et al 1998). Instead, as they had 'different interpretations' they developed a multiplicity of meanings and were 'unable to develop the detailed design'. To meaningfully sense read by

integrating clues, many of which are tacitly held, the programmers needed more contextual knowledge in addition to the explicit knowledge encoded in the spec.

The Indians lack of knowing how to build the GENSYS system was largely due to their limited understanding of the local and international (re) insurance context. On the other hand, Jamaicans could meaningfully read sense into system requirements, given their considerable experience in the local industry and working with users in providing enhancements for the existing insurance systems. However, they did not have state-of-the-art technical skills and knowledge of the programming language in which to perform effective sense giving in coding the application from the spec.

It was therefore decided that a seconded group of GENSURE MIS staff would work with GROUPIT to provide the complementary expertise, which would then be coordinated in the team. The Jamaican staff were carefully tested and selected based on their promising technical skills and close involvement with end users. Working collaboratively, it was hoped that the MIS staff could provide the missing tacit knowledge and skills (expertise) necessary for sense-reading meaningfully from the spec. The successful development of the system depended on GROUPIT's ability to coordinate the unique technical skills and knowledge of Indian programmers and the expertise of the MIS insurance staff on insurance domain knowledge and situated user knowledge. Through collaboration, it was expected that Indian programming skills would be coordinated with the MIS staff's unique knowledge of local insurance system requirements into a meaningful integration of knowledge. A GROUPIT developer summarized the importance of the Jamaican developers' expertise:

> 'There were delays due to inadequacies of design…GENSURE MIS who had a better understanding of what functionality was required along with getting input from a few users played a critical role in quality control and carrying out major reworks'

The above quote also highlights the flexible role the spec played in the coding processes. The spec alone was considered to be 'inadequate' for coding, but rather was drawn on in different ways by the workers to develop and direct knowledgeability. GLOBAL had developed the spec by drawing on their understanding of user needs and local insurance context as they understood it and which satisfied the management of JAMSURE as to the scope and direction of the project. The Indian programmers drew on the spec as their sole source of knowledge and of user requirements, as is common to programming practice in Indian software houses. The MIS analysts interpreted the meaning of the spec in the light of their knowledge of local insurance practice and user needs and pieced together what seemed like 'holes' in a flexible way that supported local use. Their understanding of local needs could be incorporated in adding to the spec, indicating the changing and malleable nature of the spec, as viewed at this early point in the development process. This reinforced the 'plasticity' of the spec as a key boundary object in the knowledge sharing process and coordinated their expertise around the IS development process.

Changing reinsurer requirements during the development process were another important issue which affected the flexibility of the spec. For example, reinsurers changed their treaty structures to include territories in addition to products and perils, and later on risk category (e.g, earthquakes) was added to the requirements. Dr Prava explained:

> Reinsurers have started spelling out different levels of risk based not only on products and perils, but also territories…the reinsurance part of the [GENSYS] had to be modified for

> territories including different rate structures. This involved a change in the system design to keep track of the territories

As a boundary object between the JAMSURE management and the development team, the spec represented a malleable set of requirements that the reinsurers through the management used to clarify ways of reducing risk, and the development team used to build a system. MIS analysts' drew on their domain knowledge of insurance activity in the Caribbean to rework the spec to meet the new risk requirements.

The flexibility of the 'spec in use' (cf Orlikowski 2000, Levina and Vaast 2005) was acknowledged by the team leader Dr Prava:

> Programmers are logical, analytical, with a mathematical disciplined mind….once the program specifications are decided on they are programmed right away….the Jamaican [analysts] view programming as artistic work… they must have the freedom to be creative [in using the specifications]… My role is simply to take the best of both.'

He saw the potential strength of enabling different interpretations and expectation of the 'spec in use' as it is drawn on differently by the occupational groups. By facilitating a knowledge sharing environment, he aimed to blend the strengths of each group to enhance the programming.

In addition to the spec operating as an important boundary object as discussed above, Polanyi's concepts of sense giving and sense reading allow us to better understand how incompleteness of the spec affects knowledge sharing in the development process by focusing on the relationality between the developer (as an agent) and the spec (as an artifact). JAMSURE's initial solution to the incompleteness of the spec was to 'fill in the knowledge gaps', by getting a knowledgeable analyst to build up the spec to the point where the Indian team could develop a detailed design and subsequently code the application. These actions suggested an objective view of knowledge and did not seem to fully appreciate that the explicit knowledge of the spec

would only be truly effective if it was adequately connected to the tacit knowing of insurance industry and user needs and practices.

The Changing Role Of The Spec as a Boundary Object in Knowledge Sharing

During the first few months, morale was high in the culturally diverse team of Indians and Jamaican MIS developers. The latter group was excited and valued this privileged opportunity to learn from the Indian developers who were taking the time to share their technical knowledge and skills. In an effort to effectively coordinate the team's expertise, positive incentives and motivation were successfully implemented to encourage knowledge sharing between team members. To emphasize the importance of knowledge sharing, the leader gave weekly prizes to the most helpful member. At this point coordinating expertise did not only rely on sharing task specific knowledge, but also negotiating the direction of the program as a group where all members were able to influence and participate in the process. As one Jamaican explained, 'If there was a problem to be solved, we would sit down and solve it…it was a team effort, meet and discuss each project.' As such, the dialogue would centre on the spec, but was not solely determined by the spec, which was seen to be flexible and somewhat limited in directing the programming effort, especially by the Jamaican analysts.

Team performance (and system development) was deemed successful, with one international company wanting to market their product globally and another short-listing their system in a global search for a flexible insurance system. Though the team noted cultural differences amongst the cross functional members, this did not impede successful collaboration and knowledge sharing. Members developed an understanding of the spec requirements and then drew on each others' knowledgeability through sense reading and sense giving processes to share

an understanding that yielded high quality coding. The spec functioned effectively as a boundary object, which acted as a facilitating and coordinating device for information exchanges across the cultural and occupational boundaries between the workers, even though each group drew on the spec in different ways as undergirded by their expert tacit knowledge. In hindsight, several team members referred to this period as their 'honeymoon phase'.

However, the development process had gotten off to a slow start as the programmers had taken over a month to rework the spec and another couple of months in realizing the need for the additional team members from GENSURE. At around the halfway mark of the 9 month contract, the Indian leader increased his focus on formal coordination methods to meet scheduled project deliverables, a practice confirmed in other studies (Kraut and Streeter 1995) of software development. Jamaican MIS staff expressed difficulty in identifying with and embracing these stringent and more formal coordination practices, which emerged and are typical of Indian software houses. For example, they complained that the newly emphasized weekly deadlines were unrealistic. A MIS team leader explained:

> Though teams were (initially) compliant, deadlines [became] rather stringent, if not unreasonable…The whole project was conditioned by the strict deadlines imposed weekly

At this mid point in the project development schedule, the project leader became more focused on deadlines and the Gantt charts which were mounted in the offices and meeting rooms. This emphasis on formal project management decreased his attention to the collaboration needed in expertise coordination around the interpretation of and coding from the spec. He explained:

> This is how it (testing) has to be done as they contracted us to produce software based on the specification. Afterwards, if the specifications are changed (based on further user input), then we can redo the software

At weekly meetings, the project leader increasingly emphasized the need to code strictly from the spec, and would often physically point to the written specification and terms of reference. This focus on 'fixing' the spec and 'coding to the spec' in its current form was perceived to be necessary modus operandi by the project leader as flexibility would likely mean further delays. When the Jamaicans suggested that certain user needs required further clarification, the leader would dismiss their interpretation stating that there was insufficient time left to be altering the spec or adding to it in any way. Dr. Prava believed in a 'contractual' approach based on meeting the pre-defined spec, which could ill afford the time and cost involved with user acceptance testing.

The Jamaicans lacked appropriate coding expertise, and thus were inefficient in articulating their understanding of the spec into program content (a sense-giving process) to meet the deadlines. It was hoped that the MIS staff could learn good programming and project management skills through close collaboration and open sharing with the more experienced Indian programmers. However, missed deadlines put enormous time pressures on both the Jamaicans and Indian developers squeezing out opportunities for peer level knowledge sharing between team members.

Dr. Prava repeatedly mentioned in interviews a singular focus of building and testing against the spec in meeting the deliverables of the contract. In feeling constrained by the project timeline, the leader succeeded in rendering the spec, as a key boundary object in the development process, less flexible in use. It no longer had the capacity to act as a facilitating and malleable artifact that could be used in various ways to direct coders through dialogue to develop

the system. It became more difficult for developers to draw in diverse ways upon the spec in reading sense into the system requirements. This was particularly so for the Jamaican MIS staff who relied more heavily on drawing tacitly from their domain knowledge and user input, and being creative in coding the system. The spec in use shifted from a flexible boundary object to a rigid shared object. Instead of accommodating work styles and providing an occupational focus in system development the spec now required a more uniform coding practice and served to limit dialogue and knowledge sharing.

> The approach taken to writing programs was similar to baking buns (sweet bread) on a conveyor belt…the questioning was direct 'have you finished all the programs you are committed to, yes or no'…there was not much consideration that we were unfamiliar with 4GL programming and there was a necessary learning curve

The analogy of a conveyor belt for the development practice suggested an individual and serial effort rather than an interactive one with individuals building on each other's knowledge and understanding of the spec. The Jamaican staff historically enjoyed close interaction with users in building and designing a us(er)able system. This contrasted with that of traditional software houses where, as other software development studies in India (Walsham and Sahay 1999) have highlighted, work practices are often compartmentalized. A Jamaican manager summarized the prevalent MIS staff view.

> If you talk to users you learn and that is the most important thing to get the person who understands the business functional requirements and not just someone with a million letters after their name (referring to Dr. Prava) (General Manager Operations , GENSURE)

Relations between the two groups worsened, as Dr Prava was perceived to rely heavily on the most experienced Indian technical developer. This served to accentuate the privileging of technical knowledge and left the Jamaican members with little room to influence the development process. The severe time constraints and imposed project deadlines increasingly

prohibited the effective nurturing of skills, particularly amongst the less technically knowledgeable Jamaicans. Indeed, the Indian developers felt under significant pressure to complete their deliverables on time and they paid little attention to knowledge the Jamaican MIS group might contribute. At the same time, the critical sharing of technical knowledge by the Indians stopped as a Jamaican developer explained:

> The attitude changed to the Indians not assisting or sharing their skills and knowledge…Bad blood developed between Jamaicans and Indians

Cross-Cultural Conflict and Knowledge Sharing

The MIS staff did not adapt well to these unfamiliar software house routines of tight deadlines and 'coding to the spec', and started to feel that their knowledgeability was now being undervalued and largely ignored. Instead of being able to contribute their tacit knowing of user expectations and contextual insurance knowledge to the software team, they felt dominated and without a voice in the development. A Jamaican developer noted:

> The feeling by most GENSURE staff was that the Indians had been given power over the Jamaicans …the whole project had been taken away from them.

While social boundaries had always existed on the team, the Jamaicans now referred to the 'competitiveness engendered in Indian software houses' and perceived Dr. Prava's 'scientific, precise, and detailed project management' approach to be autocratic in 'laying down the law'. Further, Jamaicans experienced great difficulty 'entering into the world' of, or identifying with the rules of a 'closely knit team', which also required tight coordination and strict accountability to deadlines. This new world of software house development contrasted greatly with their own more independent occupational culture in MIS departments. A Jamaican MIS team leader explained:

> I was not used to the interpersonal relations of the closely knit teams….I was reluctant to fully integrate into the environment ….the use of language was different and the official environment was different to what we were used

While Jamaican workers believed the leader's monitoring and control of activities to be inappropriate, Dr. Prava thought this reflected cross-cultural differences towards hierarchy and control in the workplace:

> Everybody (Jamaicans) treats everyone as equal… if something is due at the end of the month you are not to intervene as the boss…The attitude is 'I will tell you if the job is done or not done'…they don't want a monitoring system…it is demeaning for the boss to ask about progress of activities in between tasks

This contrasted with his experience in India as he went on to say:

> If I assign a job in India, as the boss I would ask if there were any problems at the end of the day…The Indian would not feel he is being watched but rather that I am helping him reach his end point

Another Indian leader confirmed this viewpoint linking it to Jamaica's socio-historical context:

> The Indian expats were viewed as… throwing work at them and expecting them to work 24 hrs until the work was finished…Jamaica has gone through a phase of socialism where everyone is equal…they have reacted to years of servitude and this has hampered the project

The subsequent dismissal of the most technically competent Jamaican team leader, the assistant manager of the GENSURE MIS department, only served to fuel the climate of mistrust in the team. The CEO of GENSURE explained:

> There was an atmosphere of mistrust and resentment which resulted in a lack of ownership and political tensions…the culture differences gave [way to] mistrust and a blame culture ensured

Labeling and stereotyping of Indians against Jamaicans as 'us and them' gave rise to a widespread belief that national culture was responsible for irreconcilable differences on the team. For example, a Jamaican team member commented 'It is hard to relate to their caste system,

where hierarchy and status were so important.' In contrast the Indians felt that the Jamaicans avoided project coordination, and that they (Jamaicans) were unable to 'link hands and do parallel work.' The Indians illustrated this through an example of Jamaican athletic performances of their runners where 'they are fantastic runners [but] they miss out on medals …because.... the baton is dropped…there is no training to coordinate.'

A few Jamaicans begged to differ with the predominant view that cross-cultural differences were to blame for the breakdown in knowledge sharing. For example, the Finance Director, who initiated the insourcing arrangement, believed the key challenge was turf protection by the MIS group:

> The opposition by GENSURE MIS staff was not so much cross-cultural (as commonly argued) but a protection of turf

The discontentment dramatically slowed the development rate and Dr Prava called a grievance meeting for demotivated team members to air their views and concerns. At the meeting, Dr. Prava highlighted the deep feelings of resentment the MIS staff felt to the control and lack of ownership in the project, as one Jamaican team leader explained

> At the grievance meeting it was largely felt that the top positions were held by Indians, with Jamaicans working for them

Jamaican staff's feelings of discontentment and power asymmetry surfaced and strengthened as the expected benefits of learning disappeared with increased pressures of formal control. Instead of the spec being a source of collaboration and facilitating knowledge exchange, as it had been early on, the spec was now perceived to reinforce differences between the groups, particularly in light of the new focus on meeting tight deadlines. In the process, however, other

boundary objects were not taken up to replace the spec's role and rendered knowledge sharing to be more difficult.

In sum, our analysis suggests that while the spec acted as an effective boundary object, expertise was coordinated, and each occupational group was able to participate and have their contributions acknowledged. Knowledge sharing as a conduit between these occupational and national communities ceased over time highlighting the social boundaries between the groups. The unequal distribution of power relations amongst the sub groups within the team led to resistance and disengagement of Jamaicans who lacked the ability to influence (Nelson and Cooprider 1996), and this led collaboration to be replaced by conflict. Increasingly, at the level of the financial conglomerate, GROUPIT became known as a poor performer as the 'delivery' of GENSURE was severely delayed and could not be successfully implemented.

DISCUSSION

Table 1 summarizes the key elements of our study. Our conceptual approach to knowledge sharing as processes of sense reading and sense giving (Polanyi 1969), and the (changing) role of boundary objects were useful in understanding expertise coordination as knowledge sharing and the relationship to team performance. In addition, we suggest that *culturizing* involving the politicizing of cultural boundaries had a significant influence on knowledge sharing in a cross-cultural context.

Our knowledge perspective illuminated the breakdown and failure by technology specialists in developing meaningful knowledge structures in the building of effective software from the spec. The expatriate programmers lacked tacit understanding of the insurance industry to program effectively from the specification. The team was therefore expanded to incorporate

local insurance experts who where fairly knowledgeable in programming and had a good understanding of system requirements. Indian programmers had difficulty in *sense- reading* system requirements as compared to the local MIS group. However the Indians were better able to articulate (*sense-giving*) their understandings using the programming language tools than the less experienced Jamaican programmers.

Our case also contributes an understanding of the spec as a boundary object. The literature on boundary objects often depicts them as stable in bridging and sharing knowledge across different groups. However, our case highlights boundary objects as dynamically changing over time (Levina and Vaast 2005). During the honeymoon period of the initial formation of the team, the boundary object was effective in promoting knowledge sharing between Jamaicans and Indians. However, as others have noted (Kraut and Streeter 1995), timing is important, and like them we observed a shift towards formal coordination just after the half way point of the project. More importantly, the role and use of the spec as a boundary object shifted during this period. In meeting the imposed tight deadlines, the Indian leader represented the spec as being 'fixed' and 'filled in', complete enough to be able to design and code from it. Their occupational culture allowed them to identify with this practice, which fit with their strong technical knowledge and skills. Indian developers reduced changing the plasticity of the spec. In so doing, the spec ceased to function as a boundary object; and was rendered shared object-in-use. In contrast, the Jamaican group were continued to continue to represent the spec as a boundary object. They believed that ongoing negotiation and dialogue with users in clarifying and developing the spec was important and this would necessarily require plasticity of the spec as a boundary object-in-use (Levina and Vaast 2005). In sum, while Jamaicans perceived the continued role and use of

the spec as a boundary object as necessary for ongoing communication with end users, the Indians viewed the spec as a boundary object in use for only a limited time period, beyond which its plasticity threatened the successful completion of the project.

As the spec degenerated from a plastic, negotiated boundary object-in-use to a shared technological object, the role of the Jamaican group diminished. With technical knowledge and skills becoming centre stage, Jamaicans' contextual and domain knowledge was perceived to be less important. The Jamaicans' lack of negotiability and identification led to the emergence of symbolic boundaries expressed as 'us' and 'them' and fuelled by stereotyping. This served to accentuate social boundaries as a result of occupational groups' level and type of knowledge (Molnar and Lamont 2002). In particular, these group status differences led to feelings of exclusion and stereotyping (Metiu 2006, Ridgeway and Berger 1986). Stereotyping of 'us and them' between Indians and Jamaicans was manifested and blamed on cultural differences with respect to time, hierarchy and control, and differing mind sets. Instead of achieving a more dynamic and fluid exchange across their social boundaries to facilitate expertise coordination, there was a noticeable hardening of the groups' boundaries that did anything but allow for such coordination.

While poor leadership and project management skills at GROUPIT could explain the dynamics of this software project, these explanations offer limited insights into the conflict dynamics on culturally diverse software projects. A knowledge approach allowed us to unpack 'cultural differences' and 'poor leadership' by examining the social dynamics of organizing within this culturally diverse team. By recognizing explicitly the relationality between the agent

and the artifact and also between agents, we were able to understand how the uncertainty of the spec affected knowledge sharing in the software development process, as well as the difficulties of expertise coordination in this culturally diverse team. In unearthing these micro-processes, a knowledge perspective moves attention away from outcomes of cross cultural differences and conflict to understanding the process by which these challenges developed. Undoubtedly cultural differences, both national and occupational, are important to understand in a culturally diverse team but our analysis warns of potentially undue attention to the politicization of cultural boundaries, or what we term *culturizing*. We need to go beyond a focus on 'differences' and adopt a boundary approach to understand the slow down and eventual breakdown in knowledge sharing and coordination of expertise.

Conclusion

In our increasingly globalized world of business, the need to gain a richer understanding of knowledge sharing in culturally diverse software teams will continue to be of critical importance (Levina 2005, Leidner and Hayworth 2006). While concurring with Faraj and Sproull (2000) about the importance of expertise coordination and team performance, our paper also provides insights into the in-depth processes that challenge and enable expertise coordination within culturally diverse teams.

First, it highlights the need for researchers and practitioners to examine the inter-relationship between formal and expertise coordination. Past literature has recognized the importance of each of these concepts separately, and our case goes further to highlight how an intensification of formal administration coordination practices has implications for the use of the spec as a boundary object in expertise coordination. While the spec was an effective boundary

object initially, the intensification of formal coordination squeezed out informal interactions and negotiations between groups on the spec which rendered it as more of a rigid shared object used separately by different groups in their individual work. The implications for expertise coordination were dramatic with little knowledge sharing between the groups.

Second, formal coordination affects expertise coordination as it can accentuate the status differences of different groups, which inevitably lead to negative stereotyping between groups and a subsequent lack of interest or desire to share knowledge. The consequence as we have highlighted may be a politicization of cultural boundaries, or what we term *culturizing*, as boundaries of division develop across these groups rather than a bridging effect typical of boundary objects (Lamont and Molnar 2002).

In closing, we believe that the theoretical approach and the concepts used to understand our case of Indian-Jamaican software teams may be valuable in other cross cultural software teams. As such, it offers a starting point for others to build on to further our understanding of knowledge sharing in a cross-cultural context.

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Table 1: Key Elements Influencing Knowledge Sharing and Team Performance

Key elements	**Expertise coordination as K-Sharing**	**Effects on team performance**
Spec as a flexible boundary object	Good integration of knowledge as spec supports effective sense-reading and sense-giving amongst occupational groups	Effective knowledge sharing facilitated by Jamaicans being able to draw tacitly on their experience of user needs and local practices, while Indians share technical knowledge on design and coding
Spec gains rigidity in use	Compartmentalizing of work groups, with decreasing knowledge sharing. Technical knowledge is privileged as team is urged to 'code to the spec'	Deadlines and project schedules as formal coordination become increasingly prominent.
Culturizing	Blame culture accompanies labeling and stereotyping of national culture and ruptures knowledge sharing as expertise coordination	Focus on differences rather than cooperation. Conflict seen to stem from cultural differences in hierarchy and accountability.

Figure 1: Key Fieldwork Entities and their Inter-relationships

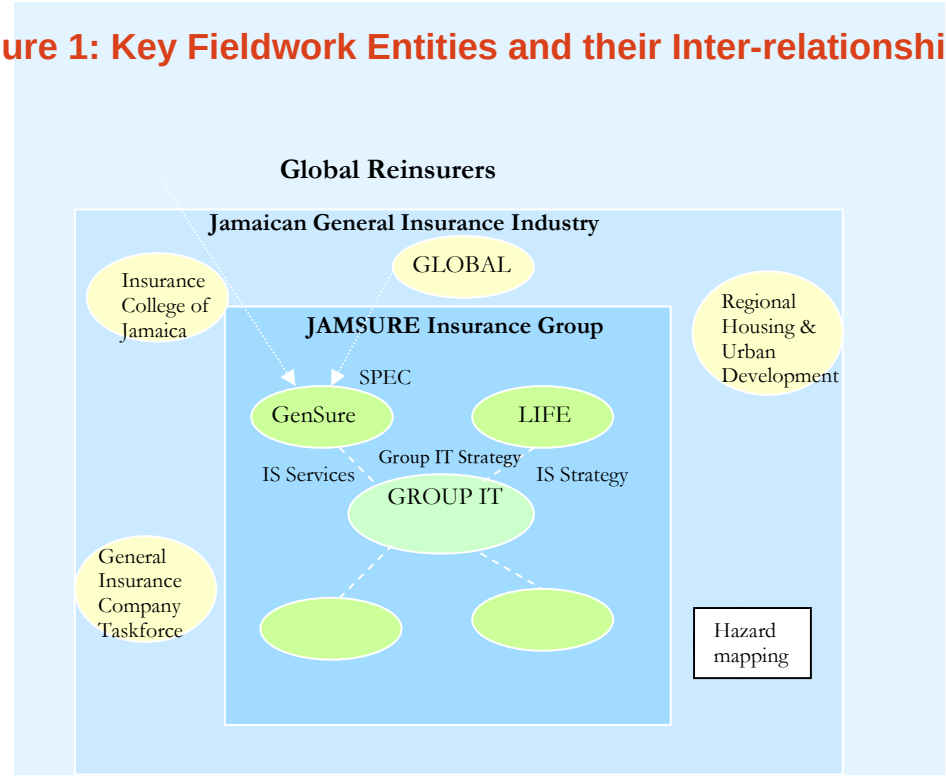

Figure 2. Schematic of thematic analysis