Narrowing the communication gap in internationally distributed teams: the case of software-development teams in Sri Lanka and Japan

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Narrowing the Communication Gapin Internationally Distributed Teams: The Case of Software Development Teams in Sri Lanka and Japan

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ABSTRACT

Communication between geographically separated subgroups in internationally distributed teams (IDTs) is quite challenging because their communication is relatively sparse and relies heavily on electronic media. In the current study, we employed a grounded theory approach and conducted an in-depth case study of two IDTs with subgroups in Sri Lanka and Japan to investigate why communication problems occur between the subgroups and how these can be solved. The findings indicated that although language fluency did not pose a serious threat, the teams encountered communication problems because they did not develop a well-shared team mental model (TMM). Our study further revealed that project process models (PPMs) play a key role in developing well-shared TMMs in IDTs, and the underlying process is facilitated by bridge individuals. Our findings extend the knowledge-sharing perspective of IDTs by focusing on the role of PPM, TMM, and bridge individuals in the communication process in IDTs.

Keywords: Bridge individuals, Internationally distributed teams, Language use, Project process models, Software development, Team mental models

INTRODUCTION

As many organizations today strive to establish a presence in multiple countries driven by market-seeking, resource-seeking, and knowledge-seeking initiatives, collaborations across national borders are becoming ever more commonplace. To that end, forming *internationally distributed teams* (IDTs) in which geographically and organizationally separated subgroups function together to achieve common goals is becoming prevalent (Cramton & Hinds, 2005; Cramton & Webber, 2005). The unique characteristics of these IDTs consisting of geographically dispersed subgroups make the communication between the subgroups challenging. On the one hand, since co-located members can easily have daily in-person communication within the subgroup, they share mutual knowledge or 'common ground' information (Cramton & Hinds, 2005) among subgroup members. On the other hand, communication between geographically dispersed subgroups is relatively sparse and relies heavily on electronic media, which cannot convey the richness of in-person interactions and substantially lacks informal context (Cramton, 2001; Hinds & Mortensen, 2005). Therefore, a closer look at how and why communication problems occur between the subgroups of IDTs and how they can be resolved is critical for the effective functioning of IDTs.

One perspective looking into subgroup relations in IDTs, what we call the *knowledge-sharing perspective*, contends that coordination problems between the subgroups in IDTs are caused by the failure to manage mutual knowledge or common grounds because of the various conflicts between subgroups (Cramton, 2001; Cramton & Hinds, 2005; Mazzucchelli, Chierici, Tortora, & Fontana, 2019). Another perspective, what we call *language and cross-cultural perspectives* in multinational/virtual teams, suggests the importance of having a common language, translators between different language groups when the members do not share a common language, cross-cultural understanding, and possessing a global mindset for the effectiveness of communication in teams (Gibson, Huang, Kirkman, & Shapiro, 2014; Harzing, Köster, & Magner, 2011; Tenzer, Pudelko, & Harzing, 2014). However, the extant literatures on IDTs and multinational/virtual teams focus on the specific and static aspects of IDTs such as, common knowledge, language, and culture and do look into the dynamic processes and emergent states through which communication problems are ignited between the subgroups of IDTs and by which they are subsequently solved.

We need a broader and more integrative theoretical framework to understand the dynamic and complex issues pertaining to communication between subgroups in IDTs. This kind of framework needs to identify (1) specific factors of the environment and/or team characteristics that are important obstructs in sharing knowledge between subgroups, (2) the role of language and culture, and (3) who plays what role(s) in the communication process, especially when the communication problems are addressed and solved. However, because this research area is still underdeveloped, we do not have adequate accumulative knowledge about what factors actually should be integrated, when, to what extent, and how. To address the research gap, the study is carried out in an exploratory and inductive manner (Eisenhardt & Graebner, 2007), using the grounded theory (GT) approach (Glaser & Strauss, 1967). We focus on the software-

development industry where IDTs are most prevalent (Colomo-Palacios, Casado-Lumbreras, Soto-Acosta, García-Peñalvo, & Tovar, 2014), and conduct an in-depth case study of two software-development IDTs that comprise geographically dispersed subgroups in Sri Lanka and Japan. By employing the GT approach, we aim to find the answer to our two-part research question: *why do communication problems occur between subgroups of IDT, and how are they solved*?

Our study contributes to the literatures on business and its management across Asian countries, by looking closely at the communication problems between IDT subgroups, which has not been extensively studied and understood by past studies. The significance of our study is that we employ the GT approach to reveal the unknown process of communication between subgroups and illustrate the dynamic information sharing process among IDTs. This paper begins with a review of relevant research on language, culture, and knowledge-sharing, (team) mental models, and bridge individuals. Next, we present our research context and method. This is followed by the findings and discussion that lead to our theoretical contributions and practical implications. The paper concludes with the limitations of our study and the directions for future research.

THEORETICAL FOUNDATIONS

Language, culture, and knowledge sharing

Language perspectives in international/virtual teams in general, suggest that linguistic differences have a profound impact on how individuals perceive information and act upon it (e. g., Gibson et al., 2014; Harzing et al., 2011; Janssens, Lambert, & Steyaert, 2004). For example, research suggests that language barriers between different language groups often cause communication problems due to information loss and distortion among individual members (Halliday & Hasan, 1991; Kayworth & Leidner, 2000). Additionally, miscommunication caused by linguistic divergence impedes trust formation among the team members because unassured communication between members leads to anxiety within the team (Jarvenpaa, Knoll, & Leidner, 1998; Tenzer et al., 2014). According to this perspective, the possible solutions for communication problems in multinational/virtual teams include using suitable communication media or code switching (Harzing et al., 2011; Tenzer & Pudelko, 2014), having a common language between members (Janssens et al., 2004), offering rigorous training programs to master the language (Tenzer et al., 2014), using bicultural translators and mediators (Brannen & Thomas, 2010), and configuring the team's cultural values or cultural context (Gibson et al., 2014; Hinds, Liu, & Lyon, 2011).

As one of the most comprehensive studies on culture, Hofstede (2001) captures *culture* as a mental program which is cultivated/adjusted throughout one's life and causes certain behavior of the person in certain situations. It draws the attention of managers of cross-cultural teams to consider the members' divergent cultural characteristics because the cultural divergence possibly affects the degree of team performance (Morrison-Smith & Ruiz, 2020). Based on the

individualism-collectivism dichotomy of Hofstede (2001), for instance, the virtual teams possessing a collectivist nature are less likely to rely on computer-mediated communication technologies and to build interpersonal relationships (Kramer, Shuffler, & Feitosa, 2017), whereas ones with an individualist nature tend to be more willing to trust each other although the computer-mediated communication is the only option for them (Jarvenpaa et al., 1998). It indicates that the members' information accessibility level and team collaboration may not work, depending on cultural differences. The instances of extant recommendations, for the inefficient virtual teams due to the cultural differences, are facilitating cultural awareness among team members and the implementation of agile development methodology guidelines (Treinen & Miller-Frost, 2006).

The knowledge-sharing perspective suggests that a team comprising members fluent in a common language or sharing similar cultural backgrounds in line with the most desirable case from the language and cross-cultural perspectives, may still encounter communication problems if the members do not possess mutual knowledge or share context (Baba, Gluesing, Ratner, & Wagner, 2004; Cramton & Hinds, 2014). The context refers to information about the circumstances and/or facts surrounding events or work settings that enable individuals to interpret behavior and events (Cramton, 2001; Hinds & Bailey, 2003). If context is not shared within the team, individual members understand and act based on their own information and perceptions of a situation, leading to misinterpretations and misattributions concerning remote partners (Cramton, 2001, 2002; Hinds & Bailey, 2003). In the case of IDTs with geographically dispersed subgroups, one cause for communication problems is each co-located subgroup has a different context or situated knowledge (Sole & Edmondson, 2002), which is not shared with the entire team (e.g., Baba et al., 2004; Hinds & Mortensen, 2005). This perspective suggests that knowledge sharing is the key to solving communication problems between IDT subgroups.

Mental models and team mental models

While constructs such as context, knowledge and common ground are general, abstract, and often ambiguous, our study shows that more specific constructs such as 'mental models' and 'team mental models (TMMs)' are essential in understanding the communication issues of IDTs with geographically dispersed subgroups. Mental models are defined as the hypothetical representations of reality based on the holder's experiences, which play an important role when the holder recognizes things and decides on how to treat the perceived objects/entities and behavior (Craik, 1967; Gentner & Stevens, 1983; Johnson-Laird, 1983). Klimoski and Mohammed (1994) developed the concept of a TMM that is shared within a team and suggested that each member in a team potentially holds his or her own mental model related to the working environment and business processes. Since these constructs are closely associated with the goal, objectives, and tasks of a project and team's working context, developing and sharing a well-established TMM within the team can have positive effects on the team's performance.

Research shows that TMMs enable teams to operate seamlessly and make enhanced decisions even in complex, dynamic, and uncertain environments without hindering performance

(McNeese & Reddy, 2014). Thus, a common theoretical assumption is that TMMs are precursors to effective team processes and performance (Klimoski & Mohammed, 1994; Kraiger & Wenzel, 1997). Indeed, several studies on teams and management of product-development projects clearly indicate a positive relationship between a TMM and team performance (Espinosa, Slaughter, Kraut, & Herbsleb, 2007; Maynard & Gilson, 2014; Mohammed, Ferzandi, & Hamilton, 2010).

Several studies specifically investigated the mental models within software-development teams and highlighted the importance of developing shared mental models or TMMs within the teams (Adolph, Kruchten, & Hall, 2012; Espinosa et al., 2007; Mathieu, Heffner, Goodwin, & Cannon-Bowers, 2000). Those studies found that a TMM in a software-development team enhances the team performance, fosters sharing of cognition and understanding among engineers, leads to benefits in terms of cost and time, and to job satisfaction by helping engineers to finish their jobs smoothly.

Bridge individuals

Our study highlights the role of bicultural or multicultural individuals who bridge the gap between the subgroups in developing the TMMs by narrowing the communication gaps that exist. These individuals are called 'bridge individuals' (Sekiguchi, 2016). Analogous concepts to that of bridge individuals include boundary spanners (Barner-Rasmussen, Ehrnrooth, Koveshnikov, & Mäkelä, 2014), brokers (Eisenberg & Mattarelli, 2017; Mattarelli, Tagliaventi, Carli, & Gupta, 2017), and biculturals (Brannen & Thomas, 2010). The concept of bridge individuals was initially used in a series of studies by Harzing and her colleagues (Harzing et al., 2011) to refer to bilingual employees who facilitate communication between headquarters (HQ) and foreign subsidiaries as part of their work responsibilities. As bilingual translators, these bridge individuals communicate with multicultural members by simplifying the language and negotiating the meanings (Aichhorn & Puck, 2017). Moreover, as communication facilitators, bridge individuals perform rapport-building and behavior 'switching' depending on the purpose, situation, and people (Aichhorn & Puck, 2017; Zakaria, 2017).

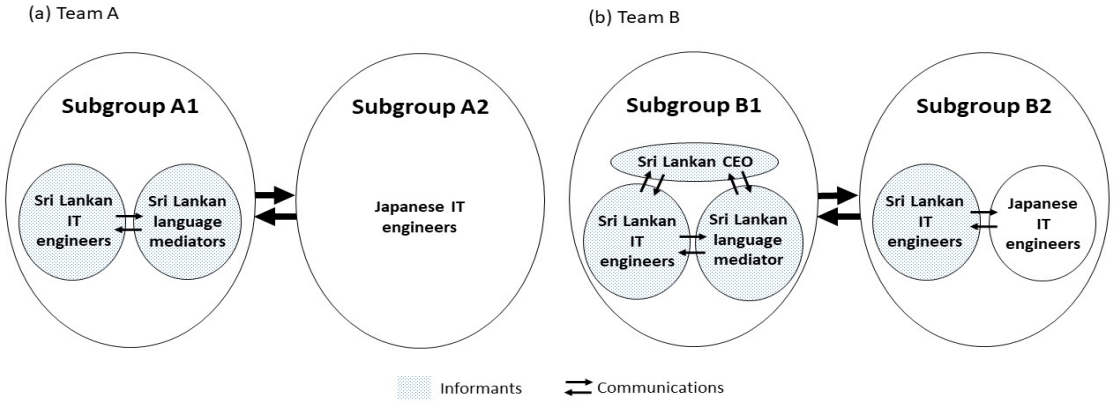
Previous works have identified the necessary skills for bridge individuals such as language proficiency, communication competence, and cross-cultural skills. However, there are many other scenarios that remain to be investigated to expand the understanding of characteristics pertaining to bridge individuals. For instance, the situations where bridge individuals play a critical role are not limited to the context of the HQ and foreign-subsidiary relationship. It is important to explore the aspect of bridging at a team level as well. In the IDT setting, Eisenberg and Mattarelli (2017) theorized that the presence of multicultural brokers, i.e., bridge individuals, help knowledge sharing between subgroups of IDTs. On the other hand, the empirical study by Mattarelli *et al*. (2017) suggests that bridge individuals can do more harm than good if they are not properly managed. In essence, there are only a handful of studies on bridge individuals in the context of subgroup relationships in global virtual teams and IDTs leaving an immensely fruitful and currently relevant area unexplored.

METHOD

Research context

This study targeted two IDTs, which we illustrate in Figures 1(a) and (b) with relevance to their compositions. Team A comprised of a subgroup of Sri Lankan employees from a Sri Lankan subsidiary of a European multinational software-development company ['Subgroup A1' in Figure 1(a)] and a subgroup of Japanese employees from a Japanese IT company located in Japan ['Subgroup A2' in Figure 1(a)]. Team B comprised of a subgroup of employees from the Sri Lankan subsidiary of a Japanese firm ['Subgroup B1' in Figure 1(b)] and a subgroup of employees from the Japanese HQ ['Subgroup B2' in Figure 1(b)]. Team B was also considered as a self-managed team that handles software-development projects associated with embedded systems assigned by the HQ.

Figure 1. Summary of teams and subgroups depicting communications and informants



Notes. The IT engineers of Subgroup B2 underwent a Japanese language-training program spanning one year and were subsequently dispatched to Japan.

Informants and data collection

As shown in Table 1, this study had 18 Sri Lankan informants in total, three IT engineers and two language mediators from Team A, and one CEO, 11 IT engineers, and one language mediator from Team B, who were all knowledgeable in software development and experienced at communication and collaboration with Japanese members to provide highly useful information for our study. The informants of Team A worked together with Japanese members handling the Japanese clients' outsourced software development projects. The informants of Team B were working on software development projects with the Japanese members. Some of the Sri Lankan informants of Team B were working in the same subgroup of the Japanese members. These informants, actors from other hierarchical levels, functional areas, and geographies, who viewed the focal phenomena from diverse perspectives contributed to our data collection with mitigated bias (Eisenhardt & Graebner, 2007). The interviews followed the semi-structured approach and were conducted in the English or Japanese language. Most of the interviews were conducted at the informants' workplaces; the rest were conducted through video conferencing. A total of 34

initial and follow-up interviews, (approximately 60–90 minutes each), were carried out with the 18 informants individually.

Table 1. Summary of informants

Type of Informants	Number of Informants	Number of Interviews
Team A:		
Sri Lankan IT engineers	3	6
Sri Lankan language mediators	2	5
Team B:		
Sri Lankan CEO	1	2
Sri Lankan IT engineers	11	18
Sri Lankan language mediator	1	3
Total:	18	34

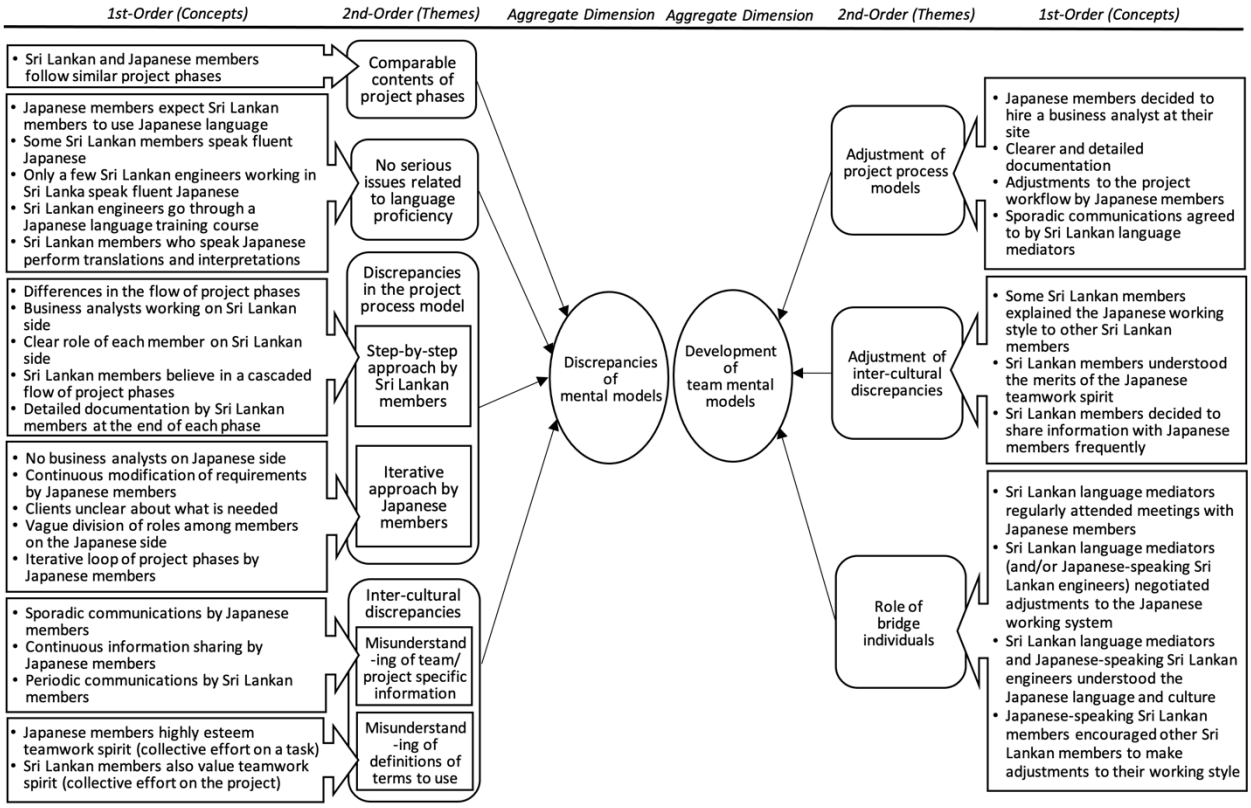
Data analysis

Our data analysis was conducted using the GT approach (Glaser & Strauss, 1967; Strauss & Corbin, 1990). This approach is particularly useful for studying behavior and the processes of change using the perspective of people who are involved in and experience these dynamic environments, allowing theory to emerge from the data (Corley, 2015; Gligor, Esmark, & Gölgeci, 2015). The GT approach is also useful to bring multiple perspectives together, bridge disconnections between them, and integrate interdisciplinary insights to advance knowledge (Gligor et al., 2015). Therefore, the GT approach was ideal for our study, which aimed to capture the dynamic and interrelated processes that lead to communication problems between IDT subgroups and the formulation of solutions to address these issues, by bringing multiple and isolated concepts together to understand the complex phenomena behind communication issues in IDTs.

Data organization and analyses were performed using NVivo (Version 10) software, which is an efficient data analysis tool for qualitative research. It provides an easy to use framework for storing all data sources under one roof, convenient methods for creating codes and discovering themes, and performing inter-coder reliability checks as one follows the GT approach step-by-step. In preparing our data for coding, we first performed data transcription using English. In the case an interview was conducted in the Japanese language, we created the original transcript in Japanese and translated it into English following the translation and back-translation method by Chen and Boore (2010). Next, we archived the transcripts including the raw interview data using NVivo. We began analyzing the data from the beginning of the data collection process for constant comparison (Lincoln & Guba, 1985; Strauss & Corbin, 1990). We performed open-coding of the interview transcripts and other data paying close attention to a set of first-order focus points, such as language proficiency, miscommunications and misunderstandings, language requirements, and language training. This allowed us to examine whether any language-proficiency related issues were the potential causes of miscommunications and misunderstandings among team members, and in effect, delays and shortcomings in the

project-related activities. In addition to the language-related concepts, we identified other concepts, such as project phases, activities within phases, cultural aspects, work environment, and business practices clearly emerging from interview data.

Figure 2. Data structure



The open-coding process was followed by axial coding, in which, we identified new second-order focus points during the process of categorizing and summarizing the first-order concepts (Vough, Cardador, Bendnar, Dane, & Pratt, 2013). As the second-order concepts, we focused on the discrepancies of project process models (PPMs) and culture. We revisited all initial data in order to ascertain that useful information on these second-order focus points was not missed in the first iteration of our analysis. We also used these second-order focus points to expand our preceding data collection process. This enabled us to discern the key differences in the project approaches, which were further examined in the follow-up interviews.

By coding quotes that were related to team members' understandings toward PPMs or cultural differences, we recognized some new concepts as the first-order focus points, e.g., adjustments that took place while proceeding the development projects by the IDTs and sharing of information about the two cultures by Sri Lankan language mediators. Based on the first-order concepts, we extracted themes as the second-order focus points, such as convergence of PPMs, convergence of inter-cultural discrepancies, and important roles played by bridge individuals. After crosschecking the results by the process of iterative coding, we finally aggregated a

plausible dimension in performing selective coding: the development of TMMs, which mainly comprised of changes to the perceived PPM coupled with cultural adjustments. Closing of the gap between discrepancies was driven by the bridge individuals, because convergence was achieved through an iterative communication and readjustment process facilitated by the bridge individuals. Figure 2 shows the dual information structure we arrived at following the GT approach.

FINDINGS

Language use

Within the co-located subgroups A1 and B1, members easily communicated with each other by using their mother tongue. The Sri Lankan members of B2 communicated with their Japanese members using the Japanese language without problems related to fluency. Between the subgroups, both Teams A and B used the Japanese language as the primary communication medium (Table 2). In Team A, communications between Subgroups A1 and A2 were carried out via the Sri Lankan language mediators, who performed seamless interpretation and translation on behalf of the team. In Team B, likewise, the members of Subgroup B1 used a language mediator. We found that none of our informants claimed communication issues rooted in the language proficiency when communicating both within and between subgroups.

Table 2. Labels and descriptions: language issues

Label	Description	Example quotes
Language mediators as communication media	Non-Japanese speaking Sri Lankan engineers communicate with Japanese members through the Sri Lankan language mediators	"We are not well-versed in Japanese language, but we have two well-qualified mediators…. they always help in the communications with the Japanese members…." (Engineer of Subgroup A1) "There is no language barrier between the members as long as we have such good mediators." (Engineer of Subgroup A1) "I do not have any major problem in communicating with Japanese members, since we have translators here…." (Engineer of Subgroup B1)
Japanese-speaking Sri Lankan engineers	Some Japanese-speaking Sri Lankan engineers help other Sri Lankan engineers communicate with Japanese members	"…. (we) study Japanese language for one year…. after we finish the course, we immediately start collaborating with HQ using Japanese language…. I have never felt that I was not included in the team due to language…." (Engineer of Subgroup B2) "We can access the Sri Lankan members working at Japan headquarters. They can speak fluent Japanese…. If we have something to ask about the design, we speak to them…." (Engineer of Subgroup B1)

Discrepancies of mental models due to different PPMs and culture

None of our informants highlighted any problems due to language proficiency, however, subgroups A1 and B1 encountered communication difficulties when they interacted with the team members on the Japanese side. The problems occurred because subgroups A1 and B1 and those on the Japanese side had their own perceptions on the management of the entire project and

their individual as well as subgroup activities within the team. In other words, there was divergence in the mental models of the subgroups, which lead to communication pitfalls between the subgroups that hindered the ability of the members to work cohesively as a team.

We found that the communication difficulties between the subgroups were largely caused by the discrepancies of the adopted PPMs between the subgroups in Sri Lanka and Japan. PPM (project process model) is defined as the abstract representations of a product development process and how tasks are aligned and accomplished during the project (Gnatz, Deubler, Meisinger, & Rausch, 2004). PPMs are based on the members' previous experiences and/or some contagion effects at the local working environment due to daily in-person interactions and cultural influences. The software development projects of both IDTs followed similar stages, i.g., requirement analysis, system design, system implementation, and testing. Our findings revealed that the members of the two IDTs understood the separate phases and the activities within those phases. However, the understanding of the sequence and the relative flow of the phases, which defined the PPM, was different among the subgroups constituting the respective IDTs. Further analysis revealed that there were differences between the flows of activities adopted by the subgroups A1/A2 and B1/B2, and these differences caused many problems at different stages of the project.

Discrepancy in the way of requirement analysis

In Team A, Subgroup A1 acknowledged the need for experienced business analysts (BAs). The BAs are in charge of analyzing customers' requirements, and development teams can usually start implementation of a project based on the analysis provided by the BAs (Bassil, 2012). On the contrary, Subgroup A2 did not employ BAs: the software engineers were in charge of the analysis, as well as design and development. As understood by the comments in Table 3, Subgroup A1 held the perception that Subgroup A2 wasted a lot of time and resources by not employing specialized BAs. Subgroup A1's original understanding of the role of software engineers was to conduct only design and development based on the requirements analysis performed by Subgroup A2. Therefore, Subgroup A1 felt uncomfortable performing their role when Subgroup A2 expected team-level responsibility in analyzing requirements.

Likewise, Team B did not have the luxury of BAs because the whole team adhered to the direction from Subgroup B2. The clients' requirements were analyzed by all members including both subgroups located in Sri Lanka and Japan. Subgroup B2 regularly changed the product specifications based on the clients' feedback on the prototypes implemented by the engineers. Furthermore, the Japanese clients also changed their requirements often. Such a process seemed to be of use for clearly establishing the requirements and polishing the product concept before shifting to the development phase. Subgroup B2 was trying to understand and adjust the product concept on behalf of the clients, because even the clients were sometimes not fully aware of what they needed from their products and relied on a vague concept. The absence of experienced BAs, especially in a scenario like this, was in conflict with the expectations of Subgroup B1.

Table 3. Labels and descriptions: discrepancies of mental models between subgroups

Label	Description	Example quotes
Analysis Phase	Requirements analysis without business analysts on the Japanese side	"Our Japanese members do not have specialized business analysts and they analyze the clients' requirements…. all team members together…. it takes a lot of time to prepare the completed document of requirements…." (Language mediator of Subgroup A1) "The Japanese members keep modifying the requirements, we get confused and it's difficult for us to decide what to do next and schedule other tasks." (Language mediator of Subgroup A1) "The design phase is the most difficult time for us. The HQ continuously instructs us to modify things in the products' initial requirements…." (Engineer of Subgroup B1)
Design and Development Phase	Different expectations of subgroups	"…. (they change) even if we have already started development based on what they once requested…. we end up developing something that is beyond original plans." (Engineer of Subgroup A1) "They don't clearly divide tasks among team members. It's more like doing a single task with all the members until we complete the task. We talk about project-related topics anytime." (Engineer of Subgroup B2) "….in Sri Lanka, we used to be assigned a particular task and each one concentrated on his assigned task…. we don't have to discuss matters always within the team." (Engineer of Subgroup B2)

Discrepancy in expectations of workflows

During a project, Subgroup A1/B1, after receiving the analyzed and documented requirements, moved on to the designing phase. Once the designing phase was completed, they moved on to the development phase and subsequently to other phases in a step-by-step approach. The engineers involved in each phase worked on a particular task and undertook full responsibility for it. Therefore, the team members had only a rough idea of what other members were working on, requiring a thorough sharing of information at the end of the phase in order to document and hand over the project to the subsequent phase.

On the other hand, Subgroup A2/B2 did not follow clear-cut phases and divisions. Instead, information was shared with everyone at all times. Clearly documented information was not forwarded from one stage of the project to the next. Information continuously arrived at Sri Lankan subgroups from the Japanese side when decisions and modifications were made. Accordingly, Subgroup A2/B2 expected and encouraged all the team members to share their ideas continuously with the entire team in order to share responsibility of the total project. Such expectations of Subgroup A2/B2 were in conflict with the expectations of Subgroup A1/B1.

Table 4 describes how the mental models of subgroups pertaining to Teams A and B differed. The major differences between the mental models of the Sri Lankan members and Japanese members were almost identical for Teams A and B.

Table 4. Attributes of Mental models of Sri Lankan and Japanese members before establishing TMMs

Attributes of mental models		Perception by Sri Lankan members (Mental model)	Perception by Japanese members (Mental model)
PPM-related attributes	*Workflow*	Step-by-step approach	Iterative approach
	Time spent on conceptual phases	Relatively short	Relatively long
	Business analysts	Highly acknowledged	Absent
	Documentation	Relatively clear	Relatively unclear
Other attributes	*Job assignments*	Specific and particular	Vague and entire team
	Information sharing and interactions	Specific individuals between adjacent phases and individuals within phases	All team members across all phases
	Communication expectations	Predictable contents and timing	Random timing, contents, and modifications

Communication to establish TMMs

The divergence of perceptions between subgroups was gradually resolved through effective communication initiated and driven by particular members who are partially equivalent to bridge individuals discussed in the literature (e.g., Harzing et al., 2011). With respect to Team A, the language mediators of Subgroup A1 assumed the bridging role. They not only played the role of language mediators who facilitated communication but also performed an additional bridging role using their prior knowledge of the culture that may govern the subgroup members' business practices and process activities. With respect to Team B, the Sri Lankan engineers of Subgroup B2 played a bridging role because they had firsthand experience working at the HQ enabling them to compare and contrast business practices and process activities. Such key individuals instinctively perceive differences in the mental models of subgroup members through prior knowledge and experience.

As shown in Table 5, the bridge individuals' practical approach to communication comprised of three steps: (1) *perspective-taking/empathy*, (2) *paraphrasing*, and (3) *inspiring.* In the first step, the bridge individuals tried to identify the pros and cons of both subgroups' PPMs by putting themselves in the shoes of both subgroups and understanding the feelings and reasons behind their actions or inactions. In the second step, the bridge individuals tried to "paraphrase" one subgroup's statement(s) into something the other subgroup can make sense of, based on empathetic understanding of each subgroup gained through perspective taking. This approach of paraphrasing motivated the members to take action according to the project's purpose, concept, and team dynamics. In the third step, the bridge individuals tried to inspire the team members using appropriate expressions to encourage changes and sometimes compromises for the greater

good of the team function. For example, in the case of Team B, members of Subgroup B1 made changes to their work practices to shift towards the Japanese project process style.

Table 5. Descriptions of effective language use by bridge individuals

Usage	Description	Example quotes
Perspective-taking/empathy	Ready to listen and make effort to understand the pros and cons of both subgroups.	"I deeply understood the need for business analysts at the Japanese side, after hearing many comments and complains from my Sri Lankan colleagues." (Language mediator of Subgroup A1) "…. I never thought of making changes to the design at such a stage. Later I learned that we could design…. something better than what the customers initially expected by sharing ideas among team members." (Engineer of Subgroup B2) "We…. agreed to maintain periodic communications with Japanese engineers even if we primarily deal with the business analyst during the inception phase of the project." (Language mediator of Subgroup A1)
Paraphrasing	Communication using tactful words, based on empathetic understanding.	"I sometimes give a kind of lesson for the engineers, teaching the differences in the meanings of 'teamwork,' 'harmony,' or 'cooperation' between us and the Japanese, because the Sri Lankan engineers' perceptions of those words are slightly different from Japanese members' ones." (Language mediator of Subgroup A1) "I made presentations to the Sri Lankan engineers educating them as to why the Japanese members maintain constant communication among all the members and their customers throughout the project." (Language mediator of Subgroup B1)
Inspiring	Helping members to see the positive aspects of the other subgroup and stimulating change, when needed.	"The engineers started to understand the key points and are taking positive steps to include the Japanese members' way into their understanding." (Language mediator of Subgroup B1) "We had to…. discuss with Japanese members and highlight the advantages of a specialized business analyst many times…" (Language mediator of Subgroup A1) "…after several team meetings, the Japanese members agreed to employ a specialized business analyst on their side." (Language mediator of Subgroup A1)

Using the aforementioned practical approach, the bridge individuals made use of every opportunity to share knowledge and close the gap between subgroup mental models. For example, when realities opposed and contradicted the subgroup mental models that govern the understanding of the work functions, responsibilities, and practices, members became uncomfortable and searched for reasonable explanations for the discrepancies they observed. One instance of this was the communication styles between subgroups, where, one group expected repetitious and continuous communications, while the other expected precise and periodic communications. When subgroup members searched for reasonable explanations, the bridge individuals made good use of the opportunity to guide the process of understanding differences and motivated and inspired to make changes, compromises, and optimizations in subgroup mental models through extensive cyclic communication, which ultimately lead to the formation of a convergent TMM among the subgroups of the respective teams.

TMMs established within Team A

We summarize the TMMs that were established in Teams A and B in Table 6. As for the TMM of Team A, members of Subgroup A2 completed individual tasks as a subgroup facilitated

by the frequent and continuous sharing of information within the subgroup. However, after taking into consideration the step-by-step approach followed by Subgroup A1, Subgroup A2 hired a specialized business analyst in order to perform the initial requirement analysis with greater accuracy. In addition, the members of Subgroup A1 and A2 constantly contacted each other through the language mediators in order to avoid freezing the initial requirements and designs.

Table 6. Attributes of the established TMMs

Attributes of TMM		**Perception by Team A (TMM)**	**Perception by Team B (TMM)**
PPM-related attributes	*Workflow*	Relatively step-by-step approach	Dual wielding of a step-by-step approach and a team-mobilized approach
	Time spent on conceptual phases	Relatively short	Relatively long
	Business analysts	Hired	Not hired
	Documentation	Clear	Clear
Other attributes	*Job assignments*	Specific and particular	Specific and particular
	Information sharing and interactions	The Japanese members (Subgroup A2) contact the language mediators, and the mediators share selected information with the Sri Lankan engineers (Subgroup A1).	Information is shared with everyone in all phases at the Japanese HQ (Subgroup B2); Specific members of Subgroup B2 and the language mediator of Subgroup B1 share selected information with the Sri Lankan members (Subgroup B1).
	Communication expectations	Contents and timing are easy to predict for the Sri Lankan engineers of Subgroup A1.	Contents and timing are easy to predict for the Sri Lankan engineers of Subgroup B1.

Note. Driving factors involved in establishing a TMM through integration between the two different PPMs adopted by the two subgroups

Subgroup A2 kept constant contact with the customers in order to benefit from the merits of the iterative approach. Communication of new developments of the project concept and requirements were documented and reported following a refined schedule that allowed flexibility for Subgroup A1 to plan and organize their resources and tasks according to the step-by-step approach. Such progressive refinements in the mental models of the subgroups through acceptance, compromise, and adjustments can lead to convergent TMMs in IDTs.

The resultant adjustments made by Team A were facilitated by the integration between the two different PPMs adopted by the subgroups A1 and A2. The subgroups started off by identifying differences in the project process activities and their relative flow. They entered an information-sharing phase that allowed them to be informed of the practices of the other

subgroup. This was not a one-time process as understood by the informant comments, such as, 'The engineers *started* to understand…,' 'We had to discuss…*many times*,' etc. This constant sharing, reconciliation, and refinement process was initiated and driven by the language mediators, who acted as the bridge individuals in this case.

TMMs established within Team B

As for the TMM of Team B, the Sri Lankan members of Subgroup B2 who were working together with Japanese members within the subgroup continued constant formal and informal in-person interactions with each other regarding the project enabling all members to engage in all aspects of the project. The members of Subgroup B1 continued their previous way of dividing the tasks among their individual members who exercised full responsibility and autonomy. The sharing of information was based on interdependencies between tasks and was carried out periodically at formal settings. The assignments of tasks from Subgroup B2 were carried out in an organized fashion at well-defined stages of the project in order that Subgroup B1 could complete the tasks without undue interruptions.

The progress of tasks assigned to Subgroup B1 was monitored by a language mediator at the Sri Lankan subsidiary and a Sri Lankan engineer in Subgroup B2. The language mediator reported progress periodically to Subgroup B2. In addition, this mediator attended the formal meetings of Subgroup B2 that were held constantly through videoconferencing. This adjustment helped Subgroup B1 and B2 to stay up-to-date on the latest developments of both subgroups enabling them to plan and steer activities of Subgroup B1 effectively. Since the other members of Subgroup B1 had no experience working with Japanese members directly, the two contact persons, the language mediator and the Sri Lankan engineer of Subgroup B2, worked together and acted as a hub through which refined information about the project developments was passed on periodically to Subgroup B1 to keep extracting the benefits of the iterative approach. Similar to Team A, Team B went through a constant-sharing, reconciliation, and adjustment process guided by the bridge individuals before they arrived at a workable TMM.

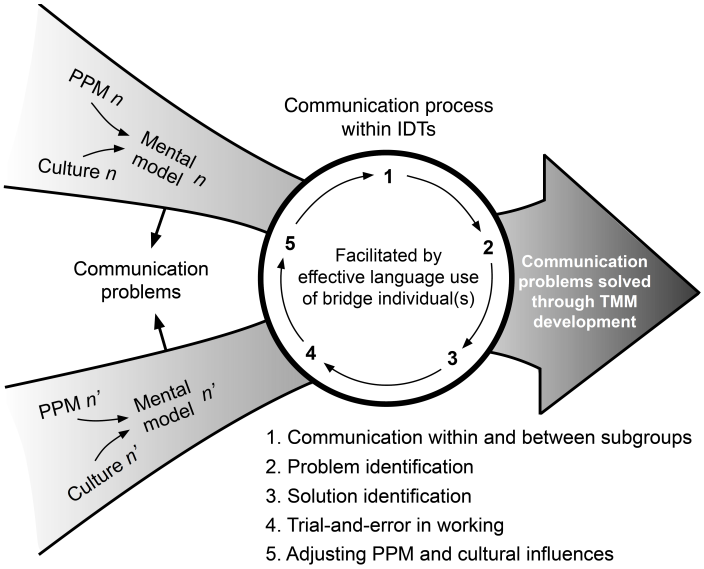
Solving communication problems through TMM development

Our findings suggest that the IDTs encountered communication issues because they did not possess a TMM that was applicable for their respective team. We bring to light the process through which TMMs were developed and how the major communication problems between the subgroups were resolved. This process is best illustrated in Figure 3, which depicts the interplay among the six main elements of this study (PPMs, cultural influences, mental models, effective language use, bridge individuals, and TMM) that were identified through our data structure summarized in Figure 2. Figure 3 also indicates the five steps of communication within an IDT that bridge individuals facilitate in aiming to develop a TMM.

As shown in Figure 3, the two subgroups of both IDTs already had their own mental models toward the project (mental models *n* and *n'*) molded by the PPM familiar to the subgroup (PPMs *n* and *n'*) and cultural influences of their respective locations and organizations (cultures

n and *n*'). The respective mental models may have been established through daily face-to-face communications with the co-located subgroup members over time. In identifying and adjusting the discrepancies between subgroup mental models and developing a TMM, the bridge individuals played a key role with effective language use, which included perspective-taking/empathy, paraphrasing, and inspiring. Their key role is illustrated in the communication process within IDTs in Figure 3.

Figure 3. Process of solving communication problems through TMM development in IDTs



The communication process was initiated by the bridge individuals through communication with the co-located subgroup members in regard to the progress and any anxieties they had related to the project and their assignments. Having this information, the bridge individuals initiated communications between the subgroups with the intention of finding explanations, remedies, and any reciprocating issues the counterpart-subgroup may have been facing (step 1). These communications required the bridge individuals to use the language effectively. With continual back-and-forth communications between the subgroups, they were able to observe discrepancies in the way the subgroups proceeded with the project and isolate major problems stemming from them (step 2). The bridge individuals identified that the difference between the PPMs adopted by the subgroups was the underlying cause for the discrepancies, and the solution would be to devise a common PPM acceptable to both subgroups (step 3). With this in view, they worked on trial-and-error negotiations within and between the subgroups using language effectively in terms of paraphrasing and inspiring (step 4) until both subgroups could cohesively collaborate. Through these trial-and-error negotiations, the bridge individuals inspired adjustments and modifications to the respective PPMs of the subgroups of a team to establish a workable team-level PPM, which also required changes to certain practices of the subgroups that were influenced by cultural aspects (step 5).

The adjusted PPM, in the respective IDTs, provided the skeleton of the TMM because it described the most fundamental information on how the work should be organized and how the team-level/subgroup interactions could be sequenced to facilitate the workflow. The bridge individuals played an important role in identifying the key differences in the mental models of the subgroups of IDTs investigated in this study. They facilitated the knowledge-sharing process to guide the IDTs toward adjusted PPMs that provided a skeleton on which TMMs could be developed. This knowledge-sharing process was a repetitive cycle that comprised communications, compromises, optimizations, and adjustments of the subgroup mental models and practices.

DISCUSSION

To understand why communication problems occurred between IDT subgroups and how they were resolved, we conducted an in-depth case study of two software-development IDTs comprising of geographically dispersed subgroups in Sri Lanka and Japan. Regarding the former part of our research question, we found that communication problems occurred between IDT subgroups because the subgroups did not share a TMM that could help them to grasp the meaning and context of the information being exchanged between the subgroups. Regarding the latter part of our research question, we found that the communication problems were resolved by developing a TMM extensively facilitated by bridge individuals.

Theoretical contributions

The previous literature on language, culture, and knowledge-sharing perspectives are abstract, broad, and often ambiguous with regards to understanding communication problems specific to IDTs with geographically dispersed subgroups. While these extant studies did not reach a unified viewpoint because they have been studied separately, our study integrated diverse constructs such as PPMs, culture, mental models, language, bridge individuals, and TMMs which have been studied separately in various streams of research. Integrating these constructs in our comprehensive framework enabled us to view the interrelationships among these constructs and how these influence the communication issues that occur between IDT subgroups. It led us to capture the dynamical processes through which communication problems arise due to discrepancies between the mental models of subgroups, and how these are solved by developing a TMM facilitated by bridge individuals.

Our study also contributes to the literature on TMMs. Whereas the previous works on TMMs focused on how a TMM positively affects the team's performance (Adolph et al., 2012), we derived the process model for TMM development from our data and suggested that the PPMs are key antecedents in this process. The relationship between PPMs and TMMs illustrated in our study may not be limited to software-development IDTs and can be extended to other industries where project-planning elements similar to PPMs are used. Therefore, the process by which a TMM is developed to solve prevalent communication issues as described in our study is potentially generalizable to a wide range of knowledge-based team environments.

Our study further contributed towards understanding the important aspect of the bridge individuals' role in TMM development. Previous studies on bridge individuals or analogous roles such as boundary spanners, brokers, and biculturals mainly highlighted their language and cultural skills and indicated that their main roles were to foster communication through translation, introducing a different culture (Barner-Rasmussen et al., 2014; Harzing, Pudelko, & Reiche, 2016), and/or transferring knowledge (Mattarelli et al., 2017). Our study went one-step further by highlighting the role of bridge individuals who facilitate knowledge sharing and mediating between subgroups with the view to establish a TMM through effective language-use such as perspective-taking/empathy, paraphrasing, and inspiring. In particular, we brought to light how they contribute to solving communication problems between subgroups not only through linguistic and cultural skills but also through observational, situational, and organizational skills to isolate discrepancies in the mental models between subgroups and spearhead the formation of a TMM to address the prevalent issues.

Practical implications

Our findings suggest that in addressing communication problems between subgroups in IDTs, managers and leaders of the teams could benefit from paying attention to potential mental models and PPMs (or their equivalents) that diverse team members bring to the table, as well as language and cultural influences. In particular, our findings suggest that the communication problems between subgroups in IDTs are largely caused by the discrepancies between subgroup mental models that are molded by the respective PPMs and cultural influences. As the relatively controllable aspect of a project environment in knowledge-based teams, the PPM can be used as the skeleton to drive the TMM-development process in IDTs.

However, the aforementioned project practices in terms of a PPM of a subgroup are often implicit and are adopted through contagion effects within the localized environment, which makes it difficult to identify discrepancies between subgroups, especially when in-person daily interactions are scarce. Therefore, even when the subgroup members of an IDT are fluent in the language that is used for communications between subgroup, problems may still surface because the implicit existence of subgroup mental models and their workings behind the scenes in igniting conflicts are less visible to the members. Therefore, when designing language training programs for employees of IDTs, the managers and instructors should not only focus on intensive linguistic training but also providing adequate information on the subgroup characteristics of the IDT, relevant process models, and cultural aspects that may come into play.

The geographically dispersed subgroups should depend on nothing but communication to develop and share a TMM, even in the face of communication problems. This is the case because subgroups of IDTs cannot observe the practices and processes of their counterparts in person to make knowledgeable judgments and adjustments, and can only rely on virtual forms of communication. The key to overcoming this paradoxical situation lies in bridge individuals who play an important role in narrowing the communication gaps. However, the bridge individuals may not necessarily have a formal and specific job description of bridging between different

groups in international settings (Harzing et al., 2011). Hence, managers and subgroup leaders of IDTs should identify, develop, and utilize key individuals to play the bridging role, who can effectively foster communications, identify problems, devise workarounds, and develop team-level solutions (e.g., TMMs). The potential candidates for this role are those who possess proficiency in the relevant language(s) of the IDT setting, working knowledge in the technology domain, emotional and analytical capacity to handle inter-border interactions, and so on.

Limitations and future Research

One of the limitations of our study is that the informants were all Sri Lankan employees who worked at Sri Lankan and/or Japanese subgroups. This was due to the fact that we were granted permission to access internal data and conduct interviews from only the Sri Lankan side of the IDTs. Even with this restriction, however, we were able to gauge the communication problems that occur at the interface of subgroups of IDTs and identify the key issues that trigger these problems, which eventually facilitated our inductive theorizing. Another limitation is that we focused on software-development teams with two geographically dispersed subgroups in Sri Lanka and Japan, which limits the generalizability of our findings. Our target teams had only two subgroups and nationalities. Besides, the two countries, Sri Lanka and Japan, share some cultural characteristics prevalent in high-context cultures (Hall and Hall, 1990; Kaluarachchi, 2010). Therefore, there remains ambiguity whether the findings and the proposed conceptual model are also applicable to IDTs with more than two subgroups, nationalities, cultures, and locations.

Aforementioned limitations along with our main findings and implications provide avenues for fruitful future research to further refine and extend our theory and the conceptual model. First, to replicate and extend our findings that brings to light the key role of PPMs in the development of TMMs in IDTs, future work can investigate this relationship across different knowledge-based industries such as structural, mechanical, and aerospace engineering that also use PPMs to guide their projects. Future studies along these lines also need to focus on identifying additional key antecedents that may determine the boundary conditions of TMM development across industries and also understanding the process through which such potentially useful antecedents contribute to the development of a TMM. In this regard, longitudinal studies that observe the evolution of TMM development within IDTs are of utmost importance.

Future research could also investigate IDTs with more than two subgroups involving multiple cultures, languages, nationalities, and locations to see whether the interplay among PPMs, culture, mental models, language, bridge individuals, and TMMs found in our study still holds or whether modifications are required to fine-tune the interactions. In terms of cultural differences, it is intriguing to explore the communication problems that might occur between subgroups located in different combinations of low-context and high-context cultures (Hall and Hall, 1990). Other potential locational characteristics that are worth investigating include different combinations in terms of the degree of economic development and different language environments. Moreover, the key role played by bridge individuals in TMM development could be further explored to establish their specialized functions, responsibilities, required skills, and

training to greater detail. In addition to bridge individuals, the roles, attitudes, and adaptations of other members of the subgroups can be investigated to observe how the knowledge-sharing and TMM development takes place spatially and temporally. Exploring how advanced technologies play a crucial role in bearing fruit in effective communication between subgroups would also provide clues to direct this area of research further.

CONCLUSION

Our findings indicate that communication problems between the subgroups of IDTs are mainly caused by the discrepancies of PPMs and the absence of a TMM, as well as linguistic and cultural differences. The key to solving the communication problems is to rely on skillful bridge individuals who can spearhead the development of an effective TMM. We expect that future research will strengthen this perspective and improve or extend our proposed model.

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