

Why Does Site Visit Matter in Global Software Development: A Knowledge-Based Perspective

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Abstract

Context: Face-to-Face (F2F) interaction is a strong means to foster social relationships and effective knowledge sharing within a team. However, communication in Global Software Development (GSD) teams is usually restricted to computer-mediated conversation that is perceived to be less effective and interpersonal. Temporary collocation of dispersed members of a software development team is a well-known practice in GSD. Despite broad realization of the benefits of visits, there is lack of empirical evidence that explores how temporary F2F interactions are organized in practice and how they can impact knowledge sharing between sites.

Objective: This study aimed at empirically investigating activities that take place during temporary collocation of dispersed members and analyzing the outcomes of the visit for supporting and improving knowledge sharing.

Method: We report a longitudinal case study of a GSD team distributed between Denmark and Pakistan. We have explored a particular visit organized for a group of offshore team members visiting onshore site for two weeks. Our findings are based on a systematic and rigorous analysis of the calendar entries of the visitors during the studied visit, several observations of a selected set of the team members' activities during the visit and 13 semi-structured interviews.

Results: Looking through the lens of knowledge-based theory of the firm, we have found that social and professional activities organized during the visit, facilitated knowledge sharing between team members from both sites. The findings are expected to contribute to building a common knowledge and understanding about the role and usefulness of the site visits for supporting and improving knowledge sharing in GSD teams by establishing and sustaining social and professional ties.

Keywords: Global Software Development (GSD), Knowledge Sharing, Knowledge Management, Face-to-Face interaction, Empirical, Case study

1 Introduction

Nowadays, globally distributed software development teams have become a norm, a paradigm that is known as Global Software Development (GSD). Geographically distributed nature of GSD lacks sufficient opportunities of frequent interactions among a team's members. Frequent and intense interactions are necessary for acquiring, sharing and applying technical and domain knowledge for software development that is inherently a knowledge intensive undertaking. That means GSD usually inhibits knowledge sharing among software development team members [1, 2]. Nor can GSD team members share implicit knowledge around coffee machines or during breaks. GSD usually reduces the frequency and speed of communication [3] and eliminates the shared context [4]. Additionally, GSD teams are also challenged by linguistic gap and cultural differences, which can lead to miscommunication. Hence, GSD projects are expected to have appropriate strategies to compensate the negative impact of distance and support knowledge sharing needs of dispersed teams.

Temporary collocation of dispersed software development team members is considered a common practice of establishing and growing social ties and collaborations [5, 6] that help support knowledge sharing about technical and social aspects of software development projects. Site visits are organized with diverse durations and involves employees at different levels of organizational hierarchy depending upon the needs and priorities. Given the cost of organizing site visits, it is important for managers to clearly understand the objectives to be achieved and the expected Return on Investment (ROI). It is equally important to have a well designed and organized set of social and professional activities to maximize the social and monetary ROI [5]. There is an apparent lack of empirically founded knowledge and understanding about how to plan social and professional activities for site

visits in GSD and their potential impact on building and growing social ties that can be leveraged for supporting knowledge sharing in GSD [5]. We decided to carry out a case study to empirically explore the key activities organized during temporary collocation of GSD teams as a strategy to build and leverage mechanisms for knowledge sharing between sites.

This paper reports the design and findings of our case study of a GSD team with focus on an offshore technical team's visit to onshore site¹. Our findings are based on an in-depth analysis of calendar entries of visitors, observations of the interactions between the visiting and local team members, and semi-structured interviews of a selected set of team members conducted a few months after the visit. We have performed the analysis of the gathered data using the knowledge-based theory of the firm [7] to investigate the influence of temporary collocation on knowledge sharing among distributed team members. Our key findings are that organized social and professional activities during the visit contributed to building common knowledge between remote co-workers in areas such as personalities, culture, work ethics, business domain knowledge and general vision of software product. We have also identified and discussed the ways that the visit facilitated knowledge sharing between sites by easing interaction of individuals and enabling group problem solving (i.e., known as implicit coordination mode from the perspective of knowledge-based theory).

The rest of this paper is organized as follows. Section 2 provides extensive review of related work that frame theoretical background of our research. Section 3 presents our research method and details of conducting this study. Section 4 describes our findings from data analysis. Section 5 covers our discussion and reflections.

2 Related Work

This Section discusses work that provides the theoretical framework for the reported research.

2.1 Global Software Development (GSD) and Knowledge Sharing

Global Software Development (GSD) refers to software development that makes use of resources distributed around the globe. Practitioners and researchers use different terminologies and business models to characterize GSD. Geographical location and the ownership of distributed sites are two high level dimensions normally used to distinguish between different business models. "Outsourcing" refers to collaboration with a third-party, while "offshoring" refers to collaboration with distant site(s) crossing geographic borders [8-10]. There is a trend towards GSD adoption among software development companies [11-13] due to a number of drivers. Producing large-scale software requires building and maintaining large development teams. This is not only very expensive but also challenging because of a lack of local resources. This situation encourages organizations to capitalize on a global pool of software development professionals [12, 14, 15]. Furthermore, competition in a growing market can mean a quick response to fluctuating demands and access to diverse expertise. Herbsleb and Moitra [14] note that GSD enables competitiveness through quick formation of virtual teams enabling market exploitation. Follow the sun, benefiting from longer working days, closer proximity to local markets and opportunities for merger and acquisition are other well-known business motivators for GSD [1, 12, 14]. Nevertheless, GSD is associated with a number of challenges due to geographical, temporal and socio-cultural distances [2, 15]. Geographical distance deprives distributed team members of face-to-face interaction and informal chats [1, 2], which are considered important for successful collaboration [1, 16]. Dispersed team members are less likely to communicate with each other [17, 18]. Time zone differences decrease overlapping time that allows for synchronous communication and introduces difficulties in scheduling team meetings and on-the-spot questions answers sessions. Cultural and linguistic distance plays a significant role in communication gaps between distant colleagues.

Knowledge sharing is an integral part of Knowledge Management (KM) processes [19, 20]. In the context of software engineering, it is defined as « *provision of task information and know-how to a person, so that (s) he can collaborate with others to solve problems, develop new ideas or implement*

¹ The host company estimated cost of the visit being around 112,000 DKK = almost 15000 Euro.

policies or procedures» [20, 21]. Numerous studies have found that GSD imposes challenges on sharing knowledge between dispersed members (e.g., [22-26]). The process of capturing and sharing knowledge generated at different sites can be quite difficult because of the involvement of multi-culture, multi-stakeholders and multi-processes. Manteli et al., [27] discuss how business strategy, relationships between sites, team structure and work distribution approach could influence creation and transformation of software engineering knowledge among distributed members. Their study showed organizational policies to share filtered information with remote sites increases the need of clarifications. Moreover, hierarchical structures, variety of role descriptions and unbalanced team sizes are observed as issues that could introduce the notion of “sticky knowledge” to the locations where the majority of competences are located [27].

Socio-cultural distances in GSD lead to several knowledge sharing challenges such as lack of trust and rapport between dispersed teams [28], [24], [29], [30], difficulties in establishing and leveraging social networks and informal communication channels [30], [24]. Newell et al. [28] classify the issue of lack of trust and its impact on knowledge sharing process into three categories: lacking trust in competency of remote members, lacking companion trust (i.e., difficulty to identify a member with relevant knowledge, or if known, difficulty to establish contact), and lacking commitment trust (i.e., being truly committed to knowledge sharing). Several studies (e.g., [31], [32], [33], [23], [34]) point out that fear of losing job can lead to unwillingness to share knowledge with remote colleagues as people become insecure about their jobs. Zimmermann et al. [34] observe that fear of losing jobs is higher in departments with specialized tasks and fewer opportunities for innovation and/or defining new tasks; so individuals from those departments were reluctant to share knowledge.

GSD also poses difficulties for fluently sharing knowledge between dispersed teams because of cultural ([31], [32], [35], [23]) and linguistic ([24], [32], [23]) distances. It is evident that cultural differences either national (e.g., hierarchies, difficulties to say “No”) or organizational (e.g., misalignment in culture of innovation and collective ownership of deliverables) prohibit capabilities of members in effectively seeking inputs and sharing information. Social-related issues such as lacking openness and clarity of interactions between sites [31], [36], [37], [38], [23] can be interpreted as being worry or feeling embarrassed because of a poor idea [36]. Jensen and colleagues [31] discussed that due to a lack of openness, vendor team was often not sure about what was expected of them and seldom received feedback from client team until there was an extreme situation. Betz et al., [23] found that misunderstandings of offshore team from specifications had roots in limited signals that they could provide about their lack of knowledge.

Researchers have proposed various practices to mitigate knowledge-sharing challenges in GSD. Treude and Storey [39] explored how web-based tools such as forums, wikis, mailing lists and blogs are utilized by distributed teams to share software development knowledge. They conclude that community portals could be more effective to support knowledge sharing needs of distant teams by providing mechanisms such as “like” an article, leaving feedbacks and involving clients in documentation [39]. It is evident that strong social ties between dispersed team members enable faster exchange of information compared with documentation [24]. Individuals who have higher credibility can transfer higher volume of knowledge to their trusted network [40], [41]. Al-Ani et al. [42] found a tendency of GSD members to seek knowledge through personal networks rather than browsing through codified knowledge. They argued that trust (affective and cognitive) significantly influenced the way teammates approach each other for seeking or sharing knowledge [42]. Zimmermann and Ravishankar [34] highlighted that building social ties and shared identity between dispersed team members significantly helped them to develop shared contextual understanding. It accordingly influenced ability of dispersed team members to communicate and interpret each other’s messages. Literature suggests that removing hierarchical hurdles [30] and enabling flat communication pattern [43] ease flow of information at different levels of distributed teams for sharing knowledge in GSD. It assists one-to-one communication between dispersed members and provides more opportunity to share tacit knowledge through informal chats. The use of boundary-spanners (or knowledge brokers) [44],[32] for improving knowledge exchange can be quite effective in bridging communication and knowledge gaps between sites. Finally, temporary collocation of dispersed members is known as one of the most effective practices in GSD for enhancing knowledge sharing between sites.

2.2 Temporary Collocation and Face-to-Face interaction

It has been reported that temporary collocating dispersed software development teams can have several advantages [13, 45-48]. According to the work reported in [49], [24], [50], [51], [43] site visits can be an effective tool to facilitate knowledge sharing in distributed settings. Visiting remote sites and experiencing face-to-face interactions increase cross-site cultural awareness and familiarities with behaviors [47]. It promotes developing social ties [24], [32], [52], [43] that can lead to increased knowledge sharing through informal communication channels. Some studies [13, 45] have found that face-to-face kick off meetings at the beginning of a project were helpful to establish personal relationships and trust between distributed stakeholders. Avram [53] argues that the best way to learn how to do something is observing someone who is doing the task. Herbsleb and colleagues [48] observed frequent site visits within an enterprise were helpful to alleviate issues of process incompatibility and leveraging understanding of team members about how things are operated at other locations. The involvement of business management with development site in collocated analysis sessions can help foster common understanding of requirements [45].

Despite the significance of site visits, there have been only a few efforts to carry out in-depth studies of different aspects of site visits. Oshri et al. [54] argue the need of having strategies to initiate, develop and refresh cross-site social ties before, during and after site visits. Von Stetten et al. [55] investigate the pattern of face-to-face meetings between sites based on four parameters: Who participate in a visit, Where the visit happens, Why it is required and When it happens; the authors propose different effects of site visits including social bonding, knowledge transfer, better communication, and collaboration. Sole and Edmondson [56] discuss the importance of frequent site-visits to share and apply situated knowledge for enhancing effectiveness of distributed teams. Situated knowledge is defined as knowledge that is embedded in work practices of a particular organizational site, it is associated with location and varies in different social and physical contexts [56]. Analyzing potentials of dispersed teams in collaborative problem solving, the authors argue that not only *awareness* of the relevant situated knowledge is required but also dispersed teams should be able to *appropriately* apply the knowledge. Temporary collocation provides opportunity to get involved in different events, joint trainings and get familiar with ongoing practices at different sites. It enables remote colleagues to expose their minds, realize knowledge gaps and consequently experience more effective team learning. Hence, moving key people between sites raises awareness on existing expertise situated at each location, while ensuring that a team's collective knowledge is fully appropriated and effectively applied to collaborative problem solving.

Hinds and Cramton [5] investigated the impact of site visits on transforming relationships between coworkers in GSD projects. They introduced the concept of "*situated familiarity*" as multiplex understanding that coworkers had of their counterparts in relation to themselves and their work together. They argue that temporary collocation enables coworkers to closely interact and observe each other for gaining a good understanding of personalities, cultural context, work/ communication styles, capabilities and interests. The authors state that situated familiarity during the visits influences interaction between coworkers even after going back home. The studied participants formed closer social relationships that led to being more responsive to emails, frequently communicating and sharing personal matters. Hinds and Cramton [5] also state unsuccessful visits, and draw attention to the importance of organized activities during the visit to reinforce situated familiarity rather than blankly relying on face-to-face interaction of coworkers during visit. They argue that there is a general lack of understanding about what really happens during visits due to limited empirical data. Our study contributes in filling this gap by investigating the social and professional activities that could take place during a temporary collocation of GSD team members. It provides empirical evidence on themes of activities and pattern of interactions during the visit and analyzes the influence of the visit on sharing knowledge between dispersed members.

2.3 Knowledge-Based Theory of the Firm

Knowledge-based theory of the firm was proposed by Grant [7] in 1996. The theory looks through dynamics of organization from knowledge perspective and discusses how different management

strategies could influence knowledge sharing and integration in an organization. Grant [7] challenges previous organizational learning literature that view organization as an entity, which creates and stores knowledge in its procedures and norms by learning from members. He proposes to explore knowledge creation, sharing and integration process of a firm at the level of individuals rather than organizational unit. From Grant's perspective knowledge creation is an individual activity and role of the firm is to create conditions under which individuals can share and integrate their specialized knowledge to create value. He enumerates different characteristics of knowledge that have critical implications for management such as transferability, appropriability and capacity for integration. Grant recognizes tacit knowledge with "*knowing how*" and explicit knowledge with "*knowing about the facts*". Accordingly, he argues that explicit knowledge is attributed by ease of communication; it can be codified and easily transferred to others. However, tacit knowledge can only be realized through its application. Therefore, transferring tacit knowledge between people could be slow, costly and uncertain.

Knowledge-based theory of a firm [7] revisits the definition of coordination mechanisms to effectively share and integrate knowledge between individuals to create value. Differentiating between implicit and explicit coordination modes, it is discussed that while explicit approaches (e.g., rules and directives) focus at integrating knowledge with minimized interactions, implicit approaches (e.g., group problem solving) encourage high volume of communication for sharing and integrating knowledge between individuals. Implicit coordination approaches, though being less efficient, are known to be more suitable for complex and uncertain tasks [7].

From the perspective of Grant's theory [7], employing all of the above coordination mechanisms in a firm depends on commonality between individuals' stocks of knowledge, i.e. called *common knowledge*. Common knowledge is also referred as mutual knowledge or common ground in literature. Davis and Khazanchi defined this concept as "*knowledge that communicating parties share and each party knows that they both possess*" [57]. It grounds group communication based upon shared meanings and supports efficacy by decreasing misunderstandings [58]. According to Grant [7], intersections between individuals' knowledge sets is required for enabling individuals to share and integrate aspects of knowledge, which are not in common. He recognizes different types of common knowledge (i.e. language, other forms of symbolic communication, commonality of specialized knowledge, shared meaning and recognition of individual knowledge domains) and argues each type plays different roles in fulfilling knowledge sharing and integration.

In our study we have got inspiration from Grant's theory [7] for analysis and synthesizing the findings. The theory provided us a suitable analytical tool to look into knowledge sharing and integration of the studied organization at the level of individuals. In addition, the proposed concepts assisted us in framing and interpreting our results.

3 Research Method

Case study is considered an appropriate method to explore a phenomenon in its real-life context, particularly when the border between the phenomenon and its context is blurred [59]. Case studies can be descriptive, exploratory, explanatory and evaluatory [59, 60]. Selecting an appropriate type of case study depends on the nature of research questions [59]. Yin argues that a case study is an independent research methodology that uses both qualitative and quantitative data [59]. This methodology is particularly designed by considering the case as unit of analysis. Yin distinguishes between *holistic case studies* where a case is studied as a whole, and *embedded case studies* where multiple units of analysis are studied within a case [59]. Furthermore, case study method has a different approach towards using a theory in a study. Qualitative methods such as grounded theory emphasize the generation of theory from data. Some grounded theorists (e.g. Glaser [61]) place more emphasis on the importance of allowing codes and categories to *emerge* from data and prohibit viewing data through pre-defined framework. However, case studies can be designed to investigate specific propositions or hypotheses based on existing models, frameworks, tools, or theories [59].

Our research method was an exploratory holistic case study with a globally distributed software team (also called Extended Team) as unit of analysis. Given the duration of the studied case, we characterize it with longitudinal nature. We had been studying distributed collaboration of the studied case for almost 2 years (2012 - 2014) and collected data at different occasions. Even though this paper

is based on one of our data collection efforts, we believe it is worthwhile to mention the level of familiarity of researchers with the case. The longitudinal nature of the case is also motivated by consideration of a time period in our data collection based on which we report in this research.

We aimed to explore a temporary collocation of distant teams by studying an arranged visit to onshore site for a few offshore technical members. We intended to study the details of the activities that take place during collocation period and their impact on enhancing knowledge sharing between dispersed members. In summary, we investigated the following main research questions:

RQ1: What activities take place during temporary collocation of GSD teams?

RQ2: How temporary collocation could facilitate knowledge sharing between GSD teams?

3.1 Organizational Context

We studied a software development team distributed between Denmark and Pakistan forming an Extended Team Model (ETM), as depicted in Figure 1. ETM is a customized offshore outsourcing collaboration based on long-term partnership involving two independent companies [62, 63]. Whilst the involved companies are independent, their collaborative arrangement goes beyond a typical client-vendor relationship and emphasizes close interaction and integration of distributed teams. Each company has around 25 staff in software development roles. The onshore site represents IT department of a large book publishing company in Denmark. A majority of projects are for internal customers (e.g., automation of a business process, integrating systems, websites, maintenance and enhancement of legacy system) in Denmark.

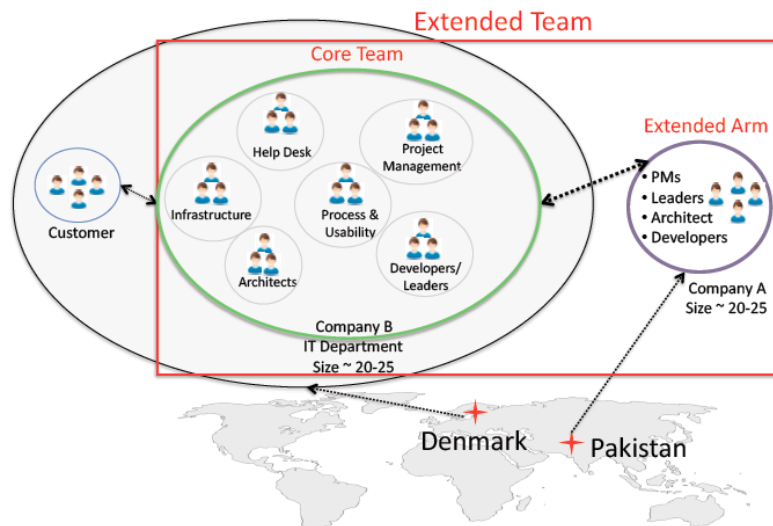


Figure 1 - Organizational Structure

Given the demands of customers, typically several small projects run in parallel. The companies have been following the ETM for the last 4 years. While different roles (e.g., project manager, architect, technical leader and developer) exist at both sites, being an extended team, the organizational boundaries are blurred in team structure. That means projects could be setup with different team structures and utilization of resources at each location. Having customers in Denmark, the onshore team members interact with customer for requirements elicitation and architectural analysis, while offshore site mainly contribute to development tasks.

During our study, we observed the implementation of different strategies (e.g., equality and minimizing hierarchies) to strengthen social ties between sites [62, 63]. Given the agility and dynamicity of work structure in studied case, we observed that the distributed teams were highly reliant on social interactions for supporting their work process. In this context, understanding knowledge sharing between sites required researchers to zoom-in companies' practices and see behind the scene. Site visit is commonly counted as one of the practices to exchange tacit knowledge and setting up social ties. The studied company runs frequent visits between sites at the level of

management. For this study, however, we focused on the visit organized for offshore technical staff members including developers to Denmark.

3.2 Data Collection

We aimed at investigating a 2-weeks visit of offshore technical team to Denmark. The visiting team comprised of 4 members including a senior project manager and 3 software developers. Table 1 represents an overview of our data collection activities. We performed data collection in two phases. The first phase of data collection took place during the visit. Before arrival of visitors, we had a meeting with the visit coordinator in Denmark. We gathered calendar entries covering all the planned activities for each of the visitors. We also sought clarification about the purposes of and the roles of the participants of different planned activities in the calendar. Appendix A presents a sample of the calendar entries, which included scheduled meetings with management and different functional teams, as well as all the major social events such as lunches, dinners, visiting homes and city tours over the weekends. Gathering the calendar entries helped us to get familiar with the nature of the visit and planned activities.

During the 2 weeks, we visited onshore company for 2-3 times. A complete access to the company's software development team and facilities enabled us to closely observe the atmosphere, team interactions, and sitting plans. We also conducted observation of two of the major management-oriented and technical-oriented meetings and took extensive notes. The first meeting was organized at the management level for introducing process improvement that was observed by both of the authors. The second meeting was organized for developers with usability team that was observed by the first author.

Table 1 - Overview of Data Collection Activities

Data Collection Phase	Method	Remarks
Phase I – May/ June 2013	<ul style="list-style-type: none"> Calendar Entries (103 entries) Observations (3.5 hours) 	<ul style="list-style-type: none"> Individual calendars of 4 visitors. All the planned activities for 2 weeks were in-depth studied and discussed. Extensive notes of observing Technical Meeting of Visitors with Usability team. Extensive notes of observing Technical Meeting about Process Improvement. Minutes of Technical Meeting.
Phase II – first week of Sep 2013	<ul style="list-style-type: none"> Semi-Structured Interviews (13 interviews; approx. 10 hours) Artifacts (13 pages presentation slides) 	<ul style="list-style-type: none"> Denmark – 9 interviews, conducted with hosts. Pakistan – 4 interviews, conducted with visitors. All interviews were audio recorded and transcribed. Presentation slides from talk of visitors back to offshore about experiences of their trip.

The second phase of the data collection took place after 3 months of the visit when the companies were collaboratively introducing organizational process changes. We considered a 3-months interval between the two data collection phases as it could provide sufficient time to the visitors and the hosts to experience, perceive and reflect on the results of the visit. Yet, the interval was not too long impacting memory of the participants. We performed semi-structured interviews of most of the people involved in different socio-technical activities during the studied visit either as a visitor or a host. We interviewed all the 4 visitors as well as 9 onshore team members including the head of the IT department, the leaders of different functional teams (e.g., helpdesk, usability, and infrastructure), 2 project managers, and one developer. Table 2 enlists the details of the interviewees. We interviewed the hosts in person in Denmark and the visitors via video call on Skype. We managed to conduct all the 13 interviews within a couple of weeks. Both the authors participated in all of the interviews and

took notes. For the sake of reliability, all the interviews (i.e., in-person and Skype calls) were audio recorded and fully transcribed.

The interviews were designed open-ended and varied in duration between 0.5 to 1 hour long. The total recorded time was approximately 10 hours. Appendix B demonstrates the interview questions. We asked questions about the activities and experiences from the visit in terms of social interactions as well as work-related matters. We also asked perceptions of the participants about the impact of the visit on seeking and sharing knowledge (e.g., about requirements and domain knowledge) between sites. We should note that the level of insights of the interviewees about the visit varied. Six interviewees provided very detailed accounts of the visit; others entertained random quotations mainly in response to generic questions about the experiences from the visit.

Finally, we performed follow-ups with the participants for further clarifications (e.g., via Skype call and email) that were needed during our data analysis. We got more details on the calendar entries from the participants during the follow up discussions. For example, how the planned activities worked, for what purpose they were organized, approximately how long each event lasted and who participated. The clarifications enabled us to gain further understanding of the activities during the visit. That understanding helped us to interpret the findings from the analysis of the gathered data.

Table 2 - Overview of Interviewees

Location	Roles	Identifiers
Pakistan (Visitors)	1 Senior Project Manager, 3 Developers	<i>P1 – P4</i>
Denmark (Hosts)	2 Project managers, 2 Usability members, 2 Management, 1 Help desk lead, 1 Infrastructure lead, 1 Developer	<i>P5 – P13</i>

3.3 Data analysis

We have analyzed the data using social network analysis technique and qualitative analysis approaches. The data analysis was performed in two rounds including analyzing calendar entries and the interviews as elaborated in the followings.

- **Analysis of Calendar Entries**

We initiated analyzing calendars by transferring all the entries into excel sheets. The data was structured into columns including: a) activities b) participants, c) number of hours and d) remarks. Cross-checking with our notes about calendars, we transferred additional explanations regarding the meetings into the excel sheet. We separated social events from work-related meetings and analyzed them under separate datasheets. We calculated approximate number of hours each visitor spent with any of the team members at onshore company. Then, we used Gephi² (i.e., an open-source social network analysis tool) to visualize patterns of interactions between the visitors and the hosts from social and work-related perspectives. The nodes correspond to individuals and edges indicate the participation of individuals in common meetings. The total number of hours that two nodes spent together has been added as weight of the edge. Given our interest in the patterns of interaction *between* visitors and hosts, we excluded all the edges that relate either visitors or hosts to each other. We used the layout function embedded in the tool, named *ForceAtlas2*, with customized³ settings for visualization. The coloring scheme is also used to differentiate between attributes of nodes (e.g., location and roles). Each node has been annotated with an identical label.

We ran another round of analysis on calendar entries to classify information about the activities organized during the visit. For this purpose, we performed thematic analysis [64] on the calendar data that we had transformed to excel sheet and categorized the social and work-related meetings under the emerging themes. Having identified the approximate duration of the meetings and the number of participants, we calculated the person-hours that were allocated to different themes of the meetings.

- **Analysis of Interviews**

² - <https://gephi.github.io>

³ - Scaling = 35, Gravity = 1, Thickness = 2

We performed qualitative analysis of the interviews' data using open coding techniques [65]. We extracted all the quotations referring to the recent visit such as elaboration on activities, experiences, learning and reflection on knowledge seeking/sharing activities. Making use of Nvivo⁴ (i.e., qualitative data analysis tool), we benefited from linking quotations to the codes. It enabled us to easily move between codes and review all the extracted data under a particular code frequently. Progressing with the analysis, we iteratively revised the codes and accordingly modified the assignment of quotations to the updated codes that were getting merged or newly defined. Working towards synthesizing the results, we consulted with existing literature that could help us to frame the findings. In this phase, we found Grant's theory [7] being a suitable analytical tool to guide our work for synthesizing the results. Firstly, the viewpoint of the theory towards sharing and integrating knowledge in organizations had flexibility to describe dynamics of the studied team and the interaction of the individuals from knowledge perspective. Secondly, we found an appropriate match between the codes that emerged from our data and some of the concepts proposed by Grant. It is worth noting that we first performed open coding on our data and extracted all the relevant quotations. Then, we examined the codes against the concepts from Grant's theory to structure the results. We categorized our coded data under the relevant concepts and utilized sub-categories of the theory wherever they were available and applicable (i.e., Common Knowledge). We have used our own interpretation and understanding for defining sub-categories in situations (i.e., Implicit Coordination) where either Grant's paper did not provide detailed definitions, or the theory was not sufficient to describe the issues related to distributed teams. Therefore, whilst we could categorize all of our codes under the high-level concepts of the theory, the sub-categories were partly adopted from Grant's work.

3.4 Threats to Validity

The validity of an empirical study (e.g., a case study) indicates the trustworthiness of the reported findings. Hence, it is important to discuss the validity threats in order to enable readers to assess the reported results. In the following paragraphs, we describe the potential validity threats to our study based on the four tests that are typically used for evaluating a case study's findings [59, 66].

- **Construct Validity:** This validity test concerns the extent to which a researcher has developed operational measures and decreased impact of subjective judgments. It questions the validity of constructing concepts against research objectives. Yin [59] enumerates different tactics to alleviate threats to construct validity such as triangulation and getting case study findings reviewed by informants. Triangulation is a well-known tactic to increase construct validity [59, 66] by taking different angles towards the phenomenon under study so providing a broader spectrum. It is primarily obtained by collecting data through different sources [59] such as employing different data collection methods and/or selecting a variety of informants to hear perspectives of different roles in different locations. Runeson, Host and colleagues [67] [66] discuss that collecting data by a team of researchers rather than a single researcher helps decrease the risk of being biased and contributes to triangulation objective.

In this study, we tried to address the potential validity threats using triangulation technique. We used different data sources including interviews from both perspectives of the onshore and offshore sites, observation of a couple of work-related meetings and artifacts (i.e., calendars). During the interviews, we extensively used open-ended questions, taking notes and providing complementary explanations to interviewee whenever required. The majority of the interviews were conducted in collaboration of both authors. It was specifically beneficial to complement the discussion points and remaining on the topic given the open-ended nature of the questions. The first author conducted the majority of the data analysis; in case of any doubt, discussions were organized with the second author for carefully checking the findings. Yet, given the nature of qualitative data, the results are based on our understanding and interpretation. It is worth noting that we discovered a set of patterns of interactions (social and work-wise) between hosts and visitors based on the organized meetings in their calendars. Given the small number of the participants in each meeting, we have assumed that all of the participants in a meeting have

⁴ - <http://www.qsrinternational.com>

interacted with each other. As we were not present in all of the events, we could not precisely verify if this was the case.

- **Internal validity:** This validity test is a concern for causal or explanatory studies, but not relevant for exploratory studies. It questions an investigator's logic for making causal relationships between different concepts (e.g., x leads to y) [59].

This paper presents findings based upon an exploratory case study using qualitative data. As a promise of an applied research method, the findings have resulted from continuous interpretations and inferences of researcher(s) from the explored phenomenon. However, it is not categorized under causal studies to prove logical relationships between the studied concepts; so it is not objected to internal validity threat.

- **External validity:** This validity test questions whether a study's findings are generalizable beyond the study. One of the typical arguments about the case study research method is that it fails to generalize the results. Yin [59] describes that this argument has roots in differences between statistical and analytical generalization. A case study presents its findings based on the investigation of a phenomenon in its real-world context. However, it differs from other research methods that report findings from statistically representative samples drawn from a population [59, 67]. Rather in a case study, the attempt is to enable analytical generalization of findings to the cases with similar characteristics, e.g., context. Yin [59], suggests that tactics such as using theory in single-case studies could be helpful to increase external validity of findings. Our findings in this paper are based on a single case. Hence the results are only applicable to a similar organizational context (e.g., size of organizations and teams, project domain, and distribution dimensions).
- **Reliability:** This validity test raises concerns about the extent that the results of an analysis are dependent on a researcher [59, 67]. Reliability is also dependent upon the rigor with which a researcher has documented the steps taken and decisions made; so that other researchers could replicate the process. In this study, we have tried to address the reliability threats by documenting all the steps taken during data collection and analysis. In regard to the calendar data sources, we have collected the digital copies of the calendar entries and organized them into excel spreadsheets associating with all the notes that we took for clarifications. In regard to the interviews, we prepared interview questions beforehand and organized digitally. For the sake of reliability and refer-ability all the interviews were audio recorded and verbatim transcribed. Given the nature of the interview questions being open-ended, transcriptions were used to extract follow-up questions that we asked during the discussions held with different interviewees. We performed all the analysis using digital means, which enabled us to easily navigate between results from different data sources, refer back and revise them whenever it was required. We utilized Microsoft Excel for analyzing the calendar entries and identifying themes of the meetings. Gephi was used for visualizing the patterns of interactions. Besides, all the interviews were analyzed using Nvivo through which, all the extracted data and coding scheme are recorded.

4 Findings

This Section presents the results from analyzing all types of data gathered for this study.

4.1 Socio-Technical Interactions During the Visit

In this Sub-Section, we present our findings from the analysis of the calendar entries and clarification remarks provided by the participants. Based on the calendar entries, we distinguished between two types of activities planned for the visitors including professional meetings and social events. Professional meetings refer to all the meetings arranged with different members of IT department at the onshore company. Social events cover all the major social activities that were anticipated in the calendar entries. We confirm that socio-technical interactions were beyond this schedule, which is hard to measure. Figure 2 shows that the visitors were given desks in an open space area. They were sitting close to the onshore software development team members. The sitting was expected to enable the hosts and the visitors to have frequent informal chats during lunchtimes, at the coffee machine, and during ad-hoc outings for shopping.



Figure 2 – Sitting arrangement for the visitors alongside the onshore team members in Denmark.

Nevertheless, the calendar entries enabled us to estimate approximate number of hours. Figure 3 represents the total number of person-hours spent on professional meetings as well as on social events according to the calendars entries. The numbers are calculated based on the following formula:
*Sum (number of hours of an event or meeting * number of participants in that event or meeting)*

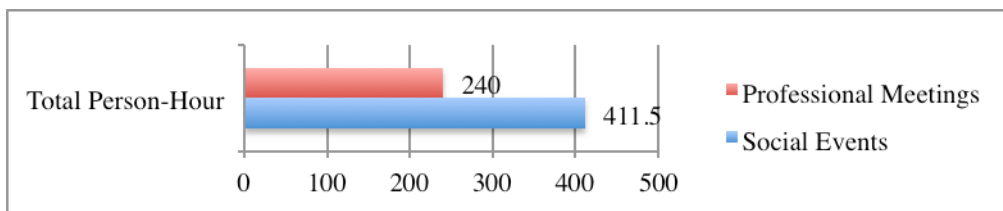


Figure 3 - Distribution of Total Person-Hour based on Professional Meetings vs. Social Events

The use of Person-Hour enabled us to consider in our calculation the weight of the spent hours based on the number of the participants. It helped us to normalize the differences in the visitors' schedules for participating in different activities. Based on the estimations from the studied calendar entries, we observed that there was a significant emphasis on social activities during the visit. Most of the social events were arranged after working hours or on the weekends; however, approximately 45.5 out of 411.5 person-hour took place within the working hours.

4.1.1 Professional Meetings

Having analyzed the calendar entries, we placed the professional meetings into three categories: organization, functional teams and project, as it can be seen in Table 3. Managers and team leaders mainly attended the organization category meetings. Typical company management meetings were regularly happening at onshore company for general updates, discussions, and planning. However, the company found temporary collocation as an opportunity to get offshore project manager involved and also plan for future to run these meetings at the level of virtual organization (i.e., onshore and offshore companies). At the time of this study, the onshore company was holding sessions for introducing some changes in the virtual organization structure and initiating process improvements. Physical presence of visitors enabled engagement of offshore representatives in these meetings to grasp the discussion points and having sayings in changes.

Table 3 – An Overview of the Professional Meetings

	Theme of Meeting	Participants' Remarks about the Purpose of the Meetings
Organizational - Level	Company Management	<ul style="list-style-type: none"> General updates, discussing issues and planning as a common practice of onshore company. Aiming to involve offshore site in these meetings in future.
	Process Improvement	<ul style="list-style-type: none"> Analyzing changes to improve process of project initiation. Introducing Quality Assurance team at offshore. Updates in virtual organization structure (including offshore and onshore members).
	"What Team" Meetings	<ul style="list-style-type: none"> Practicing frequent communication between the members of newly defined virtual team (i.e., called "What Team" which is responsible to regularly interact and monitor implementation of improvements in project initiation).
Functional Teams - Level	Project Management	<ul style="list-style-type: none"> Random project management meetings with different members about projects plans, deploy evaluation and assessing project initiation documents.
	Meeting Process & Usability Team	<ul style="list-style-type: none"> Discussing Standards for developing front-end (e.g., use of jquery vs. Telerik controls). Discussing Structure of Functional Specifications, Mockups and linkages between them. Discussing provision of Message Library to standardize all messages given to end-users.
	Meeting Infrastructure Team	<ul style="list-style-type: none"> General optimization of infrastructure services for developers. Discussing procedure of Change Requests.
	Meeting Help-Desk Team	<ul style="list-style-type: none"> Discussing future close collaboration of help-desk with newly defined Quality Assurance Team.
	Meeting Data Team	<ul style="list-style-type: none"> Technical Discussions.
	Meeting Development Team	<ul style="list-style-type: none"> Discussion about achieving loosely coupled architecture. Discussing kick-off a project assigned to the developers on both locations.
Project - Level	Project Specific Meetings	<ul style="list-style-type: none"> Focused discussion about current features, issues and plans for next releases.
	Meeting End-Users	<ul style="list-style-type: none"> Informal introduction of offshore technical team to end-users. Formal meetings with focused discussion on features of the system.

For instance, one of the objectives of the changes was to form Quality Assurance (QA) team at the offshore site. Hence, one of the offshore developers also got engaged in these sessions due to anticipated change in his role for leading the QA team to be set up. Furthermore, based on the new changes, the offshore project manager was given a critical role to closely collaborate with senior architect and project management lead in Denmark. These three members were forming a new virtual team, called "What Team", to monitor the implementation of process improvements and portfolio management. The temporary collocation provided the "What Team" with an opportunity to initiate and practice regular meetings that were meant to continue from distance in future.

At the level of functional teams, we observed several sessions arranged for visitors with different teams including process and usability (P&U), development, help-desk, infrastructure and data. These meetings were mainly scheduled for offshore developers and aimed at broadening face-to-face interactions between distant members. There were various themes of discussions. Some (e.g., help-desk and infrastructure) covered more generic topics while some others (e.g., P&U) were allocated to detailed discussion of issues. Since most of the visitors were developers, we were expecting more technical interactions scheduled between developers from both sides. However, this was not the case.

The visitors met onshore development lead for general discussions. They also participated in a technical meeting with one of the developers for starting a common project. There was no meeting scheduled with other onshore developer since they were not having any joint project at that time. Several short meetings were scheduled for offshore project manager with different onshore team members. The topics of those meetings were general project management issues such as projects plans, deploy evaluation and assessing project initiation documents.

For the project category, we classified project-specific meetings that were organized for the visiting developers to closely work with their direct onshore project manager. All the 3 visiting developers were dedicated to a specific project for maintenance and enhancement of a legacy system. Through several hours of focused consultations, the current features of the system and issues were discussed with onshore project manager for drawing plans for the future releases. The project manager also organized face-to-face meetings of the visiting developers with the end-users of the system being used in different departments such as finance, marketing, editorial and production. These meetings varied from informal introduction to more formal discussions about different features of the system.

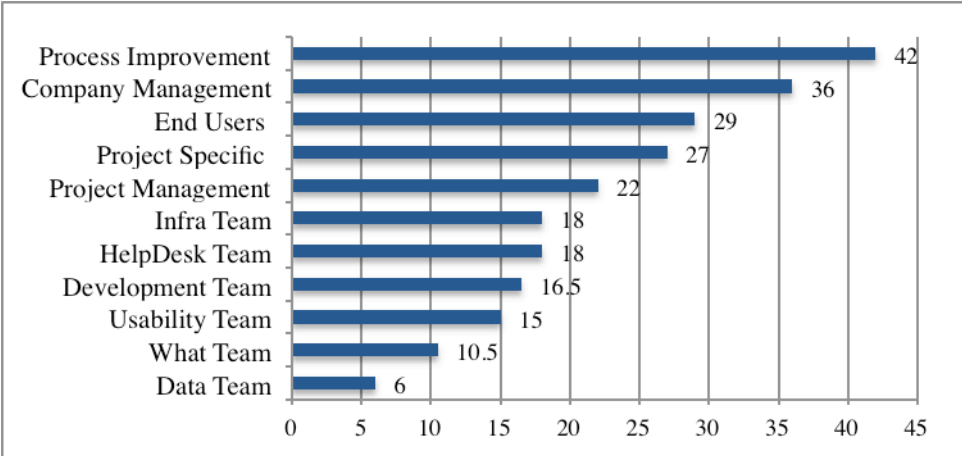


Figure 4 - Distribution of Person-Hours based on Professional Meetings

Figure 4 shows the distribution of the person-hours based on the professional meetings. The highest number of the person-hours belong to organizational-level activities namely company management and process improvement. A high number of the person-hours for these activities indicates a large number of participants in these meetings. There were investments on project-level meetings both with onshore project manager and end-users. For the functional-teams category, except meeting with data team, the distribution of the person-hours is almost in the same range with no significant difference.

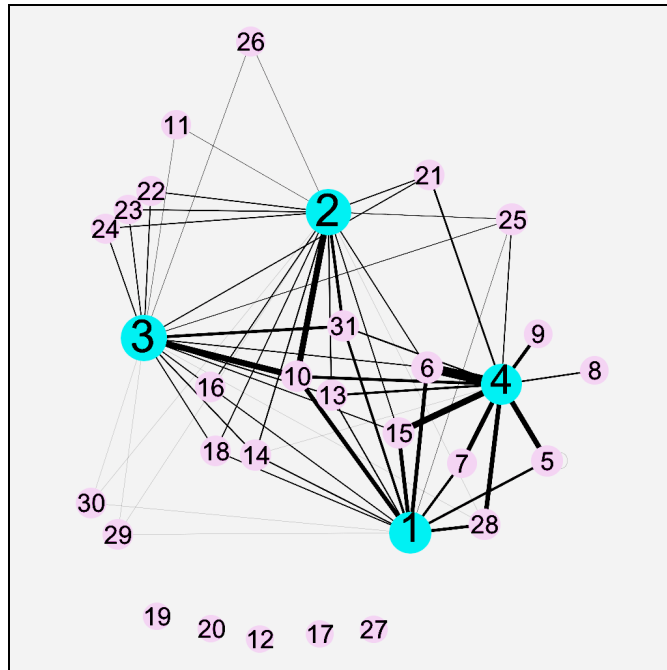


Figure 5 – The Patterns of Interactions through Professional Meetings (Onshore Members: Pink, Visitors: Blue)

Figure 5 and 6 visualize the patterns of the professional interactions between visitors and hosts during the visit. Gravity of the edges indicates the intensity of the professional interactions between each pair of nodes. Figure 5 demonstrates the overall view including all the participants that are differentiated based on location using a color scheme (i.e., Onshore members: Pink, Visitors: Blue). Figure 6 presents a closer look to the patterns of interactions for each visitor. In this graph, we have organized the nodes based on their corresponding roles.

As it can be seen, offshore project manager (i.e., annotated with number 4) highly interacted with the management team. He spent a significant number of hours with the senior architect (i.e., annotated with number 6); with whom they were allocated to “*What Team*”. Yet, professional interactions of offshore project manager with other functional teams were limited to leaders (i.e., annotated with numbers 9,13, 15, 21, 25 and 28).

However, the schedule of the offshore developers (i.e., annotated with numbers 1,2 and 3) represents significant project-level interactions. According to the interaction visualization, all the visiting developers highly interacted with their direct onshore project manager (i.e., annotated with number 10). They spent a good amount of time with end-users from different departments (i.e., annotated with number 31). In addition, they participated in meetings with most of the team members in different functional teams including team leaders. As previously mentioned, one of the developers (i.e., annotated with number 1) was having slightly different schedule from other ones; he participated in “*process improvement*” meetings with the management staff for discussing the details of the changes anticipated in his role. Thus, there exist edges between the nodes representing him and the management team.

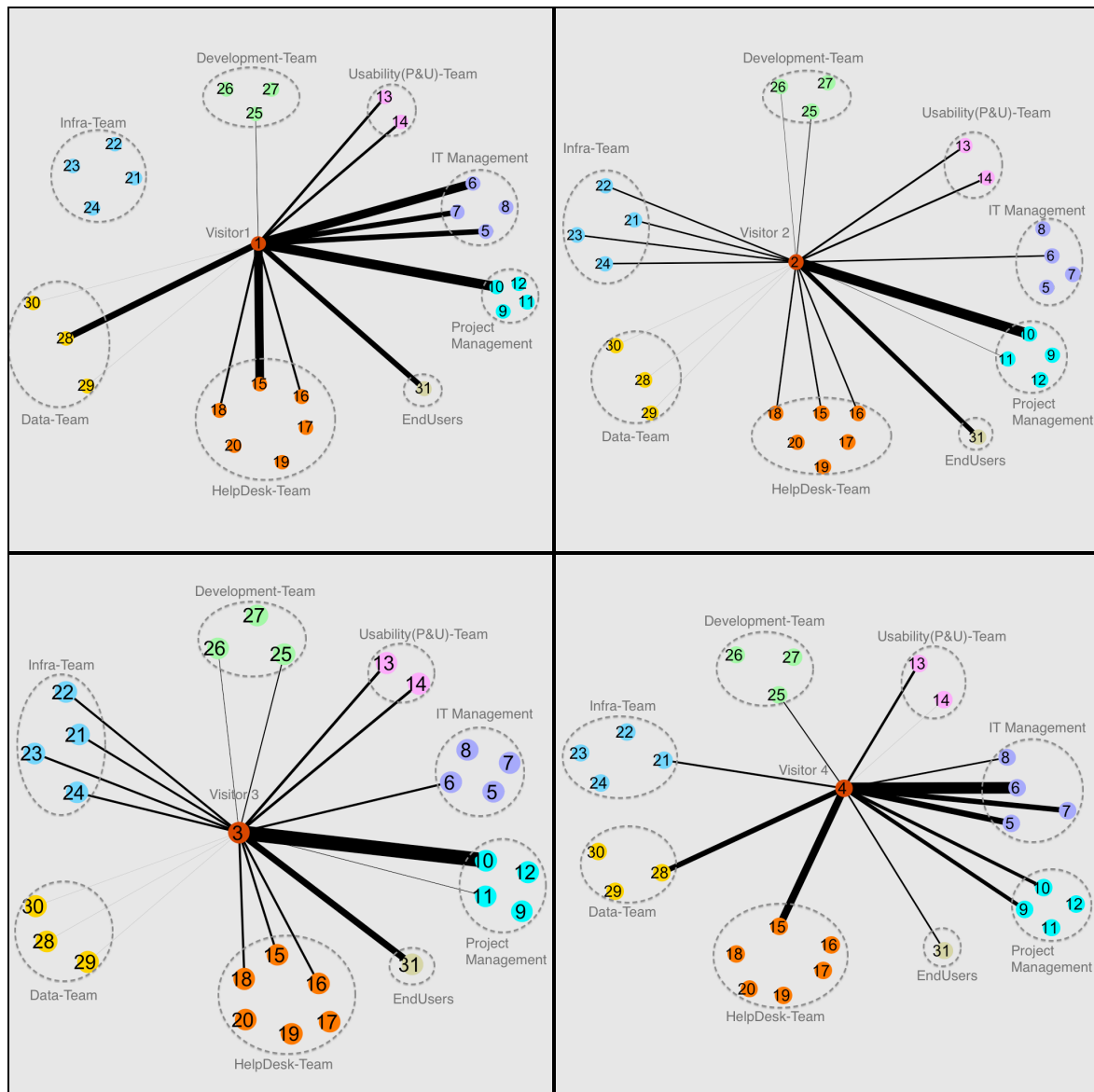


Figure 6 – The Patterns of Interactions through Professional Meetings demonstrated for each visitor (Visitor 4: Project Manager, Visitor1, 2,3: Developers)

Looking at the graphs, we can observe some of the onshore members did not participate in any meeting with the visitors including individuals from project management and help-desk teams (i.e., annotated with numbers 12, 17, 19, 20, 27). We understand that it was because of unmatched schedule, as the participants provided no particular reason in this regard.

We can understand that the specific professional objectives were followed during the short period of the visit. Firstly, most of the meetings purported to workshop on different aspects of the software development process improvements for sharing knowledge with the representatives of the offshore company in face-to-face meetings. These meetings were building ground for collaboratively rolling out process changes at both sites, as we reported in [68]. Secondly, there were also meetings aimed at effectively sharing the project-specific knowledge between sites. That is why the visiting offshore developers were scheduled to spend a significant amount of time with their project manager and end-users of the systems that they were developing and/or maintaining. In addition to the main objectives of the visit, we also observed that the visit was also aiming at broadening the network of connections between people at both sites. Organizing face-to-face meetings with different functional teams (e.g., infrastructure and helpdesk) provided an opportunity for distant team members to have direct interaction and get to know each other. Many of these members were not directly in touch with each

other because their work assignments did not require any interaction but it was anticipated that they would need to interact as a result of the planned process improvement changes.

4.1.2 Social Meetings

We have enlisted and categorized the social meetings during the visit in Table 4. We differentiated between events organized at the level of company and socialization initiatives taken by individuals. Our analysis of the calendar entries revealed several social meetings organized during the visitors’ stay as shown in Table 4. They varied from organized lunches and dinners with company management, project managers, team leaders and the whole IT department. The visitors were also invited to their Danish colleagues’ homes, where they had the opportunity to spend time with the family members of their colleagues aimed at showing hospitality and familiarizing visitors with the Danish culture. There were also initiatives from individual Danish colleagues to spend time with the visitors over the weekends and holidays to show the tourist attractions in Copenhagen.

Table 4 – Overview of Social Events

	Social Meetings	Participants’ Remarks
Company Event	Lunches with company management	Few lunches (i.e., considered as free time) planned for visitors with the company manager.
	Dinner with project management team	Organized dinner for visitors with all project managers.
	Dinner with whole department	Organized dinner for visitors with all the onshore team members.
	Weekly social breakfasts	Friday’s breakfasts with coffee and snacks. A typical practice of onshore company participated by all team members.
Individual Initiatives	A quick tour around the city	Meeting visitors in the lobby of hotel at arrival day and taking them around the city for few hours. It was initiated by one of project managers and the change manager (i.e., from IT management team).
	Full day trips to landmarks	During the weekend two full day trips planned for visitors: <ul style="list-style-type: none"> - Biking to a city landmark and spending afternoon at house with family- initiated by one of developers. - Driving to few tourist attractions initiated by the company manager and senior architect.
	Breakfast at a project manager’s house	Organizing a meeting at the project management house: a semi-social event.
	Dinner with family of project management lead	Inviting offshore project manager for dinner at house with family – Initiated by project management lead as one-to-one event.
	Dinner at HR’s house	Organizing dinner for visitors at house of HR (i.e., from IT management team); also participated by management and team leaders.
	Full day visit to senior architect’s house	Inviting visitors to house and meeting family – initiated by senior architect.
	Shopping	A few hours allocated to go to shopping places – initiated by P&U leader for one of developers as one-to-one females activity.

Figure 7 visualizes the patterns of interactions based on social events. Our analysis of the data revealed a fully connected graph that indicates participation of all the team members in social activities. The corresponding nodes to visitors are located at the heart of the graph (i.e., annotated with numbers 1-4). Looking at the graph, we recognize that the strongest links of social interactions exist between visitors and management team, specifically with company manager (i.e., annotated with number 5) and senior architect (i.e., annotated with number 6), which can derive different interpretations. One of the reasons for that interaction could be making use of the calendar entries that included all the *planned* social events by the company in which the management team was always included. We also observed that the managers also participated in some of the individually initiated social activities (e.g., city tours and home invitations). Hence, it can be interpreted the company’s strategies were meant to emphasize on building and strengthening social ties and eliminating hierarchies for offshore development team through the visit.

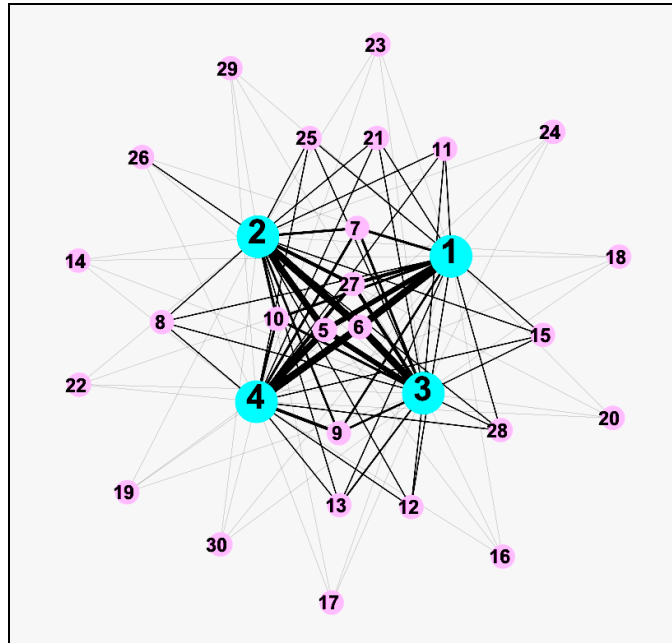


Figure 7 - Pattern of Interactions through Social Events (Onshore Members: Pink, Visitors: Blue)

Our analysis also reveals that the onshore project manager (i.e., annotated with number 10) is also close to the center of the graph. That means not only professionally, but also socially, she actively interacted with the visitors. This observation could support the idea of strengthening social ties between offshore team and their direct onshore project manager that could facilitate close interaction and knowledge exchange between them about a particular project through virtual means. The graph of social interaction also demonstrates that social events have complemented professional meetings in terms of providing opportunity for face-to-face interactions between dispersed colleagues. We observed that onshore development team (i.e., annotated with numbers 25, 26, and 27) have taken relatively active participation in social interaction with the visitors. Though, the short duration of the visit did not provide the visitors and the hosts with an opportunity to have longer professional meeting with each other. Given the individual initiatives of the onshore developers for socialization, it can be interpreted that it was due to their tendency to get to know their offshore counterparts personally, which would have facilitated their communication and collaboration from distance after the visit. We observe social interactions were more limited to the ones organized by the management. It included few events in which most of the onshore software development team members participated; others were limited to the participation of the team leads (i.e., annotated with numbers 9, 11, 12, 13, 15, 21, 25, and 28), that is why these nodes are connected to the visitors with stronger edges.

4.2 Analyzing Site Visit from Knowledge-Based Perspective

In this section, we present the findings of the visit from a knowledge-based perspective utilizing conceptual elements of the theory proposed by Grant [7] and described in section 2.1.

4.2.1 Common Knowledge

As we previously mentioned, one of the elements of Grant's theory [7] is the existence of commonality between individuals' stocks of knowledge. The theory highlights that identifying intersections between individual knowledge sets is important for enabling individuals sharing the aspects of knowledge that are not in common [7].

Yet, in the context of globally distributed teams, distance prohibits the ability of remote team members to develop common knowledge [4, 58] due to a reduced chance for close interaction, sharing context and observing each other's behavior. Our findings suggest that temporary collocation provides

opportunities for team members to compensate impact of distance and develop common knowledge on different areas. Table 5 demonstrates results of our analysis and frequency of codes in regard to types of common knowledge as proposed by Grant [7]. Our results showed that not only the visit contributed to enlarging commonality of the specialized knowledge between team members, but also to develop common knowledge for symbolic communication, obtaining shared meaning, and recognizing individual knowledge domains.

- Common Knowledge for Symbolic Communication

Sharing official language (e.g., English) plays a fundamental role in verbal communication, yet it is only one aspect of the commonality of language. Individuals utilize other forms of symbolic communication that they develop through sharing geography, culture, and familiarity with each other. While learning official language could be relatively easy due to explicit instructions of grammar and vocabularies, symbolic communication rules could not be simply shared due to their tacit-ness and embedded-ness in the context of individuals' behavior, however, missing symbolic clues could cause misunderstanding.

Our findings suggest that commonly sharing tacit knowledge on social aspects as one of the significant achievements of the visit. Spending two weeks together enabled hosts and visitors to grasp each other's culture and personal life. For example, inviting remote colleagues to Danish homes, getting familiar with family members and lifestyles brought informal atmosphere through which people started to know behaviors and beliefs. One of the interviewees reported:

“They were grateful to see our environment and what we do for lunch.”-P6, “They came to my place and had dinner with my wife and kids. That was nice to getting to know each other personally.”-P5

The interviewees appreciated face-to-face interaction for getting to know each other. This experience enabled them to start understanding facial gestures, tones of speaking, and attitudes that are not easily understandable through virtual communication. The visitors also observed the differences in the working styles of their counterparts by observing their daily activities at work. Such observations were helpful to understand the need of and justification for distribution of workloads, extended working hours and commitments towards deliverables. A few interviewees reported in the following words:

“At offshore it is common to think everyone in DK is enjoying life and not have much tough time. But, here we realized how mature are these guys, they don't nag!”-P4, “Here, everybody is in the office at 8:00 am and nobody sits until late; it is their culture.” -P2 “so we gained a lot of common understanding and respect to each other”- P2, P4

Temporary collocation also provided team members more opportunities to have casual talks, observe each other's work context, freely discuss difficulties they face and raise expectations in a friendly atmosphere. The visiting developers observed the size of onshore company and the distribution of business departments within the organization. They experienced direct interactions with the end-users and observed the difficulties of the onshore colleagues for sourcing requirements from customers, getting questions clarified and dealing with requirements changes. One interviewee shared:

“Previously, we were sometimes feeling that [onshore people] did not give us the requirements correctly and changed totally after like two days. We now realize that it's not their fault. It's the end-users that don't give them requirements like on piece of paper and keep on changing because they don't know what they actually want. So these guys also face tough time here.”- P2

- Commonality of Specialized Knowledge

Having team members with a variety of specialized knowledge is beneficial for companies as sharing and integrating knowledge between them could create value, yet if individuals miss the knowledge basis, sharing and integration could not effectively occur between them [7]. In our study, we realized

this aspect of common knowledge as distance between specialized technical view of developers (at offshore) and broader knowledge about software product and its business domain (at onshore).

Our findings show that the visitors appreciated face-to-face meetings with end-users to recognize how system is used. The offshore developers gained a better understanding of the needs, expectations, and reasons for the significant changes in the requirements after having direct discussions, observations, and listening to the users' of the systems they were developing or maintaining.

"We met customer groups and some end-users of our [current] project in different areas such as marketing and finance where our expertise is rare. That greatly helped us to know how they are using the system. We got to know their experiences, the problems they face and how they like to improve the modules." P1, P2

Complexity of business logics and calculation functions are enumerated as difficulties that the visitors have been dealing with to understand business requirements. Yet, interacting with end-users contributed to the visitors' knowledge about the domain by discussing the details of the business rules and observing different scenarios of using the system in reality.

"I've been working on a project that calculates the cost [of product] with all complex formulas to collect the sale points from different channels. [I had no idea related to calculation]. Now, I had the luxury to meet the finance guy and see how they actually using the system"-P2

Furthermore, the temporary collocation also provided an opportunity for sharing domain knowledge embedded in the Danish organization's context. We found that the onshore members utilized face-to-face interaction to show their offshore colleagues samples of real products (i.e., paper books) and sharing information about different products' attributes. For example, explaining differences between front pages vs. end pages, different types of leaves, bounding, pricing and corresponding Danish terminologies were the initiatives taken to leverage competency of offshore team in analysis and understanding of business requirements.

"I insisted on them looking at the books, feeling why it's important to have different bounds and why the hard cover is much more expensive than the soft cover. I also translate all the words for them. For instance, front-leaf in Danish is end leaf in English. I try to give them a lot of domain knowledge" – P11

In addition, the visiting developers were able to capture much of the project-specific knowledge during the visit. Close interaction with their direct onshore project manager provisioned a bigger picture of the legacy system, its dependencies to other systems and the longer plan of management for improvements. Our analysis shows that developers valued hearing about high-level knowledge of the project. They found it quite helpful to increase their capability in analyzing the enhancement features and making the detailed design decisions. Some of the visitors reported their observations in the following words:

"Now we have the overall picture and know how they want us to progress in certain direction. We know why this is the requirement and how it will interact with other systems, interfaces etc."- P1, P3.

"Now I can give them a valid reason of what will be the issue or important for them to improve. I can give them opinion about technology based on what they described about future and using third-party component for example." –P3

- Shared Meaning

One of the typical challenges of knowledge sharing is the loss of meaning during conversion of tacit knowledge into explicit form; hence the establishment of shared meaning (e.g., defining metaphors, stories) between individuals is suggested to facilitate sharing tacit knowledge and mitigating misunderstandings [7]. In the context of GSD teams miscommunication is more likely to occur due to distance and limited opportunities for observation and informal chats between individuals. Our

analysis suggests that temporary collocation of distributed team members could provide an opportunity for identifying and resolving miscommunications. A visit could be considered as a vehicle to establishing shared meaning through social means.

In this regard, we found that close interaction with onshore members and participating in technical meetings helped the offshore software development colleagues to share their minds and clarify misunderstandings. One of the noticeable misperceptions was in regard to sharing information through mock-ups (i.e., graphical design of user interface) vs. requirement specifications (i.e., static document). As a typical practice, usability team was employing a tool to share mockups in which they design appearance as well as sequence of different parts of user interface (UI). While the mockups were elaborative (e.g., included font size, color, spaces between components), identifying the details for all parts of UI was quite time consuming. Therefore, only a couple of main parts were designed thoroughly in the tool, while complementary explanations provided in the specifications. Nevertheless, in spite of spending time, deliverables received from offshore were not synchronized with the expected details and leading to several threads of emails for indicating issues and fixations.

Face-to-face meetings provided the visitors with opportunities to share their concerns and frustrations, which revealed the misunderstanding at offshore site. It appeared that the offshore developers assumed mockups as main source of knowledge that comprehensively indicates final appearance of application. Hence, they were not referring to complementary UI standards that were documented in requirement specifications. While this matter was rather simple to communicate, it was not resolved until both parties had the opportunity to discuss it face-to-face because they did not know the root cause of misunderstandings. One of the onshore members stated:

“We were getting annoyed of receiving deliverables that were full of flaws [...] even though we have been very careful in specifying things very detailed...now I just understand why it is like that”- P8

And one of the visiting offshore developers described:

“[Prior to our visit] we were considering the mockups [...] as being the pixel level requirements for the UI...We were developing all of that within exactly the same manner [...] but after talking to usability team we have come to know that this is just the mockup [...] and we have to develop UI based on the UI design standards that we have.” P1

Discussing this issue in face-to-face meetings also helped both parties sharing suggestions to improve their work without being defensive about their respective understandings and positions. Onshore members explained that:

“I was imagining they could take the specification and do [programming] directly from different parts but it seems [wordy document] does not support the way they work. They just don’t read it [laugh]... because they want to have mockup in one screen and do the coding in another screen. ”-P10, “We are going to make specifications easier to read and make them more visual.”-P8

Identifying misinterpretations, team members utilized the visit time to brainstorm about possible solutions that fulfill concerns of both parties. They discussed a generic guideline for user interface design and agreed upon improving the structure of the specifications from being static to visual. The offshore developers also offered to apply their technical knowledge to provide an application that could facilitate the implementation of the deliverables based on UI rules. Given the issue being generic, the visiting developers also confirmed to share the agreement with other offshore members back home to resolve the issue.

- Recognition of Individual Knowledge Domains

Knowing about the areas of expertise of individuals in a group facilitates effectively sharing and integrating knowledge through mutual adjustments [7]. This aspect of the common knowledge was not significantly reflected in our data. We can speculate that given the dynamicity of work structure and the size of the distributed team in our case study (i.e., small/medium), it was more likely that the team

members got to know each other's areas of expertise overtime. However, a close interaction of the distant team members during the visit empowered them to share information needs at each end and raise awareness on wishes for more elaboration in a friendly manner. For instance, the visiting developers could informally bring the knowledge of the onshore team members about their limitation from business domain and the areas on which they needed more explanations. One of the visiting offshore developers stated:

“The biggest challenge was that they were giving us business requirements in 2-3 lines which we had no idea about the background...we have tried to break this a lot in our visit that they need to elaborate more. I think they [onshore colleagues] now have better idea of us, where we stand in the business model, how they should give us technical details and how they should [communicate with us] business terminologies.” P2

Similarly, we witnessed that the visit facilitated knowledge exchange of offshore team with the help desk team members; in the sense that the help desk members know whom to contact directly for a bug, and offshore members provided more elaboration to their colleagues at the help desk. In this case, our interviewees underlined that the face-to-face interactions were helpful to strengthen the social ties between team members that enable them to understand what information was needed and why it was needed at the other end of the development team. One of the onshore team members indicated that:

“Often help-desk doesn't know much about the problem and the solution; but they are getting more information now from [offshore] developers than they did before. ...Because now developers see the reason for informing the customer [...] I think if you got social ties and you understand each other, you see need for information of both sides.” – P7

Table 5 - Developing Common Knowledge; Coding Scheme and Frequencies

Common Knowledge	Freq. (total = 47)	% Freq.
Symbolic Communication	16	34.04 %
Culture and Ethics	7	14,89 %
Personalities	6	12,7 %
Local Work Processes	3	6,3 %
Commonality of Specialized Knowledge	12	25,5 %
Business Domain Knowledge	9	19.1 %
Bigger Vision of System	3	6.38 %
Shared Meaning	14	29,7 %
Conflict Resolution about Requirement Artifacts	14	29,7 %
Recognition of Individual Knowledge Domains	5	10.6 %
Understanding Areas of Expertise and Information Needs	5	10.6 %

4.2.2 Enabling Implicit Coordination Process

Knowledge-based theory [7] considers coordination in a firm as mechanism to share and integrate knowledge between individuals, which varies from explicit (e.g. rules and standards) to implicit (e.g. group problem solving) approaches.

In the context of GSD, enabling implicit coordination between dispersed team members is challenging. One of the main reasons is difficulty to build social relation between distant team members. Social relations are considered a prerequisite for implicit coordination. Our analysis demonstrates that the temporary collocation was significantly helpful in building social relations and facilitating knowledge sharing for enabling implicit coordination mode. Table 6 summarizes the results of our analysis on this aspect of the study, including two main categories of “informality and openness” and “enabling offshore-end user communication link”.

- Informality and Openness

Our data analysis revealed that face-to-face interactions significantly helped the visitors and the hosts to experience more relaxed environment and feel comfortable in their communication. Knowing each other at personal level, familiarity with attitudes, values and culture raised confidence of the individuals to anticipate reactions at the other end. It was frequently raised by the interviewees that the temporary collocation helped them to become informal and freely talk about personal matters while mutually respecting each other's values. Some of the interviewees at onshore mentioned:

"[The visit] helped a lot with informality in our relationship." P5, "There is more social activity. We talk privately...share photos of our kids and so on. [Previously], we were afraid of joking with them ... afraid of stepping on their toes. But now we feel trusted, we can joke." P7

Our analysis of the available documents and presentations slides in the context of the interviewees' comments revealed that the visit also helped spread friendly atmosphere to the rest of the offshore team in Pakistan after the visit. It was clear that the visitors had shared their experiences from the visit to their colleagues back home. In addition to the technical learning, the visitors also talked with their colleagues at the offshore development center about the social experiences (e.g., showing pictures and describing personalities) that helped in improving social interactions with the onshore co-workers. One of the onshore members reported:

"They talk together and share information about us. After their visit, more people from offshore have contacted me...I've received invitations on LinkedIn from people that I didn't know." P7

Our analysis shows that fostering friendships between dispersed members had significant influence on ease of communication about work. The visitors explained an uneasy feeling of asking questions (referred as *"being hesitant"* - P1, P2, P3) they had prior to their visit. Despite the availability of the tools (e.g., Skype and videoconferencing) and no formal restrictions, they felt uncomfortable to ask simple questions and clarifying doubts on several occasions. Their hesitation had root in unfamiliarity with behaviors and fear of disturbing remote colleagues, exposing incompetency or simply being shy to interact. Nevertheless, the visit has notably helped them to overcome hesitation. Given our analysis, the visitors believed that becoming informal and talking about personal matters enable them to freely ask work-related questions, for instance to clarify the requirements.

"This informal communication has greatly made us relax and less hesitant to talk to them and grasp knowledge about requirements and all the stuff we need."-P1, "Sometimes, [when they were sharing business terms], it was just crossing over our minds. We were thinking is it ok to ask again and again the same thing? Or they may get annoyed...now after visit we've seen their work ethics and feel comfortable to ask because we know they don't mind questions." P2

From the perspective of onshore members, however, promoting friendship through face-to-face interactions was helpful to communicate direct or difficult messages to offshore (referred as *"hard way of expressing ourselves"*-P7). They believed that they could easily share their feedbacks about quality of work and need of improvements without being worry that offshore team may feel offended.

"Here in DK, I can go to developers and say this is not good enough, you have to do this and that. But, I should be more careful to do that on Skype to someone I've not met before. It may provoke reactions. Now, I feel more confident talking to them. I don't have to be careful how I express myself"- P12, "It's much easier [to talk] now when we know each other better. If you say good-job to somebody five times and then say you did a poor job... that's easier."- P6

- Enabling End user- Offshore Communication Link

Our analysis also revealed a noticeable impact of face-to-face meetings with end-users on building mutual trust between offshore and business parties. The findings show that meeting offshore developers in the flesh and having direct chats improved the confidence of the customers in the capabilities of the remote team members. It became clear that the technical meetings with the end-users provided both sides with an opportunity to hear each other's concern, express rationales, and have ideas about the existing expertise; that accordingly helped to break the stonewalls between them. The visitors and the hosts reflected on the impact of the visiting end-users in the following words:

"We had long talks with end-users and shown them our interest in how they use the system. That greatly improved trust between us." P1, "The most important thing is we've gained confidence with each other (users)." P3

"Users were thinking offshore company is not as good as Danish, but now that mindset has changed." P9, "[Users] got the confidence that [offshore guys] are good. They listened to what they were saying and saw some nice reasoning." P6

Hence, one of the most noteworthy outcomes of the visit was to enable virtual communication channel between the offshore software development team and the business units using different channels ranging from videoconferencing sessions to email exchanges. We witnessed that the onshore company started to organize joint meetings after the deployment of each release (i.e., related to the legacy system). After the visit, the visitors started getting more directly engaged in meetings with the business representatives through videoconference facilities to present the enhancement features, collect feedbacks and elicit requirements for the next releases. We also noted that the progress of this practice by including the offshore in different brainstorming sessions with the end users such as testing complex scenarios in order to improve the business domain knowledge at the remote site. One of onshore project managers stated:

"Next week we are having a testing with users. We sit here for two hours and test some sort of really [complex] stuff that has a lot of business [logics]... even we [in Denmark] don't understand it completely either and can't really test it without users. So [a visiting developer] will also join us in order for him to get on the same level as [our onshore developer]. We are trying to build up that knowledge in Pakistan as well.... Now users are here, in the house and they met [offshore developer]. So, the next step is having him on the screen, smaller. We can try to have virtual collaboration because they met him the other day." P6

This practice was very appreciated by those users that had fluency in English. They were also inclined to communicate directly with the offshore developers. They found the practice of direct communication with the offshore developers especially beneficial in emergency situations or when the corresponding onshore members were not available. We also found that some of the end-users started to exchange emails with the visitors after meeting them personally during the visit. In a couple of cases, they even used video-conferencing facilities available at the onshore company to contact the offshore developers on their own. One onshore project manager explained it as:

"When I was on holiday, one of the users had a problem and contacted [a visiting developer] directly. She did it on her own. She had a conference with him, went to the meeting room, sat and talked to him. He [offshore developer] showed her our work around and she could get on going with the work" P6

However, the interviewees also underlined that the offshore-customer communication did not mean excluding the onshore project managers from the ongoing dialogues, rather the project manager was kept in the loop. It was appreciated that the onshore project manager was present to facilitate communication of different viewpoints between the two parties, bridge linguistic gap, and maintain control on the areas of commitment.

Table 6 - Enabling Implicit Coordination; Coding Scheme and Frequencies

Enabling Implicit Coordination	Freq. (total = 68)	% Freq.
Informality and Openness	38	55,8 %
Ease of Expressing Direct Messages	4	5,8 %
Feeling Comfortable to Ask Question	14	20,5 %
Having Informal Chats	10	14,7 %
Spreading Good Feeling to rest of Offshore Team	6	8,8 %
Trust and Team-ness	4	5,8 %
Enabling Offshore-End User Communication Link	30	44,11 %
Mutual Trust between Offshore and End users	10	14,7 %
Virtual Communication between Offshore and End users	20	29,4 %

5 Discussion

In this paper, we have reported the design and findings from an in-depth empirical study of a site visit of offshore software development team members in the context of GSD. Our findings shed light on activities that took place during the visit. It has also highlighted the role of the visit in enhancing knowledge sharing between dispersed members.

5.1 Comparison with the Literature on the Site-Visit

Whilst organizing site visits is a well-known practice in GSD, there is a general lack of in-depth studies of sites visits' different aspects such as purpose of a visit, participants, duration, key activities and the outcomes. We assert that empirically founded detailed information about site visits and their contextual attributes can be useful for practitioners to understand the value of the site visit practice in GSD and how to design and implement the practice in a similar or different contexts. To the best of our knowledge, the most significant contribution in this regard has been made by Oshri et al. [54] in 2007 as well as a recent exploration of this topic by Hinds and Cramton [5] and von Stetten et al. [55]. These research efforts indicate an increased interest in studying and understanding site visits in the context of GSD. Our study contributes to the existing body of knowledge in several dimensions. It reports a longitudinal case study conducted in the context of Small/Medium sized Enterprises (SMEs). Hence, our study differs from the above-mentioned studies that have been carried out in significantly large organizations. Given the noticeable differences between SMEs and large companies in terms of budget, size of teams, type of projects, work practices and need of being competitive, we argue that organizing site visits usually follow different purposes and may be implemented differently in dissimilar types of organizations. Comparing our results with the existing literature, we have identified several similarities and differences and highlight the need of more research in this area.

- We investigated a 2 weeks visit organized for a group of offshore members (including 1 Project manager and 3 developers) whom they have been collaborating with onshore site for almost 3 years. It denotes that the aim of the visit was beyond the well known typical purposes such as introduction, collocated kick-off or extensive onsite trainings [55]. In fact, during the period of our study, we witnessed frequent visits (every 2-3 months) between sites at the level of company management. However, it is quite rare to organize visits for introducing newcomers or collocating the whole team for project kick-off. This pattern of site visits could be justified by limited budget of SMEs and underlines the importance of outcomes of the visit for the studied companies.
- Our findings demonstrated that hosting a group of offshore members in Denmark aimed at supporting and advancing existing collaboration model between sites. We previously mentioned that the studied teams were collaborating under extended team model that promotes close long-term collaboration of dispersed members [62]. Dynamicity of work structure and tightly coupled tasks, in deed, require high volume of interaction and sharing knowledge across the sites, which underscores importance of continuously establishing and sustaining social capital between locations to support work practices. Whilst we had observed that dispersed teams were closely working and highly communicating (e.g., via Skype and Videoconferencing) [62], our findings about the effects of the visit on relationships between sites are quite surprising. We found a significant impact of the visit on improving the openness in communication due to informalities

and friendships established during the visit. This observation could be justified by distinguishing between familiarity at a surface level and deeply embedded familiarities that are achieved through collocation period [5]. Our study also reveals that virtual communication and collaboration of team members had enabled them to develop familiarities to each other over the years. Nevertheless, temporary collocation provided opportunities of working side-by-side, observing day-to-day activities and participating in noticeable hours of professional and social meetings. It all resulted in deep understanding of co-workers from each other and developing common knowledge on different areas such as culture, personalities and ethics. It accordingly promoted safe and secured communication among dispersed members, which may not have happened over several years of virtual interaction. Therefore, we consider our findings in alignment with Hinds and Cramton [5] regarding the significant contribution of temporary collocation on situated familiarity and fostering closer relations between remote colleagues. However, we would like to state our observation about broadening communication network in addition to deepening existing relations. Our data suggest that the visitors got familiar with more members at onshore site, whom they were not having direct collaboration with. It was achieved through a wide range of professional meetings with different functional teams as well as participating in social events. Besides, visitors encouraged more communication links from the rest of the offshore team to onshore site by sharing their experiences back at home.

- We argue that in the context of our study, typically technical members with considerable experience and shared working history are the potential candidates for a temporary collocation period. Yet, different technologies (e.g., videoconferencing and IM) and strategies (e.g., flat communication patterns) are in place to strengthen social ties between sites before and after face-to-face interaction. This observation is aligned with the proposed lifecycle model of social ties by Oshri et al. [54] in terms of preparations before face-to-face meetings as well as the provision of technologies during the whole life-cycle. Nevertheless, our findings do not support the recommendation of utilizing face-to-face meetings for buildup stage, rather our findings emphasize on temporary collocation for renewing and sustaining relationships. We discuss that this difference could be specific in the context of SMEs in utilizing site visits, yet it deserves further investigation through in-depth case studies in different organizational contexts.

5.2 Analytical Value of Knowledge-Based Theory of Firm

Grant's theory provides the means to look into the dynamics of GSD teams from knowledge perspective among all the other different views (e.g., organizational, economic, and social) [7]. Our study has demonstrated the theoretical and analytical value of the knowledge-based theory of the firm [7] as a suitable framework for analyzing, understanding and interpreting the site-visit practice and its influence on knowledge sharing between GSD teams. It is worth noting that the theory [7] has neither been discussed in the context of software teams (i.e., involve in knowledge-intensive tasks) nor globally distributed settings. However, there are several avenues of revisiting the proposed arguments and further discussing them in the context of GSD.

We have built on the identified areas of common knowledge [7] to understand, structure, and present our findings that emerged from data analysis. We discuss that the interactions of GSD members during temporary collocation contribute in building a common ground in a wide range of areas including social and professional aspects that are complex to study. Our study has taken an initiative to characterize different dimensions of common knowledge that could be built during collocation period. Our effort in this regard can be used by other researchers to further study the suitability of the knowledge-based theory of the firm [7] as it provides a suitable framework to analyze and interpret the influence of visit on process of sharing and integrating knowledge between sites.

Grant [7] highlights that organizations implement different coordination modes for sharing and integrating knowledge including the explicit mechanisms (defining rules and standards) and implicit mechanisms (getting individuals engaged in high-volume communication). He further discusses that explicit mechanisms usually need to be supported by implicit ones, especially, when individuals deal with complex uncertain tasks.

We observed that in the studied case, there were already a number of explicit mechanisms (e.g., plans, schedules, documents, roles and responsibilities) in place that promoted sharing and integrating

knowledge between the sites. However, our results suggest that the contribution of the visit was more significant in fulfilling implicit mechanisms, which could complement the existing rules in the organization. Our analysis revealed a dense network of interactions including social and professional activities that took place between the hosts and the visitors during the visit. We have presented that the planned activities enabled the visitors to become familiar with the onshore team members from all the functional teams and also with some of the end-users. Our analysis of the social and professional activities during the visit represents an emphasis on developing and enhancing one-to-one communication between dispersed team members. Our findings reflect that the visit significantly facilitated interactions of the involved individuals by creating informalities and openness. Therefore, we argue that the visit gave rise to sharing and integrating knowledge between sites by building and strengthening interpersonal relationships, which is considered important for supporting the implicit coordination mode in GSD.

5.3 Promoting Business Domain Knowledge in Distributed Teams through Site-visit

In most of the GSD settings, all communication to business representatives goes through clients due to different reasons such as linguistic gap or client organizational policies. However, lack of access to customers can limit the ability of an offshore development team in gaining and understanding business domain knowledge [43]. In the context of our study, we observed an interesting and rare practice of the Danish company in putting the offshore developers in touch with the end-users. Our findings showed the importance of the face-to-face meetings was twofold:

- Several studies (e.g., [56], [49], [69], and [50]) indicate that remote visit helps the visitors to better understand the local context and leverages team learning. It has been discussed that temporary collocation of vendor staff at onsite helps create mutual understanding of background information and realize how end-user uses respective system [49], as knowledge transfer not only takes place through dedicated trainings but also by observing coworkers. Our findings demonstrate that a close interaction with the end-users provided a unique opportunity for offshore developers to observe how the system is used in practice. It helped them to learn about business logics and perceive the domain within the Danish context (e.g., use of terminologies and rules).
- Organizing face-to-face meeting of developers with the end-users helped them to establish mutual trust and created space for virtual communication between the two ends. We found that this virtual communication link was potentially helpful to get offshore team engaged in workshops with end-users (e.g., negotiating and testing enhancement features) that can promote the business domain knowledge at the remote site.

5.4 Temporary Collocation in the light of “distance matters” Literature

Distance matters by Olson and Olson [70] is one of the most popular papers highlighting the importance of face-to-face (F2F) interaction and its related challenges in distributed collaborative work. The authors enumerate the key characteristics of F2F interaction such as: spatiality of people and work objects, shared local context, multiple information channels (e.g., voice and gesture) and sharing personal information. Drawing comparison between the collocated and distributed teams, Olson and Olson propose four dimensions of challenges (i.e., common ground, coupling in work, collaboration readiness and technology readiness) that are influential in distributed collaborative work in the absence of F2F interaction. The authors’ primary viewpoint is to realize the difficulties of collaborative work when the contributors are distributed, and in particular, understanding the mediating role of technology to support their collaboration. The findings of their study present one of the most fundamental arguments about the challenges of collaboration on intellectual work from distance, i.e., applicable to GSD in general. Since the publication of Olson and Olson study [70] in 2000, a significant amount of research has been conducted along those lines and discussed whether or not distance matters in GSD (e.g., [71], [72]). Bjorn and colleagues [72] have recently published a study in which the authors examine the proposed dimensions of challenges reported in [70]. The authors [72] conclude that while technology readiness is not a hurdle any more, the other dimensions are still critical for distributed collaboration. The findings of [72] also indicate a shift in the traditional

view towards work coupling, and suggest that tightly coupled work structure could support distributed collaboration by enforcing required interaction between distant members.

We argue that the distance framework [70] provides an underpinning argument for our study by characterizing the potential of F2F communication and its contribution in achieving a common ground among individuals. However, our study differs from the previous literature [70, 72] as we primarily look into the solution area rather than analyzing the challenges. In this study, we did not aim at understanding how the lack of F2F interaction could create difficulties for the team members; rather we focus on exploring the potential benefits that can be introduced by temporary collocation of members that are already distant (e.g., geographically and socio-culturally). At the same time, we can say that the distance framework could elevate different aspects of our findings as described below.

Olson and Olson [70] discuss that distance could impact the quality of exchanging information between contributors and can lead to misinterpretation. They argue that individuals can achieve a common ground through cues that they develop by observing and learning from a shared environment [70]. Moreover, a common ground can be built between two ends by getting engaged in negotiation and identifying conflicts. Distribution across geographical locations and societies not only eliminate interpretation cues, but also inhibits ease of negotiation that is needed for obtaining a common ground [70]. In this regard, Bjorn and colleagues [72] discuss that after almost 15 years from the study of Olson and Olson [70], it is a challenging task to build a common ground between GSD team members. Taking a step forward in this regard, the authors [72] argue that in the context of GSD the challenge of a common ground could be experienced in areas such as business domain knowledge and work processes and practices. There is a need of more investigation to identify different dimensions of common ground that matters in GSD and the practical solutions for addressing them [72].

Our study makes contribution in this regard and highlights some of the possible areas of common ground that can be developed through temporary collocation of GSD team members. Looking through the lens of Grant's theory [7], we have realized that temporary collocation enables dispersed members to develop a common ground in a wide spectrum overarching from social (e.g., culture, personalities, and ethics) to professional (e.g., business domain and system requirements) dimensions. Temporary collocation not only contributes to individuals' interpretational cues, but also facilitates conversation and negotiation of doubts and conflicts from distance. Our findings enable us to assert that visiting onshore site could be a promising solution for building a common ground of business domain knowledge, if it is leveraged to organize a F2F interaction between end-users and offshore visitors.

Olson and Olson [70] conceptualize the challenge of distance from the perspective of collaboration readiness, and discuss that provisioning technology is not sufficient if distributed parties are not willing to communicate and collaborate with each other through groupware. Bjorn and colleagues [72] further discuss that in the context of GSD, collaboration readiness is not only limited to motivational issues [70], but could also be investigated in conjunction with issues such as organizational setup and business relationship of the involved companies. We discuss collaboration readiness from knowledge sharing perspective due to the theme of our study. We recognize knowledge sharing as an embedded entity that contributes to the success of distributed collaborative work [73]. Our findings demonstrate that temporary collocation could contribute to collaboration readiness of distributed sites through bonding and relationships that are built via F2F interaction. This concept is manifested in informalities and openness in seeking and sharing information that the participants experienced after the visit. Our findings also reveal that how F2F interaction of the end-users and the visitors could break stonewalls and promote virtual communication between them. It was evident that even a short F2F meeting could promote collaboration readiness by building initial trust.

Olson and Olson [70] also highlight the challenge of coupling collaborative work between distributed locations. They opt for loosely coupled work structures that require minimal communication and coordination effort from distance. Since their study, there has been plenty of research on that aspect of GSD. For example, some researchers discuss loosely-coupled work structure in relation to Conway's law [74] and suggest an architecture-based coordination mechanism [75] that emphasizes the assignment of product components to distributed sites. Carmel and Agarwal [15] propose tactics to alleviate intensive interaction between distributed sites over project life-cycle. Whilst loosely coupled approach enables distant sites to work independently, it is associated with issues such as masking important interface information and introducing integration risk due to missing communication links

between team members [76]. Herbsleb and Grinter [75] argue that using an architecture-based coordination mechanism without addressing the crucial role of flexible ad-hoc communication between distant members may lead to potentially high cost of incompatible interfaces at integration phase. In addition, this type of isolation usually results in knowledge of particular work-items sticking to a single location [27] and decreases the chances for sharing knowledge between sites. There is evidence that some GSD teams implement interdependent work structure in practice. For instance, the results of a study by Boden et al. [43] show that in the context of small/medium sized organizations employing this type of work structure supported agility, knowledge sharing and double-loop learning between distributed members.

In the context of our study, we observed the implementation of an extended team model between remote locations in which distant team members worked as a unified team on interdependent tasks. We have previously reported on dynamicity of their work structure that was manifested in the diversity and multiplicity of projects running in parallel [62]. Given the customers' demands, several SME projects were being carried out simultaneously with allocation of human resources from both sites. Fulfilling dynamicity of the work structure derived a variety of project team setups based on the availability and the required skillsets at both locations. As a result, the team members were allocated to multiple projects at the same time and were closely collaborating on different phases of the projects. We argue that the dynamic and interdependent work structure between sites that was already in place, could explain the pattern of interactions (i.e., socially and professionally) that we observed during the visit. It was evident that the collocation period was utilized to broaden and strengthen communication network between offshore site and all the other functional teams (e.g., helpdesk, usability, infrastructure, and project management and development) in Denmark. It was also used to enable collaboration of a key virtual team (i.e., What Team), which was expected to highly interact from distance. Given our results, we can state that temporary collocation of distributed members can be an effective means to support implementation of tightly coupled work structure in distributed settings. We assert that F2F interaction contributes to common knowledge of individuals and forms social relationships, which facilitate high-volume of interaction that is required for interdependent work.

6 Conclusion and Implications

This paper reports our research effort aimed at exploring the practice of site-visit in GSD and understanding its influence on facilitating knowledge sharing between distributed teams. Based on a rigorous analysis of the collected data for this case study, we can conclude:

- (i) Key themes of the interactions during the collocation period included professional meetings (i.e., Organizational-level, Functional Team-level, and Project-Level) and social meetings (i.e., Company events and Individual initiatives), where relatively larger number of person-hours was allocated to social meetings.
- (ii) Analyzing the patterns of interactions showed that temporary collocation was utilized for: a) broadening communication network of the visitors through F2F meetings with the members from all the different functional teams (e.g., helpdesk, usability, infrastructure, and project management) at onshore, b) enabling collaboration of defined virtual teams (e.g., What Team and Quality Assurance) from distance, c) potentially discussing and analyzing process improvements between sites, d) close interaction of offshore developers with onshore project manager for project-specific discussions, e) organizing F2F interaction of offshore visitors with the end-users in Denmark.
- (iii) Temporary collocation contributes in developing common knowledge between globally distributed teams in the following areas: symbolic communication (e.g., culture and ethics, personalities, and local work processes), commonality of the specialized knowledge (e.g., business domain and bigger vision of system), shared meaning (e.g., conflict resolution on requirement artifacts) and individual's knowledge domains (e.g., areas of expertise and information needs).
- (iv) Temporary collocation contributed in sharing and integrating knowledge between globally distributed teams through implicit mechanisms. It significantly promoted informality and

openness between team members. It also appears to have created space for enabling direct communication link between end-users in Denmark and development team in Pakistan.

The findings from this study have several implications for researchers and practitioners of GSD. This study provides empirically found information that can be useful for practitioners' understanding about organizing temporary collocation periods for dispersed members to enhance knowledge sharing. Practitioners can take into account the planned social and professional activities reported here and adapt the ones suitable to their organizational context. Our effort in measuring average person-hours spent on social and professional activities can be important input into the discussions about the required planning and investment for organizing temporary collocations. Our findings underscore the successful experience of the studied team in organizing face-to-face meetings of offshore visitors with the end-users, and demonstrate the positive impact of the meetings on virtual collaboration between two parties. Based on our findings, we can recommend the practice of meeting with end-users during sit visit to other organizations involved in GSD. However, it is important that the suitability of the practice should be carefully assessed with respect to issues such as collaboration model, the degree of familiarity and collaboration history between sites.

The findings are expected to make important contribution to the research literature on the role of temporary collocation in facilitating knowledge sharing in GSD. Researchers can use the results in several ways. For instance, our findings can be utilized and enhanced to define metrics for systematically evaluating the impact of temporary collocation on effectiveness and efficiency of knowledge sharing between sites and assessing Return On Investment (ROI). This endeavor may include getting inspiration from the high-level themes proposed by the knowledge-based theory of firm [7] and the detailed themes that have emerged from our study (e.g., common knowledge on personalities, common knowledge on business domain, ease of expressing direct messages, and feeling comfortable to ask questions) and investigate them quantitatively through further empirical research.

We argue our study address the gap of a general lack of empirical research providing in-depth insights into different aspects of site visits in GSD despite the site-visit practice is frequently followed for several reasons. Our study has also contributed to the research literature on this topic by critically investigating a temporary collocation period implemented in the context of Small/Medium sized organizations collaborating under an Extended Team Model. Given our familiarity with the studied case, we had an in-depth knowledge of the rationale for investing and organizing the social and professional activities during the visit. However, we believe empirical findings from other organizational context could be highly useful to understand how such visits can be leveraged to facilitate knowledge sharing between sites.

For the future work, we aim at designing and conducting a follow up study with the participants of this study to analyze the achievements of the visit on a long-term horizon. Furthermore, we are interested in understanding how a future site visit could be implemented in the studied case given the insights provided by our findings.

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Appendix A – Sample of Calendar Entries

Visitor 1 (Project Manager)		Morning	Midday	Afternoon	Evening
SAT	Arrival				
SUN		13:00 - H1, H2 will meet you in the lobby of your hotel for a small tour of Copenhagen.			
MON	First day in office	10:00 - 10:30 What Team Meeting (H3)	11:00 - 13:00 (with H4)	13:00 - 16:00 (with H4,H5, H6, H2, H8)	
TUE		10:11:30 (with H7)	11:30 - 13:00 Team Lead Meeting	13:00 - 16:00 (with H4,H5, H6, H2, H8)	Dinner with Prof. Babar
WED		9:00- 10:00 Project Plans Update (with H3)/ 10:00 - 11:00 WHAT team Meeting (with H3)	11:00 - 13:00 Lunch appointment (with H4)	13:30-14:00 Deploy evaluation meeting (with H9)/15:00 - 17:00 (with H4) will drop you at H3's place	Dinner at home with H3
THU		9:30 - 11:00 Feedback interview (with H5)	12:00 - 14:00 Management Team Meeting	14:00-15:00 Meeting with P&U team (H10)	
FRI		8:30- 9:15 Social Breakfast/ 9:30- 10:15 WHAT team Meeting	11:00 - 12:30 PID meeting/ 12:30 - 14:00 Lunch meeting (with H4)	14:00 - 15:00 About generic project plan (H3)	Dinner with Project Management Team
SAT					
SUN			Trip out of city and biking		
MON		10:00 - 10:30 WHAT meeting (H3, H5)		Private Visit with H5 and family	
TUE		9:00 - 16:00 (with H4, H5, H6, H8, H2)			Dinner at home with H11 and family
WED			Car Trip to out of City(e.g. Lego land)		
THU			12:00 - 14:00 Management Team Meeting	14:00 - 16:00 Join H1 for Project related meeting	Dinner with the department
FRI		8:30 - 9:15 Social Breakfast/ 9:30 - 10:15 WHAT team meeting (H3, H5)	9:00 - 11:00 could join H1 for visit customers		
SAT	Departure				

Note: All the names used in the calendar are replaced with Ids(e.g.H1) for the sake of anonymity.

* Social activities are highlighted with green color in the calendars.

* All the names used in the calendar are replaced with Ids (e.g. H1) for the sake of anonymity. Whole list of Ids with associated roles listed below:

H1: Project Manager	H2: Change/IT Manager
H3: Project Manager	H4: IT Manager
H5: Senior Architect	H6: Operation Manager
H7: Team Lead	H8: Data Manager
H9: Infrastructure Manager	H10: P&U Manager
H11: HR Manager	H12: Developer

Visitor 2 (Developer)		Morning	Midday	Afternoon	Evening
SAT	Arrival				
SUN			13:00 - H1, H2 will meet you in the lobby of your hotel for a small tour of Copenhagen.		
MON	First day in office	10:00 - 11:00 (with H8/ Data team) 9:00 - 12:00 (with H1/Project Meeting)	11:00 - 13:00 (with H4)	13:00 - 16:00 (with H1/Project Meeting)	
TUE				13:00 - 16:00 (with H9/ Infra team)	Dinner with Prof. Babar
WED		9:00 - 12:00 (with H6/ Helpdesk team)		13:00 - 16:00 (with H1/Project Meeting)	
THU		9:00 - 12:00 (with H1/ Project Meeting)		13:00-15:00 Meeting with P&U team (H10)	
FRI		8:30- 9:15 Social Breakfast			Dinner with Project Management Team
SAT					
SUN				Trip out of city and biking	
MON		10:00 - 10:30 WHAT meeting (H3, H5)		Private Visit with H5 and family	
TUE		10:00 - 12:00 (with H7/ Development Team)		13:00 - 14:30 (with H12/ Project Meeting)	Dinner at home with H11 and family
WED				Car Trip to out of City(e.g. Lego land)	
THU		10:30 - 12:00 (with H10/ Shopping)	12:00 - 13:30(with H10/ P&U team)	14:00 - 16:00(with H1/ Project related meeting)	Dinner with the department
FRI		8:30 - 9:15 Social Breakfast	9:00 - 11:00 (with H1/ visit customers)		
SAT	Departure				

Note: All the names used in the calendar are replaced with Ids(e.g.H1) for the sake of anonymity.

* Social activities are highlighted with green color in the calendars.

* All the names used in the calendar are replaced with Ids (e.g. H1) for the sake of anonymity. Whole list of Ids with associated roles listed below:

H1: Project Manager	H2: Change/IT Manager
H3: Project Manager	H4: IT Manager
H5: Senior Architect	H6: Operation Manager
H7: Team Lead	H8: Data Manager
H9: Infrastructure Manager	H10: P&U Manager
H11: HR Manager	H12: Developer

Appendix B – Interview Protocol

From Visitors:

- 1** What are the experiences and outcomes from your visit to Denmark?
 - * Was it helpful to build social relationships with onshore team? And how it influences your collaboration?
 - * Do you think that this visit could help you in asking questions from onshore team? If so, how?
 - * How the visit might have helped you in understanding requirements?
 - * Was the visit helpful to gain business domain knowledge? If so, how?

- 2** Have you shared your experiences from the visit with your team members back in Pakistan?
 - * If so, how? What was reaction of your colleagues?

From Hosts:

- 3** What are the experiences and outcomes from the last visit of offshore team to Denmark?
 - * What were the key objectives (socially and technically) of the visit?
 - * Was the visit helpful to share concerns of customers with offshore team? How?
 - * Was the visit helpful in sharing requirement knowledge? How?
 - * Have you transferred domain knowledge to the people who visited Denmark? If so, how?
 - * What kind of information people may not be sharing before and they started sharing afterwards?
 - * How do you transfer the feeling of comfort to enable them asking questions?

- 4** Do you think there has been any change (positive/negative) in your work and social relationships with remote team (Denmark/Pakistan) after the visit?
 - * How relations and communication have changed?

Note: The questions were open-ended. Given the role and insights of interviewees we got engaged in discussion and asked follow-up questions. Here, the main follow-up questions are also included that are marked with (*).