Global Software Development - Coordination and Project Management
Strategies from a Vendor Perspective

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ABSTRACT:
Global software development (GSD) is often impeded by global distance which may be geographical, cultural, temporal or linguistic. When compared to a collocated setting, specific methods are required to coordinate a range of activities in the GSD environment. Therefore, to manage and reduce global distance there is a need for continuous coordination within both client and vendor companies. Our literature review [Deshpande et al, 2011], shows that only 15% of the research studies for GSD are from the vendor’s perspective. There is a similar assertion made by Gonzalez et al (2006) where they identified that only 16% of the research studies explore outsourcing from the perspective of the service provider or vendor. Vendor companies have solved many of the global distance related issues. Both client and vendor companies need insight into these solutions which will assist them to successfully coordinate distributed projects. The research presented in this paper is addressing these gaps. Following our systematic literature review and empirical research within vendor companies, we have compared GSD coordination from the vendor perspective with the Project Management Body of Knowledge guide [PMBOK® Guide, 2008]. We have established that while the PMBOK® Guide partially supports GSD coordination within vendor companies, there are some solutions implemented by vendors but are not included in it. In this paper we present a comparative analysis between the human resource management techniques of the PMBOK® Guide with the coordination practices in GSD that in future will be incorporated into a model for coordination of tasks in GSD.

KEY WORDS: Global Software Development (GSD), Coordination, Project Management, Human Resource Management, Client, Vendor.
1. INTRODUCTION

Over the last two decades, software development has become increasingly geographically distributed across the globe [Sengupta et.al, 2006]. Various business motives such as local skills shortage, cost saving, entry into new markets, gaining competitive advantage in existing markets, mergers and acquisition and many more drive organisations towards distributed or global software development (GSD) [Herbsleb & Moitra, 2001]. Given the highly competitive environment in which companies operate, the client who is outsourcing and the vendor who is receiving this work have to enable themselves to operate successfully across geographical, national and international boundaries. However, GSD is mainly impeded by global distance [Carmel & Agarwal, 2001], which can be grouped into two categories - exterior and interior. Exterior distance is due to geographical, cultural and temporal differences and is recognised by many researchers, for example, Carmel & Agarwal, 2001; Casey & Richardson, 2006. The interior distance is formed due to organisational, technological and knowledge differences [Raylte et.al, 2008]. Organisational distance occurs when there are variations in the organisational structure and business processes of two organisations [Raylte et.al, 2008]. Differences in their methods of work, management of human resources, knowledge and the software development processes also exist [Bass & Paulish, 2004]. Where a software application is being developed, there may be inadequate domain knowledge. This triggers knowledge distance and knowledge gaps within organisations [Raylte et.al, 2008]. Dissimilarity in the technology used by various development sites causes’ difficulty in developing and maintaining the software which in turn creates technology distance [Raylte et.al, 2008]. All these distances make GSD and the management of GSD projects exceptionally difficult. The result of having these distances in GSD is that they draw out primarily communication, coordination, culture and control issues [Deshpande & Richardson, 2009]. When team members are collocated these issues tend to get resolved quickly and informally. However, in the GSD environment, it can often be difficult to know the right person to contact for resolution, thus often
causing them to spiral out of control. The fundamental problem of GSD is that many of the mechanisms that function to coordinate the work in a co-located setting are absent or disrupted in a distributed project [Herbsleb, 2007]. The literature on global software development gives evidence on how various tactics are applied to alleviate communication, cultural, coordination and control issues created by distances.

While each of these is of interest to GSD researchers, the research presented in this paper focuses on coordination – specifically through the management of human resources as defined by PMBOK® Guide, 2008. Coordination is necessary to manage interdependencies and achieve project goals, particularly when several actors are involved and multiple activities are performed [Malone & Crowston, 1990]. To firmly hold on to the project goals and policies, effective control over groups, tools and standards are essential in GSD [Carmel & Agarwal, 2001].

The PMBOK® Guide (2008) is a recognised standard for project management which describes the established norms, methods, processes, and practices that are also applicable to the software industry. As per the PMBOK® Guide (2008), managing human resource activities is an integral part of project management. In GSD, when software development projects are distributed it becomes essential to manage and coordinate human resource activities. The human resource management techniques mentioned in the PMBOK® Guide can be adapted to coordinate GSD projects. The following sections in the paper puts focus on coordination practices in GSD and human resource management activities from the PMBOK® Guide.

The paper is structured ahead as follows; Section 2 discusses the need for coordination in GSD, Section 3 describes the Research Methods we used to answer our research question and explains the rationale for using the PMBOK® Guide to underpin our study. Section 4 gives the overview of PMBOK® Guide. Section 5 compares coordination practices and strategies based on the Project Management Book of Knowledge (PMBOK® Guide, 2008). A summary of our research findings and concluding remarks are presented in Section 6.
2. **COORDINATION**

Effective integration of communication, culture and control in GSD requires ongoing coordination. This is due to the substantial dependency among various activities, exterior and interior distances and the effectiveness of various coordination mechanisms which differ in collocated, distributed and time-separated contexts [Espinosa & Carmel, 2004]. Coordination between software development teams is one of the very difficult aspects of software engineering [Begel et.al, 2009]. However, coordination is an interdisciplinary subject. For example, Malone & Crowston (1990) have studied coordination for computer science and define coordination as ‘the act of working together harmoniously and managing interdependencies between activities to achieve goal in which several actors are involved and multiple activities are performed’ [Malone & Crowston, 1994]. They state that coordination has four main components- goals, activities, actors and interdependencies. Thus, identifying goals, mapping goals to activities, assigning activities to actors and managing resources and interdependencies are the processes which should be included in coordination.

Outsourcing and offshoring tasks have become the norm in software development [Herbsleb et.al, 2001]. Problems relating to coordination of distributed software projects, teams and team members are constantly analysed and formalised. The GSD literature reveals several effective coordination strategies implemented and followed within companies engaged in global software development. The strategies followed are often original and innovative but their occurrences tend to be random and vary according to particular circumstances.

Additionally, research carried out by Richardson et al (2010) asserts that published software process models do not cater explicitly for GSD despite the recent growth in GSD internationally, and our literature review and focus group supports this assertion. We have confirmed that while there are strategies available for project management in software engineering (SE), there is no
particular focus on GSD. Vendor companies use standards such as the Capability Maturity Model Integrated (CMMI), ISO9000 and the Project Management Body of Knowledge (PMBOK® Guide) although these do not focus specifically on GSD.

We assert that to alleviate global distance problems and to benefit the GSD community for continued and effective management of projects, it is necessary to collate a set of proven project management techniques that relate specifically to coordination techniques. Therefore, we have identified our key research question as:

*Can we provide a strategy for overcoming various coordination issues and challenges encountered by vendors operating in a GSD environment?*

In this paper we specifically focus on the following related sub-question:

*Does the PMBOK® Guide (2008) help to address coordination techniques in GSD projects?*

3. **RESEARCH METHODS**

To address our research sub-question, it is essential that we understand what coordination techniques are used in GSD. To do this, we followed two steps. Initially, we carried out a systematic literature review [Kitchenham, 2004] to comprehend what research had been published on this topic. We then conducted a primary research study which explicitly focused on the perspective of the vendor engineers and management team. We used small but opportunistic and focused samples [Kuzel, 1992] within five multinational companies and one national company based in India. We conducted an on-line survey followed by telephone and face-to-face interviews. The preliminary findings of this research have been published in [Casey et.al, 2008] and [Deshpande & Richardson, 2009].

To support our identification of a standard which could be used as a basis for the provision of a strategy for overcoming GSD coordination issues and challenges encountered by vendor, we held a focus group with five expert practitioners who had knowledge of software project management.
standards. Facilitated by one of the authors, the experts discussed guidelines for coordination strategies that were found to work in practice. The results of this study informed our understanding of various standard documents and maturity models that are followed in the software industry and are relevant to the coordination strategy. On the basis of the inputs given by the focus group and the recent work carried out by Richardson et.al (2010) we identified that the PMBOK® Guide (2008) would be potentially useful to us in mapping the coordination strategies.

The recognised ‘good practices’ mentioned in the PMBOK® Guide is a set of knowledge and practices applicable to various projects and are contributed by the project management practitioners. The scope of the PMBOK® Guide extends over a wide range of topics relating to project management therefore it was necessary to understand its relevance to our research study. The focus of this study is given in our research sub-question, “Does the PMBOK® Guide (2008) help to address coordination techniques in GSD projects?”

In order to answer this question we performed the following activities. We took an in-depth review of the PMBOK® Guide to understand which good practices could be useful in conducting a comparative analysis. Based on a good understanding of all the sections in the PMBOK® Guide, we were able to identify specific sections within the guide that correlate to our current research work. This was achieved by comparing the PMBOK® Guide and the coordination techniques used in GSD. We established that the “Project Human Resource Management” section of the PMBOK® Guide includes the processes that organise, manage and lead the project teams. These processes are relevant to our research work. Therefore in this paper we explicitly focus on this section.

We recognised that the various techniques mentioned in the project human resource management section of the PMBOK® Guide are either corresponding or differing. Some activities mentioned in the PMBOK® Guide and are also performed by GSD teams. There are also specific activities mentioned in the PMBOK® Guide that are not performed by GSD teams but can be helpful from a GSD perspective. Therefore, we took three different views of how to map the coordination...
activities of GSD with the project human resource management techniques from the PMBOK® Guide. We categorised all the recommended activities into three distinct groups:

A. Activities in the PMBOK® Guide performed by GSD teams in practice.
B. Activities in the PMBOK® Guide not performed by GSD teams in practice.
C. Activities not in the PMBOK® Guide but are performed by GSD teams in practice.

4. PROJECT MANAGEMENT BODY OF KNOWLEDGE (PMBOK® Guide, 2008)

The PMBOK® Guide (2008) is a recognised standard for project management. It describes the established norms, methods, processes, and practices for a range of industries including the software industry and defines project management and related concepts. ‘Good practices’ in the PMBOK® guide are generally applicable to projects and there is consensus about their value and usefulness. It is recognised that the application of PMBOK® Guide skills, tools and techniques can enhance the chances of success over a wide range of projects. However, the knowledge described cannot always be applied uniformly to all projects and it is up to the project manager to determine what is and is not appropriate for any given project.

Within the PMBOK® Guide there are five sections - project human resource management, project communications management, project scope management, project cost management and project quality management. While we are interested in each of these topics, this paper focuses on the project human resource management strategy as a subset of coordination strategies.

Project human resource management includes ‘the processes that organise, manage and lead the project teams’ and the project team is comprised of the team members who are assigned specific roles and responsibilities for successfully accomplishing the project [PMBOK® Guide, 2008]. From the GSD perspective this section of the guide is important because it includes plans, tools and techniques that are useful in the management of the human resource required for the project – and this is where many of the issues and challenges arise in GSD.
5. **MAPPING GSD AND PMBOK® GUIDE**

In this section we present results of a comparative analysis of the PMBOK® Guide (2008) activities, to show where these overlap with our literature review and primary study research into coordination strategies in GSD. The results are presented in three subsections to list activities in the PMBOK® Guide that are also performed by GSD teams, followed by activities in the PMBOK® Guide new to GSD teams, and finally GSD activities not covered by the PMBOK®-Guide. Quotes that are drawn directly from our primary study are given in italics.

**A. Activities in the PMBOK® Guide performed by GSD teams**

We established that six activities are common to both GSD and the PMBOK® Guide.

i) **Networking** - Networking between the team members is essential to manage and coordinate project activities and has an influence on the effectiveness of projects [PMBOK® Guide, 2008, pg222]. Networking activities mentioned include proactive correspondence, luncheon meetings, formal and informal conversations during meetings and events. Networking is also important in GSD projects. One of the project managers we interviewed stated that:

   “Networking helps to build on effective communication, create good team dynamics and bring team members out of their boundaries to integrate them professionally and socially with other teams and team members”.

Along with the cases we studied, GSD literature has revealed various networking activities performed for distributed teams and team members involved in GSD projects. Techniques we have noted in our research include easily coordinated activities such as – giving team members an opportunity to spend time together socially so that they can discuss their project as well as matters relating to the project. Different social activities are organised for the team members that includes
hosting team lunches and dinners and celebrating religious festivals of team members. These all help to develop interpersonal relations and exchange ideas for collocated team members which ultimately improve team performance.

**ii) Team Building** - In the PMBOK® Guide, team building activities are emphasised. They are necessary to improve interpersonal relationships within the teams to help team members work together efficiently [PMBOK® Guide, 2008, pg232] as they help build trust and establish good working relationships. The guide also states that ‘team building strategies are particularly valuable when team members operate from remote locations without the benefit of face to face contact’ [PMBOK® Guide, 2008, pg232]. This results in easier handling of project team problems and effective team discussion and resolution of issues which may arise. Our research demonstrates that GSD vendors utilise similar strategies. When analysing the case studies, we observed that the software project managers conduct regular team meetings to develop team dynamics. Additionally project issues are discussed. In some cases, where the problem has been resolved before the team meeting, its resolution is discussed. If it has not been resolved, members discuss its potential resolution, thus harnessing prior knowledge. We have also seen that regular team meetings, interactive sessions, brainstorming sessions, induction programs are also carried out as part of the team building exercise. One of the interviewees has stated that -

“Establishing a cohesive team at the outsourcing destination is important for the global software development…team building exercise brings stability within the team and largely helps in successful completion of the project. It helps to build united and integrated software development teams”.

**iii) Training** – Training, also mentioned specifically in the PMBOK® guide, is important to improve team performance and consequently to achieve project success. Training can be formal or
informal as it is essential to develop team competencies. Before training is implemented, it is important that project managers formulate a proper plan for scheduling training programs for the team members.

In the GSD situation, training is an important activity for all of the software companies we studied. Our analysis revealed that regular training activities are carried out for the team members working on GSD projects and most of the companies maintain training calendars. One of the project managers we interviewed explained that -

“When senior team members are due for promotions…they encourage their subordinates to take-up such trainings…so that the subordinate can be chosen to take up higher position”.

Consequently, project managers include relief from project duties by team members in their project plans so that they can undertake the training programs. Training sessions are conducted at various stages within the project. This includes training of new team members, with sessions specifically conducted to brief them about project details and the roles and responsibilities. Other training programs include enhancement of technical and communication skills of the team members and specific technology training. It is normally expected that each team member undertakes specific hours of training every year which helps them to work successfully on the projects. Training can also be used as a solution to filling skills gaps [PMBOK® Guide, 2008, pg232] and can be helpful to overcome attrition that hugely affects GSD projects.

iv) Cultural Differences - The PMBOK® Guide acknowledges that project managers operating in global environments have to manage cultural differences [PMBOK® Guide, 2008, pg230]. GSD team members come from various cultural backgrounds, speak multiple languages and possess different industry experience. They operate in the ‘team language’ (often English), which is different from their native language [PMBOK® Guide, 2008, pg230]. The PMBOK® Guide very specifically emphasises that project managers should ‘capitalise on cultural differences’ [PMBOK®
It is expected that project managers should be able to encourage working together interdependently in a climate of mutual trust to help develop team spirit in a culturally diverse environment [PMBOK® Guide, 2008, pg230]. This is important for improving individual and team productivity while working on projects in a global environment.

We carried out our case studies in India, the most culturally diverse nation [Library of Congress, 2004] and have observed project managers there managing diverse cultural and religious backgrounds [Deshpande et.al, 2010]. To do this successfully, project managers should have comprehensive knowledge of the prevailing cultural diversity, therefore taking advantage of it to effectively accomplish their GSD goals. One of the interviewee stated that -

“We have never felt that cultural background of any team member is an issue for team management...in fact we have certain advantages with the team members religious background....as they work on each other’s festive holidays...the strength is that team members work in a multicultural environment....they learn lots of various aspects of different religions and culture”.

Interviewees from the Indian software companies discussed how they set up backup teams to leverage this cultural diversity. They can be used, for example, to overcome the potential loss of support and communication during festive and religious holidays, providing support 365 days per year, thus transforming cultural differences into strengths.

**v) Team performance assessments** - Team performance assessments are necessary to increase the probability of achieving project objectives in the desired timeframe. [PMBOK® Guide, 2008, pg237]. Conducting an evaluation of the team’s overall performance helps to gauge the existing competency within the team. It becomes particularly significant when teams and team members are distributed as in case of GSD projects and it becomes essential that individual team performance is
evaluated. This allows the project manager to take necessary steps to improve team performance, in turn helping to avoid consequences that may affect the overall project.

Our research demonstrated that Indian vendor software companies conduct such performance assessments on a regular basis.

“The project manager or team leads prepare the performance card to identify the positive or negative elements of each team and team member’s performance. Based on the weakness appropriate steps are taken to enhance the skills”.

In the PMBOK® Guide this activity is mentioned for collocated team members but the empirical data reveals that the GSD vendor software companies perform this assessment on two levels - for the entire GSD team and for the team members within site teams. This allows detailed analysis of team performance and gives the project manager the opportunity to take necessary steps to overcome any issue that can affect the project outcome.

vi) Recognition and Rewards - The PMBOK® Guide includes recognition and rewards for team members, stating that plans relating to team member reward schemes should be part of the human resource management process [PMBOK® Guide, 2008, pg234]. It also allows for the consideration of ‘cultural differences’ when determining these. Teams and team members of GSD projects in the case study companies are motivated through the use of appropriate recognition and rewards. In team motivational schemes, the whole team is rewarded which help to create rapport within teams. Individual team members within the teams can also be rewarded:

“To motivate our teams and team members we have reward-based system…we give rewards to an outstanding team and also excellent team performer…who has done something special beyond his or her responsibility…that is related to project…we also have spot awards…which is a surprise to the team members….and is given at that individuals desk….so such small rewards do help us in motivating our team members”.
Monetary rewards may also be given to the teams and team members for their special achievements. We studied one case where team members were given special remuneration for working in various time zones. However, it is important that the project manager, while rewarding teams and individuals, maintains the cohesiveness of the GSD team.

B. Activities in the PMBOK® guide not performed by GSD teams

While there are project human resource management activities in the PMBOK® Guide performed within GSD teams, there are some activities in the guide for which we have no evidence of use in the GSD environment. These four activities are discussed in this section.

i) Organisational charts: Within the PMBOK® Guide organisational charts have been presented as a tool to document team members’ roles and responsibilities. They can also be used to explain the position of various teams and team members within the GSD project. Such project charts should include graphic display of project team members and their reporting relationships. These charts can either be formal or informal, highly detailed or broadly framed based on the project needs [PMBOK® Guide, 2008, pg223]. Mostly such charts can be made for individual teams within the project.

There have been calls by GSD researchers to define such roles and responsibilities when setting up GSD teams [Casey, 2009] and we have also observed that the exercise of creating project charts is very rarely carried out in GSD projects. In GSD, creating such project charts can help project managers to track the activities of GSD teams and team members. These charts would also support the creation of an appropriate project communication plan and tracking of individual project team members. They can help to keep a repository of available skills and competencies throughout the project duration which can be utilized effectively within the project. Using such charts would also help project managers to plan in advance for the acquisition of required skill sets and the relocation of team members within the distributed project sites.
ii) Staff acquisition and management plan: The PMBOK® Guide affirms that human resource plan must describe the requirements of human resource for the project. The plan should detail

- How and when the human resource requirements for the project will be met.
- The number of team members expected to work full-time on the project.

From a GSD perspective these guidelines support the requirement to have a clear plan of team members either in collocated and geographically distributed teams. This in turn can help to control cost of the project to some extent as the project managers will know in advance the required human resource for the project. The project managers can also plan and schedule in advance for the training programs and other activities required for building teams for the project.

iii) Resource Calendar - In relation to staff acquisition and management, the PMBOK® Guide states that a resource calendar must be maintained to estimate the level of expertise available for the project. The calendar must have description of all the team members involved in the project and can help to [PMBOK® Guide, 2008, pg231]:

- Document the duration that each team member needs to work on the project
- Identify proper times when team members can participate in team development activities
- Track each activity of the team members and the progress of the project
- To understand each team members schedule, availability including personal holidays and necessity on other projects.

It should also be updated regularly during the project life cycle to guide the acquisition, release and development actions of team member.

While it is prominent within the PMBOK® Guide, maintaining the resource calendar is not an activity documented in the GSD literature review nor have we noted it during our empirical research. However, the introduction of a resource calendar could help to manage the available
resources in GSD and overcome the issue of attrition. The project managers could use it to track available resources within the project and build up in-house resources amongst the existing team members. This would allow them to immediately take over new responsibilities from the team members who leave the project. A resource calendar would also assist mobility of team members between various locations as per the project needs, providing updated information on the available resources and helping to plan in advance for acquisition and release of team members. One of the project managers has stated that -

“we have to make sure that sufficient team members are available to work in shifts as per the client time zones and on holidays to provide 24/7 support. Not all team members are eager to work in shifts…or they cannot work all the time from evening 10pm to morning 8am….its practically not possible….so we have to find team members who can replace and give this support…to work as per clients time zone”.

In such situations maintaining a resource calendar can be very useful for project managers. It could also be the basis for training, team building activities.

iv) Roles & Responsibilities: The human resource plan mentioned in the PMBOK® Guide provides guidance on how project human resources should be staffed, managed and controlled. This plan in turn helps to precisely define roles and responsibilities for every team member involved in the project and achieve project success. A role is the “label describing the portion of a project for which a person is accountable” [PMBOK® Guide, 2008, pg222] and each role must have clarity pertaining to “authority, responsibilities and boundaries” of each team member [PMBOK® Guide, 2008, pg222]. The guide also states that team members must be made aware of their right to apply project resources and make decisions about the methods for completing a task and that they should be well informed about acceptable quality standards and what responses they should make to project variances [PMBOK® Guide, 2008, pg223]. Responsibilities would mention the work that a
team member is “expected to perform in order to complete the project activities” [PMBOK® Guide, 2008, pg223]. For project managers to ensure that project activities are completed effectively, they must be aware of the competencies of each responsible team member. If team members do not possess required competencies, proper action needs to be taken – otherwise the performance of the project can be affected. When incompetence’s are identified, positive approaches such as training, hiring new people, changes in scope and schedule must be brought about.

There have been calls by researchers to precisely define and include roles and responsibilities to explain the position of teams and team members in the GSD projects [Casey, 2009]. Clear definition of roles and responsibilities can help planning and tracking of distributed project and team activities in GSD. It can also assist project managers to assign appropriate tasks to team members as per their interest and skill sets. As one of the interviewees stated -

"we look for the skill set of the resource that can match the project requirement in order to assign them specific tasks”.

Hence exactly defining roles and responsibilities can assist project managers in selecting team members who can be assigned specific tasks in the GSD projects. Clarity in roles and responsibilities is essential to coordinate distributed activities and to bring homogeneity within teams and team members across various sites of GSD. Hence it becomes vital that roles and responsibilities are defined clearly in GSD.

Effective usage of the PMBOK® Guide would solve this issue. Definition of roles and responsibilities must include position, skills and competencies that are essential for the project.

C. Activities not in the PMBOK® guide performed by GSD teams

When completing our primary research and literature review we identified four GSD coordination and management activities that should be considered by GSD project managers although they are not included in the PMBOK® Guide. The GSD literature provides evidence of successful
coordination strategies which have been supported by our empirical research conducted within software companies based in India.

**i) Onsite Coordinators:** A solution to GSD coordination problems, as noted in the literature, can be met by the ‘onsite coordinator’ [Carmel, 2006]. We have also noted the existence of this position in our empirical research, where a project manager explained:

“We have onsite coordinators stationed at the client site....so that they can manage the work load whenever required.....the advantage of having onsite coordinators is that we mostly do not have communication issue....they take care of clients and other issue if any”.

The role of the onsite coordinator is to plan, coordinate and manage the work between different geographically located teams and team members. Therefore they need an understanding of the software development project and are mostly senior team members who are positioned at the client site to act as a liaison across team for the development project. They can also help to manage cultural diversity [Carmel, 2006] through bridging the cultural and linguistic differences between teams and facilitating organizational flow of communication [Carmel & Agarwal, 2001], improving cross-team communication [Hogan, 2006] and sometimes becoming the main communication channel for the non-colllocated teams [Begel & Nagappan, 2008]. Their role may also include the arbitration of team conflicts and resolution of miscommunications that happens between team members. They try to build relationships amongst various teams and provide a mechanism to create trust and transfer knowledge. They also communicate lessons learned and set future direction for the project [Hogan, 2006].

The onsite coordinator usually visits the client locations where they carry out onsite work. Apart from having an understanding of the software development project, they need to have sufficient global knowledge and a willingness to travel between locations. They may also go to other distributed sites for specific time periods and can be regularly rotated between various geographical
locations to create homogeneity between sites. Natives of a particular country who previously emigrated can serve as the cultural liaison with an offshore site [Carmel & Agarwal, 2001]. On return to their original teams, these delegates become ‘Point People’ for cross-site collaboration in establishing communication across sites [Bass et.al, 2007] and their knowledge of personalities and culture can act as a communication short-cut between the teams, thus allowing for relevant communication to flow in both directions [Hogan, 2006].

Onsite coordinators have also been labelled as cross-site delegates [Bass et.al, 2007], panel points [Begel & Nagappan, 2008] or ambassadors [Hogan, 2006].

ii) Bridging: Bridges for GSD teams are normally groups of heterogeneous workforce available within a reasonably short geographical and temporal distance and become nodes to manage two or more separated work sites that exist on either side of their location. They receive work from one site and outsource work further to other sites. Therefore they have the experience of both outsourcing and insourcing in a two-stage outsourcing relationship [Holmström et.al 2008]. Being a bridge site allows teams to understand and potentially help when dealing with projects between sites, increasing knowledge management and coordination [Boden, & Avram, 2009]. Our empirical research has identified companies that have established bridges. Their GSD projects include the provision of support 365 days per year and bridge locations have been setup to monitor the flow of work from one location to another within time zones. Where software companies have development sites throughout the globe, the bridge sites take care of activities within their vicinity by managing daily overlapping working hours. During these overlapping hours, team members from two sites hand on tasks to the next site during “hand-on and shake off” sessions.

“There are always overlapping hour between two team sites to cover ‘hand-on and shake-off’ sessions. This process is followed between other team’s sites throughout the day. During
these overlapping hours members from departing team communicate about the work they have carried out and what needs to be done further”.

The interdependencies such as each sites goal and objectives that are dependent on the other sites have to be taken into consideration while building bridges [Holmström et.al, 2008]. The bridge teams should match the bridging function and team members must be compatible with the cultures they are interacting [Milewski et al, 2008]. A particular location has to be selected based primarily on the existing or real availability of the experienced staff that can support the staffing requirements [Battin et.al, 2001]. Physical closeness such as distance and time zone between sites is also important – thus allowing overlap in working hours.

iii) Management of Attrition: Attrition is intrinsic to any business or industry and is an issue within the Indian software industry because the industry is young, thriving and growing. Managing attrition levels is important within the companies we researched. Appropriate steps include the understanding of triggers, and subsequently the management of this attrition.

In our empirical research we found that team members aspire to progress in their career through extending their skills and work experience. Team members may have different priorities in their life as they look for useful and exciting work in the initial stage of their career. Satisfying, supportive and varied work opportunities are shown to be important to the practitioner and may be more of a hook than competitive salary packages. One of the interviewees stated that

“We have understood the main reason for attrition…..it is because people want to explore new opportunities that are available in the industry and they also look for new and more challenging jobs to work on at the initial stage of their career.”

In some cases team members prefer to be close to their home town. Therefore they look for suitable opportunities. In other cases, team members look for new and more challenging jobs which will increase their knowledge. As there are various opportunities available in the software industry
internationally, Indian software professionals are often mobile, especially when they are young and have less family responsibilities. We have also observed that entry level professionals or freshers change their jobs quite often as they get better benefits within each change. However, it is expected that once the software industry matures, the level of attrition will gradually fall.

There are various measures taken to overcome attrition levels in Indian software companies. Project managers must ensure task allocation based on interest, work satisfaction and skills development. Team members are often allowed work hours to suit their particular circumstance. Job rotation can be introduced so that team members can continually develop their competencies. Additionally, project managers should try to develop multiple skill sets within their teams with the intention that team members can be replaced on any task.

**iv) Task Allocation:** Appropriate task allocation is important while coordinating various tasks in software development projects. During our empirical research we found that, in order to coordinate between task, tasks are often broken down and subdivided before they are assigned. The project managers take into consideration the strengths and interests of the team members while allocating tasks to them. Technical and domain knowledge, work experience and personal interest, skills sets and capabilities of the team members is considered. Project managers judge task allocation as important so that the team members can enjoy their part of work within the project.

Various other strategies are followed when allocating tasks. Job rotation is the main strategy practised by project managers. This helps them to enhance various skill sets, allocate resources efficiently, and plan towards training, skills development and future resource allocation. As mentioned under attrition (iii above), this will also contribute towards the reduction of staff turnover. A flexible yet strategic approach to task allocation is clearly shown in this quote from one of the project managers we interviewed -
“If a team member is not very keen on coding part of the project and is more interested in communicating with the clients or customers…then we allocate him the communicator’s role within the project…. Thus understanding their working interest and behaviour helps us analyse and make such decisions”.

The consequence of this is that project managers must be able to understand and analyse available skill sets, interests of the project team members and project requirements when allocating tasks. Appropriate task allocation helps to coordinate activities more efficiently within the project. It also helps to build cohesive teams within the project and overcome conflicts and other issues that can arise in the project.

6. RESEARCH SUMMARY AND CONCLUSION

In carrying out our research, we have identified a need for a structured set of standards which focus specifically on Global Software Development. Therefore, using comparative analysis, we mapped the PMBOK® Guide to known coordination activities in GSD. We found that a sub-set of activities contained in the human resource management section related specifically to team coordination. This comparison allowed us to categorise recommended coordination activities into three distinct groups: activities in the PMBOK® Guide performed by GSD teams in practice, activities not performed by GSD teams in practice and also activities that are not in the PMBOK® Guide but are performed by GSD teams in practice.

The activities mentioned in the human resource management section and performed in practice by GSD teams assist us to emphasise their importance to manage and coordinate software development teams in GSD environment. The team building activity is necessary to improve interpersonal relationships within the teams and help team members’ work together and establish good working relationships across geographical boundaries. The emphasis given by the PMBOK®
Guide on taking advantage of cultural differences supports our assertion of transforming cultural differences into strengths (Deshpande et al, 2010). Team performance assessments help to gauge the existing competency within the team. These activities are crucial and have an influence on the effectiveness of GSD project success.

We have also documented particular activities mentioned in the human resource management section of the PMBOK® Guide but not used in the GSD environment. In answer to our research question we found that the Guide does indeed help us to address coordination techniques in GSD projects by highlighting some new areas to consider. These activities can help to improve coordination in GSD projects. An organisational chart is one of the essential activities that must be followed in GSD projects. Organisational charts can explain the position of various teams and team members and display their reporting relationships. They can also help to precisely define and include roles and responsibilities and the position of teams and team members within the GSD project. Also, a resource calendar can be maintained to estimate the level of expertise available for the project.

The coordination practices such as onsite coordinators, bridging the sites, managing attrition and task allocation are not mentioned in the human resource management section of the PMBOK® Guide. Onsite coordinators help to manage cultural diversity by bridging the sites through cultural and linguistic differences between teams and facilitating organizational flow of communication. Understanding the triggers that cause attrition can help both client and vendor companies to take necessary steps to overcome it. In task allocation it is essential to consider the strengths and interests of the team members. This helps in motivation and team members can enjoy their part of the work within the project. These practices are well established and followed by vendor companies and are endorsed by the client companies in GSD. Therefore these practices need to be acknowledged and included as part of regular practice to ensure the success of the GSD project.

6.1 Concluding Remarks
While the PMBOK® Guide is the standard document for project management activities, the results of our comparative analysis that looked specifically at coordination strategies indicates that its scope is limited when applied to GSD project management, as it does not take all the challenges and issues of GSD into account. For example, we found that problems associated with attrition and task allocation are required and not adequately addressed in the guide. Also the need for additional roles is required, such as the role of onsite coordinator and bridge between sites. Working in a distributed environment means that organisations need even more robust processes than working in a collocated environment for which the PMBOK® Guide was designed. It is therefore not surprising that our research uncovered processes and techniques not present in the PMBOK® Guide.

The comparative analysis presented in this paper proved a useful way to identify activities that will support coordination between geographically distributed software development sites. By using the PMBOK® Guide, we were able to propose new coordination guidelines that are not recognised in the GSD literature. Furthermore, by analysing our work with vendor managers, we were able to identify and add GSD specific coordination solutions not present in the more generic PMBOK® Guide.
REFERENCES:


