A Coordination Model for Global Software Development Teams

Submitted by
Sadhana Deshpande
B.Sc, MCM, MBA

For the award of Doctor of Philosophy

Supervised by
Dr. Ita Richardson
Dr. Sarah Beecham

University of Limerick

2012
This thesis is dedicated in memory of my father

Mr. Rangnathrao Muley

Who truly believed that education is the way to empower his daughters!!
Sadhana Deshpande

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Abstract

Over the last two decades of globalisation, the software industry has witnessed the emergence of Global Software Development (GSD). Various business motives have driven software companies to outsource software development projects to software companies based in low cost economies. Given the highly competitive environment in which software companies operate, the client and the vendor have to equip themselves to operate successfully across national and international boundaries.

Software development carried out at various geographical locations across boundaries is mainly impeded by distance which can be categorized as exterior and interior. The exterior distance is formed due to geographical, cultural and temporal differences while the interior distance is created due to organisational, technological and knowledge differences. The outcome of these distances is that they draw out primarily communication, coordination, culture and control issues which can spiral out of control if not resolved. The literature on GSD gives evidence as to how various tactics are applied to alleviate these issues created by global distance.

While each of these is of interest to the GSD researchers, this research study has particular focus on coordination. Coordination is the act of making things work together for attaining common goals. In GSD projects, the mechanisms essential to coordinate the work and manage interdependencies may get disrupted. Hence appropriate coordination strategies are essential to achieve project goals when several actors are involved and multiple activities are performed.

The explicit aim of the research presented in this thesis was to develop a GSD-COORD Model. The GSD-COORD Model comprises of specific processes with a defined set of strategies for coordination of tasks that can be followed by Project Managers when managing GSD projects. These strategies have emerged from literature, multiple case studies conducted in the vendor companies operating in India and mapped with the relevant sections of the PMBOK® Guide. This GSD-COORD Model is then validated by GSD researchers and experts from software companies in various countries. The validation process helped to evaluate the significance of each strategy in the model and its applicability. The GSD-COORD Model is an adaptable approach to project management where the processes and strategies can be tailored to suit different global and organizational settings.
Declaration

I hereby declare that the work presented in this thesis is entirely my own work. It has not been submitted previously to this or any other institute for this or any other academic award. Where use has been made of the work of other people, it has been acknowledged and referenced.

Signed: ______________________   Date: ______________

Sadhana Deshpande
Acknowledgments

First and foremost, I would like to express my sincere thanks to my supervisor Dr. Ita Richardson. I first met Dr. Richardson back in December 2006 and since then she has not only been a research advisor but my inspiration as I hurdle all the obstacles in the completion of this research work. Her motivation, immense knowledge and constant guidance helped me in all the time of research and writing of this thesis. I could not have imagined having a better advisor and mentor for my Ph.D study.

I also take this opportunity to thank my Co-Supervisor Dr. Sarah Beecham for her timely review and feedback on my PhD thesis.

I would like to thank my examiners Dr. Ban Al-Ani and Dr. Gabriela Avram for their comments and thought provoking discussions during the viva.

My sincere thanks are also due to Prof. Kevin Ryan, Prof. Mike Hinchey and Prof. Bashar Nuseibeh and all others at Lero for their encouragement and support while pursuing PhD. I would also like to thank Science Foundation Ireland (SFI) for funding this research study.

Pursuing doctoral research away from homeland along with managing family without any support system has not been an easy task. As a matter of fact, this doctoral dissertation is a confluence of many elements—my own intense desire to pursue a Ph.D and undoubtedly, the generous support of many people without whom this would not have become a reality. I take this opportunity to thank them all.

Every individual is incomplete without family and friends. I above all want to thank my parents for their constant love and support. I wish my father could be here today to behold this achievement. I express my sincere gratitude to my mother for imparting the importance of education in my life. Her patience and confidence has helped me in taking on this journey. Aai you are my super-woman. My sincere apologies for not being there with you during your life threatening illness three years ago and moreover not visiting home since then!!

My younger sisters Sampada, Swapna and their families who consoled during this period and allowed me stay back here in Ireland to continue my studies. Their support began long before I even undertook this journey. Thanks for being there for me all the time; I am very fortunate to have you all in my life.

I take this opportunity to express my sincere thanks towards my paternal uncle B.N. Jahagirdar for all the pains he took during my childhood. His upbringing has helped me to be what I am today. He taught me to dream and achieve them with confidence and courage. I never forgot what he
wished for me!! It was his desire to see me graduate as a doctor, which I have been able to fulfill.

I would like to thank my family-in-law, especially my father and mother-in-law for being the source of encouragement since my marriage. Specially, my father-in-law, from whom I constantly learn many things, in particular to be disciplined and focused to achieve goals in life!!

In addition, I would like to thank several people without whose kind help and support I could not have completed this dissertation:

Mr. Sameer Dalal (Vice President Projects, Polaris Software) along with all my friends working in different software companies in India for their wholehearted support and trust in my abilities. You all provided me the access to obtain the data needed for this study.

Prof. Meera Kulkarni for her constant support over last 15 years.

Dr. Brian Coates and Eileen Coates for being so helpful here in Ireland and for proof reading my thesis time and again.

Finally, my husband Parag and our son Akshat, the two most important people in my life, who served as pillars of strength through my efforts. Parag nurtured my endeavor to do research with continuous encouragement and support. Akshat taught me to smile as I struggled my way through the completion of this dissertation….thank you Akshat!! I am ever thankful to both of them for making it so easy for me to pursue my long cherished dream of earning a Ph.D.
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Chapter 1: Introduction

1.1 Overview

1.1.1 Globalisation - The Big Picture

The origin of globalisation is subject to debate. It is historically evident that the process of globalisation started way before Marco Polo travelled to Asia in 1271. In the last two centuries, business and political leaders with global outlook have realized the impact of the synergy resulting between infrastructure and technology development on the market. This century has witnessed the profound impact of globalisation on business, culture and people.

The term ‘Globalisation’ was first coined by Prof. Theodore Levitt in 1983 and published in the Harvard Business Review. Eckes and Zeiler (2003), broadly define globalisation as ‘the process of integrating nations and people – politically, economically and culturally into a larger community’. Today, the term is most commonly used to refer to economic globalisation - where increased distribution of production and the services industry have crossed the national boundaries. Globalisation is the process through which the world’s economy has led local or regional businesses to operate in international markets without boundaries (Fraser and Oppenheim, 1997).

Globalisation is a complex process which has taken advantage of improved infrastructure and communication technology to integrate people, businesses and nations beyond national boundaries. To many critics, globalisation is of concern because it causes wage and job suppression in developed countries (ACM Report, 2006). On the other hand, while economic development has brought prosperity to developing countries there is a fear of losing traditional culture and values.
Despite these pro and cons, it is clear that globalisation is here to stay. The increasing trend towards globalisation has amazed the experts who have labelled the development in globalisation in various ways. For example, Ohmae (1994), labels the development of globalisation into a ‘Borderless World’ and according to Friedman (2005), the ‘World is Flat’.

There are various driving forces that have attributed to the increase in globalisation. The availability of highly skilled work force and the quality of work at a comparatively low cost has attracted many industries from developed nations to setup operations in developing nations. The software industry is not an exception and has undeniably taken the advantage of globalisation. Software companies have either setup operations or have collaborated with local software companies in developing countries to tap the economic benefits. This in return has helped low-cost countries such as India, China and Malaysia to develop a vibrant and export-oriented software industry (ACM Report, 2006).

1.1.2 Globalisation of Software Engineering

The step towards economic liberalization taken by developing countries like India and China in the early 1990’s has enhanced globalisation. The improved infrastructure has facilitated software companies from countries such as United States, United Kingdom and Germany to set up operations in these countries almost a decade ago. Software companies from other countries have also established business relationships with software companies in low-cost countries to gain the benefits of globalisation. Globalisation has helped software companies in numerous ways. Typical software product development involves functions such as - programming; software testing, software maintenance, software architecture and product design, research and development (R&D), Business Process Outsourcing (BPO) and Information Technology (IT) enabled services. These
engineering functions of the software product development lifecycle are partitioned and distributed to various global centers to take advantage of the economic benefits and skilled work force. Hence it is referenced as ‘Global Software Engineering’.

There are various definitions of Global Software Engineering. Thus, on the basis of the facts discussed, the term Global Software Engineering (GSE) can be described as – global distribution of different engineering functions related to software product development. Further, Bartelt et al. (2009) have defined Global Software Engineering (GSE) as – ‘software engineering work that is allocated to people at distributed (global) sites with different software engineering cultures’. The term ‘work’ relates to ‘function’ in the description given above.

The main building blocks of global software engineering projects include requirements specification, software architecture, software development or programming and software testing. Software development/programming or software testing are the most common elements distributed to various global locations (Jain et al. 2011).

1.1.3  **Global Software Development**

In the GSE literature, the terms Global Software Engineering (GSE) and Global Software Development (GSD) are used interchangeably. Global distribution of software development projects is also referenced as Global Software Development (GSD) (Karolak, 1999; Carmel and Agarwal, 2001; Herbsleb and Moitra, 2001; Senguta et al. 2006). In this thesis, global distribution of software engineering and development projects will be termed as Global Software Development (GSD).

Mockus and Herbsleb (2001), define the term GSD as distribution of software development functions across global sites that are located in
different countries. Conversely, GSD is defined by Agerfalk et al. (2005) as ‘the activities of software project lifecycle which involves actors who are dispersed across two or more sites located in different countries that are separated by multiple time zone differences and socio-cultural distance’.

The term Global Software Development (GSD) is relatively wide-ranging and needs further definition. The word ‘global’ in ‘Global Software Development’ is used to describe distribution of software engineering and development projects in global settings. There are a few other terminologies that are frequently used to describe Global Software Development (GSD) in context of GSE such as - ‘Distributed Software Development’ (DSD) (Kiel, 2003;) or ‘virtual software development’ (Casey and Richardson, 2006a, 2006b).

Over the last two decades, Global Software Development (GSD) has become the norm for large sections of the software industry (Herbsleb et al. 2001). The popularity of GSD has increased (Herbsleb, 2007) and is considered as a globally sourced commodity (Hayes, 2002). Software companies are trying to gain competitive advantage from global software development (Grinter et al. 1999; Herbsleb, 2007).

1.2 The Economics of Global Software Development

1.2.1 The Rise of Global Software Development

The growth of GSD as an economic and software development strategy is facilitated by numerous technical and commercial factors. These include the revolution in communication technology resulting in the development of the Internet, incorporating the adoption of e-mail and the availability of low cost international communication tools (O’Brien, 2002). These developments in communication are coupled with the accessibility and
option to arbitrage on a highly skilled workforce available within low cost economies that are capable and willing to undertake outsourced and offshored software development projects (Toaff, 2002). This consecutively allows cost saving along with 24/7 support all round the year with the opportunity of implementing *follow the sun* strategies (Toaff, 2002; Carmel and Tija, 2005). This approach offers the prospect for continuous software development by leveraging temporal differences between development locations (Espinosa and Carmel, 2003). However, this is contested by stating that one should avoid using follow-the-sun strategy since it requires extra communication and coordination between sites (Setamanit et al. 2007). An additional consideration is that GSD allows companies to position themselves close to emerging markets and capitalise on their future growth.

The economic imperatives driving the globalisation of software development and *Offshore Location Attractiveness Index* (Kearney, 2004, 2009) have identified many countries as outsourcing destinations for software development. Countries from Eastern Europe, Latin America and the Far East have also emerged as popular locations for offshoring and outsourcing software development (Geer, 2006). Since the 1990s significant GSD has taken place within Ireland, India and Israel (O’Brien, 2002; Arora and Gambardella, 2005). From these initial three I’s, India still continues to be a popular location for outsourcing and offshoring software development (Geer, 2006; Gonzalez and Gasco, 2006; Kearney, 2011). It is also predicted that India will maintain this position in the short to medium term (Kearney, 2011).

Today, Israel and Ireland have seen their popularity as locations for low cost offshoring and outsourcing software development decrease (Kearney, 2009, 2011). However, they still continue to experience economic success because the focus of their respective software industries has changed from low cost software development to knowledge-based and niche-centric to capitalize on their particular strengths (Carmel and Tija, 2005).
1.2.2 **Benefits of Global Software Developments**

Four widely cited benefits of GSD are - access to a highly skilled talent pool from all around the world (Carmel and Agarwal, 2001), low-wage work force (Damian et al. 2003), propinquity to existing and new markets (Herbsleb and Moitra, 2001) and continuous software development by leveraging time-zone differences (Espinosa and Carmel, 2003).

Apart from these, there are other benefits achieved through GSD.

- GSD helps to induce more rigorous documentation and automated Software Configuration Management (SCM) (Battin et al. 2001) systems. Further, it encourages experimentation with communication tools outside of standard methods usually followed in GSD.
- GSD helps to improve software processes with better communication about expectations and knowledge encouraging a strong release management team (Begel and Nagappan, 2008).
- GSD, with the help of global partners, makes it possible to obtain capabilities that may not be currently available or which would involve significant time to obtain internally (Forbath et al. 2008).
- Culturally, it exposes workers to new customs, ideas and new ways of doing business allowing employees to make key contacts around the globe who are subject-matter experts in their field (Begel and Nagappan, 2008).
- National policy in some countries requires locating a facility in that country as a condition of sale or a favorable tax treatment (Mockus and Herbsleb, 2001).

An overall benefit to GSD is that it helps to establish improved processes in distributed development which in turn helps team members at collocated development sites to enhance tasks while working on the GSD projects.
1.2.3 Complexity in Global Software Development

Software outsourcing to other organisations or offshoring to remote locations is not a straightforward task (Carmel, 1999; Karolak, 1999; Herbsleb and Moitra, 2001; Clerc et al. 2007). Some of the difficulties encountered are the problems of understanding requirements, testing of systems and the coordination of projects (Carmel, 1999; Ågerfalk and Fitzgerald, 2006). These difficulties are further compounded by cultural and language differences, lack of communication, different process maturity levels, development and testing tools, standards, technical ability and experience of different teams. The differences in time zone cause the majority of their coordination problems with distributed teams (Herbsleb, 2007; Bass et al. 2009). As a result, the management of globally distributed software development projects has been recognised as a difficult and complex task (Lanubile et al. 2003). Geographical distance has been identified as a key problem and by its very nature introduces barriers and complexity into the management of globally distributed projects (Rutkowski, et al. 2002). It introduces physical separation between team members and management (Casey and Richardson, 2006b). At the same time, temporal distance hinders and limits opportunities for direct contact and cooperation (Carmel, 1999; Prikladnicki, et al. 2003; Noll et al. 2010). Linguistic distance limits the ability for coherent communication to take place (Jensen, et al. 2007). Many have expressed frustrations over the communication delays that happen due to time zone difference (Herbsleb and Grinter, 1999). Cultural distance negatively impacts on the level of understanding and appreciation of the activities and efforts of remote colleagues and teams (Hayes, 2002).

Coordination, visibility, communication, control and cooperation are all negatively impacted by geographical, temporal, linguistic and cultural distance (Casey and Richardson, 2004b, 2005). Further, the non-standard working hours, the need to remain online to communicate with the other distributed team members and frequent traveling are considered cause of
increased tension in family lives (Begel and Nagappan, 2008). If these elements of distance and their potential for negatively impacting on projects are not recognised and managed correctly, they can be responsible for creating serious barriers and complexity within GSD projects (Casey and Richardson, 2009). Offshoring and outsourcing software development has proved a complex endeavour and should be considered seriously prior to implementation (Casey and Richardson, 2009). Often the implementation of an outsourcing or offshoring strategy has been seen as simply the replication of those strategies which are implemented for collocated software development. This short sighted approach has led to serious problems and numerous failures (Carmel, 1999; Prikladnicki, et al. 2003).

1.3 Coordination in GSD

1.3.1 The Four Cs of GSD

Coordination, control, communication and culture are typically the 4 Cs of GSD. They are the basic elements that need to be appropriately investigated when the GSD projects are distributed across different sites.

In management science, coordination is defined as the act of making different people or things work together for attaining common goals. Coordination can be defined 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 and Crowston, 1990, 1994). Coordination between software development teams is one of the most difficult-to-improve aspects of software engineering (Amrit, 2005; Begel et al. 2009; Bass et al. 2009). The effectiveness of various coordination mechanisms differs in collocated, distributed and time-separated context (Espinosa and Carmel, 2004).
Control is closely linked with planning to achieve each organisational activity. In business management, control is collectively defined as the practice of clinging to goals, policies, standards, or quality levels that are embedded in each level of organisational hierarchy. It is important to have certain specific plans that can help to keep control over the activities of distributed teams. These activities need to be well coordinated to achieve GSD project success. Hence having an effective coordination plan may help resolve various control issues that arise while managing the GSD projects.

Communication is the key to team-based success (Battin et al. 2001). Communication is defined as a process by which information is exchanged between individuals through a common system of symbols, signs, behaviour or tools. In the list of terminologies developed for GSD by Vizcaíno et al. (2012), communication is defined as the exchange of complete and unambiguous information so that the sender and receiver can reach a common understanding about the GSD project. Specific coordination strategies are essential to boost communication between distributed teams working in different time zones. Resolving only the communication issues may not help to improve distributed team performance in GSD especially when precise outcomes are expected from the projects. Hence it is essential to have a distinct combination of communication and coordination strategies that may help to manage the GSD projects. Putting an emphasis on coordination can resolve the communication issues, as a distinct combination of communication and coordination strategies may help to manage GSD projects.

Culture is the integrated pattern of human knowledge, belief and behaviour that depends upon the capacity for learning and transmitting knowledge to succeeding generations. Hofstede (1980) defines culture as “the collective programming of the mind which distinguishes the members of one group from another”. Globalization of software projects has increased demographic and cultural diversity obstructing smooth team functioning
(Beise, 2004) as geographic and temporal distance limits opportunities for direct contact and cooperation (Carmel, 1999; Prikladnicki et al. 2003). The significance of culture in an organisational setting is demonstrated in the various cultural theories presented by several social scientists as discussed in Chapter 2 of the thesis. It is a challenging task to manage culturally diverse teams but it becomes necessary that project managers examine the existing cultural differences to embark on the method to manage cultural diversity. For this reason, cultural proximity needs to be estimated to develop concrete strategies to recognise the potential impact of culture on distributed development. Addressing cultural issues may just not help to manage the GSD projects. Appropriate steps need to be taken to coordinate activities between culturally diverse teams working on the GSD projects. It can be anticipated that appropriate coordination strategies may help resolve the cultural issue in GSD.

In summary, when the software development teams are geographically distributed, there is a requirement for intense and ongoing coordination to manage communication, culture and control issues. Hence, the focus of the research presented in this thesis is coordination of tasks between distributed teams operating in the GSD environment.

1.4 Research Agenda

1.4.1 Offshoring and Outsourcing

Offshoring and outsourcing are two main phenomenon of GSD. In GSD, software development projects are either offshored or outsourced to various geographical locations. The terms offshoring and outsourcing are often used as synonyms. However, they demonstrate entirely different significance in the business world.
Offshoring involves transcending geographical boundaries by upholding organisational limitations. Typically manufacturing and production activities were offshored since the early 1980s. This trend has changed over the last two decades with services and high-end technical tasks including research and development now offshored to other countries (Bartlett and Ghoshal, 2002; Moitra, 2008). Many software companies have set up subsidiary operations outside their home countries to take advantage of the global talent pool available in the low cost economies (Carmel and Tija, 2005). However, offshoring is creative and requires careful leveraging of available talent in different continents to reduce the cost (Venkatraman, 2004).

In contrast, outsourcing refers to the distribution of software development projects to software companies that are outside the client’s geographical and organisational boundaries. In outsourcing, any two collaborating software companies are separate entities who enter into a client and vendor collaborative agreement. Basically, outsourcing is a phenomenon in which a client organization transfers tasks and processes of software projects to an external vendor organization operating in different countries (Loh and Venkatraman 1992b; Holmstrom et al. 2008). A number of studies indicate that the main reason for outsourcing is to reduce operating costs (Ang and Straub 1998; Slaughter and Ang 1996) and to access the pool of technical talent available globally (Lacity and Willcocks 1998).

The benefits of offshoring and outsourcing are that they enable modularity and permit disintegration of development functions in software projects. The software companies gain an advantage of tapping the local markets in offshoring and outsourcing. The major criticism is that even if the companies gain cost benefits, the jobs are transferred to other countries.

Holmstrom et al. (2008) has further drawn attention to the phenomenon of offshoring and outsourcing. They state that offshoring is about location while outsourcing is about governance. The task, when distributed to a subsidiary of the company operating within the same country, is recognized
as ‘in-house onshore’ development (Holmstrom et al. 2008). On the other hand, when tasks are distributed to vendors (third party) operating in the same country as the client, it is acknowledged as ‘inshore outsourcing’ (Holmstrom et al. 2008).

In this research study, the primary focus is on offshore-outsourcing of GSD projects where the client and vendor companies are located in different countries. It is assumed that the client is from a developed country while the vendors are mostly from various developing countries separated from the client by geographical, temporal, cultural and linguistic differences.

1.4.2 Research Motivation: The Vendor Perspective

The growing trend towards offshore-outsourcing is a strategic need for technology firms as it helps to expand their competitive options (Carmel and Tija, 2005). Understanding the real benefits and issues of GSD outsourcing is a requirement for its progress. An appraisal of the literature (Chapter 2) indicates that the published studies mainly focus on the perspective of the clients and the companies who are outsourcing software development to low cost economies (Siffat et al. 2009; Gonzalez et al. 2006). There are various reasons for conducting such studies from the client perspective. One of the main reasons is that, as compared to the vendor companies, client companies readily invest into conducting such studies to identify the issues that occur while managing GSD projects. Additionally, the researchers in general are based in the same countries as that of the client; hence they get easy access in the client companies as compared to the vendor companies which are in various countries. Therefore a large proportion of the published research in the area of Global Software Development (GSD) is centered upon the client organisations that are outsourcing or offshoring software development projects. This indicates that vendors who perform an important role in the outsourcing arrangements are underrepresented in the GSD literature.
Despite the vast growth in outsourcing, there is limited documented information of the actual issues that exist between clients and vendors. I can distinctly state that there is a wide gap in the understanding of the potential benefits and issues of GSD particularly from the vendor perspective. My working experience in the Indian software industry of over 12 years has made me aware and eager to research this issue. Hence, I made a decision to conduct this research study from the vendor perspective.

Moreover, there is a lack of understanding about the triggers that cause issues between the client and vendor sites. Current evidence of issues and solutions regarding outsourced GSD projects are fragmented and perhaps incomplete. There has been less effort taken to systematically select, review, and synthesize the literature from the outsourcing (client) and outsourcing destination (vendor) perspective. This calls for appropriate steps to be taken to improve understanding of the actual issues that exist between clients and vendors.

As discussed earlier, coordination, control, communication and culture (Carmel, 1999) are the key issues impeding GSD. At the outset, it was necessary to unearth these issues that exist between the client and vendor. As a step forward from these four C’s this research study has investigated the coordination issues in GSD considering the vendor perspective for investigation.

1.4.3 The Research Objective

The purpose of this study is to investigate the issues and recognize the real benefits of GSD outsourcing from the vendor point of view. A research objective and research question was defined and an appropriate research approach was followed to accomplish this goal.
The primary objective of the research in this thesis is:

To develop a model that incorporates strategies from a vendor perspective to facilitate coordination between client-vendor teams working on outsourced GSD projects.

On the basis of this primary objective two sub-objectives were defined as –

- To identify strategies followed in vendor companies for successful coordination between client-vendor teams from the GSD perspective.
- To add to the established knowledge on GSD.

To meet this objective, the research endeavoured to bring together previous published empirical research with recognised project management standards that are appropriate to the software industry. The coordination model developed in this research study and named as ‘GSD-COORD’ is aimed to provide specific process, strategies and practices to both the client and vendor companies to manage the GSD projects. The second objective of this research study is to identify strategies followed in vendor companies for effective coordination between client-vendor teams from the GSD perspective. To build the GSD-COORD model, this study has collated practices from literature and multiple case-studies. The provisional model is then mapped to recognise software development processes and project management standards. This refined model is then validated by the GSD experts to make it adaptable to the software companies.

1.4.4 Research Question

The main research question that this research study intended to answer is–
This is broken into following sub-questions:

- **SRQ1:** What are the strategies identified in the literature for successful coordination between client-vendor teams while operating in the GSD environment?

  This research question is answered in Chapter 2 of the thesis.

- **SRQ2:** What are the strategies followed by the vendor companies to overcome the coordination barriers when operating in a GSD environment?

  This research question is answered in Chapters 2 and 4 of the thesis.

- **SRQ3:** What are the standard documents that support coordination of GSD? Can the PMBOK$^\text{®}$ Guide, be used as the basis to support coordination strategies in GSD projects from the vendor perspective?

  This research question is answered in Chapter 5 of the thesis.

### 1.4.5 Research Scope

The study is related to outsourcing of GSD projects and the focus of the research is on the coordination of tasks in outsourced GSD projects, where the client has made a decision to sub-contract parts of the project to vendors located in various countries and continents. Hence, it may be noted that collaboration, governance and decision-making are not taken
into consideration. Also, this study does not take into account all the published research that divulges the range of tools used for coordinating various tasks and activities in the GSD projects.

1.5 Key terms and Definition

In support of this research, it is important to draw attention to a few key terms that are frequently used in this thesis.

**Globalisation** – is defined as the process of integrating nations and people- politically, economically and culturally into a larger community (Eckes and Zeiler, 2003).

**Global Software Engineering (GSE)** – is defined as the software engineering work that is allocated to people at distributed (global) sites with different software engineering cultures (Bartelt et al. 2009). Alternatively Smite et al. (2012) have defined Global Software Engineering (GSE) as development of a software artifact across more than one location.

**Global Software Development (GSD)** – is defined as the activities of software project lifecycle which involves actors who are dispersed across two or more sites located in different countries that are separated by multiple time zone differences and socio-cultural distance (Agerfalk et al. 2005).

**Offshoring** – In general terms offshoring can be stated as the process when a software company makes a choice to transcend geographical boundaries by upholding organisational limitations. Smite et al (2012) define offshoring as leveraging resources from a different country.
**Outsourcing** – Refers to distribution of software development projects to different software companies that are outside geographical and organisational boundaries. The two software companies involved in outsourcing are separate entities in a collaborative agreement of being a client and vendor. Smite et al (2012) define outsourcing as leveraging external third-party resources.

**Onshore Insourcing** – The task when distributed to a subsidiary of the company operating within the same country is recognized as Onshore Insourcing (Holmstrom et al. 2008; Smite et al. 2012).

**Onshore outsourcing** – The tasks when distributed to vendors (third party) operating in the same country as the client, it is acknowledged as Onshore Outsourcing (Holmstrom et al. 2008; Smite et al. 2012).

**Nearshoring** – Leveraging resources from a neighbouring country (Smite et al. 2012).

**Outsourcing Company** – It is the client company that sends or outsources the software development projects to various vendors operating from different geographical locations.

**Outsourcing Destination Company** – It is the same as the vendor and may be located in any part of the globe.

**Client** – In general terms, a customer or client is a recipient of goods or services in return for monetary or other valuable considerations. In GSD, a client is a company that outsources software development projects to various vendors operating from different geographical locations.

**Vendor** – In general terms, a company which supplies parts or services to another company is termed as a vendor or supplier. In GSD, a self-
governing company which provides software services to the client and is located in any part of the globe is called as vendor.

**GSD Team** – Distributed members who collaborate on a common software project while working across geographic, temporal, cultural, political and organisational boundaries to accomplish an independent task (Barney et al. 2009; Vizcaíno et al. 2012).

**Client-Vendor Teams** – In the context of GSD, in this thesis the team that includes members from both client and vendor side working on the same project at distributed locations are termed as client-vendor teams.

**Project Management** – Project Management is defined as the application of knowledge, abilities and techniques to plan activities that can reach the needs and expectations of all stakeholders involved in a project (PMBOK® Guide, 2008).

### 1.6 Structure of the Thesis

This chapter has introduced the context of the research area with the objective and research question this study intends to address. The rest of the thesis is structured as per the following chapters:

**Chapter 2** presents a review of the GSD literature with explicit focus on coordination strategies followed in client and vendor companies managing the GSD projects. The identified strategies in this chapter are categorised and clustered together to form a useful framework for the coordination and successful management of the GSD projects. This framework is built upon in subsequent chapters to help analyse the empirical data gathered from the case studies.
Chapter 3 discusses the research methodology adopted in this research study. This chapter will present the approach and the research design including the research methods in detail to describe how these methods are executed through each stage of the research.

Chapter 4 presents the data analysis. It describes the content analysis done on the empirical data gathered from the vendor perspective. Certain specific practices have emerged from the analysis of the empirical data. The combination of these strategies and those revealed in the literature review are used to build the foundation of the GSD-COORD model.

Chapter 5 presents the comparative analysis of the coordination practices in GSD to Project Management Standard. In this chapter, an assessment is conducted of the provisional GSD-COORD model to standard processes and models that are applicable to software engineering environment. The comparative analysis presented in this chapter has proved to be a useful way to identify activities that will support coordination between geographically distributed software development sites.

Chapter 6 describes the validation process of the GSD-COORD model. The validation process was important in this research study to appraise the GSD-COORD model. The validation process was carried out using an expert panel method as the research tool. This chapter reviews the questions asked to the experts during the validation process. The discussion with the experts is analysed to investigate the results achieved with the practices mentioned under each strategy within the GSD-COORD model. The validation process has given an opportunity to verify if the methodology followed to develop the GSD-COORD model is valid, logical and if it makes sense to use the model while managing the GSD projects.

Chapter 7 presents the validated GSD-COORD model that can be useful for coordination of tasks between various teams and team members working on the GSD projects. The GSD-COORD model is developed on
the basis of the literature review and empirical research. It is further mapped with the Project Human Resource Management and Project Communications Management chapters from the PMBOK® Guide. The development of the GSD-COORD model satisfies the objective of this research.

Chapter 8 outlines the contribution of this thesis to the existing body of knowledge on GSD. It discusses the key findings drawn from the research and places them in a context to answer the specific research question. Finally it discusses the opportunities for further research on the basis of this study.
Chapter 2: Literature Review

Overview

This chapter presents the state of the art in Global Software Development (GSD) which is based on the literature and identifies the coordination problems that various organizations experience while operating in the GSD environment. Results of the literature review provide some pragmatic solutions to the problem in GSD in the form of specific coordination strategies. This chapter concludes with the identification of the gap in research which is expressed in terms of the research questions this thesis aims to address.

2.1 Introduction

Over the last two decades with increasing trends towards globalisation, software development has emerged from being concentrated at a single site to become 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 other factors drive distributed or Global Software Development (GSD) (Herbsleb and Moitra, 2001). As a result, software companies have to cope with increased challenges to survive in the highly competitive environment and penetrate new markets and leverage low costs opportunities. The outsourcing (client) and outsourcing destination (vendor) companies therefore have to adapt to operating across geographical, national and international boundaries.
Global software development (GSD) carried out at geographically distributed locations across various boundaries is mainly impeded by distance (Carmel and Agarwal, 2001). This distance in GSD can be grouped into two categories: exterior and interior. The exterior distance is formed by geographical, cultural and temporal differences and is well accounted for by many researchers, for example (Carmel and Agarwal, 2001; Casey and Richardson, 2006a). The interior distance is formed by organisational, technological and knowledge differences (Raylte et al. 2008).

Geographical distance, an instance of exterior distance, is created because software development is carried out beyond national boundaries in various countries and continents. The linguistic, religious and ethnic diversity that exists within various countries creates social and cultural distance. Cultural distance in GSD is created by differences in languages, religions, style of communication, trust, etc. between each distributed teams and team members. Variations in time zones that exist in different countries where remote teams are based, build up temporal distance as software development is carried out at different geographical locations to provide 24/7 support all year round. These geographical distances make it challenging to create a shared understanding and develop rapport amongst distributed team members (Hinds and McGrath, 2006). The effect of distance on GSD projects will continue in the future even with the phenomenon of ‘nearshoring’ (Carmel and Abbott, 2007, Smite et al. 2012). Thus, distributed development gives rise to geographical or physical distance between teams and team members which becomes an issue that is further compounded by cultural and temporal distance.

Organisational distance in offshoring and outsourcing is created due to variations in the organisational structure and business processes of two organisations (Raylte et al. 2008). There also exist differences in their methods of work, management of human resources, knowledge and the software development processes (Bass and Paulish, 2004; Herbsleb et al.
Inadequate domain knowledge of the software application that is being developed triggers knowledge distance and gap within the organisations (Raylte et al. 2008). Differences in the technology used by various development sites create difficulty in shared software development and maintenance tasks which in turn creates technology distance (Raylte et al. 2008; Smite, 2005). All these distances make geographically distributed software development and project management exceptionally difficult.

The major outcome of these global distances is that they raise various issues that can be categorized into communication, control, culture and coordination issues in GSD (Casey et al. 2008). Communication is essential for synchronous and asynchronous information exchange. Social and cultural propinquity is necessary to create understanding and accepting the norms and values of actors involved in GSD (Agerfalk et al. 2005). To firmly hold onto the project goals and policies, effective control over groups, tools and standards is essential in GSD (Carmel and Agarwal, 2001). Coordination is necessary to manage interdependencies to achieve project goals when several actors are involved and multiple activities are performed (Malone and Crowston, 1990).

When team members are collocated all these issues get resolved in a few minutes or hours. However, in distributed development it is difficult to know the right person to contact (Begel et al. 2009). 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). An important challenge faced by distributed teams is the lack of perceived distance often caused by factors such as communication and cultural differences (Prikladnicki, 2009). The literature on GSD gives evidence on how various tactics are applied to alleviate communication, cultural, control and coordination issues created by distances. The following subsections focus on these four major issues of GSD to justify how implementing appropriate coordination practices support the successful management of the GSD projects.
2.1.1 Coordination in GSD

GSD requires ongoing coordination to manage communication, culture and control issues. The collocated projects make very effective use of coordination mechanisms and communication channels but adjusting them to GSD is all harder since there is a tendency to underestimate the difficulties and the additional capabilities that the GSD projects require (Mullick et al. 2006). There is less need for coordination when activities are carried out independently but, in GSD, these needs are high as various activities are distributed and dependent on many other ongoing activities (Espinosa and Carmel, 2004). If a proper analysis of task dependencies is conducted at a fine-grained level, it becomes easier to identify different coordination mechanisms to manage dependencies and the need to communicate more uncertain aspects of the task (Espinosa and Carmel, 2004). Having knowledge of the people you are working with has an impact on communication (Gotel, et al. 2009) and coordination. The effectiveness of various coordination mechanisms differs in collocated, distributed and time-separated context (Espinosa and Carmel, 2004). Also, in the case of outsourced GSD projects, the coordination practices in terms of articulation of work within SME’s may differ from the needs of large companies (Boden et al. 2007). Project Managers believe that socializing, getting the chance to see each other’s work environment and communicating directly are ingredients of a lasting partnership which helps team members to coordinate effortlessly and overcome social issues among them.

Managing work interdependencies between teams is one great challenge as each team member has to perform and coordinate in order to pursue their own tasks due to the interdependences between the tasks (Détienne, 2006). Coordination between distributed software development teams is one of the most difficult-to-improve aspects of global software engineering (Herbsleb and Mockus, 2003; Amrit, 2005; Bass et al. 2009; Begel et al.
There is no single reason why software projects fail, but the main problem is of coordinating activities within large software systems (Kraut and Streeter, 1995; Herbsleb, 2007; Bass et al. 2009). To achieve project success in GSD there is a continuous requirement for innovative and effective coordination strategies. For example, coordinating tasks of distributed team members working in the same time zone is easier because communication can happen instantly. However, when team members are separated by various time zones different coordination strategies are essential.

Coordination is an interdisciplinary subject and regular studies are carried out in various disciplines. In computer science, the study of coordination is essential because it involves both human and machines. Malone and Crowston (1990) have studied coordination for computer science and distinctly define coordination in a narrow and broad sense. Their collective definition of coordination is ‘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 and Crowston, 1990, 1994). In their coordination theory, Malone and Crowston (1990, 1994) state that coordination has four main components - goals, activities, actors and interdependencies. Identifying goals, mapping goals to activities, assigning activities to actors and managing resources and interdependencies are the processes of coordination (Malone and Crowston, 1990, 1994).

2.1.2 Control in GSD

According to French management theorist Henri Fayol (1916), control is the process to see if everything occurs in conformity with policy and practice. In business management, control is collectively defined as the practice of clinging to goals, policies, standards, or quality levels that are embedded in each level of organisational hierarchy. Control is closely linked with
planning to achieve each organisational activity. A lack of involvement in project control is perceived when the project is distributed and problems are normally ignored when they appear on a remote site with a hope that they will be resolved by themselves (Ralyte et al. 2008). Controls can be formal as well as informal (Carmel and Agarwal, 2001). Formal control techniques include budgets and explicit guidelines while informal controls techniques can be peer pressure and expectations (Carmel and Agarwal, 2001). When project teams are located on one site it becomes relatively easy to evaluate work progress and to respond to control problems but with the geographical distance in distributed projects it is difficult to have a good visibility of project progress even though some project management tools are used (Ralyte et al. 2008). Questions such as when, whom, how and what that arise while resolving strategic issues need to be answered to gain and maintain control on the GSD projects. Implicit requirements of organisations and clients should be converted into objectives to easily track and measure them.

It is important to have certain specific plans that can help to keep control over activities of distributed teams. These activities need to be well coordinated to achieve GSD project success. Hence having an effective coordination plan may help resolve such control issues that arise with GSD projects.

2.1.3 Communication in GSD

Communication is a process by which information is exchanged between individuals through a common system of symbols, signs, behaviour or tools. Communication is the key to team-based success (Battin et al. 2001) and is a mediating factor affecting both coordination and control (Carmel and Agarwal, 2001). Communication between collocated and distributed teams can be formal and informal, vertical and horizontal, synchronous and asynchronous. Complete and clear information needs to be exchanged
between the sender and receiver to have a common understanding about the project in GSD. Geographical distribution of software development in itself challenges formal and informal communication across distances (Herbsleb and Grinter, 1999). Increase in the complexity of the communication tools can degrade team performance, especially when work involves definite outcomes (Tushman and Katz, 1980).

Various tools are used to support communication in distributed development; however, apprehension is raised regarding these tools as distributed team members may seem to be unresponsive. Messages sent by unknown people who have not met are mostly ignored or considered as unimportant because the receiver does not understand the context well enough to determine their importance (Herbsleb and Grinter 1999). It is difficult to empathize with people that you never meet and so it is easy to ignore them and devalue their contributions and abilities (Kiel, 2003; Raylte et al. 2008).

Though English is often the ‘lingua franca’ (Lutz, 2009) of GSD, appropriate knowledge of the English language among team members is essential for good and fluent communication to satisfy project needs. There exists latent pressure over telephone conversation between native and non-native English speakers (Herbsleb and Grinter 1999). In such cases, non-native English speakers put extra effort into writing emails (Herbsleb and Grinter 1999) which delays communication and affects coordination between teams, thus escalating the project schedule. A different sense of time can lead to acrimony over the interpretation and seriousness of deadlines (Hofner and Mani, 2007). Many senior executive members express unwillingness to engage in international projects and to team up with nations in which the command of English is weak (Carmel and Agarwal, 2001). The language factor is considered as one of the reasons for the success of offshore IT work in countries with strong English language capabilities (Carmel and Agarwal, 2001).
Geographically distributed team members are either recognised by their roles in the team or by their job profile (Begel et al. 2009). The distinct working environment between distributed teams provides less opportunity for face to face communication. Formal as well as informal face to face communication that happens between collocated team members either during formal meetings or informal meetings such as coffee breaks or while walking towards restaurants during lunch-hours in the work premises gives team members an opportunity to discuss projects, to exchange personal information and to get to know each other better to create mutual association (Begel et al. 2009). It is well-known that groups of people who spend time together develop a ‘transactional memory’ about every individual (Herbsleb, 2005). Lack of experience in working together as well as lack of face-to-face interactions can reduce trust between remote partners (Raylte et al. 2008; Pyysilinen, 2003) thus affecting coordination.

Despite the considerable power of today’s asynchronous technologies for dispersed work, there are still powerful reasons for synchronous communication (Carmel and Agarwal, 2001). The most obvious obstacle to communicating across sites is the inability to share the same environment and to see what is happening at the other site (Herbsleb and Grinter 1999), and the selective availability of the person being contacted (Palacio et al. 2009). In such cases, communication protocols implemented for coordinating geographically distributed teams are ineffective in comparison to synchronous and lateral communication between collocated teams. Given the critical role of effective communication in the successful orchestration of GSD projects, it is not surprising that new tactics for addressing distance are being adopted (Carmel and Agarwal, 2001). To achieve similar and parallel understanding amongst geographically distributed teams and team members, strategies such as structured communication (Godart et al. 2001) or distributed pair programming (Bass et al. 2007) are followed to coordinate tasks on the GSD projects.
Direct communication between distributed team members working in the same time zone helps to ease coordination between them. However, when team members are separated by various time zones they increase the complexity in communication. Even the communication tools can disintegrate the team performance. Despite the availability of sophisticated collaborative and communication tools, coordination continues to be challenging in large size GSD projects and can put them behind schedule and over budget (Taweel et al. 2009). Communication is considered as a mediating factor affecting both coordination and control (Al-Ani and Keith, 2008). Hence specific coordination strategies are essential to boost communication between distributed teams working across different time zones. Resolving only the communication issues may not help to improve distributed team performance in GSD especially when precise outcomes are expected from the projects. Hence it is essential to have a distinct combination of communication and coordination strategies that may help to manage the GSD projects. Putting emphasis on coordination can help resolve the communication issues that have an adverse effect on the GSD project.

### 2.1.4 Cultural Diversity in GSD

With the emergence of technologies in a world which has become increasingly globalised, the relationship between culture and management of remote work has become an unavoidable issue which needs to be addressed (Watson et al. 1994). The significance of culture in an organisational setting is clearly demonstrated in the work of several social scientists over the years. They have presented theories which demonstrate that there are many ways to view culture and understand various aspects of culture within various countries. These theories are relevant to this study as they can help managers to gain insight into culture in various ways.
Hofstede (2001) conducted a study to find the impact of culture in workplaces. He has identified 5 cultural dimensions that give insight to different national cultures for effective interaction with people from different countries. The dimensions are Power Distance (PDI), Individualism/Collectivism (IDV), Uncertainty Avoidance (UAI), Masculinity/Femininity (MAS), Short-term or Long-term Orientation (LTO). If these dimensions are understood and applied appropriately it should help reduce the level of frustration, anxiety among team members and help in effective communication.

Based on anthropological analyses Hall (1990, 1997) identified key cultural factors. These factors are similar to that of Hofstede’s except that they are classified into High Context and Low Context based on time and space. He states that in High Context cultures more importance is placed on context rather than on content while in Low Context cultures information is transmitted through clear and explicit messages. In Low Context cultures more explanation is needed and there is less chance of misunderstanding. With respect to time, he says that cultures that follow monochronic time prefer doing one thing at a time while in polychronic time human interaction is valued over time and material things.

Hampden-Turner and Trompenaars (1997) state that the purpose of national culture is to provide answers and solutions to challenges faced by individuals. They have identified seven distinctive dimensions of culture to explain to international managers how to build the skills, sensitivity, and cultural awareness needed to establish and sustain management effectiveness across cultural borders.

Many other researchers such as D’Iribarne (2009) have the same approach as Hall but with an ethnographic method for sense-making. Vaara (2000) has broadened these cultural studies with an epistemological approach where they state that culture and cultural differences exist only when people become aware of it in their social interactions. Through these
theories, social scientists have tried to show international managers how to build the skills, sensitivity and cultural awareness needed to establish and sustain management effectiveness across cultural borders.

Globalization of software projects has increased demographic and cultural diversity obstructing smooth team functioning (Beise, 2004) as geographic and temporal distance limits opportunities for direct contact and cooperation (Carmel, 1999; Prikladnicki et al. 2003). In GSD, culture is termed as the centrifugal issue (Carmel, 1999) and cultural diversity is often stated as a barrier within distributed teams (Larkey, 1996; Baugher and Weisbord, 2000). This diversity appears in different forms such as language and ethnic differences, national and political differences, and individual perceptions and motivation or work ethics (Kotlarsky and Oshri, 2005; Holmstrom et al. 2006). Cultural distance is assumed to increase with the degree of cultural differences between geographically distributed teams (Carmel and Agarwal, 2001) and can therefore negatively impact on the level of understanding and appreciation of the activities and efforts of remote colleagues and teams (Hayes, 2002). Linguistic distance limits the ability for coherent communication to take place (Jensen et al. 2007) and can impact on the development of trust amongst teams (Pauleen and Yoong, 2001). Distributed team members must trust each other when engaged in cooperative activities (Al-Ani and Redmiles, 2008) Thus, managing distributed teams whose members are geographically and linguistically dispersed is seen as a daunting task (Ebert and Neve, 2001) due to the numerous constraints involved (Gurung and Prater, 2006).

Correspondingly, there are some positive aspects of cultural differences that are also visible in the literature. It is stated that the diversity of spoken languages or cultural backgrounds does not affect team performance (Chudoba et al. 2005). Gaining knowledge of the national culture and religious values facilitates in interpreting and understanding the behaviour of culturally diverse groups (Olson and Olson, 2003; Krishna et al. 2004). Heterogeneous groups with enhanced standards of collaboration and
conflict management systems achieve higher levels of consensus (Paul et al. 2004a). Hsieh (2006) states that, in GSD projects, cultural diversity poses interesting challenges to the team’s ability to acquire a shared understanding since team members come from different cultures have distinct problem-solving and communication processes. To reduce project risk, it is necessary to improve technical versus social diversity within various teams (Klein et al. 2002). Cultural diversity has the benefit of increasing a team’s creativity, innovation and problem solving potential (Milewski et al. 2008). When team members are exposed to new customs, ideas and different work cultures, it helps them get better at creatively sorting out issues of collocated development (Begel and Nagappan, 2008). While the validity of these findings have been contested (Ó Conchúir et al. 2009), developing a working relationship with other team members facilitates communication between key contacts around the globe who are subject-matter experts in their field (Begel and Nagappan, 2008). Indeed, it is arguable whether the observed cultural differences truly result from culture difference or are merely measurement artifacts (Karahanna et al. 2002), and it has been suggested that multicultural models consisting of multiple cultures, subcultures, and countercultures better represent contemporary organizations (Jermier et al. 1991).

Cultural diversity is an inevitable aspect of GSD. The magnitude and pace of GSD emphasizes the need to acknowledge cultural issues to ensure project success. It is a challenging task to manage culturally diverse teams as numerous constraints are involved. Therefore, it becomes necessary that project managers should examine the existing cultural differences to embark on the method to manage cultural diversity. For this reason, cultural proximity needs to be estimated to develop concrete strategies to recognise the potential impact of culture on distributed development. Addressing cultural issues only may not help to manage the GSD projects. Appropriate steps need to be taken to coordinate activities between culturally diverse teams working on the GSD projects. It can be anticipated
that having appropriate coordination strategies that may help resolve the cultural issue in GSD.

### 2.1.5 Need for Coordination in GSD

GSD requires continuous coordination. There is less need for coordination when activities are carried out independently but, when there is substantial dependency among various activities, there is more need for coordination (Espinosa and Carmel, 2004). This is particular to the case of GSD, when various activities are distributed and highly dependent on many other ongoing activities coordination needs. In GSD, team members coordinate the routine aspects of their work via task programming mechanisms (e.g., tools, schedules). However, they need to coordinate more with uncertain aspects of the task (Espinosa and Carmel, 2004). The effectiveness of various coordination mechanisms differs in collocated, distributed and time-separated context (Espinosa and Carmel, 2004). Therefore, to firmly hold on to the project goals and policies - effective control over groups, tools and standards are essential in GSD (Carmel and Agarwal, 2001).

With globalisation, outsourcing and offshoring becoming the norm of GSD (Herbsleb et al. 2001), problems related to coordination of distributed software projects, and to teams and team members are consistently analysed and formalised. From the available literature it is evident that several effective strategies, for example onsite visits (Boden and Avram, 2009), team structuring (Narayanan and Muzumder, 2006), task allocation (Jalote and Jain, 2004) are implemented and followed to overcome the coordination issues within those companies who are engaged in GSD. The strategies followed are original and innovative but are not prevalent. Their occurrences are random and vary according to the circumstances as and when they are essential.
There is an imperative need for appropriate coordination techniques which can suggest compatible process across sites to reduce the amount of coordination required for GSD projects. To identify the actual coordination issues it is necessary to bring together all the effective coordination practices that are followed in the management of GSD projects. Therefore this study intends to develop a process model to facilitate effective coordination between distributed teams working on the GSD projects. As a next step towards this, a mapping study is conducted to review the literature and bring together effective coordination strategies followed while managing the GSD projects.

2.2 Mapping Study

A large proportion of the published research in the area of Global Software Development (GSD) has centered upon the requirements of organisations outsourcing or offshoring software development. Most of the research is carried out within those companies who are outsourcing software development to low cost economies (Siffat et al. 2009; Gonzalez et al. 2006). There is less attention paid to conducting such studies from the standpoint of the vendor or the outsourcing destination companies. There has been less effort taken to systematically select, review, and synthesize the literature from the outsourcing (client) and outsourcing destination (vendor) perspective. Hence, I made a decision to map the primary studies which reported research on coordination strategies within the client or the vendor companies that manage GSD projects.

A mapping study is a form of secondary study intended to identify and classify the set of publications on a particular topic to categorize 'evidence gaps' as well as 'evidence clusters' when more primary studies are needed to perform a systematic literature review (www.dur.ac.uk/ebse/). Mapping studies are called secondary studies because they aim to aggregate the research of other studies which are referred to as primary studies.
(Kitchenham, 2010). In this research to search for relevant studies, the main condition was to understand the significant coordination strategies that are followed by both client and vendor companies while managing the GSD projects. As a researcher, I had attained elementary understanding of the GSD literature. This suggested me to set a basic criterion to search and retrieve primary papers on coordination in GSD from various electronic databases. To select the imperative studies from bibliographic databases, the papers with titles that contained key words as characterized in the generic Boolean search string (Section 2.2.3.1) were selected. Further, the abstract and conclusion was reviewed in order to select the papers for this research (Refer Table 2).

2.2.1 Research Questions for Literature Review

The objective of this literature review was to answer the following research questions –

- SRQ1: What are the strategies identified in the literature for successful coordination between client-vendor teams while operating in the GSD environment?

- SRQ2: What are the strategies followed by the vendor companies to overcome the coordination barriers when operating in a GSD environment?

2.2.2 Sources identified for primary studies

The primary source for carrying out this study was by reference to various electronic databases from which relevant research papers could be retrieved.

The following electronic databases were used.
i. IEEEXplore (www.ieeexplore.ieee.org/Xplore/)
ii. ACM Digital library (www.portal.acm.org/dl.cfm)
iii. Google Scholar (http://scholar.google.com.au/)
iv. Elsevier Science Direct (www.sciencedirect.com/)
v. SpringerLink (www.springerlink.com/)

A separate search was performed in the proceedings of International Conference on Global Software Engineering (ICGSE), International Conference on Software Engineering (ICSE), Software Engineering for Offshore and Outsourced Development (SEAFOOD) and Global Sourcing Workshop (http://www.globalsourcing.org.uk/). An initial scoping study was planned in order to determine an appropriate strategy given the time constraints imposed.

This mapping study was performed within the period October 2009 – December 2009. However, the literature published subsequently has been used in the thesis ensuring that the knowledge has been kept up to date.

A paper was included only if it –

i. Directly answered the research question.
ii. Is an empirical study and relates to industry practices.
   
   OR
   
   iii. Is a theoretical study related to GSD and contains important concepts that aid the understanding of coordination.
iv. Is a full paper (Not an introduction to any session such as panel discussion or workshop)

v. Is in the form of a book chapter only if the work relates directly to a PhD thesis, or if it summarizes or expands on peer reviewed articles.

A paper was excluded if it is
i. A student-based study
ii. Published before year 2000
   
   *Rationale* – Literature on GSD as research area has flourished since year 2000 (ACM Report, 2006; Smite et al. 2010) hence this ceiling is put down within the search criteria in an attempt to ignore any insignificant studies before this year. (Smite et al. 2010) have also set the same constraint in their literature review process for GSE.
iii. Published research studies that divulge the range of tools used for coordinating various tasks and activities in the GSD projects.
iv. Published as a textbook, or book chapter
   
   (Not taken from a peer reviewed journal/conference, or PhD).

### 2.2.3 Development of a Review Protocol

#### 2.2.3.1 Search for Primary Studies

To retrieve the papers relating to coordination in GSD, various bibliographic databases were searched for papers with titles that contained key words as characterized in the following generic Boolean search string:

```
(coordination <OR> collaboration <OR> project management <or> task allocation) <AND> (global software development <OR> gsd <OR> global software engineering <OR> gse <OR> distributed development <OR> distributed software development <OR> dsd <OR> virtual teams <OR> global virtual teams <OR> GVT))
```

#### 2.2.3.2 Documenting the Search

The process of performing a mapping study of the related literature was transparent and replicable (Kitchenham, 2010).
The bibliographic package Zotero® was used to manage the large number of journal articles, conference and workshop papers that were retrieved from various digital libraries for this literature review process. The format in Table 1 was used to store the information of the retrieved papers.

The actions listed in Table 2 were applied to all the papers retrieved from the various digital libraries and from individual conferences and workshops. Further, an assessment was carried out on all the selected papers (Table 1 and 2) to understand the quality of the reported studies.

The focus of this review process was to examine the literature that is published for Software Engineering (SE) and in particular for Global Software Engineering (GSE). The purpose was not to uncover every paper that has been written about coordination, but to gain a general understanding of coordination strategies and practices in GSE. For example, this scoped search did not include a specific search on coordination strategies or techniques in the Information systems (IS) and Management Science domains. However, subsequent to conducting the mapping study, and through checking related citations within the selected

<table>
<thead>
<tr>
<th>Title of paper</th>
<th>List the exact title of the paper</th>
</tr>
</thead>
<tbody>
<tr>
<td>Author</td>
<td>List all the Authors</td>
</tr>
<tr>
<td>Citation</td>
<td>Proper citation which can be later used in References section</td>
</tr>
<tr>
<td>Publication Type</td>
<td>State whether paper was published as Journal, Conference Proceedings, etc.</td>
</tr>
<tr>
<td>Year of Publication</td>
<td>Year when paper is published</td>
</tr>
<tr>
<td>Publication</td>
<td>Specific Journal/Conference etc. name</td>
</tr>
<tr>
<td>Volume/Issue and Pages</td>
<td>Include the volume or issue number with exact page numbers.</td>
</tr>
<tr>
<td>ISSN</td>
<td>International Standard Serial Number</td>
</tr>
<tr>
<td>Repository</td>
<td>Electronic database paper is retrieved from.</td>
</tr>
<tr>
<td>Date Accessed</td>
<td>Date when this paper is searched or accessed</td>
</tr>
<tr>
<td>Tags</td>
<td>Key words to identify this paper</td>
</tr>
<tr>
<td>Comments</td>
<td>If any.</td>
</tr>
<tr>
<td>Notes</td>
<td></td>
</tr>
<tr>
<td>Accept/Reject</td>
<td>According to the inclusion/exclusion criteria</td>
</tr>
</tbody>
</table>

Table 1: Procedure for documenting the search process
papers, I was able to add to this list of core work as can be viewed in the list of references.

<table>
<thead>
<tr>
<th>Action</th>
<th>Remark</th>
</tr>
</thead>
<tbody>
<tr>
<td>Check if the paper mentions empirical or theoretical study on coordination strategies.</td>
<td>Classify empirical and theoretical studies</td>
</tr>
<tr>
<td>Separate papers that discuss coordination strategies from the client perspective. Find which countries are involved in outsourcing.</td>
<td></td>
</tr>
<tr>
<td>Separate papers that discuss coordination strategies from the vendor perspective. Find which countries are involved in this study as outsourcing destination.</td>
<td></td>
</tr>
<tr>
<td>Check if the destination company is a subsidiary of the parent company and if the work is offshored to such company.</td>
<td>Reject papers that report studies based on offshoring setup.</td>
</tr>
<tr>
<td>List the practices the organisation employs for successful client-vendor relationship. (Only list those that were found to work)</td>
<td></td>
</tr>
<tr>
<td>List what practices didn’t work and what were the issues.</td>
<td></td>
</tr>
<tr>
<td>Author direct contact</td>
<td>If study is important, incomplete or suggests author is continuing to research in this area, note contact details here and what question we want to ask them.</td>
</tr>
<tr>
<td>Does the author have other related work or has the author carried out any such prior studies similar to this study</td>
<td>If this is likely, run secondary search on Author name.</td>
</tr>
<tr>
<td>Does the source (e.g. journal or conference proceeding) contain other related work?</td>
<td>If this is likely, run secondary search on the source.</td>
</tr>
</tbody>
</table>

Table 2: GENERIC FORM FOR SEARCHED PAPERS (Beecham et al. 2006)

2.3 Results

It was essential to take a logical approach to examine and categorise the coordination strategies revealed from the literature. Hence a structured process for clustering similar themes that gave comprehensive information about comparable coordination practices in the GSD environment was formalised and followed. This led to substantive findings from the synthesis of selected papers that form the basis of the literature review.
2.3.1 Primary Studies

A total of 1005 papers were retrieved from various digital libraries by means of the Boolean search string. I read the Abstract and Conclusion of each paper to decide whether to include or exclude the paper. On the basis of the inclusion and exclusion criteria within the protocol, 715 papers in total were rejected. Additional scrutiny was then performed on the selected 290 papers. These papers were again analysed and 151 papers were rejected after re-applying the inclusion and exclusion criteria to the full text of the paper. I accepted 139 papers, Table 3 and 4 give the overall statistics of the primary classification of all the papers.

<table>
<thead>
<tr>
<th>First Round</th>
<th>Directly Searched</th>
<th>Rejection</th>
<th>Not Related</th>
<th>Accept</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACM Conference</td>
<td>397</td>
<td>295</td>
<td>51</td>
<td>51</td>
</tr>
<tr>
<td>ACM Journals</td>
<td>169</td>
<td>146</td>
<td>11</td>
<td>12</td>
</tr>
<tr>
<td>IEEE Conference and Journals</td>
<td>292</td>
<td>152</td>
<td>78</td>
<td>62</td>
</tr>
<tr>
<td>Science Direct</td>
<td>100</td>
<td>95</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>Web Of Knowledge</td>
<td>47</td>
<td>27</td>
<td>8</td>
<td>12</td>
</tr>
<tr>
<td>Total</td>
<td>1005</td>
<td>715</td>
<td>151</td>
<td>139</td>
</tr>
</tbody>
</table>

Table 3: Statistics of Total Papers Selected in First Round

2.3.2 Secondary Studies

An assessment was carried out on the 139 accepted papers to distinguish empirical and theoretical reporting on coordination practices. Table 4 gives an overview of the paper selection process and the classification of the secondary studies. Out of these 139 papers examined, 81 papers were rejected and the main reasons were that –

♦ 11 papers reported on tools and models.
♦ 12 papers reported either conducting pilot studies or projects with student’s teams.
♦ 12 papers reported on Collaboration, Task-Allocation, Control Mechanism, Culture and Communication.
♦ 6 papers were PhD proposals.
♦ 40 papers included various other reasons such as studies that reported coordination related to other disciplines, second copies of the same paper, same study reported in other conference, short papers, etc.

<table>
<thead>
<tr>
<th>Papers</th>
<th>No. of papers</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Directly searched from various databases</td>
<td>1005</td>
<td>Selection as per search criteria</td>
</tr>
<tr>
<td>Rejected</td>
<td>715</td>
<td>Rejection on the basis of reading title and abstract</td>
</tr>
<tr>
<td>Selected</td>
<td>290</td>
<td>Accepted for additional scrutiny</td>
</tr>
<tr>
<td>Rejection after additional scrutiny</td>
<td>151</td>
<td>Rejection on the basis of their abstract and conclusion</td>
</tr>
<tr>
<td>Selected after additional scrutiny</td>
<td>139</td>
<td>Additional scrutiny was done by reading abstract and conclusion and were selected for further examination</td>
</tr>
<tr>
<td>Rejection after additional scrutiny</td>
<td>81</td>
<td>Rejected because these papers were not empirical or theoretical papers, and also did not fully satisfy the search criteria (Reference Table 5)</td>
</tr>
<tr>
<td>Theoretical Studies</td>
<td>28</td>
<td>Influential studies by well known authors who have contributed to the GSD research area</td>
</tr>
<tr>
<td>Empirical Studies</td>
<td>30</td>
<td>Served as the basis for this research work – fully met all inclusion and exclusion criteria</td>
</tr>
</tbody>
</table>

Table 4: Paper Selection Process

Out of the remaining 58 papers selected, thirty papers were empirical studies and 28 were theoretical studies that satisfied the search criteria set in the protocol.

The thirty empirical papers that are selected served as the basis for the study and are published in various key journals such as IEEE-Software, JMIS, TPC, SPI and in the proceedings of various conferences such as ICGSE, ICSE, HICSS, APSEC and CHASE/ICSE Workshop.

Moreover, out of these thirty empirical research papers - nine are journal articles, fourteen are conference papers and seven are workshop papers. Analysis of these thirty papers with respect to the research question
revealed several coordination strategies with wide-ranging solutions that help to manage and overcome any obstacles that impede GSD projects. These thirty studies are listed in Table 8 and Appendix A.

Apart from this, the twenty eight theoretical papers that meet all the criteria were selected as they support certain arguments, provide definitions, and contain important theoretical background to aid the understanding of coordination in GSD. These twenty eight papers are listed in Appendix B. These papers will be cited and referenced in later stages of this research study.

Through the literature review, in the selected empirical studies, the major outsourcing countries were identified from where the clients outsourced their software development project to vendor companies. Four countries were listed as the major outsourcing countries from where the work was outsourced. Fourteen studies mentioned the US and five studies mentioned the UK as the outsourcing country, while one study mentioned Europe without providing the country name. Furthermore, seven studies did not clearly mention any country. Table 5 and Figure 1 gives more details about this.

<table>
<thead>
<tr>
<th>Outsourcing Countries</th>
<th>No. of Studies</th>
</tr>
</thead>
<tbody>
<tr>
<td>US</td>
<td>14</td>
</tr>
<tr>
<td>UK</td>
<td>5</td>
</tr>
<tr>
<td>Europe</td>
<td>1</td>
</tr>
<tr>
<td>Germany</td>
<td>3</td>
</tr>
<tr>
<td>Not Clearly Mentioned</td>
<td>7</td>
</tr>
</tbody>
</table>

Table 5: Major Outsourcing Countries

On the other hand, 23% of the empirical studies mentioned India as the most common Outsourcing Destination Country where the vendors usually received the GSD projects from clients in the outsourcing Countries. Table
6 and Figure 2 provide more details on the outsourcing destination countries engaged in the GSD projects.

Another observation is that 21 papers mentioned multiple countries involved as outsourcing destinations, while 9 studies mentioned only a single country as their outsourcing destination for client-vendor relationship.

In the course of the literature review, I was interested to know how many studies were independently carried out from the client or the vendor side. Eighteen papers report coordination strategies from the client's viewpoint, only four papers give details from the vendor point of view, while another four papers are partially reporting client and vendor side because they perform a task as Bridging Countries. Out of the remaining four papers, one paper does not give full clarity as to which side they are reporting from.

<table>
<thead>
<tr>
<th>Countries</th>
<th>No. of Studies</th>
</tr>
</thead>
<tbody>
<tr>
<td>France</td>
<td>1</td>
</tr>
<tr>
<td>Germany</td>
<td>3</td>
</tr>
<tr>
<td>India</td>
<td>11</td>
</tr>
<tr>
<td>Japan</td>
<td>2</td>
</tr>
<tr>
<td>East Europe</td>
<td>1</td>
</tr>
<tr>
<td>Australia</td>
<td>2</td>
</tr>
<tr>
<td>Latvia</td>
<td>1</td>
</tr>
<tr>
<td>Slovakia</td>
<td>1</td>
</tr>
<tr>
<td>Siberia/Russia</td>
<td>2</td>
</tr>
<tr>
<td>England</td>
<td>2</td>
</tr>
<tr>
<td>Ireland</td>
<td>3</td>
</tr>
<tr>
<td>Malaysia</td>
<td>1</td>
</tr>
<tr>
<td>Asia</td>
<td>1</td>
</tr>
<tr>
<td>China</td>
<td>2</td>
</tr>
<tr>
<td>Singapore</td>
<td>1</td>
</tr>
<tr>
<td>Europe</td>
<td>3</td>
</tr>
<tr>
<td>Global Presence</td>
<td>5</td>
</tr>
<tr>
<td>Not Clearly Mentioned</td>
<td>5</td>
</tr>
</tbody>
</table>

Table 6: Outsourcing Destination Countries

The remaining four mentioned their global presence, hence, they are considered to be reporting from client side. Table 7 and Figure 3 present the details.
Therefore this investigation indicates that almost 70% of the coordination strategies or practices studied in GSD are from the client perspective while only 14% studies are from the vendor perspective. In GSD research, there is very little emphasis given to performing such studies from the vendor’s point of view.

<table>
<thead>
<tr>
<th>Effective Strategies</th>
<th>Bibliographic Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Onsite Visits</td>
<td>(Battin et al. 2001); (Begel and Nagappan, 2008); (Bass et al. 2007), (Hogan, 2006); (Boden and Avram, 2009); (Begel, 2008); (Herbsleb et al. 2005); (Krishnan and Ranganathan, 2009)</td>
</tr>
<tr>
<td>Liaisons or gatekeepers/Cross-site delegation</td>
<td>(Battin et al. 2001); (Begel and Nagappan, 2008); (Hogan, 2006), (Pichler, 2007); (Cataldo and Herebsleb, 2008); (Begel A, 2008); (Milewski et al. 2008); (Bass et al. 2007),</td>
</tr>
<tr>
<td>Bridging and Bridgeheads</td>
<td>(Carmel and Agarwal, 2001); (Holmström et al. 2008); (Boden and Avram, 2009); (Milewski, 2008); (Hogan, 2006); (Pichler, 2007)</td>
</tr>
<tr>
<td>TSM (Technical Supplier Manager)</td>
<td>(Pichler, 2007)</td>
</tr>
<tr>
<td>Dyad Model/ Two actors/ Distributed Pair/Buddy System/Mirroring</td>
<td>(Espinosa and Carmel, 2004); (Hogan, 2006); (Begel, 2008); (Bass et al. 2007)</td>
</tr>
<tr>
<td>Teams</td>
<td>(Begel et al. 2009); (Hogan, 2006); (Bradner et al. 2005); (Sutanto et al, 2004); (Narayanan and Mazumder, 2006); (Espinosa et al. 2005); (Espinosa et al. 2007); (Keith et al. 2009)</td>
</tr>
<tr>
<td>Team Cognition Team Knowledge</td>
<td>(Espinosa et al. 2005); (Keith et al. 2009); (Fuller et al. 2006)</td>
</tr>
<tr>
<td>Shared Mental Model</td>
<td>(Smite, 2005); (Rasmussen et al. 2008); (Espinosa et al. 2005); (Bass M, 2006)</td>
</tr>
<tr>
<td>Task Allocation</td>
<td>(Jalote and Jain, 2004); (Smite, 2005); (Mockus and Weiss, 2001), (Hogan, 2006); (Battin et al. 2001); (Taxen, 2006)</td>
</tr>
<tr>
<td>Communication for Coordination</td>
<td>(Bradner et al. 2005); (Godart et al. 2001)</td>
</tr>
</tbody>
</table>

Table 8: Research Studies Reporting Effective Coordination Strategies
Hence, it can be stated that there is a need to carry out more studies from the vendor side to understand the actual issues that exist between clients and vendors while outsourcing software development projects. If more studies are carried out from the vendor side, it will help the outsourcing clients to overcome the different issues that exist within the GSD projects. Thus, investigating various issues will help in resolving problems related to culture, communication and control that are major barriers of GSD.

Additionally, this literature review has contributed towards finding the best coordination strategies or practices that are largely followed and are successfully implemented by client and vendor companies. Table 8 gives the list of most applicable and effective strategies within outsourcing companies.

<table>
<thead>
<tr>
<th>Ineffective Strategies</th>
<th>Bibliographic Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Daily stand-up meetings via teleconference</td>
<td>(Hogan, 2006)</td>
</tr>
<tr>
<td>Uncooperative behaviours to accomplish team goals</td>
<td>(Panjer et al. 2008)</td>
</tr>
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</table>

Table 9: Research Studies Reporting Ineffective Coordination Strategies

Certain coordination strategies which are particularly ineffective in GSD were also mentioned in the literature. For example, daily stand-up meetings via teleconference (Hogan, 2006) are considered to be futile. Also uncooperative behaviours to accomplish team goals (Panjer et al. 2008) have been indicated as a hindrance to coordination of GSD teams. Table 9 gives the list of ineffective coordination strategies.

### 2.4 Synthesis of Literature

To achieve project success, there is a requirement for effective coordination amongst distributed teams and team members working on the
GSD projects. Coordination needs are high on daily pooled tasks. Each distributed team has essentially to put together extra value-added-tasks so that the other teams can quickly proceed to add its own value. This reduces delay for 24/7 support in the distributed software development environment (Espinosa and Carmel, 2004).

Problems relating to coordination of distributed software development or GSD projects, teams and team members are constantly analysed and formalized. Zigurs et al. (2001) have proposed a conceptual framework for coordination of virtual teams. Based on this framework, Sutanto et al. (2004) have also studied coordination for global virtual teams (GVT) wherein they show that coordination for effective teamwork depends on the basic structure of the distributed teams. Further, Wiedu (2006), has conceptualized a framework for coordination based on the theoretical information drawn from the literature for GSD. On the other hand, a range of empirical investigations are also carried out to study coordination in GSD. Espinosa and Carmel (2004) have conducted research to study coordination between two team members who are separated by time and distance. Taxen (2006) has proposed a strategy to support the common understanding about coordination of the engineering process in distributed development. Smite et al. (2008) and Bass et al. (2009) both have investigated coordination and risk analysis between geographically distributed teams in GSD. Hossain, (2008) states that a good understanding of coordination difficulties can help devise strategies to overcome them. Many pragmatic studies are carried out to investigate coordination in GSD but until now they have been isolated. Through this literature review, I have endeavoured to integrate such studies and shape a foundation to accomplish further steps essential in this research study.

It is evident that there are several effective strategies implemented to overcome the coordination issues within the companies engaged in GSD but very little is known about these strategies. They are original and innovative but are not prevalent; they are random and vary according to the
circumstances as and when they are needed. Begel et al. (2009) categorically state that researchers regularly carry out empirical studies with software development teams to examine how processes, tools and team members coordinate in GSD. However, a particular approach that is successful in one project may not be suitable in other projects (Bass, 2006). No right model or framework for coordination has so far been set up in GSD. Hence, the main research question is how to bring together all the effective coordination strategies that are followed to successfully manage the GSD projects.

Most of the strategies are centered upon the issues confronted by the outsourcing (client) companies and are implemented within these companies to overcome the coordination barrier with the outsourcing destination (vendor) companies. Not many strategies are discussed from the vendor perspective.

In an attempt to study these coordination strategies from the client and the vendor perspective, I have categorised and clustered them to form a set of analogous practices. The premise to adopt this innovative method was because in the process of synthesis of literature I realised that there are various associated strategies. Hence I categorized all the interrelated strategies into subsections which helped me to give comprehensive information about comparable coordination practices followed in the GSD environment.

It is important to indicate that, there are certain innovative and successfully implemented stand-alone practices such as Bridge Integration, Delegation across Sites, Small Teams, Large Teams, Team Knowledge and Urgent Request. These practices are revealed from the literature and answer the main research question. As these practices are reported for the first time there may not be more than a single study in support of these practices. Hence there is inadequate evidence to critique such strategies. Additionally, these strategies are functional and successfully practiced in various
software companies. In view of this, instead of following the traditional method of merging related themes with each other, these practices are mentioned in separate subsections to highlight their importance.

### 2.4.1 Onsite Visits

The majority of research studies analysed have emphasized onsite visits as one of the important coordination strategies for GSD. These are the visits made by members of client companies to the vendor companies and vice versa. Ideally all team members from each team are encouraged to visit the sites of other teams with whom they are coordinating daily. Scheduling such visits to the location of the other teams serves to improve understanding between teams and team members (Begel and Nagappan, 2008). It also makes them aware of their work practices; priorities and the environment in which they are carrying out their development work (Begel and Nagappan, 2008). These visits also let team members resolve issues and misunderstandings (Begel and Nagappan, 2008) that may have happened prior to meeting each other and thus establish relationships amongst members of teams from different geographic locations (Bass et al. 2007). Having connections amongst the teams has a positive impact on team performance as compared to disconnected teams (Cataldo and Herbsleb, 2008). Consequently, this helps in effective coordination of distributed software development teams. The onsite visits help to ‘put faces to roles’, where otherwise team members are mostly known by their job roles or profiles and help to set expectations better than can be done through teleconferencing (Begel and Nagappan, 2008).

While performing the review of the GSD literature, it was realised that various correlated practices are followed while planning the onsite visits. Hence in the following subsections, I have made an effort to bring to light all such practices that are considered relevant to the onsite visits.
2.4.1.1 Planning the Visits

Through the literature review I can suggest that onsite visits need to be planned meticulously taking into consideration various aspects of the project. When people meet and work together for a certain period everything else works better (Herbsleb et al. 2005). Generally it is implied that these visits should be planned mainly during the initial phase of the project (Bass et al. 2007) as well as through the last phase of the project before the final product is finished (Boden et al. 2008). It is recommended that a substantial amount from the travel budget must be spent during the initial phase of the project (Herbsleb et al. 2005). Visits made during the initial phase of the project can help both the client and vendor companies to discuss the detailed project plan, project deliverables, role of each team and team members and what each team can expect from one another. Visits made in the ending phase of the project can be the best way to deal with the many small bugs and problems that are expected during that phase which often involves a great deal of coordination (Boden et al. 2008).

These onsite visits need to be encouraged for members from both the client and vendor side. The members from client companies must use these visits to check the project status, ensure progress and address any issues at vendor project sites (Bass et al. 2007). Contacting remote teams about their concerns and requirements well in advance gives enough buffer time to respond to issues (Begel and Nagappan, 2008). It is also essential that these visits are made by all levels of staff such as senior executives, project managers and relatively junior team members.

The literature indicates that visits made by senior management personnel during various phases of the GSD projects allow them to carry out exchanges that may otherwise not happen from a distance (Bass et al. 2007). It is also proposed in the literature that project managers, sub-project leaders and various team members such as line managers need to visit other sites to have technical exchanges and presentations (Bass et al.
The onsite visits need to be continuous and rotating where a replacement has to be sent out as the preceding team member returns home (Hogan, 2006). These rotating visits need to be planned well in advance to avoid any superfluous situation that may affect the project schedule. Visiting members need to be informed beforehand about their travel plans. Detailed status of the stay and their role during visiting the sites should be made available to them (Bass et al. 2007). An effort should be made to obtain proper visas in advance for the members who might be travelling (Battin et al. 2001) taking into consideration all related issues. It is very important to have a proper understanding of all required documentation imposed by the laws of the various countries and the time incurred when completing it (Battin et al. 2001). Sufficient experience and planning into onsite visits is necessary. An onsite visit also allows visiting members to make key contacts around the globe who are subject-matter experts in their field (Begel and Nagappan, 2008).

2.4.1.2 Visits by Cross-site Delegates

In the GSD literature, a strategy for visits by cross-site delegates suggests that team members from the central site can visit any remote site or a member from any remote site can go to the central site or other remote site for a specific time period. While analysing the literature I identified that the visiting team members are termed as ambassadors (Hogan, 2006), onsite coordinators (Battin et al. 2001), cross-site delegates (Bass et al. 2007; Begel and Nagappan, 2008), liaisons and gatekeepers (Pichler, 2007; Cataldo and Herbsleb, 2008). These team members travel among sites for improving cross-team communication and the primary role of these visiting members is to coordinate activities between distributed teams (Hogan, 2006). Their role is to build a relationship amongst various teams, to provide a mechanism to create trust and transfer knowledge, to communicate lessons learned and to set future direction for the project (Hogan, 2006). These cross-site representatives can take various roles
depending on the need (Bass et al. 2007) at each site. Such representatives from central as well as remote sites must be involved in all activities at the visiting site such as meeting, teleconferences, and videoconferences, as they become the contact person for their original sites (Bass et al. 2007). Cusick and Prasad (2006) in their conceptual framework suggest that it is essential to retain an onsite team lead for each outsourced project throughout the project life cycle. On return to their original teams, these delegates become ‘point people’ for cross-site collaboration in establishing communication across sites (Bass et al. 2007). The cross-site delegates or ambassador’s relationships, knowledge of personalities and culture acts as a communication short-cut between the teams allowing for complex and subtle communication to flow in both directions (Hogan, 2006). In accordance with the GSD literature, it can be stated that planning regular visits of onsite delegates to different team sites can help improve coordination between team and team members working on the GSD projects.

### 2.4.1.3 Social Time during Onsite Visits

Social time is the spare time that is spent together by visiting team members with the members of the current team at any social event. Though not a part of formal agenda, some social time spent with the host team members gives the visiting individual an opportunity to understand the organization’s culture and provides a coherent perspective of the goals, objectives and principles that guide actions and decisions in the organization (Krishnan and Ranganathan, 2009). Bass et al. (2007) have emphasized the need to build free and social time into the agenda of ‘onsite visits’. It is important to understand that a large proportion of the conversation occurs outside of the formal meetings (Bass et al. 2007). The social time needs to be encouraged and allowed for, as time spent socially with the team members from other locations after work by the visiting delegate or ambassador provides much of the missing contextual information to their colleagues (Hogan, 2006). The social interaction helps
in building ties between team members that lasts even after they return home and improves cross-team coordination and communication (Hogan, 2006). It also allows building personal relationships and provides a mechanism to build trust and transfer knowledge (Hogan, 2006).

2.4.1.4 Duration of Onsite Visits

The duration for which a delegate or ambassador visits other team sites is measured as an important feature of onsite visits for the GSD teams. It is recommended that the onsite visits should not be scheduled for shorter time periods than, for instance, one or two weeks. Instead they must be planned for a longer duration of time which can ideally be from four weeks up to two years (Bass et al. 2007). A longer time spent together helps to create a personal connection between remote team members (Begel et al. 2009). This connection results in faster turnaround time on emails as compared with someone you do not know and leads to become an obvious partner for a buddy system (Begel et al. 2009).

At the starting phase of the project, the project manager should visit the remote sites once every 6 - 8 weeks (Bass et al. 2007). Later regular visits by different team members for durations of 4-6 weeks can facilitate project coordination. Further, the literature also suggests that 8-12 weeks of such visits need to be planned during the final phase of the project to resolve various matters and deal with coordination issues (Boden et al. 2008).

2.4.1.5 Impact on Cultural Differences

Onsite visits help resolve many other issues that impede effective coordination in GSD. One such issue is cultural distance. Gaining knowledge of other national cultures and religious values facilitates in interpreting and understanding the behaviours of culturally diverse groups (Olson and Olson, 2003). National cultures differ in terms of religious values, ethnic norms and linguistic diversity. These differences are often
delineated by political boundaries between nations (Carmel and Agarwal, 2001).

Cultural distance develops when distributed team members from culturally, linguistically and ethnically diverse backgrounds are unable to complement and communicate with each other. Therefore cultural distance is considered a major issue in GSD (Carmel and Agarwal, 2001). Such cultural differences between team members are believed to obstruct coordination between distributed teams (Carmel and Agarwal, 2001; Casey, 2009). Thus onsite visits may well help to reduce cultural distances that exist between teams and team members located within various countries. The other benefit of onsite visits is that they help in gaining an understanding of the beliefs and disbeliefs that exist within every culture and help incorporate rational thinking among team members. In these visits, team members get exposed to new customs, ideas and different work cultures of the site they are visiting, which allows them to compare various cultural norms to understand how they are different from their own.

2.4.1.6 Implications of Onsite Visits

An overall advantage of the ‘Onsite visit’ strategy in GSD is that it helps visiting team members know other team members well. On return these visits help get them better at sorting out issues at the collocated development site (Begel and Nagappan, 2008). Social interaction helps in building ties between project team members which continue even after they return home (Krishnan and Ranganathan, 2009). Onsite visits and social interactions are the basis for formation of project social capital and the potential accessible resources to the project through the network of relationships for the duration of that project (Krishnan and Ranganathan, 2009). During their stay, visiting members absorb a significant amount of tacit knowledge as they work closely with each other. This is later disseminated to the team members on their return back home (Hogan, 2006).
2.4.2 Bridging

To overcome coordination issues in GSD another approach that is revealed from the GSD literature is ‘bridging’ teams from various sites. Bridges are identified as groups of ‘heterogeneous workforce’ (Milewski et al. 2008) available within a reasonably short geographical and temporal distance. These workforces can become nodes to manage two or more separate work sites that exist on either side of their location (Milewski et al. 2008). In GSD, specific sites function as bridges when they outsource work further to other sites and thus experience being both client and vendor in two-stage offshore-outsourcing relationships (Holmström et al. 2008). The GSD literature suggests that bridging can help in successful knowledge management and coordination of GSD projects. Though research on establishing bridges is evolving, so far, Holmstrom et al. (2008) and Milewski et al. (2008) have studied bridge type arrangements and found that bridges can facilitate in successful coordination of GSD projects (Milewski et al. 2008). To examine bridges and bridging tactics, it is essential for the GSD experts to understand various attributes that are involved in building bridges.

2.4.2.1 Building Bridges

Bridges are to be established when there is a high need for real-time interaction (Milewski et al. 2008). The interdependencies such as each site’s goal and objectives, match between the bridging function, flexibility and willingness to make adaptations to changing circumstances must be considered while building bridges (Holmström et al. 2008; Milewski et al. 2008). Cultural compatibility with others’ beliefs and values must also be measured while building bridges (Holmström et al. 2008; Milewski et al. 2008). It is suggested that setting up managerial level bridges helps the managers to directly manage the activities of their local teams and minimize the day-to-day coordination with improved communication and
deeper trust (Holmström et al. 2008; Hogan, 2006). The benefit of implementing the managerial level bridges results in a reduction of the communication overheads that subsist at the bridge site (Holmström et al. 2008).

Van de Ven et al. (1976) considered that setting up an intermediate communication centre only tends to add additional complexity to communication between workgroups rather than serve as an aid to improving communication and coordination. On the contrary, Milewski et al. (2008) state that building bridges can work out as a viable management strategy to resolve the problems of culture, time zones and geographic distance by improving communication and coordination in GSD. In support of this Setamanit (2007) have established that a follow-the-sun strategy is applicable best between three development-sites working in 24-hour cycle in order to reduce cycle time. The expertise and experience of building bridges is critical because they are at the hub of information sourcing and equally they are fragile therefore need to be protected in the swiftness of software development (Milewski et al. 2008).

### 2.4.2.2 Bridge Location Selection

In GSD, selecting appropriate bridge location is an important building block for establishing bridges. Battin et al. (2001) state that a particular location has to be selected based on the domain expertise and the experience in the area of bridging and real availability of the staff. Further, the opportunity of physical closeness between the sites from where they can interact is important in selecting a bridge location (Battin et al. 2001). Milewski et al. (2008) point out that bridge location should be able to decrease distances and help create shorter paths among non co-located team members or workgroups. Therefore, bridges can be located in countries with overlapping working hours that will permit real-time communication to reduce the temporal distance (Milewski et al. 2008).
In the literature, bridgeheads are identified as gatekeepers, point people or liaisons. The incorporation of liaison or gatekeepers to manage the dependencies is a mechanism that facilitates coordination in GSD (Sangwan et al. 2006). According to Begel and Nagappan, (2008) liaisons act as the main communication conduit to ease coordination between the non-collocated teams. They enact as ‘boundary spanners’ to fill the structural holes (Boden and Avram, 2009). Therefore, they need to be strategically embedded in the coordination network to acquire the necessary knowledge and discover the important dependencies to provide a valuable liaison role (Cataldo and Herbsleb, 2008). It is suggested that liaisons need to understand the intent of the architecture and the overall theme of the project. This provides the link between the development teams and the architecture teams to resolve the architectural and domain related questions locally (Battin et al. 2001). Liaisons positioned centrally in the social system of information exchanges for coordination (Cataldo and Herbsleb, 2008) can help in arbitrating team conflicts and resolving miscommunications that happen between team members (Carmel and Agarwal, 2001). They can perform the informal role of ‘cultural liaisons’ to bridge the cultural and linguistic differences between teams and facilitate organizational flow of communication (Carmel and Agarwal, 2001). An emigrant of a particular country with sufficient global knowledge and willingness to travel between locations might serve as the cultural liaison (Carmel and Agarwal, 2001). The bridgeheads need to have the skill of time management and should be aware of the cultural diversity within groups (Milewski et al. 2008). Knowing whom to contact within particular teams at various times can help reduce coordination (Herbsleb and Grinter, 1999).

In the GSD literature, numerous tactics to manage liaisons are suggested and one of them is that liaisons from all places should meet at the headquarters at the beginning of the project to acquire sufficient knowledge.
of the project. They can then return back to their centers to reinforce coordination and communication channels (Battin et al. 2001). Another approach is ‘Outsourcing the outsourcing manager’ in which technically and culturally competent team members with a willingness to travel is outsourced to the remote site to become the connection between the two sites (Pichler, 2007). This team member is familiar with the product to be developed, has sufficient understanding to handle queries from his/her home team and knows the strengths and weaknesses of his own team. This allows him/her to come up with a well suited plan (Pichler, 2007).

Another tactic that helps building bridges is to follow a 75/25 rule of thumb (Carmel and Agarwal, 2001) where 25 percent of workforce is present at the site maintaining closeness to the clients. They understand the client’s requirements and translate them to the team in home country to reduce miscommunication by enhancing the cultural buffer (Carmel and Agarwal, 2001).

2.4.2.4 Bridge Integration and Delegation across Sites

Travelling across sites and maintaining a joint development process document allows for closer integration of two sites in the GSD projects (Holmström et al. 2008). As per Holmström et al. (2008) sharing ownership so that each site has a stake in the project is considered beneficial for integration.

Delegation of work across sites is important in bridging as it affects the team structure in the bridge model. Delegation in the bridge can be to train new recruits and establish new teams across the site (Holmström et al. 2008). Delegation of work implies power hierarchy in the relationships between the two sites (Holmström et al. 2008). Therefore, it is necessary to define the delegation role and channels of delegation in bridge model for GSD.
2.4.2.5 Bridging Implications

Milewski et al. (2008) state that managers working within bridging contexts need to be aware of the dynamics of bridging and should monitor the efficiency of communication channels for effective coordination. They consider that regulating group dynamics can be a complicated task especially within bridges as they can impose huge stress on the bridge team members in terms of both long workdays and interruptions. Identifying the approximate point where the trade-off between deciding to establish a bridge site or not is necessary in GSD (Milewski et al. 2008) as some individuals within the project may not be as comfortable as others in performing the bridge function (Burt et al. 1998; Milewski et al. 2008). It is considered that bridging can not be an everlastingly strategy that is viable in the long-term because the bridge model gets affected by the changing organisational structure, depending on how closely the teams at different locations are integrated (Holmström et al. 2008).

The advantage of bridges is that communication becomes faster, thus reducing waiting time for other locations to start their day (Milewski et al. 2008). Bridges helps target exact information to the other groups that need it most, reducing redundancy and overload (Milewski et al. 2008).

2.4.3 Teams

A team is a group of people who work together to achieve common goals. Moe et al. (2010) define teams as a small number of people with complementary skills who are committed to a common purpose and goals that are mutually accountable. In GSD, when teams and team members from various geographical locations work to achieve project success they need a high level of coordination and communication techniques. Various overheads such as lack of communication or constant contact between team members trigger the need to maintain association between teams to
coordinate on a daily basis (Begel et al. 2009). Different attributes such as team size, team structuring, and team knowledge need to be considered for successful coordination in GSD projects. While reviewing the GSD literature, analysis of these attributes has revealed some noteworthy aspects essential for effective coordination in GSD. Though many of these concepts are derived and are based on organisational behaviour theories they are important from the perspective of coordination in the GSD projects. The magnitude of available literature on GSD emphasizes the significance of all such aspects.

2.4.3.1 Team Size

In GSD literature, team size is considered as an important attribute for coordination (Sutanto et al. 2004) as its effects on distributed development is still largely unknown. Bradner et al. (2005) has studied team size to identify the consequences of small and large teams on the GSD projects. The following findings related to team size are all due to Bradner et al. (2005).

Today, the technology can engage a large number of team members to coordinate virtually from any geographic location. Availability of network connectivity and communication technology encourages team size to grow unrestrained. However, a limit still exists on the size that a team can expand to with current technological capacities. Team size affects fundamental factors such as team behaviour, participation, rapport, and awareness amongst team members that maintain complex social behaviours of trust, identity, and leadership. On the basis of the different features, GSD projects may require either small teams or large teams. Hence, it becomes imperative to gauge the team size to have proper balance at all geographic locations. The assessment between having a small team size and a large team size helps to uncover the issues that impede coordination in GSD. The study done by Bradner et al. (2005) to
understand the difference between small and large teams was the only study and was retrieved while performing this literature review.

**Small Teams** – A team with more than one and up to ten members is considered a small team (Bradner et al. 2005). It is judged that small teams outperform large teams as team members are relatively more aware of their goals than large teams (Bradner et al. 2005). Small teams are found to have their team goals more clearly defined so that all the team members take responsibility to enforce the agreed processes, objectives and ground rules (Bradner et al. 2005). This responsiveness in small teams is greater because they are better acquainted with each others’ work, roles and expertise (Bradner et al. 2005). The rationale is that, as they are familiar with each other on a personal basis, they know the exact time and proper means of communication for coordination. There is openness, trust and honesty within small team members which allows the building of relationships and they work closely to improve daily coordination and communication with reduced overheads (Hogan, 2006). As the team leaders encourage more interaction and participation, small teams have higher levels of team rapport (Bradner et al. 2005). Small team members contribute their best to keep commitments and complete their work on time not just to accomplish the team goals but to achieve higher levels of individual satisfaction (Bradner et al. 2005). This in turn assists the small teams to align with each other for effective coordination and improve confidence through increased trust and a greater feeling of camaraderie (Hogan, 2006). Work coordination is synchronous in small teams; therefore non-participation and poor performance is highly visible which makes it easy to keep accurate mental records of who is participating and who is not as compared to large teams (Bradner et al. 2005).

**Large Teams** – Teams with more than ten members are considered to be large teams and are judged to have more complexities in comparison to small teams (Bradner et al. 2005). As the team size increases, the number of participants in standard team meetings rises which introduces pressure
on team members not to talk and drive the meetings much longer (Hogan, 2006). The variation between the participants or the outsized number in team meetings leads to ineffective coordination and prevents having a deep understanding of each others’ work (Bradner et al. 2005; Hogan, 2006). Further, during meetings either insignificant topics crop up or members mostly from the client side try to multitask all through the meeting which shows that they are not fully involved in meetings (Bradner et al. 2005). Therefore the intention of the meeting and the importance of the topic under discussion diminishes and the team members from the other side feel disoriented (Bradner et al. 2005; Hogan, 2006). Large teams incur high coordination costs as combining work, arranging schedules, and remembering each member’s skills and expertise becomes difficult (Bradner et al. 2005).

Apart from these drawbacks, there are few appealing characteristics about large teams. Large teams predominantly select asynchronous coordination techniques such as web-based meeting technologies designed to facilitate logistics of asynchronous work and support team coordination (Hogan, 2006). Large teams have an advantage of including more diverse expertise and skills with problem solving approaches (Bradner et al. 2005). In large teams, formal procedures are well maintained (Bradner et al. 2005) as more attention is paid to coordination processes by putting up details of meetings and agendas in advance and providing a facility to access various related documents online (Hogan, 2006).

2.4.3.2 Multidisciplinary and Infrastructure Teams

An alternative approach for coordination in GSD is to establish multidisciplinary teams where each team is allocated a specific task that is independent from other teams (Hogan, 2006). As stated earlier, the literature reports on some successful and unique stand-alone practices followed in software companies. These practices are included here even if there are no additional studies that testify to them.
In the GSD setting, multidisciplinary teams are specialist teams that are setup to carry out particular work which requires less coordination and communication. Time-zone differences are effectively managed with multidisciplinary teams since team members from different sites do not have to wait for other team members to return to work (Hogan, 2006).

Another innovative and coherent approach to multidisciplinary teams is setting up dedicated infrastructure teams within the GSD projects (Hogan, 2006). These infrastructure teams are established to maintain and coordinate real-time projects where 24/7 support is necessary in GSD. Infrastructure teams are considered reliable as they allow various teams to work on a common code base using continuous integration methods (Hogan, 2006). These teams monitor network and environments to provide unprecedented support to the teams when outages cause significant coordination problems in GSD (Hogan, 2006). The team members from infrastructure teams take responsibility to provide fast and reliable access to a shared server with stable and up-to-date databases along with privately owned systems, services and configuration (Hogan, 2006). These infrastructure teams are also dedicated to integrate and manage releases and resolve any failed builds (Panjer et al. 2008).

### 2.4.3.3 Inter and Intra team coordination

Inter team coordination happens when collocated team members coordinate work within their own teams while intra team coordination happens when one team aligns and coordinates with another geographically located team. The dependencies differ in both these types of teams; hence it is essential to have a proper understanding of different methods followed for intra and inter team coordination (Begel et al. 2009). Complex tasks in large scale projects have many high interdependencies when team members are in multiple geographic locations (Espinosa et al. 2005). Three main dependencies are identified for inter and intra team

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coordination in GSD. They are technical, temporal and process dependencies (Espinosa et al. 2005). When the dependency is within the (inter) team, members prefer paying personal visits to other members’ workplace to unblock the dependency. On the other hand, Begel et al. (2009) state that when dependencies are outside the team (intra) members prefer first sending an email and then use the phone to resolve the dependency. Team members who act as a ‘point person’ are given responsibility to keep track of such dependencies for intra team coordination (Begel et al. 2009). Program managers handle requirements, scheduling and coordinate features of work items with other program managers using track dependency tools for intra team coordination (Begel et al. 2009).

Problems related to technical coordination surface when technical dependencies among software parts are not effectively managed (Herbsleb et al. 2006). Issues in temporal coordination occur when time dependencies are not effectively managed such as various tasks are not finished as per the project schedule (Herbsleb et al. 2006). Further, problems related to process coordination crop up when there is non-adherence to established standards and dependencies in the software development process are not managed effectively (Herbsleb et al. 2006).

2.4.3.4 Team Knowledge

Team knowledge or team awareness is the detailed information about each team’s work domain and team members expertise. Maintaining team knowledge facilitates team members to find expertise and foresee task issues more accurately (Espinosa et al. 2005). With the emergence of advanced technologies, team members can share team knowledge effectively (Keith et al. 2009). A collective knowledge of group members and their tasks can counterbalance communication deficiencies and help team members to coordinate more effectively even if the intensity of their communication is reduced by geographic distance (Espinosa et al. 2005).
In GSD projects, managing technical, temporal and process dependencies (Espinosa et al. 2007) requires adequate team knowledge and appropriate coordination mechanisms (Keith et al. 2009). Managing technical dependencies requires shared knowledge about the application domain, managing temporal dependencies requires only brief knowledge of the teams, whereas, managing process dependencies requires both enduring and brief team knowledge (Espinosa et al. 2005).

Different coordination problems that need to be managed are reported based on these dependencies. Technical teams are concerned with technical dependencies while managers are concerned with process and temporal dependencies (Espinosa et al. 2005). Hence dependencies need to be carefully studied and understood based on team knowledge before proposing any coordination tactics (Espinosa et al. 2005).

2.4.3.5 Team Cognition

Team cognition is the rational process that allows team member gain awareness and harness each others knowledge using a range of technologies (Keith et al. 2009). The performance of distributed teams depends on their knowledge and capabilities of using communication technologies to coordinate actions across space and time (Fuller et al. 2006; Keith et al. 2009). Different types of team cognition mechanisms are employed which have different effects on coordination where a particular mechanism may be less necessary for a certain team and vice versa (Espinosa et al. 2005). Hence, it is important to control the use of multiple coordination mechanisms and forms of team cognition, particularly in the case of highly dependent tasks in GSD projects (Espinosa et al. 2005). Team members should be assigned roles which can make them dependent on one another and help develop a high level of team cohesiveness (Keith et al. 2009). A higher level of team cognition is required when projects are new and team members are not familiar with the new project domain (Keith et al. 2009). It has been empirically proven that team cognition positively
influences team performance for knowledge coordination (Keith et al. 2009). Studies suggest that technologies designed to support communication and coordination in GSD have a significant influence on the ability to develop healthy team cognition (Keith et al. 2009).

2.4.3.6 Shared Mental Models

A shared mental model is the knowledge that members of a team should have in common about the task and the team in order to perform well (Rasmussen et al. 2008). Research in team cognition proposes that development of a shared mental model is important for successful team performance in GSD (Bass, 2006). Organised knowledge that is shared by team members in understanding the common task helps project managers to measure the extent to which teams are coordinating on a given task (Bass, 2006). Shared mental models help team members to anticipate task events and other team member’s behaviour so as to plan their own events (Espinosa et al. 2005). Good developments take place when team coordination mechanisms aid effective role coordination and build shared mental models for team interaction (Sutanto et al. 2005). Shared mental models, also referred to as ‘joint repository’, suggest effective configuration management systems to reduce misunderstandings between distributed team members (Smite, 2005). They provide a tool for better progress control for the remote partners in GSD projects (Smite, 2005). When GSD projects are managed using various artifacts there is a possibility for projects to go off track. In such situations a high level of management pressure is applied to achieve a deadline which involves huge efforts and expenses (Bass, 2006). Shared mental models help reporting on work task completion and timely risk identification (Smite, 2005). Hence shared mental models are recently becoming the essential part of GSD Projects. The synchronization meeting, explicitly aimed to synchronize projects, helps to measure various cognitive actions such as human behaviour, think aloud report and revealing thought processes by observing collaborative activities (Robillard, 2005). Such models help to coordinate the team
members as opposed to using typical document or artefacts; driven approaches that predefine schedule and project progress (Bass, 2006). Shared mental models are used to measure the extent to which coordination exists within teams and can make project managers aware of the interdependencies within teams so as to plan and coordinate the tasks well.

2.4.3.7 Uncooperative Behaviours

Collaboration and cooperation is essential between distributed teams. Issues related to GSD settings are consistently studied and one of the issues that surfaces is uncooperative behaviour that obstructs team coordination. Uncooperative behaviour largely appears when the information is unnecessarily withheld by teams or even while carefully timing the release of information in an effort to accomplish team goals (Panjer et al. 2008). Certain teams deliberately engage in these tactics to gain monetary and other rewards.

Literature on GSD suggests that various organisational behaviour theories and social interaction techniques are applied to resolve uncooperative behaviour with an aim to create better understanding amongst teams. Organizational behaviour includes analysing group dynamics that can be compared to team dynamics in GSD. To resolve uncooperative behaviour by teams, it is important to define proper team goals to release deliverables in a timely manner. Effective coordination tools that can highlight team issues and suggest team goals (Panjer et al. 2008) can help resolve uncooperative behaviour.

2.4.3.8 Team Structuring

With the changing global markets, GSD teams have to align themselves to improve competency. Companies structure their teams to reduce operating and labour costs by capturing the human talent that is abundant in
developing nations (Trant and Latapie, 2006). Good team structuring facilitates GSD projects (Cole, 2006). Therefore, project managers especially at the vendor side have to think about various alternatives to structure their teams to optimally utilise all the available resources (Narayanan and Mazumder, 2006). Team structuring is important for the vendor companies to align their teams with client teams for effective coordination. Common practice is that vendor companies follow the same team structure as that of the client company and try to reorganise their teams each time as per their client’s team structure. It is arguable whether the vendor teams should be the replica of the client teams or whether they should consider the dynamics of GSD to align and improve coordination (Narayanan and Mazumder, 2006). There are merits and demerits in these two types of team structures as they affect the success or failure of the projects and client-vendor relationship (Narayanan and Mazumder, 2006).

Further, software development teams can also be structured on the basis of the product architecture. These team structures can be based on component integration, framework integration, product phase and virtual teams (Trant and Latapie, 2006) for teams working on GSD projects. Each of these team structures has its strengths and weakness that needs to be considered. Team structures can be evaluated using three parameters, people, customer and organisation (Narayanan and Mazumder, 2006). People parameters in team structures are used to analyse team member relationship, expertise, comfort level, growth opportunities and breadth of knowledge (Narayanan and Mazumder, 2006). Customer parameters are used to measure resource commitment by the vendor teams, effective project management, impact of reorganization and impact of attrition (Narayanan and Mazumder, 2006). Organisation parameters are used to analyse ease in team structuring, client satisfaction, domain knowledge and so forth (Narayanan and Mazumder, 2006). Performance of team structures can be evaluated by means of these parameters so as to find the merits and demerits of each team structure for effective coordination in global software development with changing markets.
2.4.4 Task Allocation

In GSD, there are ways to decouple the work and allocate them at the different sites so that they can be independent from one another (Herbsleb and Mockus, 2003). Allocation of tasks to the resources is important to harness the potential of 24 hour software development model and minimize the completion time of the GSD project (Jalote and Jain, 2004). Task allocation can be a moderating variable to improve coordination between teams in GSD projects (Amrit, 2005). A task is the smallest unit of work that is well defined with its function and interface with other tasks. Task allocation primarily depends on the number of resources available and their expertise at a specific development site (Taxen, 2006). Project managers must particularly take into consideration operational, resource and skills constraints that may exist while allocating tasks in the 24 hour model in GSD (Jalote and Jain, 2004).

Work breakdown or process breakdown are two practices suggested while coordinating tasks between distributed teams (Smite, 2005). It is suggested that resources must be assigned to a task in the start and freed at the end of the GSD project (Jalote and Jain, 2004). When assigning a task to a remote location, it is important to ensure that the task matches the development sites resource capacity (Mockus and Weiss, 2001).

2.4.4.1 Techniques of Task Allocation

Instead of horizontal or component based allocation, tasks can be allocated vertically for GSD projects (Hogan, 2006). In vertical task allocation the project can be split vertically where each team can work on an entire feature including user-interface and other components (Hogan, 2006). The advantage of vertical task allocation is that it encourages communication and improved coordination and yields larger productivity (Hogan, 2006). This technique also gains efficiency by avoiding unnecessary
communication as in the horizontal or component based task allocation (Hogan, 2006).

Mirroring is another approach that is followed for task allocation in GSD projects, where small and similar teams are structured at each site of GSD projects (Hogan, 2006). Then each team member is allocated parallel roles to work closely with their remote counterpart on the same tasks doing 24 hour work across time-zones (Hogan, 2006). Team members can then spend a few hours explaining progress and issues within the project to their peers on the remote team site as the task is handed over during overlapping hours. This mirroring technique allows extending the bridging relationships between individual team members involved in the GSD project (Hogan, 2006). This technique also facilitates rich communication between the teams by making it part of day to day task completion activity.

The other approach suggested is chunking where the project is organized into subsystems and split further to allocate only one task to each team member (Mokus and Weiss, 2001). This method also helps to establish a common understanding about what is delivered from whom and when (Taxen, 2006). This gives an opportunity to assign tasks to distinct development sites to carry on independently instead of maintaining tight coordination within the smallest task (Mokus and Weiss, 2001). Within chunking, tasks can be allocated to various sites as per the functional area, localization or can be transferred as per the development or maintenance stages (Mokus and Weiss, 2001). The disadvantage of this approach is that experts from several sites are required while adding new functionality to the project thereby increasing the need to coordinate work between sites (Mokus and Weiss, 2001).

Tasks can be allocated by localization, in which team members can develop or modify the product locally as per the need of the local market (Mokus and Weiss, 2001). In this technique the local development team must be highly aware of its customer needs and the nature of the locality-
specific features (Mokus and Weiss, 2001). In this approach there is virtually a requirement to maintain local experts when adapting the system to the local market (Mokus and Weiss, 2001).

Tasks can also be allocated within the development stage where the developers perform activities such as design, coding, and system testing at different locations (Mokus and Weiss, 2001). This allows development stage experts to be at a single site. In this technique there is a higher need to communicate and coordinate between sites to proceed to the next development stage. Task allocation can also be at the maintenance stage where developers can transfer older releases to other sites for the maintenance when they do not anticipate adding any new features to the release (Mokus and Weiss, 2001). In this situation, more resources are available for developing new functionality at the site that is not involved in the maintenance phase (Mokus and Weiss, 2001). Here, potential issues can arise in problem solving because the maintenance site may not have participated in the design and implementation of the product and the communication needs between sites might increase (Mokus and Weiss, 2001).

2.4.4.2 Integration of Tasks

In GSD, integration of tasks is interlinking deliverables from each sub-system back again to the system to make it a final product. During the last phase of the project, it is important to integrate all the tasks that are allocated to the different development sites involved in the GSD project. An incremental integration plan based on clusters and shared milestones, also known as deliverables, can be followed to put together the software from multiple levels to project level (Battin et al. 2001). A set of incremental milestones can be defined at system and sub-system level to integrate clusters and coordinate the worldwide development. Appropriate plans about the deliverables of the increments to system integration can be defined in advance while allocating task to GSD teams (Taxen, 2006).
Certain key deliverable features can be selected and scheduled at the system level. These system deliverables can then break down into cluster-level milestones which can further be decomposed into subsystem deliverables (Battin et al. 2001). Inter-cluster integration has to be done within a sub-system and later within the system which allows building confidence at the sub-system and the system level (Battin et al. 2001). Software configuration management (SCM) tools with multi-site data replication can be used during system integration to help inform other subsystems of any changes (Battin et al. 2001). Due to the complexity in projects, there can often be a requirement for physical meetings during the integration phase while interlinking deliverables (Holmström et al. 2008).

### 2.4.5 Communication for Effective Coordination

Communication is a process by which information is exchanged between individuals through a common system of symbols, signs, behaviour or tools. Communication is the key to team-based success (Battin et al. 2001). In GSD, communication is important because it is a mediating factor affecting both coordination and control (Carmel and Agarwal, 2001). In GSD, complete and clear information needs to be exchanged between the sender and the receiver to have a common understanding about the project. Geographical distribution of software development in itself challenges formal and informal communication across distances (Herbsleb and Grinter, 1999). Further, there is loss of the rich, subtle interactions that happens between co-located teams to coordinate their work (Herbsleb et al. 2000). An increase in the complexity of communication tools can degrade team performance, especially when work involves definite outcomes (Tushman and Katz, 1980).

To support communication in distributed development, various models are implemented using tools such as telephone, emails, net-meetings, teleconferencing and video-conferencing. Given the critical role of effective
communication in the successful orchestration of GSD projects, new tactics for addressing distance are adopted (Carmel and Agarwal, 2001). To achieve parallel understanding amongst distributed team members and to improve coordination across teams, various communication strategies are followed by the companies engaged in GSD projects. For the success of a GSD project, providing a set of communications tools to the developers might not be sufficient; it is important to allow managers and all stakeholders to design appropriate organisational structure to accomplish tasks and facilitate coordination (Cataldo et al. 2007).

The complete subsystems can be distributed to different development sites to maintain effective coordination and reduce communication issues within the GSD project (Battin et al. 2001). Alternatively, small teams can improve communication and build relationships with reduced overhead allowing the teams to work more closely across the sites (Hogan, 2006). Small team size allows members to align and communicate to improve trust in each other with a better ‘feeling of camaraderie’ (Hogan, 2006). In addition, Begel and Nagappan (2008) propose that contacting distributed teams about their concerns and requirements well in advance, in order to have enough buffer time to respond to all issues at their end, is another effective way to coordinate GSD teams.

Rationally it can be stated that, good coordination is a subtle mixture of explicit and implicit coordination (Godart et al. 2001). Explicit coordination includes formalizing standard process across all distributed sites with appropriate workflow systems and shared spaces (Godart et al. 2001). In implicit coordination there is good awareness of each distributed team’s work despite standard process. This is due to the communication that happens between distributed team members (Godart et al. 2001). In support of these approaches, several other unambiguous communication strategies are also suggested to effectively coordinate the GSD projects.
2.4.5.1 Continuous Communication

Communication is the key to team-based success. However, it becomes an issue due to geographical distance in GSD (Battin et al. 2001). Liaisons, or cross-site delegates (Bass et al. 2007; Pichler, 2007; Begel and Nagappan, 2008; Cataldo and Herbsleb, 2008) after returning back to their centers from the visiting site, must become the main communication conduit for the reinforcement of continuous communication channels in GSD projects (Battin et al. 2001). When face to face communication is not possible, teleconferences must be one of the solutions to have effective and continuous communication amongst distributed teams in GSD (Battin et al. 2001). These conference calls help to resolve issues that may require a complete information exchange and detailed discussion between the team members from various sites (Battin et al. 2001). Regular overlapping hours for effective communication is essential in GSD projects (Battin et al. 2001). Extending working hours for communication helps to unblock awaiting issues quickly between distributed teams and team members (Begel and Nagappan, 2008). It is also suggested that both the client and vendor side teams must “share the pain” by accommodating their working hours (Battin et al. 2001).

2.4.5.2 Unfiltered Communication

It is important to have filtered, as well as unfiltered, communication at certain stages in GSD projects so that communication is clear, unambiguous and accurate (Hogan, 2006; Bass et al. 2007). Filtered communication can cause frustration and low morale in the distributed teams, due to missing information about underlying reasons for project decisions (Hogan, 2006). Communicating contextual information is critical to building trust between teams, a critical component within GSD projects (Hogan, 2006). Hence, in such situations, project managers from the client site can communicate directly with the team members from the distributed development site to understand the issue they are experiencing while
working on GSD projects (Bass et al. 2007). Unfiltered communication’ allows the client side managers to have overall project visibility so they can keep the needs of the entire project in mind (Bass et al. 2007).

2.4.5.3 Urgent Request

Urgent request is setting up a communication or broadcasting mechanism, requesting information from all distributed teams with precise knowledge about GSD projects (Bass et al. 2007). The primary requirement for this practice is that a well defined distribution and coordination mechanism must be created so that team members from other distributed teams can provide support by sharing information (Bass et al. 2007). This strategy promotes unplanned communication in a situation when a team member of a project has urgent need for information related to the distributed project (Bass et al. 2007). A network of highly motivated volunteers from various distributed sites who have a wide variety of technical knowledge must be formed to provide such vital support. The prerequisite of urgent request functionality is that people must readily share information and help each other when required (Bass et al. 2007).

Structured communication is another approach that is considered a useful technique to coordinate GSD projects. It helps to transmit the right information to right person at the right time (Godart et al. 2001). In this method, team members must be partitioned into groups based on their roles and tasks, where multi-membership can be allowed for effective group interactions (Godart et al. 2001). This approach not only preserves confidentiality but allows selectivity and quality of information needed by team members (Godart et al. 2001) while working on GSD projects.

2.4.5.4 Distributed Pair Programming

Distributed pair programming is a functional strategy used to coordinate tasks in GSD Projects (Bass et al. 2007). This is also referred as ‘Dyad
Model’ or ‘Two Actors’ (Espinosa and Carmel, 2004), ‘Buddy System’ (Begel, 2008) or ‘Mirroring’ (Hogan, 2006) in GSD literature. It is an ‘application-sharing’ based approach (Bass et al. 2007) where a member of one team works closely with their remote counterpart on the same tasks doing 24 hour work across time-zones and distributing the work to each other (Hogan, 2006).

One main advantage of GSD is that the corresponding geographic distance between two sites is equal, while time separation is not (Espinosa and Carmel, 2004). The key aspect of time separation in GSD is that work overlap occurs at the beginning of the day at one site and at the end of the day on the other site. In such a situation where there are time zone differences at two sites, the dyads, or pairs, communicate asynchronously during non-overlap work hours or synchronously during overlap work hours (Espinosa and Carmel, 2004).

Paired programming is particularly helpful when codes with important dependencies are developed at another site, avoiding delays with an instant review of the code by the developers from either side (Bass et al. 2007). The benefit of pair programming is that it helps build relationships between team members from either side allowing disagreements within the code to be eliminated quickly and thus it prevents fixing the code at a later stage (Bass et al. 2007).

**Synopsis:** All the papers that have satisfied the search criteria are synthesized and presented in this review. There are key coordination strategies identified in the empirical studies about teams, onsite visits, bridging, task allocation and the necessity of communication for coordination. In addition, the literature review has helped to bring similar studies that report on several practices correlated to these key strategies and implemented by the software companies. These practices form the subset of the key coordination strategies. Therefore, they are categorised and clustered together to form a framework for the coordination and
successful management of GSD projects. This frame work is presented in Figure 4 and is used to design the subsequent stages of this research study to develop the GSD-COORD Model.

![Figure 4: Conceptual Framework of the GSD-COORD Model](image)

### 2.5 Research Objectives

The key finding of the literature review is that it recommends many coordination strategies, but tends to take the client viewpoint. Thus, there is...
a huge gap between the research conducted from the client and from the vendor perspective in GSD. Hence there is a need to conduct more studies from the vendor point of view to under coordination in practice.

The primary objective of the research in this thesis is:

To develop a model that incorporates strategies from a vendor perspective to facilitate coordination between client-vendor teams working on outsourced GSD projects.

On the basis of this primary objective two sub-objectives were defined

- To identify strategies followed in vendor companies for successful coordination between client-vendor teams from the GSD perspective.
- To add to the established knowledge on GSD.

The review of literature in this chapter points to the research objective that remains unanswered. It is evident that there are several effective strategies implemented to overcome the coordination issues within the companies engaged in GSD. These strategies are original and innovative but are not yet established. They are disparate, complex and context specific, making it difficult for practitioners to know which practices to apply in given circumstance. The aim is to fill this need through the following research question:

“Can a model be developed based on the strategies followed by vendor companies to facilitate coordination between client-vendor teams when operating in a GSD environment”?

To answer this research question, the objective of the literature review was to answer the following sub-research questions
SRQ1: What are the strategies identified in the literature for successful coordination between client-vendor teams while operating in the GSD environment?

SRQ2: What are the strategies followed by the vendor companies to overcome the coordination barriers when operating in a GSD environment?

The literature review has helped to answer the sub-research question SRQ1 and SRQ2. It is evident that there are various coordination issues between client and vendor teams when working on GSD projects. These issues are mostly studied from the client’s viewpoint. In contrast to this outlook, the research in this thesis has given emphasis on the vendor point of view. An empirical research conducted in the vendor companies can help study the issues as well as the practices followed to coordinate tasks while managing GSD projects.

In the course of this research study, the GSD-COORD Model aims to provide specific process, strategies and practices to both the client and vendor companies to manage GSD projects.

2.6 Summary

The main aim of the literature review was to highlight all the empirical studies that exclusively report on coordination strategies and are successfully followed in different software companies that manage GSD projects. The review process has succeeded in this and has endeavoured to answer the research sub-question positioned for the literature study.

This literature review has succeeded in drawing together the research studies that focus explicitly on coordination strategies and does not take into account the published research that divulges the range of tools used
for coordinating in the GSD projects. Furthermore, the review has highlighted various coordination strategies reported in the empirical studies which give confidence in their working ability. Therefore, they are considered as potential practices in the GSD-COORD Model. One of the key findings of this focused literature review is that there is a gap in the research conducted from client and vendor perspective which suggests conducting more studies from vendor point of view to gain a more balanced view of the actual issues of GSD. Therefore, empirical research was conducted in India which is one of the major outsourcing destination countries and is presented in Chapter Four.

The next Chapter, Chapter Three, explains the research methodology followed to conduct the entire research study.
Chapter 3: Research Methodology

Overview

This chapter presents an overview of methodologies that have been applied in software engineering research. Based on these methods, the overall strategy and selection of methods adopted to carry out this research study is discussed. The research design, including the research methods and detailed description of how these methods were executed through each stage of the research are discussed in the subsequent sections. In the last section I will discuss how the research objectives were met and also the limitations based on the requirements and constraints of the research study.

3.1 Research Philosophy

A research philosophy is a belief about the way in which data relating to a particular phenomenon should be gathered, analysed and used. Wide-ranging research methodologies are available for software engineering and information systems researchers. It is important to select the right research method on the basis of its strengths and weaknesses. Their application to the research study is vital to achieve research objectives.

3.1.1 Positivism vs. Interpretivism Research Approaches

Understanding the relevance of positivism vs. interpretivism research is significant for software engineering and information systems research
(Orlikowski and Baroudi, 1991). As per the ontological assumption which is the branch of metaphysics that studies the nature of existence - there is a major difference between positivist and interpretive research approaches. In positivism the researcher and reality are always separate. On the contrary in interpretivism the researcher and the existing reality are not separable.

**Positivism** - Positivism has a long and rich historical tradition. A quantitative research method is usually followed because the factual data needs to be collected. Questionnaires, structured interviews, experiments and comparative studies are used as research tools in this approach. The underlying objectivity of positivism is that the researcher should not directly interact with the people under study as this might influence their behaviour. Hirschheim (1985) states that scientists must confine themselves to empirically based studies and keep facts and morals separate from the inquiry. Positivism has been criticised for its deterministic view. In this approach, if the subjects under study are not able to act as they usually do then there is a chance that the researcher may collect wrong information. Forces such as culture and environment shaping social behaviour can impact this research approach.

**Interpretivism** - The subjectivity in interpretivism is to describe, interpret, analyse and understand the social world through meanings. These facts of behaviour can be established in the context of the knowledge of the situation. The interpretive approach leans towards a qualitative research method where semi-structured interviews and participatory observation are used as the research tools. The semi-structured (focused) interview technique allows researchers to focus and collect qualitative data by setting up a situation (the interview) that allows a respondent the time and scope to talk about their opinions on a particular subject. In contrast, in participatory observation the researcher makes first hand observations of activities and interactions, sometimes engaging personally in those activities as a 'participant observer'. The advantage of interpretivism is that
even with small sample sizes it facilitates understanding of how and why things happen and enables researchers the flexibility to follow unexpected ideas during research and explore processes effectively. It also allows a more in-depth understanding of the sample, albeit in a smaller context. However in this method, since a small sample size is used, it can be unreliable because everything cannot be measured objectively as it represents only a very small portion of a very large population.

### 3.1.2 Quantitative vs. Qualitative Research Paradigms

The various arguments that surround the debate between positivism and interpretivism are also common in the contest between quantitative and qualitative research.

**Quantitative Research** – is a positivist approach in which deductive experimental methods are used for hypothesis testing for building theories in the areas being researched. Quantitative techniques are useful when the area under research needs to be reduced to numerical values to generalize the results. The observed data is gathered and numerically analysed to accept or reject the premise under study. Quantitative research is mainly based on mathematics where various statistical methods are used to mathematically model the results. Laboratory experiments are performed in a controlled environment using analytical techniques to identify exact relationships between the variables (Braa and Vidgen, 1999). The use of mathematical and statistical techniques helps to identify the facts and causal relationships between the variables under study (Fitzgerald and Howcroft, 1998). These results can be generalized with the sample size as they represent larger populations within known limits of error. The researcher remains objectively separated from the subject matter. However, the researchers clearly know in advance what they are looking for because all aspects of the study are carefully designed before the data is collected. Quantitative data is useful to test hypotheses, but may miss
contextual detail. A quantitative technique is mainly useful for testing the results gained through qualitative research and for follow-up research. Quantitative measures yield numerical results but there is a risk of measuring the unintended information (Kock et al. 2008).

**Qualitative Research** - is interpretive in approach. Qualitative research is functional in software engineering and information systems areas (Orlikowski and Baroudi, 1991). Myers (1997) in support of information systems states that ‘Qualitative research methods are designed to help researchers understand people, their social and cultural contexts within which they live or work’. For software engineering, qualitative research is mainly used to study people, situations, events, behaviour, relationships and several other attributes that cannot be easily quantified in correlation to technology. These attributes crosscut disciplines, fields and subject matter and engage an interpretive, naturalistic approach to the settings with an attempt to interpret the phenomenon in order to bring meaning to them (Denzin and Lincoln, 2005).

Strauss and Corbin define qualitative research as ‘the process that does not produce findings by means of any statistical procedures or any other means of quantification’. Qualitative research does not belong to a single discipline nor does it have a distinct set of methods that are entirely its own (Denzin and Lincoln, 2005). Qualitative research is usually not wholly pre-specified, but can evolve once fieldwork begins. Initial observations of one class of events can lead to another class of events or comparison with another to understand key relationships in the setting that reveal facets under study (Miles and Huberman, 1994, p.27).

Qualitative research is done chiefly with words. Words are considered to be weightier than numbers and usually have multiple meanings (Miles and Huberman, 1994, p.56). Words are more ambiguous in comparison with numbers and need to be processed reasonably. Though words are more unwieldy than numbers, they render more meaning than numbers alone.
With qualitative research it is essential that the researcher has an idea where to look for the parts of the phenomenon that are under study. At the outset, it is necessary to have at least a rudimentary conceptual framework, a set of general research questions, some notions about sampling, and some initial data-gathering devices (Miles and Huberman, 1994, p.17).

In this thesis the research study has taken the interpretive approach over the positivist approach. The main reason is that the research makes use of the industrial context in the form of case study research in the GSD environment. This study is not performed as a controlled laboratory experiment in order to allow the replication of the initial study (Miller, 2005). The complexity in the GSD environment makes it difficult to describe an exact set of variables and the facts to be researched in the original framework. The activities performed as part of the daily business in the software companies are unpredictable and can change very quickly. Therefore, the type of study undertaken in this research work cannot be conducted in a controlled and managed environment. Further, there is no scientific measure, numerical data or technical artefact studied in this research. Also there is no hypothesis that will be tested in this research. The results from this study are expected to be pragmatic and the aim is to make them applicable to others who operate in a similar environment. Hence, under such conditions the interpretive approach with qualitative method is selected to carry out the research. The literature review conducted for this study laid the foundations to formulate the research question.

3.1.3 **Exploratory vs. Explanatory Research**

The purpose of any research study can be exploratory or explanatory. Exploratory research involves a literature review, interviews or focus groups to explore new phenomenon under study (Yin, 2003). These research tools help the researcher to gain a better understanding of the
precise research issue. Exploratory research helps to clearly define the objective of the research and identify key issues and key variables (Yin, 2003; Patton, 1990). However the key variables are not defined in the problem definition. The Focus Group is one of the research tools that can be used in exploratory research (Morgan, 1997).

Explanatory research focuses on testing hypotheses with a scientific and positivist approach to provide an understanding of the relationships that exist between variables. Key variables and their relationships are well defined in explanatory research. Zikmund (1984), states that the explanatory research process begins with the discovery of the research problem and the degree of uncertainty about the research problem determines the research methodology.

This research study is making an effort to set the basis for a defined approach to model development. On the basis of this comparison, it can be stated that this research study is exploratory because there is new phenomenon under study. The literature review, questionnaire, interview, focus group and expert panel are the research instruments used to explore the new phenomena under study.

3.1.4  **Inductive vs. Deductive Reasoning**

In research there are mainly two methods of reasoning - inductive and deductive that is applied for the development and validation of theories. In quantitative research, data is collected to test hypotheses while in qualitative research with an inductive approach; theory is built from the data or is grounded in the data. These two approaches have the same objective but there is a difference in the method employed.

In deductive reasoning, theory building is based on the conceptual and theoretical view that begins with the general and ends with the specific in a
top-down approach (Gill and Johnson, 1991). Concepts under investigation are used to formulate theories and hypotheses. The arguments are based on rules and principle and the data generated is used to confirm or reject the hypotheses. An important aspect of the deductive approach is that the hypotheses can be repeated and compared using empirical data to confirm the validity of theories and hypotheses.

In inductive reasoning, specific observations are used as a premise to develop concepts and theories in a bottom-up approach. Inductive research can be demonstrated with grounded theory (Strauss and Corbin, 1998) or case study research (Yin, 2003). This approach helps to draw together information and build theories moving from specific to general on the basis of the reasons and conclusions drawn. The inductive approach does not have a strong relationship between reasons and conclusions and therefore includes a degree of uncertainty (Cooper and Schindler, 2003). However, the researchers have their own reasons to justify the conclusions which may not be sufficient, there is hope that further reasons may be found (Dancy, 1985). The main difference between induction and deduction is that in inductive reasoning it is presumed that the conclusions can be presented beyond the evidence (Cooper and Schindler, 2003).

This research study uses inductive methods such as grounded theory (Strauss and Corbin, 1998) and case study research (Yin, 2003) to investigate the existing knowledge and industrial approaches in order to develop a model for effective coordination in GSD. Therefore, developing a model with this approach is building a general theory. Hence this research is inductive research.

### 3.2 Research Strategy

An effective research strategy plays an important role in knowledge based research work. The right choice of research method is ascertained by the
research objectives and the nature of the phenomenon under study. All the research methods have something to offer (Gill and Johnson, 1991). However, a single or specific research procedure is not universally applicable. It also depends on the access to the data; essentially the source of primary and secondary data (Mumford et al. 1985; Gill and Johnson 1991) also the context and eventuality in which the research has to be conducted.

There are various coordination strategies available for managing the distributed projects in the GSD literature. In this context, the significance of this research study is that it is broad and exploratory but with limited established research currently available from the vendor perspective. The main reason is that the focus of the GSD research has always been from the client’s viewpoint with less importance given to understand the issues the vendor teams have to deal with. It is therefore necessary to organise this research study into a set of clearly defined steps to select appropriate research methods to investigate issues from the vendor perspective. Every research method has its own strengths and weaknesses. To counter balance these strengths and weaknesses of various research methods a multi-method research design is adopted (Morse, 2003).

### 3.2.1 Multi-Method Research

In the multi-method research approach, one of the main challenges is to decide which research methods to combine. Multi-method research can be conducted in various ways but usually it is either from the complementary or evolutionary perspective (Wood et al. 1999). An evolutionary perspective is followed when there is little research conducted on a particular phenomenon, or where the research premise requires increased focus (Wood et al. 1999). Taking an evolutionary perspective, an initial exploratory study is conducted to gather primary data which is analysed
and used as the basis for the next stages of the research (Wood et al. 1999).

To conduct this study, an evolutionary approach was followed as there is very little research done on the phenomenon under study. The findings of one phase were used as the focus and as the basis for the design of the subsequent phase of the research.

In this research, to gain insight into the coordination issues that arise between distributed teams working on the GSD projects, a mapping study was carried out to conduct a literature review in the first phase of the evolutionary multi-method research approach. The key coordination strategies identified in the literature were categorised and the findings of this primary investigation were used in the next phase of research to design which is a questionnaire for online and face-to-face interviews. The collected data was analysed and the findings from these two initial phases were used in the subsequent phases of the research study that involved a focus group and expert panel.

3.2.2 Overview of the Research Design

Figure 5 gives an overview of the Research Design. The first stage of research design was the Literature Review which involved the groundwork to map and categorize the primary studies that reported the research on coordination strategies.

The second stage of the research was Multiple Case Studies which included empirical research with grounded approach (Strauss and Corbin, 1998). In this case study research, data was gathered using multiple-case sampling (Yin, 2003) through online-questionnaires and telephone and face-to-face interviews. This helped to construct Version One of the GSD-CORD Model.
The third stage of research design involved **Model Mapping** in which a focus group was formed and a gap analysis was done to compare GSD with the recognised software development processes and project management standards that are applicable to the software industry. Through this, the PMBOK® Guide, 2008 was selected to map to the GSD-COORD Model (Version One). This helped to develop Version Two of the GSD-COORD Model which was then validated in the next stage of the research.

The fourth and final stage of the research included **Model Validation**. An expert panel approach was followed in the validation process of the GSD-COORD Model (Version Two). The experts in the validation process helped to refine the model to make it applicable to the software industry.

These different stages of research within this study are discussed in detail in the Section 3.3.
3.3 Research Design

3.3.1 Stage 1: Literature Review

This stage of the research study includes a performing mapping study following a structured approach to review the literature. The research process followed to perform the literature review is discussed in Chapter Two.

3.3.2 Stage 2: Multiple Case Studies

3.3.2.1 Source for the Research Data

The empirical data for the research work was collected from multiple case studies. An inductive approach was followed as part of the qualitative research method in this stage of the study. Content analysis was conducted on the empirical data to group together similar data. Further, the similar concepts and practices from the literature review and the empirical research were grouped together and labelled as process and strategies in the Version One of the GSD-COORD Model.

3.3.2.2 Data Sampling

The decision about the sample size and sampling strategies depends on prior choice about the appropriate unit of analysis to study. The key issue in selecting and making decisions about the appropriate unit of analysis is to decide what it is you want to be able to say at the end of the study (Patton, 1990). Qualitative research most often uses ‘purposive’ rather than ‘random’ sampling strategies.
Qualitative research sampling is categorically theory-driven (Miles and Huberman, 1994, p.27). Sampling involves decisions not only about which people to observe or interview, but also about settings, events and social processes. Usually, qualitative research needs to be carried on small samples, as the samples tend to be purposive, rather than random (Morse, 1989; Kuzel, 1992). Sampling in qualitative research involves two actions.

- First, sampling helps to set boundaries to define aspects of case(s) that can be studied within the limits of your time and means. Also, they can connect directly to the research question and can include examples of what you want to study.

- Second, sampling helps to create a frame to uncover, confirm or qualify the basic processes or constructs that strengthen your study.

Searching deliberately for confirming and disconfirming cases, extreme or deviant cases, and typical cases, serve to increase confidence in conclusions (Miles and Huberman, 1994, p.28). Such purposeful sampling strategies for data sampling benefit inductive and theory-building analysis.

**Purposeful Sampling** – can be defined as those information-rich cases from which one can learn a great deal about issues of central importance to the purpose of the research and whose investigation will illuminate the question under study.

There are several different strategies for purposefully selecting information-rich cases. The logic of each strategy serves a particular evaluation purpose.

**Stratified Purposeful Sampling** – A stratified sample is claimed to be more representative of the population. A stratified purposeful sampling strategy allows illustrating characteristics of particular subgroups of interest to facilitate comparison and capture major variations rather than to identify
a common core. The drawback of stratified sampling is that it is not useful to exhaustively partition the population into disjoint subgroups.

**Opportunistic Sampling** - Conducting empirical research sometimes demands taking on the spot decisions about sampling to take advantage of new opportunities during actual data collection. Qualitative research sampling permits the sample to emerge during the fieldwork. This allows including new sampling strategies to take advantage of unforeseen opportunities after the field work has begun. Opportunistic purposeful sampling strategies depends on the knowledge of the setting being studied and takes advantage of whatever is discovered as it unfolds.

**Purposeful Random Sampling** - Even when a small sample size is chosen for in-depth study, random sampling strategy within this small sample size can be chosen as it helps to increase the credibility of the results. This strategy can be followed when there are limited resources and less time to devote to data collection.

**Multiple Case Sampling** – Multiple-case sampling adds confidence to findings. It strengthen the precision, the validity and the stability of the findings by looking at a range of similar or contrasting cases (Miles and Huberman, 1994, p.29). Multiple-case sampling gives assurance that our theory is generic because we have seen it work out in predictable ways. In multiple-case sampling, the total number of cases depends on how rich and complex the ‘within-case’ sampling is. With high complexity, a study with more than 15 cases or so can become more unwieldy (Miles and Huberman, 1994, p.30). Typically, sampling is continued until the researcher has achieved informational redundancy or saturation. This is the point at which no new information or themes are emerging from the data. To identify if informational redundancy or saturation is reached, data collection and analysis needs to be carried out hand-in-hand at least in a preliminary manner. This analysis directs subsequent data collection decisions. The drawback of using a small sample size is that it can be
unreliable because everything cannot be measured objectively as it represents only a very small portion of a very large population.

### 3.3.2.3 Basis of this Research Study

The scheme in this research study was to step back and critically analyse the situation that arises in a client-vendor relationship. There has to be open-mindedness and willingness to enter a research setting to look for questions as well as answers. Also there needs to be a balance to get started on as the research requires some idea of what one is looking for; but this search should not be too constrained or precise (Wolcott 1982, p.157).

This research study follows an interpretive method, where a small sample size can be used to represent the facts. To conduct empirical research work, it was important to have small but focused samples. Therefore, a stratified purposeful sampling strategy was followed to include information-rich cases. While conducting empirical research, it was essential that each of the strata constituted a reasonably homogeneous sample.

The multiple-cases selected from the vendor companies represented the homogeneous subgroup of interest. This revealed the coordination issues that the vendor companies have to face while operating in the GSD environment and the strategies followed for coordination between client-vendor teams. Sampling was continued until the point at which no new information or themes emerged from the data. The data collected from the case studies was analysed in a preliminary manner. This helped to identify information redundancy or saturation. Hence, after conducting case studies a decision was taken that there was no further need to collect additional data.

**Selection of the Participants** – For this research work, I studied small but focused samples. Five multinational companies and one national small first
generation software company based in India allowed me to conduct this study with their staff. The profile and other details of all these companies are given in Appendix: C and briefly listed in Table 10.

My work experience and personal contact in the Indian software industry helped to gain access to the cases that were of interest to this study. Hence, as the starting point, through my contacts, I approached three professionals working in three software companies based in India. Further, based on my requirements to conduct this study, these three professionals suggested the names of other professionals who participated in this research. With the help of these contacts, I created a cluster of cases to perform the research. Therefore, the cases chosen in this study are, to some extent, opportunistic. Also, a stratified purposeful sampling strategy was followed to select representative cases that illustrated characteristics of particular subgroups of interest. For this research study, it was important to have the population of interest involved in management and decision-making for the teams. Hence, I interviewed people in different roles mainly Project Managers and Senior Staff within six software companies based in India (Refer Table 10). The selected cases managed teams that included between 25-500 team members working on outsourced GSD projects. Hence, the cases selected within these software companies represented the characteristics and experience of a particular subgroup that was of interest to this study. For confidentiality reasons, I have used pseudonyms for the participating companies and only the first name of each participating interviewee.

3.3.2.4 Data Collection

A research plan was prepared to carry out and guide the use of the grounded theory approach. To collect the empirical-data I carried out this research work in three-phases.
<table>
<thead>
<tr>
<th>Company Name</th>
<th>Name</th>
<th>Gender</th>
<th>Title</th>
<th>Total Work Experience</th>
<th>Total GSD Projects Managed</th>
<th>Current Project</th>
<th>Domain</th>
</tr>
</thead>
<tbody>
<tr>
<td>SysInfo Technologies Ltd</td>
<td>Shaunak</td>
<td>Male</td>
<td>Senior Project Manager</td>
<td>9 Years</td>
<td>5</td>
<td>SAP/ERP</td>
<td>Business Mgmt</td>
</tr>
<tr>
<td></td>
<td>Manoj</td>
<td>Male</td>
<td>Senior Project Manager</td>
<td>5 Years</td>
<td>5</td>
<td>Upgrading a software</td>
<td>Business Mgmt</td>
</tr>
<tr>
<td></td>
<td>Satyajeet</td>
<td>Male</td>
<td>Junior Project Manager</td>
<td>4 Years</td>
<td>2</td>
<td>Online Trading for Stock Market</td>
<td>Business Mgmt</td>
</tr>
<tr>
<td>Dream Moon Software</td>
<td>Sameer</td>
<td>Male</td>
<td>Vice-President (Projects)</td>
<td>22 Years</td>
<td>27</td>
<td>TRIMS</td>
<td>Banking</td>
</tr>
<tr>
<td></td>
<td>Manohar</td>
<td>Male</td>
<td>Asst. Vice-President (Projects)</td>
<td>14 Years</td>
<td>14</td>
<td>TRIMS</td>
<td>Banking</td>
</tr>
<tr>
<td></td>
<td>Maharukh</td>
<td>Female</td>
<td>Principal Project Manager</td>
<td>14 years</td>
<td>25</td>
<td>TRIMS</td>
<td>Banking</td>
</tr>
<tr>
<td></td>
<td>Manish</td>
<td>Male</td>
<td>Sr. Project Manager</td>
<td>5 Years</td>
<td>4</td>
<td>TRIMS</td>
<td>Banking</td>
</tr>
<tr>
<td></td>
<td>Shobha</td>
<td>Female</td>
<td>Software Engineer/Team Lead</td>
<td>9 Years</td>
<td>4</td>
<td>TRIMS</td>
<td>Banking</td>
</tr>
<tr>
<td>Mega Technology Software</td>
<td>Kiran</td>
<td>Male</td>
<td>Principal Consultant</td>
<td>17 Years</td>
<td>10</td>
<td>Various Projects</td>
<td>Telecommunication</td>
</tr>
<tr>
<td></td>
<td>Hemant</td>
<td>Male</td>
<td>Software Engineer/Project Manager</td>
<td>6 Years</td>
<td>5</td>
<td>Interaction Design/Communication Portal</td>
<td>Telecommunication</td>
</tr>
<tr>
<td></td>
<td>Yogesh</td>
<td>Male</td>
<td>Software Engineer/ Team Lead</td>
<td>4 Years</td>
<td>4</td>
<td>Visualisation &amp; Interface Design</td>
<td>Telecommunication</td>
</tr>
<tr>
<td></td>
<td>Madhur</td>
<td>Male</td>
<td>Senior Project Manager</td>
<td>7 Years</td>
<td>4</td>
<td>Tool Development/ Telecom system</td>
<td>Telecommunication</td>
</tr>
<tr>
<td></td>
<td>Gurinder</td>
<td>Male</td>
<td>Software Engineer/ Team Lead</td>
<td>4 Years</td>
<td>3</td>
<td>Component Development</td>
<td>Telecommunication</td>
</tr>
<tr>
<td>Vision India Software</td>
<td>Sampada</td>
<td>Female</td>
<td>Founder Partner &amp; Sr. Project Manager</td>
<td>19 Years</td>
<td>12</td>
<td>Asset-Liability Management System</td>
<td>Banking</td>
</tr>
<tr>
<td>Cyber Epoch India Ltd</td>
<td>Rakhi</td>
<td>Female</td>
<td>Software Engineer/ Project Manager</td>
<td>5 Years</td>
<td>2</td>
<td>Asset-Liability Mgmt System</td>
<td>Banking</td>
</tr>
</tbody>
</table>

Table: 10 - Summary of Organisations Researched
The first phase included web-based questionnaires (Appendix D) with open-ended questions where the respondents were asked to answer the questions in brief. The second phase also included open-ended questions to conduct the semi-structured but detailed telephonic interviews (Appendix E). In the third phase, on the basis of the questionnaire used in the two previous phases, onsite observation and semi-structured face-to-face interviews were conducted (Appendix F). A test-run of the questions was done with peers before the actual interviews. It showed that the questions were understandable and unambiguous.

A brief introduction to the research study served to introduce myself to the interviewees and to illustrate the purpose of this research. The interviewees were given a chance to introduce themselves. In this part, I inquired about the years of individual expertise in the software industry and particularly on the outsourced projects. These questions were positioned at an introductory level and were not related to our study. The interviewees were requested to describe one or more brief cases from their current or past professional experience.

**Open-ended and Close-ended questions**

Open-ended and close-ended questions can be included in the questionnaire. There is difference in the response to the open-ended and close-ended questions (Reja et al. 2003). A close-ended question offers a set of alternatives and limits the role of respondent when answering the questions. Alternatively, open-ended questions allow the respondent to complete an opinion without being manipulated by the researcher (Foddy, 1993). Open-ended questions help to study responses that the interviewees give spontaneously without any bias which may occur in the case of close-ended questions. The major disadvantage with open-ended questions in comparison with close-ended questions is that they need extensive coding.
In this multiple-case study approach, it was important that the interviewees should be able to respond to the questions in an unbiased manner. Therefore, the questions included in the questionnaire for online study, telephonic interviews and face-to-face interviews were open-ended.

Phase-I: Online Questionnaires

The objective of the first-phase of the study was to complete the groundwork for the research. An online questionnaire with open-ended questions was used as a research tool for data collection to understand the demographic and preliminary details of the participants from the software development teams under study. This phase of data collection was carried out from Ireland. To conduct this study, emails and internet services were utilised to correspond with the interviewees.

The questionnaire was completed by 3 Senior Executives, 3 Senior Project Managers, 5 Senior Engineers and 4 Software Engineers. They all worked in Indian software companies. The engineers I interviewed performed a dual role which included either Junior Project Manager or Team Lead responsibilities and all were involved in decision making.

The questionnaire was developed to allow the gathering of initial information of all the participants of the study and included open questions such as:

- What are the key elements that are required for a successful Indian based team?
- What are the most important factors you look for when selecting your team members?
- What are the key activities that need to be undertaken when establishing a cohesive Indian based team?
These questions were asked to understand the basic criteria that are followed while selecting team members to work on the outsourced GSD projects and to identify different practices followed to establish cohesive teams to coordinate them successfully.

The questionnaire also included two questions where participants were asked to rank choices from the given list. The first question was to rank the factors that are considered important when selecting team members for GSD teams and the second was to rank the skills that are important for managing an Indian based team. The main idea was to understand the participants opinion which otherwise would have been impossible to recognize with the open-ended questions in the online questionnaire. The data gathered through these questions is not numerically analysed to accept or reject the premise under study but was used to understand the opinion of the participants on the given choices.

All the participants completed the questionnaires in less than 48 hours and returned them using email and internet services. This data collection phase was carried out in June 2008.

**Phase-II: Telephonic Interviews**

To carry out these interviews I adopted a planned approach which included semi-structured telephonic interviews (Appendix E). These telephonic interviews were conducted from Ireland and with the same participants who had answered the questionnaire. The discussion over the telephone with each participant lasted for more than 90 minutes. These interviews were recorded with the interviewee’s permission. At this stage, I probed deeper into the responses from the questionnaires. For example, team building exercises were stated as an activity to set up cohesive teams. In order to understand more about team building, further questions were asked:

- How often are the team building activities carried out for the members working on the GSD projects?
• What positive strengths are built on? What negative issues have to be addressed during the team building exercise?
• What are the different training programs conducted for the GSD team members?

This phase of data collection activity was carried out in July 2008.

**Phase-III: On-Site Interviews**

The interviews with the participants gave further insight to the topics under study. The response to the concepts and pre-defined topics under study was notable but needed deeper understanding. Therefore, a decision was taken to conduct observation and on-site interviews. The idea was to penetrate more into the issues that were under study.

To conduct this phase of data collection, in August 2008, I travelled to India for a period of 4 weeks. During the visits in the software companies, I had an opportunity to spend an average of 6 hours in each organisation observing and interviewing the participants in their software company. These face-to-face interviews were conducted again with the same participants who had answered the questionnaire and were interviewed on the telephone.

A semi-structured approach was implemented for all the interviews. Although, the interviews remained focused the respondents were not constrained in their responses or the topics they raised. Many new questions based on the observation and new circumstances were asked to the participants. This resulted in participants freely expressing and sharing their experiences while also presenting ideas and suggestions.

Based on answers received during the initial two research phases, a set of specific questions were developed for the face-to-face interviews. To understand the team meeting process and how for example the team
building exercises and training programs might help GSD teams, I asked the following questions –

• What advantage do you gain by conducting the training programs? Are the team members always willing to take this training? Can you give more detail on the setup of your training university/department?

• How is the brainstorming session (as part of the team building exercise) helpful for the team members working on the GSD projects?

• Explain more about the proceedings/activities that happen in the weekly meetings?

These queries allowed a more in-depth exploration of the challenges, issues and solutions which had been identified. For example, one of the senior project managers explained details about the team building exercise and other activities that are carried out to help coordination between distributed teams and reduce the attrition levels. This allowed a better understanding of other related aspects which otherwise would have been hidden. In addition, this permitted me to observe at first-hand, the manner in which the tasks are executed by each member when working on the GSD projects and also to understand how various issues are resolved that crop up while coordinating work with the distributed team members.

On average, a 30 minute interview was conducted with each participant from the companies I visited. Whenever possible these interviews were recorded or notes were taken and later transcribed.

3.3.2.5 Data Transcription

The data from the questionnaire, telephonic interviews and face-to-face interviews for each participant was transcribed using a traditional manual method. All the interviews were bilingual, either in Hindi/Marathi and
English. I heard and transcribed each interview. The transcribed data from the telephone and face-to-face interviews had to be reorganised as an extension to the various questions from the questionnaire. This was essential because more detailed and comprehensive answers were gathered to the concepts under study. Each participant’s data is considered as a separate case that is transcribed and put together. The transcribed data was restructured omitting repeated answers and total of 71 pages of transcribed data were available for analysis. ‘Content Analysis’ (Miles and Huberman, 1994) was performed on the transcribed data.

3.3.2.6 Content Analysis

‘Content analysis is a research technique for making replicable and valid inferences from texts to the context of their use’ (Krippendorff, 2004). Content analysis is a systematic research method used to analyze textual information in order to compose valid inferences from the data (Weber 1990, pg.9). The main objective of content analysis is to classify words, phrases or text presumed to have similar meanings into fewer categories. The rationale of content analysis is that, results must be generalisable beyond the specific data, methods or measurements of a particular study (Weber 1990, p.18). It is important in content analysis that the categories have to be pertinent with the concept under study. Creating codes on the transcribed data is an important phase of content analysis in qualitative research.

Content analysis is used in various fields. These fields range from marketing and media studies, to literature, ethnography and cultural studies, gender and age issues, sociology and political science, psychology and cognitive science with many other fields of inquiry. Content analysis reflects a close relationship with socio and psycholinguistics, and plays an integral role in the development of artificial intelligence. Berelson (1952), has listed more possibilities for the uses of content analysis.
Researchers have to quantify and analyze the presence, meanings and relationships of words and concepts and then make inferences about the messages within the texts. To conduct a content analysis on any text, the text first needs to be coded or broken down into manageable categories of levels. These levels are examined using two basic general categories of content analysis - conceptual analysis or relational analysis.

**Conceptual vs. Relational Content Analysis**

Carley, (1990), gives an overview of the different methodological kinds of Content Analysis. Conceptual analysis is used to establish the existence and frequency of concepts that are most often represented by words or phrases in a text (Carley, 1990). With conceptual analysis you can determine how many times any given word appears in a volume of text. In contrast, relational analysis goes one-step further to examine the relationships among concepts in a text. With relational analysis, you can identify what other words or phrases appear next to them and then determine what different meanings emerge because of these groupings (Carley, 1990).

In conceptual analysis, the text is condensed into manageable content categories based on the research question. When the text is reduced to categories consisting of word, set of words or phrases, the researcher then focuses on codes (Weber, 1990). Coding is done for specific words or patterns that are indicative of the categories.

For relational analysis, the concepts are first decided for analysis. These are further explored in different ways. Based on the concept a matrix is drawn up to suggest certain overall meaning to co-occurring concepts. The draw back here is that it functions primarily within the preserved order of the text. To overcome this, cognitive mapping is done in an attempt to create a model of the overall meaning of the text. This model is a graphic map that represents the relationships between concepts.
For this study I have incorporated conceptual content analysis including cognitive mapping from relational analysis. Based on these concepts and categories the data is coded from the transcribed data.

**Coding**

The classification of words, phrases or similar text in content analysis is coding. Coding is a way of putting names to incidents and events in order to cluster them and communicate commonly held ideas that help enveloping concepts against another wave of observations and conversations (Miles and Huberman, 1994, p.62). Miles and Huberman (1994) suggest two methods of coding; first creating a provisional ‘start list’ of codes prior to fieldwork that can come from the research questions, conceptual framework of the study and key variables under study. The second method suggested is more inductive, in which the ‘grounded’ approach is followed as advocated by Glaser and Strauss (1967), where the data is well moulded to the codes that represent them and is more context sensitive.

Strauss and Corbin (1998) suggest a coding technique in which the data is transcribed and reviewed to generate categories or labels based on the ‘conditions’, ‘interactions among actors’, ‘strategies and tactics’ and ‘consequences’. Lofland (1971) suggests the inductive technique for creating codes and proposes generating codes from micro to macro levels. Bogdan and Biklen (1992) propose dividing codes as per the setting or context, definition of the situation, perspectives of doing things, process, activities, events, strategies, relationships and social structure and methods.

In all these techniques, codes change when the work progresses. Some codes do not work; others decay because no field material fits them or the phenomenon they represent empirically appears in a different way. Codes that are accepted can flourish further and may need auxiliary dissection to create sub-codes. Lincoln and Guba (1985), mention various auxiliary
coding procedures such as ‘filling in’, ‘extension’, ‘bridging’ and ‘surfacing’. Miles and Huberman, (1994) have also specified three classes of code: descriptive, interpretive and pattern codes.

In this research study, the codes used were mainly pattern codes with a limited number of interpretative and descriptive codes. In the next section I discuss the demonstration of the pattern codes that are chiefly used for this study.

**Pattern Coding** – Pattern codes are explanatory and inferential codes that identify emergent themes, configuration or explanation (Miles and Huberman, 1994, p.69). They help to understand the patterns of data and their repetition within the data. They pull together a lot of material into more meaningful and prudent units of analysis that can be more like meta-code (Miles and Huberman, 1994, p.69). Pattern coding is grouping first level codes into a smaller number of sets, themes or constructs that help to reduce large data into a smaller number of analytic units.

Miles and Huberman (1994) state that ‘in qualitative research, pattern coding gets the researcher into analysis during data collection so that fieldwork can be more focused’. In multi-case studies, it lays the groundwork for cross-case analysis by surfacing common themes and directional processes. Pattern codes are first added in a tentative form and are tried on the sample set of transcribed data. Usually pattern codes including core codes and sub-codes are displayed on a single sheet as they are useful as the coding structure evolves. Appendix: G shows the complete list of codes that are generated for this research study.

**Memoing** – Glaser (1978) defines memo ‘as the theorizing write-up of ideas about codes and their relationships as they strike the analyst while coding’. Memos attempt to tie together different pieces of data into a recognizable cluster to show that data are instances of a general concept. Memoing helps the analyst to move easily from empirical data to a conceptual level, refining and expanding codes, developing key categories
and showing their relationships. It helps building towards a more integrated understanding of events, processes and interactions in the case. Memoing is crucial when the initial framework for the study is ready and the analyst takes a strong inductive approach.

In an inductive approach, memos serve as a ‘clustering’ function as they draw together incidents that emerge to have commonalities. Memos are typically a rapid way of capturing thoughts that occur throughout data collection, data reduction, data display, conclusion drawing and testing, and final reporting (Glaser, 1978). The main idea behind writing memos is to approach the data from different angles by asking various questions to verify against a body of literature and attempting to have another look to see where it is incomplete or well elaborated.

**Developing Propositions** – Memoing captures the thoughts of the analyst. There is a greater need to formalize and systematize the thinking into a coherent set of explanations (Miles and Huberman, 1994). Propositions help in formulating and systematizing these thoughts that connect the sets of statements reflecting the findings and conclusion of the study.

In this multi-case study, I recorded and clustered case specific propositions that took the form of emerging concepts for the model on coordination strategies. All these concepts or themes are revealed in Chapter Four – Data Analysis.

### 3.3.3 Stage 3: Model Mapping

Various standard documents and software process capability/maturity models (SPCMMs) have surfaced in last two decades that are applicable to the software industry (Wangenheim et al. 2010). These existing standard documents and capability/maturity models are constantly evolving and new versions are created to build up domain-specific models for the industry
(Wangenheim et al. 2010). This list includes models such as, AutomotiveSpice (www.automotivespice.com), EnterpriseSpice (www.enterprisespice.com), MediSPICE (www.medispice.com) which are domain specific. There are also many other models that are tailored and are applicable to specific domains and industries.

In this research study it was essential to identify specific standards that are relevant to the GSD area. To choose a relevant standard, I undertook a focus group and discussion with experts. The aim of this discussion with the experts was to identify a relevant standard that can be followed for comparing and mapping the identified strategies in the coordination model. The Section 3.3.3.1 and Section 3.3.3.2 describe in detail the steps taken to select the appropriate standard for comparing the strategies included in the coordination model.

### 3.3.3.1 Focus Group

In exploratory research, one of the research tools that can be used is focus groups (Morgan, 1997). A focus group is a form of group interview that is different from individual interviews. The members involved in this group are experts in the area under study. Morgan (1997), broadly defines focus groups as a research technique that collects data through group interaction on a topic determined by the researcher. A focus group mainly capitalise on communication between research participants in order to generate data (Kitzinger, 1995). A focus group consists of 5-15 people. The role of the researcher is to act as a facilitator rather than an interviewer. The researcher has to communicate clear themes with an agenda for discussion to the participants and has to make sure that everybody participates in the conversation. The advantage of a focus group is that it helps to generate many ideas and explore various concepts.

In this research study, a focus group discussion meeting was organised with a panel of five expert practitioners who are based in Ireland and have substantial knowledge of software project management standards. These
expert participants hold essential background and working experience of functioning within the standards for software project management. Table 11 gives the brief details about these experts. As the experts were not keen on disclosing their names I identify them as Expert 1-5.

<table>
<thead>
<tr>
<th>Name</th>
<th>Title</th>
<th>Experience</th>
</tr>
</thead>
<tbody>
<tr>
<td>Expert 1</td>
<td>Software Quality Manager</td>
<td>17 Years</td>
</tr>
<tr>
<td>Expert 2</td>
<td>Chief Technology Officer</td>
<td>20 Years</td>
</tr>
<tr>
<td>Expert 3</td>
<td>Senior Project Manager</td>
<td>22 Years</td>
</tr>
<tr>
<td>Expert 4</td>
<td>Project Manager/ Researcher</td>
<td>25 Years</td>
</tr>
<tr>
<td>Expert 5</td>
<td>CMMI Certified Expert</td>
<td>10 Years</td>
</tr>
</tbody>
</table>

Table 11: Focus Group Member Details

As an initial step in the discussion, a short Power-Point presentation about my research work and the interim GSD-COORD Model was given to the focus group members. In this presentation I explained the research methods followed in developing the interim model and the aim to compare the model with the standard documents and software process models. Before the focus group discussion I took an overview of various standard documents and software process models as suggested by a few of the experts from the focus group panel. During the focus group discussion various standard documents and software process models as mentioned in Section 5.1.1 of Chapter 5 were discussed with these experts.

Limitations of the Focus Group Approach

The major drawbacks with focus group is that of ‘group think’, where other members of the group might express their opinion in line with the rest of the group even if they might not agree. Also, it might happen that some participants may be restrained or be concerned about confidentiality. There is also a possibility that the results can be influenced by one or two group members dominating the group to create an inaccurate view thus
making the output very biased. Focus groups findings cannot be projectable in the same way as that of quantitative method findings.

As a facilitator of the focus group, I took proper care to communicate clear theme and the agenda for discussion to the participants. I also made sure that each member of the group participated in the conversation and was given a chance to express their opinion.

3.3.3.2 Gap Analysis – Software Process Models and GSD Practices

In accordance with the research activities performed to conduct this study, it is established that there exists a prevalent body of knowledge in software engineering (SE) for project management. However, with evidence it can be stated that there is no focus on Global Software Engineering (GSE) and in particular the existing software process models do not cater explicitly for GSD.

This argument is supported by the work carried out by Richardson et.al (2010) where they emphasize that the published software process models do not focus explicitly on global software engineering despite the recent growth in the area of global software engineering internationally. They further state that - standard process models must include global software engineering factors to ensure benefit to organisations that are operating in a global environment.

Coordination of tasks is the major project management activity in GSD and is one of the regular challenges experienced in collocated as well as distributed teams (Richardson et al. 2010, Casey, 2009). Furthermore, Smite (2005) also states that even though software companies follow a certified quality system, they do not offer specific regulations and practices taking into account global specifics.
Hence, a gap analysis of the standard documents and software process models was done. As defined in the business dictionary (www.businessdictionary.com), gap analysis is a technique for determining the steps to be taken in moving from a current state to a desired future-state. It is the methodology followed to investigate the gaps in current research. Gap analysis consists of:

♦ Listing of characteristic factors such as attributes, competencies, performance levels of the present situation
♦ Cross listing factors required to achieve the future objectives
♦ Highlighting the gaps that exist and need to be filled.

As a step forward, an account was taken of each standard document and capability/maturity model as per the guidelines or practices or knowledge areas stated in the standards. A detailed review of all the standard documents and capability/maturity models was presented to the focus group as stated in Section 5.1.1. Based on this, a chart that mentioned the document name, the major process covered in it and its area of applicability was produced on a white board. Further, the areas and practices included in the selected standard documents were discussed in detail and their correlation with the GSD-COORD Model was mapped. This was subsequently compared with the strategies included in the GSD-COORD Model.

On the basis of all the preliminary activities discussed in Section 5.1.1 and 5.1.2 along with the gap analysis and the inputs from the focus group, a mutual decision was taken to select the Project Management Body of Knowledge (PMBOK® Guide) to map the activities compiled in the Version One of the GSD-COORD Model. PMBOK® Guide is an ANSI (American National Standard Institute) document published by The Project Management Institute, Inc. (PMI) which states standards and guidelines for project management.
An in-depth review of the PMBOK® Guide, 2008 (Section 5.2) was carried out to understand its overall composition. The recognised ‘good practices’ mentioned in the PMBOK® Guide are 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; hence it was necessary to understand its relevance to our research study. Taking a complete overview of the structure of the PMBOK® Guide, I established that special focus needs to be given to Section III, The Project Management Knowledge Areas which includes the two chapters - Project Human Resource Management and Project Communication Management.

From the GSD perspective, these two chapters are important because they have more cognizance to coordination. The ‘good practices’ mentioned in the PMBOK® Guide are relevant to the coordination strategies included in the GSD-COORD Model. Also, the sub-set of activities found in these two chapters of the PMBOK® Guide specifically relate to various coordination practices. The coordination activities in GSD happen between teams which comprise of team members who are either collocated or geographically distributed. The process described in PMBOK® Guide includes the plans, tools and techniques that are useful in the management of the human resource and communications required for the coordination of distributed teams – and this is where many of the coordination issues and challenges arise in GSD. Therefore, in this research the explicit focus was on Project Human Resource Management and Project Communications Management chapters to answer our defined research question.

To carry out the comparative analysis, the GSD-COORD Model was mapped with the content from - the Project Human Resource Management and Project Communications Management of PMBOK® Guide, 2008. The comparative analysis proved a useful way to identify activities that support...
coordination between geographically distributed software development teams.

On the basis of the practices mentioned in the GSD-COORD Model, three different clusters of events were identified while mapping the GSD-COORD Model with PMBOK® guide.

- There are explicit activities mentioned in the PMBOK® Guide, 2008 that are practiced by the distributed software development teams in the GSD environment. These activities included additional practices in support of the functioning strategies within the GSD-COORD Model and were added to the existing list of practices which in turn has helped to enhance the GSD-COORD Model.

- There are certain activities mentioned in the PMBOK® Guide, 2008 that are not practiced by the distributed software development teams in order to coordinate tasks while functioning in the GSD environment. Such activities have become a further contribution in form of strategies in the 'GSD-COORD Model'.

- There are certain activities that are not part of the PMBOK® Guide, 2008 but have emerged from the literature as well as case studies. These activities and are shown to be successful within different software companies in coordinating tasks between distributed software development teams while functioning in the GSD environment.

On the basis of the mapping activity with the PMBOK® Guide, 2008 further changes were made in the interim GSD-COORD Model. These changes made in the model helped to develop the next - that is - Version Two of the GSD-COORD Model. It was then necessary to validate these changes to earn pragmatic evidence to back the model.
3.3.4 Stage 4: Model Validation

3.3.4.1 Objective of the Validation Process

The main objective to perform the validation process was to –

- Identify if the strategy mentioned in the GSD-COORD Model was executed within the software companies by the project managers while managing the GSD projects.
- To understand from the expert researchers if the mentioned strategy is valid and should be the part of the GSD-COORD Model.
- To identify if that particular strategy helped in better coordination of the GSD projects.

In software engineering, validation provides a foundation to place confidence in the results from a study (Robinson, 1997). Validation is defined as the ‘process of determining the manner in which and degree to which a model and its data is an accurate representation of the real world from the perspective of the intended uses of the model’ (Davis, 1992). Validation involves comparison of various aspects of the model, against the real world facts when the model is assessed under various conditions to see if it can perform in a similar manner (Robinson, 1997). An expert panel technique is followed to validate the GSD-COORD Model in this research study. It is to be noted that the group of people who were part of the expert panel were distinct from the group of people involved in the case studies and focus group.

This approach facilitated the validation of the GSD-COORD Model and also helped to review the methodology followed in the comparative analysis of the GSD-COORD Model with the PMBOK® Guide.
3.3.4.2 Expert Panel

An expert can be defined as a person who has broad understanding of particular subject. Expert panel is a group of people who have comprehensive knowledge of the subject under study. Expert panel is a technique commonly used in making predictions (Shepperd and Cartwright, 2001).

Hakim (1987), states that a small sample of 5-15 experts can be used to test the explanation under study. Beecham et.al (2003, 2005) have successfully made use of an expert panel to validate a requirements process improvement model. Dyba (2000) made use of small samples of experts to review his process, while El Emam and Madhavji (1996a) interviewed a larger sample of experts to develop a standard to evaluate RE process. The expert panel approach is also employed in other areas of SE, where, for example, Rosqvist et al. (2003) have used it for the evaluation of software quality.

In this research, similar to previous studies mentioned here, a panel of 14 experts validated the GSD-CORD Model.

The Expert Panel in this Study

The 14 experts included in the expert panel are researchers from the GSD area or practitioners working in a software company who manage GSD projects. Some of the experts from this panel have experience of both roles - GSD practitioner and researcher. These experts have an average 21 years experience in the GSD area. All the researchers from this panel have published widely in recognised journals in the field of GSD. Equally, the GSD practitioners are either at the middle or top level management in their software companies and have successfully managed GSD projects. The background detail of all the experts from the expert panel is given in Table 15 of Chapter 6.
Background Information of the Experts

The details of each expert were gathered before the start of the interview. Each expert was asked to fill in a short questionnaire (Appendix H) which included questions related to their work experience, company, years of experience in the GSD area.

The multiple case studies in the stage 2 of the research were drawn together from the software companies based in India which is a major outsourcing destination country. Therefore, experts from other parts of the world excluding India were invited to participate in the validation process. The experts who participated in the validation of the GSD-COORD Model were from Australia, Brazil, Finland, Ireland, Sweden, UK and USA.

Expert Participation

A brief introduction of the validation process was given to the experts who participated. A consent was taken from each expert to record their interview and also if they wished to participate anonymously in the validation process. With the exception of one, all experts allowed their details to be disclosed. The one expert who did not wish to reveal his details allowed his company to be named.

All the experts were provided with the GSD-COORD Model in the form of MindMap® and the Word-Document with write-up on the GSD-COORD Model well in advance before the interview day. During a short walk-through, a Power-Point presentation was made where the focus was given on how various strategies are interlinked and supports one another. The rationale to take on this approach was threefold – firstly it reduced the time for the interview especially when the experts were based in different countries and the validation process was conducted over the telephone or SKYPE. Secondly, it provided a full description about the model; and thirdly it provided a common level of knowledge upon which the interview was based.
The expert panel is a recognized way to perform an initial validation (Shepperd and Cartwright, 2001) as it allows an interviewer to examine the answers from the interviewees by being less rigid. Therefore, the questions in the validation questionnaire designed for this study were open-ended which allowed the interviewees to freely add in their own comments, ideas and thoughts on the basis of their experience in the GSD area.

Data Sampling

During the validation process, it was important to extract the information from the experts based on their experience about the coordination strategies included in the GSD Coordination Model. Considering the time limitations, I systematized and randomized the entire procedure of validation. I selected two questions per process to ask each expert. A purposeful random sampling strategy was followed to select the questions so that the information collected was comprehensive and realistic. The credibility of systematic and randomly selected cases is considerably greater than the ad hoc selection of cases to report the outcomes (Patton, 1990). In addition, opportunistic sampling strategy was also followed whenever necessary to take advantage of the situation to discuss a few additional and related questions with the experts.

3.3.4.3 Process followed to conduct validation

In this research study 14 experts were involved and interviewed to validate the model. The GSD Coordination Model consists of 10 processes and 54 strategies. Two questions were written based on each strategy and therefore the standard questionnaire included 108 questions. The full questionnaire is listed in the Appendix (I). It was not feasible to discuss all the 108 questions with each expert.

On the basis of the purposeful random sampling strategy, these experts were asked to answer two questions related to a particular strategy in each
process. Hence at least (2 questions per strategy X 10 Processes = 20) twenty questions were asked to each expert. As a result at least 280 questions were asked during the validation process. As some of the questions were interlinked to other strategies and were helpful for further probing, an opportunistic sampling strategy was also followed. Hence, a few questions were raised with more than two experts. As a result an extra 50 questions were asked of various experts. Accordingly, (280 + 50) = 330 questions were discussed with the experts.

A similar technique was followed previously by Richardson (1999) and McLoughlin (2010). Appendix (J) summarises the questions asked of the experts in the panel.

A test-run of the questions was done with peers before the actual interviews were conducted. It showed that the approach taken was feasible. Also the questions raised were understandable and unambiguous. The average time taken to conduct these test interview sessions was 60 minutes and was ideal to carry on further. The questionnaire, for example included the following questions related to the – Team Structuring strategy in the Team Setup process and Planning Onsite Visits in the Onsite Visits process:

- How are **TEAMS** working on the GSD projects **STRUCTURED** in your organisation?
- How does **TEAM STRUCTURING** help to improve coordination and competency of the distributed teams working on the GSD projects?

Planning Onsite Visits strategy in the Onsite Visits process:

- Can you explain how are **ONSITE VISITS** planned for team members working on the GSD projects?
- Can you explain how **PLANNING ONSITE VISITS** helps in coordination of the GSD project?
3.3.4.4 Performing the Validation of the GSD Coordination Model

In order to validate the model, the expected performance of each strategy was rated as follows –

<table>
<thead>
<tr>
<th>Strategy Performed</th>
<th>Performance</th>
<th>Compliance to the Model</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>YES</td>
<td>Formal</td>
<td>In full Agreement</td>
<td>VALID</td>
</tr>
<tr>
<td>YES</td>
<td>Informal</td>
<td>In Partial Agreement</td>
<td>PARTIALLY VALID</td>
</tr>
<tr>
<td>YES/NO</td>
<td>Context Specific</td>
<td>In Partial Dis/Agreement</td>
<td>CONTEXT SPECIFIC</td>
</tr>
<tr>
<td>NO</td>
<td>NA</td>
<td>Not Applicable</td>
<td>INCONCLUSIVE</td>
</tr>
</tbody>
</table>

Table 12: Expected Performance of Each Strategy in the GSD-COORD Model

As per the expert opinion –

- A strategy was measured as **Valid** and was considered to have compliance with the GSD-COORD Model if the experts mentioned that–
  - The particular strategy was performed in a formal way as part of their standard project management process while managing the GSD projects.

- A strategy was measured as **Partially Valid** and was considered to have compliance with the GSD-COORD Model if the experts mentioned that–
  - The particular strategy was performed in an informal way.
  - The particular strategy is not part of their standard project management process but they embark on it informally or occasionally while managing the GSD projects.
  - They will consider implementing the strategy as it will help them to improve their performance while managing the GSD projects.

- A strategy was measured as **Context Specific** and was considered to have compliance with the GSD-COORD Model if the experts mentioned that–
The particular strategy is only applicable to large GSD projects or large organisations.

- The particular strategy is only applicable to small GSD projects or small organisations.

- The particular strategy is applicable in a particular context.

A strategy was measured to be **INCONCLUSIVE** if the experts mentioned that—

- A particular strategy was not performed in a formal or informal way as part of their standard project management process.

- A particular strategy was never considered as part of the project management plan and therefore could not be validated due to lack of experience while managing the GSD projects.

- A particular strategy is not applicable for coordination while managing the GSD projects.

Expected results in this phase of the research study agree to construct validity. Construct validity refers to the degree to which results can be legitimately made operational from the study (Trochim, 1999). Similar to external validity, construct validity is related to generalizing results. However, in external validity on the basis of the study generalization is in context to other people, places or times while construct validity involves generalizing from your study to the concept of your study (Trochim, 1999). Section 3.4 presents further details on the validity of this research study. Trochim (1999) states that, when researchers claim that the study has construct validity, they are essentially claiming that they understand how the constructs or theories in the study operate in theory and claim that they can provide evidence that they behave in practice the way they think they should.

**Data Collection, Data Transcription and Content Analysis**

In the data collection phase, face to face meetings were held with the experts based in Ireland, while a telephonic or SKYPE discussion was
carried out with the experts from other countries and the interviews lasted for 60 minutes. The data from these interviews was heard and transcribed word for word using a traditional manual method by myself. This resulted in a total of 114 pages of transcribed data. As discussed in Section 3.3.2.6 I then performed a ‘Content Analysis’ (Miles and Huberman, 1994) on the transcribed data.

Each strategy was evaluated and the experts gave their opinion about each strategy in the model. Different suggestions in regard to these strategies were given by the experts. These suggestions were taken into consideration and integrated with the model for further refinement.

Limitations of the Validation Process

The validation process performed on any model has its own limitations. It is important to recognise that the GSD Coordination Model developed in this research study is only validated pertaining to its purpose. Robinson (1997), states that there is no such thing as ‘general validity’. A model can be described as ‘generally valid’ only if it can demonstrate that it is accurate for every purpose applicable (Robinson, 1994). The time and the circumstances when the model is validated need to be considered to determine its validity. The advantage of the validation process is that it helps to bring the confidence in the model. Therefore, validation essentially is a process to try and demonstrate that the model developed in the research work is not incorrect.

3.4 Validity of Research

In qualitative research, when a small number of case studies are involved it does not help to generalise the results (Patton, 1990). Therefore in this study, to make the results more generalised - a multi-method research approach was followed to overcome the weakness of any particular
research method. The research techniques used for literature review, multiple-case studies along with the model mapping and validation has helped to make this research more trustworthy.

There are multiple viewpoints on validity of qualitative research. Lincoln and Guba (1985); Miles and Huberman (1994); Maxwell (1996), have presented diverse methods on validating the qualitative research. There is no consensus on the right method to verify the credibility of qualitative research (Creswell, 1994, 2003). Guba & Egon (1981) has first developed ‘trustworthiness’ criteria to judge whether any research is methodologically right or wrong. Though, this criterion is further contested by Lincoln, (1990).

Drawing on this, there are various other suggestions on how to validate and evaluate the quality of research. Pretty (1994), have proposed set of twelve criteria for establishing ‘goodness’ of the research. Further, these twelve criteria are combined by Patton (1990) to confirm the validity, reliability and objectivity of the results to suggest a good qualitative research. Traditionally, researchers use these criteria to persuade if the findings of the research can be trusted (Lincoln and Guba, 1985; Guba and Lincoln, 1989).

Apart from this Trochim, 1999 suggests to measure Construct Validity – which is similar to external validity and helps to indicate what was to be measured was actually measured with both ‘convergent’ and ‘discriminant’ validity. Convergent validity is demonstrated when the measures that are theoretically supposed to be highly interrelated are, in practice, highly interrelated. And, discriminant validity is demonstrated when the measures that shouldn't be related to each other in fact were not. A concept can be described as ‘generally valid’ only if it can demonstrate that it is accurate for every purpose applicable (Robinson, 1994). The validation process followed has helped to measure the construct validity.
3.5 Summary

This chapter describes the research methodology undertaken throughout every phase of this research study. The research study is based on the empirical evidences to develop the model. Multi-method research technique is followed in the various stages of research. The following chapters in the thesis will report how various research methods introduced in this section are used to develop the GSD-COORD Model.
Overview

The literature review for Global Software Development (GSD), discussed in Chapter Two, revealed that most published research is conducted from the perspective of companies who are outsourcing all or part of their software development. There is less focus given to carrying out similar studies from a vendor’s viewpoint. There exists an imbalance between the number of studies conducted from client perspective and the number of studies conducted from a vendor perspective in GSD. As a result, one of the sub-objectives of this thesis is to identify strategies followed in vendor companies for effective coordination between client-vendor teams. In addition, this research aims to provide a more balanced and holistic model for coordination of the GSD projects that integrates different processes and strategies which are used and found to work for vendor organisations.

4.1 Background of the Research Study

The literature review has helped to investigate coordination techniques and practices followed in GSD. It is clear that the recommended practices from the literature have an intrinsic bias with almost 70% of the studies written from the client’s perspective while only 14% of such studies take the vendor’s point of view\(^1\). This lack of recorded research from the vendor perspective is supported by Gonzalez et al (2006) who identified that only

\(^1\) The remaining 14% of the studies give an account of the ‘Bridging Country’ in which the organisation act as a bridge and take on the role of both client as well as vendor. The rest 2% of the studies do not clearly mention if the research is from client or vendor side.
16% of the 131 papers surveyed relating to outsourcing took the perspective of the vendor.

Hence in this study I have approached vendor software companies based in India to carry out the empirical research. The rationale to conduct the study in India was to identify the various issues confronted by vendor companies while managing the outsourced GSD projects. It was considered necessary to realize what efforts vendor-side project managers have to make particularly while managing GSD projects. It was also important to understand the skills essential for vendor-side project managers and senior executives to manage GSD projects.

4.1.1 India - An Outsourcing Destination Country

There are various factors that have contributed to the growth of the Indian software industry. The swift availability of various technical skills has helped India to build a robust software industry, in comparison to other countries (William et al. 2006; ACM Report 2008, p.53). The primary factors are; an adequate English speaking technical workforce, finer high-end technical skills, cost and capacity. In addition, the strategic location of India, with its 8 hour time zone difference with the countries located on either east or west side, allows software companies to provide 24/7 support around the globe. Additionally, many Indian software companies offer multiple-shift services to US based clients and customers. They also manage various time-zone differences in order to reduce the time-to-market for different customers. They are able to coordinate with geographically located teams spread through various continents.

This fundamental understanding of India’s position as the primary location to undertake outsourced software development projects has motivated me to focus on software companies based in India. The software companies based in India and included in this study are involved in various phases of
global software engineering (GSE). This includes requirements gathering, architecture design, software development, maintenance and testing to research.

4.1.2 Rationale for the Vendor Perspective

The main objective of this research study was to develop a model that incorporates strategies from a vendor perspective to facilitate effective coordination between client-vendor teams working on outsourced GSD projects. Therefore, I have embarked on specific observations and measures gained while working in the Indian software industry.

Through the main research question, the focus of this research was to conduct the case studies from vendor perspective; hence the second research sub-question was:

What are the strategies followed by the vendor companies to overcome the coordination barriers when operating in a GSD environment?

This research question was mainly to understand:

- What are the strategies followed by vendor side Project Managers and Senior Executives to overcome coordination issues when managing distributed teams working on the GSD projects?
- What are the various communication strategies used by the distributed teams and team members while coordinating the GSD projects?
- How do different time zone differences and temporal distances impact coordination of the GSD projects?
- What impact does cultural diversity have on the coordination of the GSD projects?
4.2 Synthesis of Empirical Data

There are various issues faced by vendor side project managers while managing GSD projects. The synthesis of the empirical data has helped in the understanding of various strategies followed by the vendor companies to coordinate tasks between client and vendor teams working on outsourced GSD projects. The analysis of the multiple-case studies has helped to divulge these strategies, formulating a model for coordination of outsourced GSD projects.

4.2.1 Teams

A team can be defined as a group of people working together to achieve common goals. In GSD, the collective objective of all the geographically distributed teams and team members is to achieve GSD project success. This shared goal is typically achieved by means of continuous software development across distributed team sites. Hence, appropriate coordination strategies are essential to manage tasks and activities amongst collocated and distributed team members working on GSD projects.

4.2.1.1 Team Structure

Team structuring is one of the practices followed to coordinate tasks between distributed teams to improve their competency while working on GSD projects. Narayanan and Mazumder (2006), state that teams at the vendor side or at various geographical locations can either be structured as dynamic, or a replica of the client side teams. The interviewees, from the multi-national companies studied for this research, have mentioned that the total number of team members working on GSD projects usually depends on the size of the project. They stated that within their software companies they typically have large teams, where the number of team members varies
between 20-500 members. One of the reasons stated for having a large number of team members is that projects are substantially big and need to be completed in specific duration. Hence different team members work on the same project but in multiple-shifts.

Furthermore, in these software companies, every GSD project will normally have a Senior Project Manager, Junior Project Manager, Project Lead, Team Leads, Onsite-Coordinators, Software Engineers and Developers. The interviewees stated that their Junior Project Managers and Team Leads performed a dual role of Software Engineers for GSD projects.

*Usually every team will have Project Managers, Project Leaders, Team Leads, senior and junior software engineers, designers, developers and onsite coordinators....*[Yogesh]*

The entire project is then split into various teams to structure it according to the main functions. These teams are further disintegrated into ‘sub-teams’ as per the special functional requirements for the project. Usually the sub-team size is between 5-25 members.

*The team structure is as per the main jobs...such as we have teams for managing and analysing requirements, then we have teams who do the system analysis and architecture design, coding teams, deliverables and testing teams...so there are couple of such teams for a particular project and the team members are part of these teams based on their skill sets....*[Kiran]*

Each sub-team performs a specialised task for the project such as architecture design, interface design, visualisation, testing and deliverables. The advantage of having small sub-teams within the large team is that the projects are more manageable. It is also easier to position small teams near to the client site. If necessary, these sub-teams are further split to work on a particular component for the project. One of the interviewee mentioned that

*Mostly our requirements management, deliverables and maintenance teams are based either at client site or nearby where there is less time zone difference....*[Manohar]*

The interviewees stated that Project Managers are responsible for multiple teams within the project and, most of the time they are in-charge of the ‘support and release function’ team. The Project Managers maintain
constant communication with the clients. Team Leads work with their teams and report regularly to the Project Manager. The interviewees stated that Project Manager, with the help of team leads; plan the respective tasks of the project. The team leads then take the responsibility to delegate these tasks to their teams. The interviewees further mentioned that their team members also work from client sites, depending on the project requirements, and act as ‘Onsite coordinators’.

Having onsite-coordinators is suggested to be an important strategy in the GSD literature. These onsite-coordinators are known as ambassadors (Hogan, 2006), cross-site delegates (Bass et al. 2007) (Begel and Nagappan, 2008), liaisons and gatekeepers (Pichler, 2007) (Cataldo and Herbsleb, 2008). Their role is to build a relationship amongst various teams, provide a mechanism to create trust, transfer knowledge and communicate lessons learned as well as set future direction for the project (Hogan, 2006). One of the interviewee stated that

.isOnsite coordinators are our important people and we have constant communication with these team members.....most of the time by telephone. These OC’s are stationed to client site for specific time period....we keep on rotating these OC’s.....[Yogesh]

Team Demographics - In India, the IT hubs or zones are predominantly in metropolitan cities like Bangalore, Delhi, Mumbai, Pune and Hyderabad. IT professionals move to these cities to pursue their career. Therefore, it is common to have GSD project team members from different states in India, mainly Maharashtra, Karnataka, Punjab, Haryana, Tamil Nadu and Kerala. India is a large and diverse nation with many religious and culturally diverse groups. Therefore, team members come from various religious and cultural backgrounds and speak different languages.

Out of the 19 team members....3 members are from Delhi and nearby states such as Punjab & Haryana, 5 are from South India, 8 are from Maharashtra...I am south Indian.....but born and brought up in Mumbai....including me there are 7 female team members in the current team....[Shobha].
The interviewees from the companies where these case studies were conducted stated that there are approximately 60% male and 40% female team members working on the GSD projects.

We have team members from almost all part of the country... and there are approximately 40% of female team members and 60% of male team members...[Hemant]

In software companies based in India, the percentage of female team members ranges between 40-50 % as compared to male team members. This is substantiated by the NASSCOM (2007) survey report which states that the female workforce in the Indian software industry has risen from 25% to 30% in 2008 and is expected to rise up to 45% by 2010. The interviewees stated that for certain roles they prefer to have male team members over female members. The main reason, according to the interviewees, is that most of their clients are US based and there is a time zone difference between their clients. Therefore, in such a situation it is preferable to have male team members as they are readily able to work in various time shifts as per the client’s time zone.

4.2.1.2 Team Selection

In reference to team selection, the interviewees stated that various factors are taken into consideration while selecting team members for GSD projects. These factors can be grouped into two sets - technical and non-technical. The technical factors are important for the progress and development of the project while the non-technical factors are essential for managing the project. To form a successful team at the outsourcing destinations it is important to have a correct balance of technical and non-technical factors within a team. The project managers primarily look for members with good technical and domain skills.

There is always a need to have at least 10% of team members who are expert or have excellent technical and domain knowledge...then we choose other team members with good professional and communication skills irrespective of domain knowledge...[Rakhi].

One of the interviewees stated that previous experience of working on similar types of projects is important when selecting team members. This
helps to bring the new team member into the project faster. Professional skills along with communication and presentation skills are essential for the members to be part of GSD teams. The interviewees stated that technical or domain skills, as functional competencies, are considered secondary aspects while selecting team members. They believe that these competencies can be developed if the individual has the right attitude, aptitude and communication skills. Communication skills are considered an important aspect while selecting members because it helps to form effective communication channels between the client and vendor. One of the interviewees mentioned that

*Having good communication skills irrespective of the technical skills and domain knowledge is important because the members are able to communicate effectively the information and decisions of the project to the clients...*[Shobha].*

Apart from this, the project managers look for members who are team players and have an ability to achieve common team goals. The members should be able to work as a team and maintain team dynamics. They must have a proper understanding of the environment they are working in and should have the right approach towards their work and responsibilities. While selecting team members project managers look for members who are stable and flexible. To be flexible means having the ability to swap over different tasks successfully within the project and the ability to work in variable hours. The interviewees stated that, most of the time, they receive a set of requirements late in the day which they have to complete within 24 hours. Therefore, they need people who are willing to work during late hours. Another important aspect to be considered while selecting team members is their willingness to relocate to various geographic locations as per the project needs.

The project managers also look for members who are committed, self-motivated, willing to learn more and have right attitude towards work. They should be prolific and ready to work. They should possess an ability to develop themselves and advance professionally. In reference to this, one of the interviewees stated that -
Any attitude affects the team work... as teamwork is an important factor when you are working on a GSD project.... no individual can run the project. People who have egos... who cannot go along with others is something difficult to handle....and then there is frustration...so we look...how humble the person is....how much willingness is there to work hard... these all things are not very strictly followed....but we look for few of them...[Maharukh].

When selecting team members, other aspects such as leadership qualities, eagerness to take on various tasks, good work ethics, shared vision and talent related to project are taken into consideration. Also, adaptability to changing circumstances within the project, and ability to take and manage different responsibilities is also considered vital. The interviewees mentioned that basically the profile of the member should match with the task and technical requirements of the role on GSD projects.

4.2.1.3 Team Building

The interviewees stated that establishing a cohesive team at the outsourcing destination is important for GSD projects. It brings stability within the team for effective coordination which mainly helps in successful completion of the project. It helps to build united and integrated software development teams.

Team building exercise is undertaken to build a cohesive team... when I joined here....I had to undergo couple of training courses .as part of the induction programme....which have basically helped me to understand the overall objective of the project and my role....as well as the role of other team members within the team.....this has given me the feeling of being part of the project....[Shaunak]

The interviewees further mentioned that team building exercise in general is a two-stage activity. The primary or key activities happen at the start of a new project. These activities are then carried out on a regular basis during the project life cycle. The secondary-stage activities are carried out when any new member joins the team. Team building exercise is carried out to

- Help build united and integrated teams to work on the GSD projects.
- Develop team spirit.
• Bring homogeneity within the teams.

Many activities are conducted during the start or initial phase of the project. They are mainly to analyse the available resources and their skills and to plan and organise specific training for team members to fulfil the technical needs essential for the project. There is a combined meeting of senior team members from client and vendor side. Complete planning and scheduling for the project is done in these meetings. The senior members then have a meeting with their team members. During these meetings, each team member’s role is defined and project details are communicated. The deliverables and expectations from each role are made clear.

When a team members join the team they have to take on few training session before being part of the project...this is basically to identify their skills, interest and the level of knowledge they have....so as to allocate them the right job....[Sampada]

Later, during the project life cycle there are regular team meetings, interactions and training sessions. Team mentoring exercises, brainstorming sessions and many other activities are conducted regularly. Generally all the team members who work on the project are involved in these activities. One of the interviewees added that

We have regular team meetings...where we analyse the progress of the project.....what have the teams to achieve next.....then we try to understand problems and solutions found for them.......which task took the most time, why and how it was resolved.....what care needs to be taken to avoid such things.....we also understand individual members problems....may it be work related or personal...and try to find out solutions for it....[Kiran]

The interviewees mentioned the following team building activities that are conducted for team members working on GSD projects.

Interactive Sessions – These sessions are specially conducted for team members who work in flexible hours for GSD projects. This helps all the team members to coordinate well with each other especially when they do not meet regularly to interact with each other. Team members discuss various issues that occur while working with clients in different time zones. Every alternate day there are such interactive sessions for one hour. They
are either at the end of working hours or beginning of working hours for

*team members who work as per the client time zones.*

*The key activity undertaken while building and establishing cohesive teams is training and
interactive sessions.... every alternate day we have an interactive session for 1 hour either
before the end of our working hours or beginning of working hours....as few team members
work as per the client or onsite teams time zone....we undertake various training.....then we
spend time socially so that we can discuss project related or other matters....*[Satyajeet]*

**Brainstorming Sessions** – The brainstorming sessions for the team
members help to generate new ideas related to GSD projects. Team
members propose new ideas, related to coordination and management of
the GSD projects, which help to bring cohesiveness within the teams.
Team members make an effort to work collectively and resolve various
issues in these sessions.

*We also have brain storming sessions where new ideas are generated and any issues are
resolved collectively taking into consideration various inputs from all the team members...so
all such activities are performed to bring cohesiveness within the team....*[Hemant]*.

**4.2.1.4 Team meetings**

The interviewees consider team meetings essential for the coordination of
the GSD projects because they help to monitor the progress of the project.
Team meetings in the software companies where these case-studies were
conducted are scheduled at least twice a week. The Project Managers
organise these meetings mainly to

- Analyse the performance and progress of the project, teams and
team members.
- Build and maintain a cohesive team.
- To understand various coordination problems faced by the team
members.
- Report the solutions found to these problems
- To analyse if there are, in particular, any coordination issues within
the project while achieving the project goals and objectives.
• Update the progress, objectives and deliverables of the project.
• Analyse the wide resources that are easily available within the team.

The interviewees stated that the project managers and the team leads analyse and maintain a repository of the problems and solutions found within the project. They also maintain the time scale taken to resolve various problems. The performance of each team and team member is analysed in order to map the project progression. In reference to the team meetings one of the interviewees stated that

_We have regular meeting for the team members.....where we update the team members about the progress of the project, we also inform them about each individual and team progress...what are the subsequent expectation from each team towards the project...all such activities are carried out to build a cohesive team...._[Sampada]._

### 4.2.1.5 Training

Regular training activities are carried out for the team members working in the software companies where this empirical study was conducted. The interviewees from these software companies mentioned that an annual training calendar is maintained through which the project managers are informed in advance about the upcoming training programs. The training sessions are conducted for team members working at various levels within GSD projects. These training sessions are for the enhancement of technical skills and communication skills of the team members. These training sessions help project managers to fulfil the inadequacy of skill sets within the project and develop resources. One of the interviewees stated that -

_When senior team members are due for promotions...they encourage their subordinates to take-up different training... with the intention that the subordinates can be chosen to take up higher position..._[Madhur]_

Such training conducted for team members helps them to get ready to work on a project that involves specific technology. One of the interviewees stated that in India most of the companies have made training mandatory.
for their team members while working on GSD projects and each team member has to undertake specific hours of training every year to help them work successfully on GSD projects.

4.2.1.6 Social Activities and Events

In the software companies researched, various social activities and events are carried out for the team members to increase their involvement within GSD projects. Team based competitions are performed within the project to bring cohesiveness amongst the team members. The interviewees stated that team members are given an opportunity to spend time socially so that they can discuss the project as well as matters that are related to the project. Different outdoor social activities are organised for the team members. A calendar of all social events is maintained which lists various upcoming activities. As the team members come from different religious backgrounds various festivals are celebrated within these companies as part of the social activity. One of the interviewees mentioned that

*We celebrate religious festivals, birthday and the success of the project deliverables…apart from this…we have various team based competitions…all such activities are carried out to bring cohesiveness within the team.…*[Gurinder]

4.2.1.7 Induction program

The interviewees stated that induction programs are conducted when new members join the project team. They added that new team members before starting to work on the GSD project have to undergo up to two weeks of training. These training programs are conducted to get the new members involved within the project and to give them a feeling of being part of the project. One of the interviewees further added that experts from various departments within their company are also involved in training sessions during this induction program to provide varied information related to the project to the team members. Senior team members, such as project manager and team leads, interact with the new members and update them
with the project details. They also make them aware of their role within the project. This helps the new members to understand the objectives of the project and their specific role within the project. The existing members interact with the new team members and gradually get them involved in the project. In regards to this, one of the interviewees stated that

at the end of induction training all stake holder come together...introduce themselves...then discuss what their roles are...their background...what are they currently doing.....since how long they are working on the project....so that the new member gets acquainted with the project and with the team members...[Shobha].

The induction program facilitates the identification of skill sets, interest and the profundity of the knowledge of new team members. The project, managers based on this understanding, then allocate appropriate tasks to these members for effective coordination within GSD projects.

### 4.2.1.8 Team Strength

During the interaction, the interviewees stated that understanding the negative and building on the positive strengths of the teams is important from the GSD perspective. It helps project managers to analyse and overcome the weakness and build on strengths within the teams. Conducting regular stimulating meetings helps them to find strengths and weakness. The project manager or team leads prepare a performance card to identify the strengths and weakness of each team and team member. Based on the weakness appropriate steps are taken to enhance the skills of the team members working on GSD projects.

We analyse strengths and weaknesses of each team members within the team....a performance card of each team and team member is prepared..... We try to overcome the weaknesses and build on the strengths of the teams and team members...we consider the strengths, interests, positive skills and capabilities while allocating tasks to team members...[Manoj].

To improve the team strength, project managers conduct regular team mentoring sessions to ensure there is effective communication happening amongst the teams and team members working on GSD projects. The project managers try to resolve any conflicts within the team and check that
there is good team dynamics happening during the team meetings. They also try to resolve any personal issues related to the project within the team. Furthermore, the team members are given the option to work at their own convenience with flexible hours. During team meetings, each team member shares their experience about issues encountered and how they have successfully resolved it while working on GSD projects. This helps other team members to resolve any such issues that may surface later within the project. Project managers ensure that team members work towards a common goal and have an appropriate vision about the project. The impact of the team mentoring sessions is that team members begin to adjust work habits and behaviour of other team members, improving coordination within GSD projects.

4.2.2 Team Issues

Team based issues influence the performance of the teams and team members and in turn affect coordination of tasks while working on GSD projects. The interviewees stated that there are mainly two kinds of team issues that impact GSD projects. They are project related team issues and team member related issues. Both of these issues inimically affect the coordination of tasks within GSD projects. It is essential to overcome these issues to successfully coordinate and manage the outsourced software development projects.

4.2.2.1 Project Related Issues

The interviewees from the software companies where this research study is conducted mentioned that project related issues are mostly technical or functional. These technical or functional issues get aggravated due to distance and impact on coordination of tasks as the GSD teams are geographically distributed and team members work in different time zones.
Project related issues are establishing communication and coordination channels and having a proper control over the project schedule…. [Yogesh]

One of the project managers gave an example and stated that if the overlapping tasks of distributed teams are not completed due to various reasons, and teams are unable to release the tasks to the next teams. Then the teams working in a subsequent time zone cannot take on the work and this causes project delays. The other technical or functional issues that arise are either disagreement on specific codes, design of the project or understanding of requirements. Therefore the project managers have to get into the root cause of such problems. They have to understand the level of impact these issue have on the coordination of tasks and project deliverables. A two-step approach is normally taken to resolve such issues. The first step is at the team level where a dialogue takes place within the team to manage these issues. The second step is at the inter-team level where project managers discuss the process to resolve the issues. There are other project related issues that arise within the teams. One of the interviewees stated that

One of the project related issue arises when any individual team member is timid and hesitant to come out with problems related to the GSD project…. [Manoj]

The problem can either be within the task or even while dealing with the client. The project manager has to check that such issues are not withheld and get resolved quickly. It is necessary that project managers ensure that the team members are assertive while dealing with clients. They need to have a clear and precise communication concerning the project with the client team members and no assurances related to the project are given by team members from either side.

4.2.2.2 Team Member Related Issues

The interviewees stated that there are two major issues related to team members which have an impact on outsourced software development project. The first issue is managing the work shifts of team members as team member’s work at various hours of the day to coordinate and
synchronise their work with the client time zone. This is done to provide 24/7 support to the clients. These working hours for team members need to be regularly rescheduled as team members cannot always work late night shifts all year round. Hence, the project managers have to rotate team members to work in various shifts.

The major issue that PM’s have to deal with is the time zone mgmt and working hours of team members…. not all team members are eager to work in shifts…or cannot every time work between 10pm to morning 8am….its practically not possible….so we have to replace team members who can give this support .to work as per clients time zone…. [Gurinder]

The second issue that project managers have to address is personal and festive holidays of team members. They have to ensure that there is enough team backup available every time different team members are on holidays. This is crucial for coordination of tasks between distributed teams and team members and to provide 24/7 support in order to carry on the work during holidays. There are various team strategies followed to overcome these issues and one of the interviewees stated that

It is important 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… they cannot work all the time from evening 10pm to morning 8am….its practically not possible….so we have to find replacing team members who can give this support…..to work as per clients time zone… [Kiran].

Apart from these two main issues, the interviewees stated that project managers also have to overcome a couple of other minor issues. They have to assess the skill sets and interest of team members before assigning tasks to them. This is important in order to get full involvement of every individual team members into the project. Situations also arise where team members are unwilling to take up a specific task involving too much communication. Team members consider telephone conversation or writing emails to be demanding and interrupting in their daily work. There is always reluctance from team members to relocate to new project sites. Team members are not very keen to travel to the client sites as it disrupts their personal life. Therefore, the project manager has to consider all of these issues and manage the conflicts that arise within teams, impacting coordination, while managing the GSD projects.
4.2.3 Team Management

It is important to successfully manage and coordinate the GSD teams because it is different from managing collocated teams. Various team issues subsist while functioning in a global software development environment. It is necessary to understand and overcome such issues from a project perspective. To prevail over various issues of global software development, it is essential to have effective team management strategies.

4.2.3.1 Role of Project Manager

The interviewees consider that project managers have to perform an important role in team management. They believe that the success of the GSD projects to a certain extent depends on the role of project managers as they have to effectively coordinate and manage the GSD teams. Project managers must have certain skills to deal with various issues within GSD projects. Primarily, they should have high level of domain and technical knowledge related to the project. Subsequently, it is essential that they have exceptional planning and organisational skills to manage GSD projects as these skills are essential to coordinate and accomplish the projects in time.

One of the important role of project managers is to identify the interest of team members to allocate task to them so that the team members contribute best of their abilities.....also he should be able to take holistic view of various issues related to project...[Manohar]

Project managers must be able to coordinate, track and control various team activities in different time zones. They should be able to establish precise communication and coordination strategies amongst various teams. Project Managers should be good team leaders. They should have organisational and people management skills and must maintain detailed knowledge about the skills and interest of team members in order to allocate tasks to them. They should be able to take a comprehensive approach towards all aspects of the project. They should be good in
decision making and finding quick solutions for the interdependent issues within various teams. The interviewees consider this necessary in order to have proper control over team activities and further stated that the project managers must have proper planning and organisational skill, they should be able to foresee all the project related activities in advance.

The project managers must also be able to create trust and maintain a rapport within teams and team members working on GSD projects. Every project manager should be easily reachable and accessible at all times, not only to one another but also to the team members within the project. The project managers must have trust amongst themselves which in turn creates trust within members from various teams. One of the interviewees mentioned that -

*project managers should have trust amongst themselves….the main task or responsibility of project managers is to build trust within their team members and also with other teams….they have to see that all team members have full trust in each other….there is a need of trust at all levels within the geographically distributed project….*[Sameer]*

Apart from all these factors, project managers should have skills to deal with the cultural diversity that exists within the global environment. This diversity can be at the local team level or international team level. They should have plans to manage the cultural and religious festive calendar of geographically distributed teams. They should also possess good conflict management and resolution skills. They should have skills to motivate their teams and ability to develop resources within each team.

### 4.2.3.2 Team Operations

In the GSD projects it is necessary that all activities within the teams are synchronised with one another to maintain precise coordination and communication channels. The interviewees stated that improper coordination and communication channels directly affect the project schedule. Even though there are various coordination tools available, different strategies and techniques are required for coordinating team work on GSD projects.
The interviewees believe that proper control over distributed team activities is necessary to maintain project schedule. It is essential to understand requirement-specifications from clients to maintain and control coordination and communication channels. There should be sufficient team members available to carry on the work in various time zones. The right approach towards the technical and functional issues related to a project is imperative. Extensive planning and tracking of project and team activities is essential to coordinate the work of teams and team members. Team performance and work flow need to be regularly counter checked with project plans. One of the interviewees stated that -

We establish Vision Statement for the project. This vision statement mentions the implicit requirements of the organisation and the customer. The next step is that we convert this vision statement into objectives that could be tracked and measured and these objectives then disintegrate into specific deliverables and task....[Sameer].

The interviewees consider that a holistic approach is essential in team operations to manage all the available resources efficiently. It is important to create trust between teams and team members. They also consider that it is necessary to rotate onsite coordinators regularly to make team members familiar to one another. A proper conflict management strategy needs to be implemented within the project. The other aspect that needs to be taken into consideration is knowledge of team members to carry on work. Regular training sessions are essential for team development in the GSD projects.

4.2.3.3 Team Motivation

The interviewees consider that motivation is essential to carry out any teamwork as it helps project managers to achieve project objectives and check that the projects do not fail on the time schedule. Motivation is particularly essential to improve coordination when team members work as per time zones of clients. Therefore, various work related motivational schemes are followed in software development companies. These schemes are useful to motivate teams and individual team members.
Various motivational sessions are organised regularly for all the teams within GSD projects during which the team members celebrate and highlight the achievements of the teams and projects. These sessions help to assess the performance as well as analyse the cause for any non-performance of each team to take further appropriate action.

Motivation is very subjective…I would say….there are few team members who are very much self-motivated….who always work hard….and on the other hand we also have team members to whom we need to encourage…therefore we conduct motivational activities….to make all team members participate in that….this helps to improve coordination between teams and team members [Yogesh].

Reward based schemes are also followed to motivate teams and team members working on GSD projects. There are two level motivational schemes. First the whole team is rewarded which helps to create rapport within the teams. Second, individual team members within the teams are rewarded to improve team performance. Rewards are usually for the performer of the month, best team player etc. There are also surprise ‘spot awards’ given at the desk of team members. If the project is large then within the project, best team and best project managers are awarded. The interviewees claim that all such activities help them improve coordination between teams and team members working on GSD projects.

There are various team games organised to encourage team members. These simple things help in motivating team members to successfully coordinate with each other. Team members are also rewarded for undertaking specific training. This becomes an encouragement for other team members and helps in resource development. Monetary incentive or prizes for good work are given to teams and team members. Team members are given special remuneration for working across time zones. The project managers also organise social activities which allow team members to spend quality social time together. Different events are organised in order to get team members and their families together. This helps in further bonding of the team members.
4.2.4 Task Allocation

Task allocation is the process in which certain people are engaged in specific tasks. The literature on GSD has revealed various task allocation practices followed to coordinate the GSD projects. Task allocation is considered as a moderating variable to improve coordination between teams in GSD projects (Amrit, 2005). Tasks must be decoupled and allocated to different development sites so that teams can operate more independently from one another (Herbsleb and Mockus, 2001). The interviewees from the software companies involved in this study stated that in order to coordinate each task with one another, they are subdivided and assigned to each team and team member working on GSD projects. Appropriate task allocation is important while coordinating various tasks in software development projects. Task allocation, to the resources in the distributed teams, is important because it helps to harness the potential of the 24-hour software development model and minimize the completion time of the GSD projects (Jalote and Jain, 2004). The project managers from the software companies where this study is conducted take into consideration the strengths and interests of the team members while allocating tasks to them. Their technical and domain knowledge, working experience and personal interest, skills sets and capabilities are considered while allocating tasks. The scheme is to assign right tasks to team member as per their skills set. Project managers see task allocation as important so that the team members can enjoy their work within the project.

Various other strategies are also followed while allocating tasks. Job rotation is the main strategy practiced by these project managers. This helps them to enhance various skills set and knowledge of the resources and plan ahead for training sessions. When a new member joins the team, a short skill and aptitude test is conducted before assigning him the task. Performing and non-performing skill sets are also analysed before allocating tasks to them. One of the interviewees stated that in some cases
three choices are given to the team members to select tasks for
themselves. Team members are also asked what new knowledge they
would like to gain apart from their existing skill sets that will contribute to
the project.

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 them the communicator role
within the project... this helps us to understand their interest and behaviour in order to
make decisions about task allocation and improve coordination within the team...[Manish].

4.2.5 Culture

The relationship between culture and management of remote work has
become an unavoidable issue that needs to be addressed (Watson et al.
1994) while managing the GSD projects. Globalization of software projects
has increased demographic and cultural diversity, obstructing smooth team
functioning (Beise, 2004). Geographic and temporal distance limit
opportunities for direct contact and cooperation (Carmel, 1999; Prikladnicki
et al. 2003). Cultural diversity has an impact on coordination of activities
and tasks within GSD projects.

4.2.5.1 Managing Language Issues

Members in geographically located teams come from diverse cultural
backgrounds so they speak different languages and dialects. Language
becomes a barrier for communication in GSD projects. There has to be a
common language for communication in which team members can
communicate easily. The interviewees stated that in their companies there
are formal and informal languages used for communication by team
members. The project managers have to recognize these formal and
informal languages. The interviewees further stated that though English is
the formal language for communication within the Indian software
companies, the common practice is that collocated team members prefer to
communicate project related matters in informal languages which can be any regional language from India. Team members prefer to communicate informally in a language that is convenient for all. This helps team members to interact more easily with one another. One of the interviewees stated that

\[\text{Language has never been an issue within the team even though team members come from different cultural background….what is important is to interact in appropriate English accent and dialect….because many team members come from rural area….their accent is different….the challenge is to bring up to the international standards….they have huge technical knowledge…however accent of English becomes an problem…}[\text{Maharukh}].\]

In the software companies studied for this research work, the interviewees stated that the team members can easily communicate project related concepts within their teams in English or any other language. English is not an issue within the teams or between the team members. The language issue surfaces only when team members have to deal with the clients. Most of the clients are from countries where English is the primary language. The challenge for team members is to interact in appropriate English with the clients from various countries. The demand is for a comprehensive knowledge of English. The proficiency of the English language differs with each team member. Team members are reluctant to communicate with client side team members due to language ineptness. This reluctance is in both written and oral communication. Hence, language turns into communication issue regardless of team members having huge technical knowledge. Team members at times find it difficult to understand the accent of the clients or other team members from various geographical locations. The project managers have to deal with such issue while managing the GSD teams.

\[\text{proficiency of English is important when team members are communicating with clients….they come from rural part of the country….they have huge technical skills.....and have sufficient proficiency of English that is required for technical work and communication….but when it comes to speaking….this proficiency is insufficient. Hence while selecting team members….we look for basic aptitude ....as not all team members communicate with clients...hence we also allocate task as per their proficiency...}[\text{Hemant}].\]
The interviewees stated that there is a need for team members to have a certain level of command over English language to work on GSD projects. This helps them in effective communication with clients and geographically distributed team members from the countries where English is the primary language. Hence, basic aptitude level of the English language is one of the criteria while selecting team members. The interviewees also stated that team members are provided appropriate English language training when they have to extensively communicate with the client side team members.

4.2.5.2 Managing Cultural Diversity

During the discussion with the interviewees it was understood that from the Western perspective, India is perceived as a uniform or homogeneous society which is frequently portrayed by the media in a stereotypical fashion. The reality is quite different - India is a large and diverse nation which is often referred to as the ‘Subcontinent’ because of its size. It is made up of 28 States with 22 recognised languages and many religious and culturally diverse groups. India is the most diverse nation as people have different religious and cultural background. It is noteworthy that India’s linguistic, cultural, and genetic diversity is only exceeded by that of the continent of Africa (Library of Congress, 2004). There exists cultural diversity at various geographical locations within the country.

The interviewees stated that there are special zones for software companies in various cities within India such as ‘Electronic City’ in Bangalore where major software companies are located. Professionals from all over the country move to such cities to pursue their career. Thus, software developers working on global teams within India come from different cultural and religious backgrounds and speak a variety of languages in different accents and dialects. Consequently, Indian Project Managers have to establish, manage and coordinate a culturally and linguistically diverse collocated group into an operational team (Casey et al. 2008) to successfully carry out the GSD projects. Project managers have to deal with these professionals as they come from various part of the country.
to set up software development teams. They have to select appropriate team members in order to manage them efficiently.

**Selecting Team Members** – The interviewees stated that team members are not selected based on their religious or cultural background. They are selected merely on their work experience, domain knowledge and various other skills essential to work on GSD projects.

*Religious or cultural background is never taken into consideration while selecting team members...infact we look for people who have excellent technical, domain knowledge and professional skills ....apart from this we look for people with good proficiency in English...*[Sameer]*.*

If the role requires resources to work as per the client time zone then male team members are selected. This is because female team members are unwilling to work, apart from standard working hours. Also, one of the interviewees mentioned that the marital status of female team members is not of importance while selecting members. The fact is that project manager looks for team members who can bring stability to the project.

**Managing Diverse Cultural and Religious Background** – The interviewees stated that as team members working on GSD projects with their company come from diverse cultural and religious background managing this diversity becomes essential to accomplish GSD projects. Comprehensive knowledge of the prevailing cultural diversity within the teams is necessary because this helps project managers to assess and handle existing cultural differences to provide 24/7 support all year round. It also helps overcome the potential loss of support and communication during festive and religious holidays which varies from state to state within the country.

The interviewees mentioned that every state in India has its own festive calendar in conjunction with the national festive calendar. In addition, individual team members follow different religious and festive calendars. They prefer taking holidays on their respective religious festive days. Project managers have to consider this to overcome the various festive and
religious holidays of team members and hence their software companies have set up ‘backup teams’. The interviewees stated that such backup teams are formed both at national and international level to ensure coordination and 24/7 support all year round. It is necessary that at-least 10 percent of the team members should be part of the backup teams. The backup teams in other companies are referred as ‘support teams’.

We normally have backup teams who take care of the festive periods within the country and also within the teams....if a particular team member is on holiday to celebrate own religious festival...the task is then allocated to other team member. This happens quite often within our team....and if there is general festive holiday for the team...then the whole responsibility is given to either onsite team or teams from other states....[Kiran]

One of the interviewees has explained how backup team support works during festive times in India. For any large projects, teams and team members are located at multiple sites within various states in India or at client sites in different countries. For example, if the teams based in one city and state are enjoying regional festive holidays then other teams based in different cities and states takeover the responsibility to provide 24/7 support for the project. The development teams within other states in turn then reciprocate this during their festive times. Within a team, when individual team members celebrate their own religious festivals, other team members from that local team take responsibility to provide the required support. One of the interviewees mentioned that

We have never felt that cultural background of any team member is an issue for team management....infact we have certain advantages when the team members are from various religious background..... they work on each other’s festive holidays.....the strength is that team members work in an multicultural environment....they learn various aspects of different religions and culture....[Satyajeet].

During national holidays in India such as Republic Day and Independence Day or nationwide festive holidays like Diwali and Holi, the project team located in different part of the world or at the client site are often given the responsibility to complete the task. Thus ‘backup teams’ help to provide 24/7 support all round the year. They facilitate in accomplishing software development projects as per the required project plan. The interviewees were of the opinion that having culturally and religiously diverse members
in a team always helps them in planning their work schedule to provide 24/7 support.

Festive times have never been an issue for us....because we always have team members available to work during festive holiday...it happens only during Diwali and national holidays....where our work is completely close down. As we have multicultural and multi-religion members in the team.....we sort out amongst them during this period....the only thing is that we need to think and plan about this in advance....[Madhur]

They further added that project managers when setting up ‘backup teams’ must evaluate latent cultural difference that exist within various teams. It is necessary to consider linguistic, ethnic and religious background of the team members while forming ‘backup teams’. The interviewees also stated that it is important to maintain annual calendars of different events that happen throughout the year within various countries where teams are operating. Proper scheduling and information flow is necessary to ensure effective coordination and management of these activities related to cultural diversity. The interviewees in general stated that project managers in Indian software companies do not consider cultural diversity of team members as an issue. They believe that cultural diversity of team members has to be managed from the GSD perspective. They do not consider cultural diversity as a weakness but put forward that they have to take different innovative measures to manage cultural diversity.

Managing Gender Differences – During discussions one of the interviewees stated that female team members play an important role within GSD projects. The selection of team members to work on the GSD projects is based on merit, skills and work experience with no gender bias. Female team members are considered equally competent as their male counterparts. Male team members are preferred only if the task in particular requires team members to work as per the client time zone and female team members are mostly unwilling to work in various time zones. Moreover, female team members are reluctant to work and align with the various situations that transpire with flexible working hours on the GSD projects due to their personal obligations. Therefore, the project managers have to get proper balance between number of male and female team
members as both bring certain levels of advantages to the team performance.

I would give an extra 1% to female team members because they work very capably in the given stipulated time frame... they are very good in time management compared to their male counterparts.....but sometimes this goes as an disadvantage within the team...because when we are working within global environment we have to align and communicate with our client and customers...depending on the various parts and time of the world...female team members are reluctant to work or get align with such situation...they are not ready for extended or flexible working hours. But for sure...female team members are meticulous with their work...[Manish]

The interviewees when asked about the marital status of female team members stated that it is never taken into consideration while selecting team members. However, project managers did acknowledge that married female team members bring stability to the project as compared to unmarried female and male team members. There are fewer chances that married female team members will resign and relocate with family.

Having a married or unmarried team member is not an issue....however married female team members are stable as compared to unmarried team members....but then you have male team members who resign quite often...therefore having male or female....married or unmarried team members does not make any difference....what is important is the stability and commitment by the team member....[Shaunak]

During discussions the interviewees stated that any family or personal issues of married female team members do not affect their performance on the project. There is equal importance given to work and family by married female team members.

Female team members personal matters never affects her performance on the project.....see both male and female team members have their personal issues.... we have to deal with them efficiently......having female team members brings a good balance to the team....also there are very less ego clashes...[Manoj]

One of the interviewees stated that unmarried female team members may need to relocate to new place after marriage and there is a loss of good resource of the project. Therefore as per interviewees’ opinion, unmarried female team members are usually uncertain of long term commitment towards GSD projects. However, they do bring an advantage of availability to travel abroad or to relocate at client site. Hence, proper planning is
necessary when female team members are working on the GSD projects as there are merits and demerits of having female team members. The other fact stated by the interviewees is that young male team members resign very often in search of better opportunities. During the discussion, one of the interviewee stated that

The multiple case-study analysis has revealed that project managers consider it an advantage to have female team members working on the GSD projects. Female team members are considered to be very good at deliverables and time management. They are judged to be well organised and efficient in performance. They are skilled at managing work and home very effectively.

*Performance or insecurity especially with female team members is very subjective…what I have observed is that there is a big trust factor amongst female team members when it comes to deliverables…they are trustworthy, they are dedicated to their work and you can depend on them….and their performance is equal as to their male counterpart…*[Sameer].*

There are normally no major issues with female team members. Minor issues such as working hours, holidays are usually dealt with by the Team Leads for the project. Most of the female team members have well set family support systems and are careful about their personal matters. For instance, they make sure that child care or any other issues do not affect their performance while working on GSD projects. Female team members are given the option to work flexible hours. They are also ready to work a few extra hours whenever necessary in urgent situations. Though, in most circumstances male team members are flexible and willing to work extra hours. Project managers have to plan for female team members when they take long term leave, say maternity leave. In such situations, project managers look for a provisional replacement and work on the training of these new employees. The interviewees were of the opinion that both male and female team members have personal issues which need to be dealt with rationally. Hence, project managers have to plan and prepare for various situations in advance for all team members.
4.2.5.3 Managing Attrition

Attrition is intrinsic to any business or industry and it does have an influence on the GSD projects managed in India. Therefore, management of attrition levels has become imperative within Indian software companies. The interviewees stated that software companies have to take appropriate steps to cope with this issue as it creates a major impact on the coordination of tasks within the GSD projects. As per this study conducted in India, there are various reasons that trigger higher levels of attrition in Indian software companies which need to be understood.

The interviewees have mentioned that the team members aspire to progress in their profession and their aim is to gain good knowledge and work experience in their career. Team members may have different priorities in their life. They look for good and exciting work in the initial stage of their career. This work should be satisfying and helpful to career growth with better work opportunities in contrast to the salary package they may earn. In some cases team members have a preference to be closer to their home town. Therefore they look for opportunities that will bring them closer to their own place. In some other cases, team member understand less up-to-date knowledge related to their work from their current job profile with no scope for further development. Team members always want to explore new opportunities that are available in the industry therefore they look for new and more challenging jobs. Today there are such different opportunities available in the software industry throughout the globe. Therefore, software professionals are ready to move from one place to another as they are young, with less family responsibilities.

The interviewees also explained that there is a pattern of attrition where team members in software product lines find themselves established for a longer period as compared to developers. Developers quickly change their jobs because development projects are of shorter duration in comparison to the projects which include other software engineering aspects. Therefore software developers always feel insecure and prefer changing their jobs.
frequently. The other pattern that is observed is that all the entry level professionals or fresh entrants change their jobs quite often as they get better benefits with each change while this is not the case with settled or experienced team members. Project managers have to understand these facts to deal with the issue of attrition. One interviewee stated that it is likely that once the software industry gets established along with the software professionals, the level of attrition will gradually lower. The interviewee further stated that

*Level of attrition is going to be there as....there are various job opportunities available....because the industry is comparatively modern.....people are young with very less family responsibility ...therefore are ready to move from one place to another ....particularly male team members...once the industry will get matured....so will the team members...we may have the level of attrition gradually going low....*[Satyajeet].

**Measures to Manage Attrition Levels** – The interviewees explained how various measures are taken to overcome attrition levels in the software companies where this research study is conducted. The interviewees stated that, firstly, it is important to understand the expectations and interests of team members working on any project to avoid attrition. Project managers see that each team member is allocated tasks as per their choice and interest so that they achieve work satisfaction. Team members are allowed to work as per their convenient work hours. Project managers try to understand that team members are interested in gaining particular knowledge to enhance their skills while working on GSD projects. They are given an opportunity to learn and grow in their professional career so that they continue working on the given task. Project managers give team members stimulating tasks and go for the option of job rotation to develop their skills. Software companies try to build up in-house resources amongst the existing team members so that they can immediately take over new responsibilities from the team members who have left the project. Project managers try to develop multiple skill sets within their teams with the intention that team members can replace on any task.

*Basically we have understood the reason for attrition.....it is because people want to explore new opportunities that are available in the industry...so they look for new and challenging*
Project managers also try to bring team members close to their hometown by offering new job responsibilities so that they can be retained at new locations. Project managers try to understand the reason for which the member is resigning from the project. Team members are offered salary scales and given special perks as per the performance level and for working as per the client time zone. One of the interviewees mentioned an interesting fact that when female team members are relocating to a different place after marriage, their software company tries to retain these members at a new location. If the company has operations at the location where the female team members are moving then they are given an offer to work on the project from that location. In many situations a special job profile is created to retain good female team members at new locations.

When female team members are relocating to a place after marriage....then we try and engage the female team member there.....this happens most of the time....[Manish]

4.2.5.4 Festive Holidays

The interviewees stated that managing various festive holidays is not an issue for project managers in their software companies. However, they emphasized that a lot of pre-planning is required because they have to manage regional, national and international holidays to provide 24/7 support all year round with the help of team members that are from different cultural background.

Furthermore, in addition they stated that to manage regional festivals within the country, project managers take into consideration each state’s festive calendar and the religious and cultural background of individual team members. During national festive holidays within India, teams based at international level or at client site are given the responsibility to provide 24/7 cover for that period. They follow the same arrangement to manage
international holidays from various countries. During Christmas, when the team members at the client site are enjoying long holidays, the team members based in India provide maximum support. This is same for Asian, Pacific or Middle Eastern countries during their festive time or during other festive times.

Festive times have never been an issue for us....because we always have team members available to work during festive holiday...it happens only during Diwali and national holidays....where our work is completely close down...but since we have multicultural and multi-religion members in the team....we sort out amongst them during this period....the only thing is that we need to think and plan about this in advance....[Kiran].

4.2.6 Temporal Difference

4.2.6.1 Time Zone differences

As per the interviewees, their software companies have taken explicit measures to manage various time zones and temporal differences of clients who are based at different geographical locations. Project managers manage and coordinate various activities amongst the distributed teams and team members by taking into consideration various time zone differences especially for critical tasks which requires quick actions. They stated that their software companies have team members working in different work-shifts as per their clients schedule and time zone. There are mostly four shifts, each of 8 hours to manage various time zones throughout the world. The first 8 hour work-shift starts from 4 am to 12pm which covers time zones for Asia-pacific countries such as Australia, Japan, Malaysia, Thailand and South Korea. The next shift starts from 12pm to 8pm which covers time zones of Middle East and European countries. The third shift is from 8pm to the next morning, 4am, which covers most of the South and North American countries. This time zone particularly covers varying time on both east and west coast of the US. Apart from this, the companies have their standard working hours between 9am to 5pm to cover the overlapping time zones for different countries that
fit into these hours. This arrangement allows software companies to ‘follow the sun’ and provide 24/7 support all year round.

To deal with time zone differences...like other companies in India our team members work in different shifts which are adjusted to client/customers work hours....this in turn helps us to follow the sun....we also have few team members working from client site...they manage the work load whenever required...distance only impacts our work when we have extensive communication [Gurinder].

When clients are from near shore countries such as Singapore or Dubai, managing time zone difference is not a big issue as team members based in India get ample overlapping time for communication. For clients based in UK and Europe there is always a half day overlap in working hours with the team members who are working standard working hours. Most of the time the support available to manage time zone differences is essential for clients from US and India’s geographical location helps them to provide 24/7 support for live and real time projects which is otherwise impossible for many US based clients to achieve within the US. Team members working in various shifts make it possible to provide this support.

4.2.6.2 Follow the Sun – Hand-on and Shake-off Sessions

The interviewees stated that most of the major software companies in India have team members working at client sites. In particular, one of the interviewee explained that these team members manage time zone differences whenever necessary and take care of the ‘follow the sun’ concept. Team members from these software companies, where this study is conducted, mentioned that they have ‘hand-on and shake-off’ throughout the day between development teams spread all over the world. These sessions take place when distributed teams are about to finish their daily working hours. They are ready to ‘hand-on’ the work to the next team located in following time zone and ‘shake-off’ their hands for the day. Generally, care is taken that there is at least one overlapping hour between two teams to cover ‘hand-on’ and ‘shake-off’ sessions.

We do have this ‘follow the sun’ concept as our teams are based in various geographical locations throughout the globe....we have the ‘hand-on and shake-off’ sessions that take
This process is followed between other teams 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. Team members from both the teams have all the telephonic conversations during these hours which help them to address various issues. The team members are also welcomed to raise their concerns regarding GSD projects during these sessions instead of communicating them later which might create a delay in resolving them.

Our teams work on real-time project and to employ ‘follow-the-sun’ concept we have teams based in Tokyo, Singapore, India, Dubai, London, Houston and San Jose...now when the Tokyo team starts their work for next day, it is end of the previous day for teams based in San Jose. For the current project, our teams start work for the day from Tokyo...teams based in Tokyo and Singapore get first overlapping hours...later teams based in Singapore and Bangalore get next set of overlapping hours...similar overlapping hours exist between teams based in various locations where the ‘hand-on and shake-off’ activities are performed by team members...[Sameer]

The interviewees stated that many team members work from home at night and these are extra hours of work, other than their daily working hours in office. Team members are required to be available by telephone for discussion with clients whenever necessary. Team members based at client site take care of day to day requirements of the customer.

4.2.6.3 Managing Clients Work Week

As discussed with the interviewees, the previous sections illustrate how project managers manage festive, personal and national holidays for the teams working on GSD projects. In addition to this the interviewees also discussed how they have to manage coordination issues when their clients and teams are based in middle-east countries. This issue is not due to time zones but due to the weekly holidays. Most of the clients based in these countries have their weekly holiday on Thursday and Friday due to...
religious reasons and they work on Saturday and Sunday. It becomes
difficult for teams based either in India or in any other part of the world to
adjust as per their working days. Therefore, team members in their
company’s also need to work on Saturdays and Sundays and planning is
done accordingly by Indian project managers to coordinate and align with
the global working environment. In such cases team members have to be
motivated and are given special perks to work as per the client time zone.

The only problem we face is with the middle-east team…it’s not due to time zones…but due
to the weekly holiday…they have holidays either on Thursday or Friday…and are working
on Saturday and Sunday…hence it becomes difficult for our team here to get adjusted as per
their working days….so we have ask team members to come and work on Saturdays and
Sundays…. [Kiran].

4.2.7 Managing Client-Vendor Relationships

As stated by the interviewees, there are several key issues that the project
managers have to tackle while dealing with clients from various countries.
These issues are classified as technical and non-technical issues. The
technical issues are mainly due to differences in technology, variation in
development process, changes in requirement specification, and difference
in code verification. Non-technical issues are mainly associated with
communication, coordination and time zone management. The
interviewees discussed about both the issues and explained how they
impact coordination of tasks while managing the GSD projects.

4.2.7.1 Technical Issues

The interviewees stated that differences in use of technology and variations
in development processes at various geographical locations generate
complexity in coordination of tasks while managing the GSD projects. The
project managers have to deal with this issue and each time they have to
coordinate and align so as to setup their processes as per the process of
their client and other distributed teams. The issue about the method of
code verification at each geographical location was also raised. One of the
interviewee stated that different code verification methods create confusion
amongst distributed team members because there is no standard code
verification method implemented amongst the distributed sites between
client and vendor teams.

There are couple of key issues that PM’s have to manage while dealing with the
clients….there are technical issues…..differences in technology…..development process,
structural differences…..code verification…..now the other issues are related to
communication, …like constant communication, changes in requirements, coordination
issues…..coordination issues are like……work does not happen simultaneously at both the
ends as expected….there is an delay in handovers from one team to another…. [Shobha]

The interviewees mentioned a crucial issue related to requirement
specification and how project managers and team members in their
companies deal with it. Regarding this, all the interviewees have raised
major apprehension that requirements are never specified accurately.
There is always change in requirements which is never communicated
instantly to team members of vendor companies. The entire system
architecture has to be altered when requirements are not clear or if they
are changed very often and in turn many additional changes need to be
done within the project. The interviewees added that change in
requirements takes more effort than compared to new assignment or task
because team members have to start again from the original segment of
the project.

The other issue that was categorically raised by these interviewees is
about the change in team members from client side who give the
requirements. The person who specified the requirements previously may
not be the same next time and this generates inconsistency and variance in
requirements. The interviewees stated that team members from the vendor
side find it hard to deal with such situations.

We have to extract appropriate requirements from the clients…secondly we need to get them
confirmed or verified from them…and then proceed the work. After this, if the client or
customer changes them…then the cycle of verification has to be performed again. Another
issue that is involved in dealing with requirements is from the client side…people who are
Furthermore, unclear requirements affect and delay the ongoing work at the vendor side. The clients keep huge expectations from vendors even though there is no clarity in requirements. It becomes demanding for vendor side team members to carry out work with frequently changing requirement specifications. This brings instability within the project. Frequent changes in requirement specifications have the most effect on live and real-time projects. Simple changes suggested by clients affect the work at vendor side for the next 12 hours. Therefore, it becomes necessary to have experts who can manage these changes promptly on real-time projects.

Change in requirements takes more efforts than any other new assignment or task. The reason for this is that......we have to start from beginning.....we feel that we have completed our task.....and we look forward for the next task to get completed......but then when there is a need to redo the same task again its bit frustrating......as the team members have to change their frame of mind again...[Manoj].

The other technical issue mentioned by the interviewees is that there is always a lag in receiving clarification to queries raised regarding requirement specifications. Queries are mostly raised by vendor team members at the end of the day which is the beginning of clients working hours. If the clients are unable to resolve queries during their working hours then the team members in India who resume their work next day have to wait again for another 24 hours. This becomes the most crucial factor while dealing with clients and in turn delays the project schedule.

4.2.7.2 Non-Technical Issues

The non-technical coordination and communication issues are mainly concerned with time zone management. Project managers have to overcome these issues as they make major impact on technical issues that are related to GSD projects.
Specific Communication Issues – The interviewees stated that to achieve the GSD projects, there is always a need for constant communication between client and vendor team members. Communication channels need to be properly planned and established as per the client time zone in order to have effective communication with them. These channels need to be kept open 24/7 for constant communication and project managers have to monitor if team members are able to communicate productively and there is proper information exchange within the available time. They also have to ensure that all team members have continuous formal as well as informal communication with the client-side team members. When team members are collocated, various issues get resolved within a day but when they are apart it takes longer to resolve the same issues. Project managers have to assure that appropriate requirements are elicited during communication sessions because of the frequent changes in requirements specification. One of the interviewees argued that most of their time during communication is spent understanding requirements so as to carry out respective functions ahead.

The varying team structure and hierarchy at different locations builds misunderstanding in communication for team members at the vendor side. One of the interviewees stated that they have to constantly talk with their counterparts from the client side for proper coordination of tasks. If they overlook communication on a subject matter they have to wait until the next day to discuss it, because of this their work gets delayed.

Another major issue raised by interviewees was that when communication, for instance, about requirement specifications happens between client-vendor team members, the vendor side team members have to transcribe all the information and countercheck it. In this case, a 1-2 day delay occurs because the team members have to understand the all the requirements that are discussed and then put them in black and white so as to get them verified from the clients. This is called ‘turn around time’. The interviewee stated that this turn around takes major time and delays the project work.

Anything that needs to be communicated through telephone conversations becomes an issue... say for example if the requirements are communicated or discussed over
conversation with the client is not always fully understood by team members.....

so what we have to do is.... write down what has been discussed and understood...send this
back again to the client or customer...get it verified and then proceed the work...[Rakhi].

**Time Zone Differences** – The interviewees stated that while managing time zone differences, team members based in India have to work daily with the client side team members for at least 4-5 overlapping hours. These hours are sometimes additional to the regular working hours to provide 24/7 support which puts pressure on team members while working on GSD projects. One of the interviewee stated that team members have to work extra hours when there is substantial work load of deliverables and further added that

*We always have to work late hours from our office....especially during deliverables.....now
during such late hours our family life is always at stake.....though we have a family support
system......working late does affect our life style....*[Maharukh]*.

The important concern raised is that client team members tend to work in their own regulation of fixed standard working hours. They are not very keen to adjust their working hours. Therefore it is always the vendor team members who have to compromise and coordinate their activities as per the client teams.

**Specific Coordination Issues** – The interviewees stated that when the clients are spread all over the globe, it becomes essential to effectively coordinate and manage the time zone differences. There is always a need to provide the necessary support to all their client teams which are based in various countries. One of the interviewees stated that their team members have to get attuned each time as per the clients working hours.

*Every time we have to get attuned as per the client or customers working hours.... to adjust
their working hour....the unease  is that....the client or customers tend to work in their own
fixed hours....not very keen to adjust their working hours....*[Satyajeet]*

In many cases the team members have to compromise their personal lives because they have to adjust their working hours quite often. The key problem is about having proper understanding of project objectives, requirements, design and other technical issues. All these issues need to
be understood and coordinated effectively to achieve the goals for GSD projects. Once they are established and resolved, the communication and time zone issues get sorted out.

4.2.7.3 Cross Cultural Issues

As per the discussion with the interviewees the cross-cultural issues are analysed in two different ways - work culture and personal culture issues.

**Work Culture Issue** – The interviewees stated that professionally there is no apparent cultural difference between international client team members and the team members working in their software company since most of the work culture in Indian software industry corresponds to the international standards. These software companies have maintained various processes and quality levels as per the international standards. Issues related to technology are taken care of while setting up collaboration and coordination between teams. Therefore, software professionals do not experience these issues however there are differences in approach of doing specific activities. Indian team members prefer to take a holistic approach while performing any task and are accustomed to working at international levels. Therefore, they can easily accommodate and conform to the diverse professional or cultural environment while dealing with clients without many cross-cultural issues. One of the interviewee stated that

*There is a difference in doing things…our approach is very different as compared to their approach….they are very straight forward in saying or doing certain things……and we Indians are not….we mostly take a holistic approach in each and every thing…*[Yogesh]*.*

**Ethnic Culture Issue**- The interviewees stated that as the client team members are mostly from developed countries there are few apparent differences in case of personal or individual work culture that gets exposed while dealing with clients. Team members from the client side are direct in conveying both positive and negative aspects about the project while this is not the case with team members from their companies. Their team
members hesitate while communicating the negative aspects of project and are reluctant to say ‘NO’ to their clients. They easily agree to take on an extra burden of work related to projects from client team members and it is here that the project managers have to make an effort to clarify this to their team members as this increases their workload and overrides the project duration. One of the interviewees stated that

Yes there are cross cultural issues….if we look every group of people or nation have their own culture….if we talk about culture…..every family or city or area has its own culture….there is also an organisation culture…..so for we as Indian…cross cultural issues do not matter much….we are quite accommodating and adjusting people as there is so much cross culture in India itself….\[Shaunak\]

The interviewees pointed out that there is a social cultural difference between Indian and western team members. Team members based at client site who are referred as ‘onsite-coordinators’ try to merge into client and vendor culture. They are the cultural liaisons who take care of the cultural differences that exist at different client locations. Indians are cross culturally sensitive. They display the same sensitivity when dealing with clients as most of their team members are made aware of the client’s socio-culture aspects. The interviewees stated that today even the client side team members are aware of the Indian culture and diversity. Therefore, there is less likelihood of misunderstandings or behavioural issues when team members are working in cross cultural environments.

4.2.7.4 Cultural training

The interviewees stated that they provide various training to their team members to enhance their skills while working on GSD projects which include cultural training as well. This cultural training is on the culture and social values of the clients from every country with whom team members are dealing very often. If the team members are supposed to travel to client sites, they have to undertake these special training sessions which include a brief introduction to the client’s native language, traditions, culture and behavioural pattern along with many other aspects related to culture and
social values. These training sessions help team members to deal with clients from various cultures to overcome cultural issues.

Most of the software companies included in this study have their own training department or often hire qualified experts from the industry to train team members on various aspects. One of the interviewees stated that if the teams are small at any distributed sites then their training executives often travel between various geographical locations to train team members or these team members are brought together at a particular location and given training. Furthermore, another interviewee mentioned that it has been useful to establish a university especially to train their employees. One of the interviewees stated that

Similar to other software companies in India,... we have cross-cultural training and integration program in our company,... these programs are considered while building a team and dealing with western counter parts,...also we have tailor-made socio-cultural training programs for team members depending on the customers,...which country they belong to....[Shobha].

4.2.7.5 Customer Feedback and Opinion

During discussion the interviewees stated that it is essential for team members from the vendor side to have appropriate feedback from the clients about their work. Team members from the vendor side do receive adequate and fitting feedback from their clients which is either positive or negative. If there are any issues about deliverables, they discuss it with the team members from the vendor side and convey the solutions. One of the interviewees stated that from the point of view of the vendor side team members it is expected to receive continuous feedback. Also there should be a mention about the main areas that the vendor teams need to develop or take care of in order to improve the operations and deliverables.

We expect continuous feedback ....such as...which are the main areas that we as vendor need to develop or take care of..... so that the operations and deliverables can be improved....we expect feedback on regular and cyclic basis....with respect to the quality of
The deliverables.....they should share with us what their expectation standards are...[Manish]

The interviewees mentioned that team members from the vendor side have various opinions about client-side team members. They believe that working with client-side team members facilitates them to gain new knowledge related to advancement in technology, working style and approach towards work. They also learn to work in defined structures and guidelines with time management. Most team members believe that they have understood how to enjoy work and balance personal life. Team members acquire huge communication skills while dealing with clients and project managers gain skilfulness of resource planning.

We gain huge technical competence.....also we can claim that we have the capability to provide 24/7 support.....we have also learned to get quickly adapted to the changing situations.....fine communication skills...and also a higher intellect level. We also get to know about various national cultures and work cultures.....[Sampada]

However, the interviewees also stated that sometimes they have a feeling that a few client-side team members carry a fear of job security and do not reveal appropriate information. Team members also get a feeling that their skills and experience are undervalued and they do not get their due respect.

Most of the time the team members get the feeling that.... they do not get the due respect for their skills and experience.....I would rather say it's a syndrome with the clients or customer from developed countries....[Manohar]

4.3 The Evolution of the GSD Coordination Model

The analysis of the empirical data drawn from the case studies conducted in vendor software companies has revealed various innovative and functional coordination practices. Accordingly, valid inferences were drawn from the data in the form of processes and strategies. At this point in the research, findings from the literature review and data analysis were combined to create coherent themes of coordination strategies. These
interrelated themes were organised in a logical form to represent specific process and corresponding strategies to make sense of it. Figure 6 demonstrate how these main process and strategies are structured in the form of GSD-COORD Model [Version 1].

The Level 1 in Figure 6 represents the main processes of the GSD-COORD Model. These processes are displayed in two different colours - blue and red. The processes shown in blue colour such as Teams, Task Allocation, Bridging, Onsite Visits and Communication for Coordination are revealed from literature and further include defined set of strategies (Level 2) presented in lime colour. On the other hand the processes shown in red colour such as Culture, Temporal Differences and Managing Client-Vendor Relationships are drawn from the case studies conducted in vendor software companies based in India and include strategies (Level 2) presented in aqua colour. In the later stage of this research study, each strategy will presented with its significance and the coordination practices that can be followed to manage the GSD projects.

4.4 Summary

In this chapter, the data from empirical research conducted in India has been analysed. The data analysis has made possible to identify the various issues the vendor companies have to deal with while managing the outsourced software development projects. It has also helped to understand the important role performed by the vendor-side project managers and senior executives to manage GSD projects.

There are various innovative strategies implemented by vendor companies that have helped them to successfully coordinate and manage GSD projects. In particular, some of the strategies revealed from this empirical data are exceptional and never highlighted in GSD literature. For instance, the practices followed during the hand-on and shake-off sessions are never
made known in GSD literature. Some other important practices are also revealed from these case-study analyses that are followed by the vendor teams to manage GSD projects, for instance, providing cultural training to team members and having the vision statement to manage GSD projects.

The GSD literature predominantly highlights the impact of cultural diversity on the management of GSD projects and cultural diversity is considered as a major issue that has direct influence on the coordination of the task while managing GSD projects. This empirical study has highlighted specific practices followed in these software companies to manage cultural diversity of teams and team members working on GSD projects. If studied properly, these practices can also be followed at other distributed locations to overcome the cultural differences while managing GSD projects.

In the next stage of the research study, in order to make the GSD-COORD Model more precise and appropriate to the GSD environment it was essential that all the documented strategies and its practices in the model are compared with recognised software development processes and project management standards that are applicable to the software industry. The following Chapter 5 explains the steps taken to evaluate these definite strategies to standard processes and models applicable to the software engineering environment.
Figure 6: GSD-COORD Model [Version 1]
Overview

In the course of this research study, various coordination practices have emerged from the GSD literature and the empirical research conducted in the vendor software companies operating in the GSD environment. On the basis of these functional coordination practices a model is developed which is a compilation (anthology) of various processes and strategies that are helpful for managing the GSD projects. In order to make this model more precise and pertinent to the GSD environment it is imperative that all the documented activities are compared with recognised standard documents and capability maturity models (SD/CMM) that are appropriate to the software industry. In line with this, this chapter presents the comparative analysis of the interim GSD Coordination Model with the applicable standard documents and capability maturity models.

5.1 Software Development Standards and GSD

Various standards and a multitude of software process capability maturity models have evolved in the last two decades that has helped to put together vast bodies of knowledge about good software practices into a form that is easy to work with (Wangenheim et al. 2010). Additionally, many domain specific models have emerged recently which are tailored and applicable to specific domain and industries.
5.1.1 Focus Group – Analysis of Standard Documents and Capability Maturity Models

As discussed in the Section 3.3.3.1 of the research methodology chapter, a focus group was held with a panel of five expert practitioners who have substantial knowledge about software project management standards. These expert participants hold essential background and working experience of functioning within the standards for software project management. The aim of this meeting was to discuss various standard documents and capability/maturity models that are followed in the software industry and are relevant to the research activity that is carried out in this thesis. Through the discussion with the focus group members, I was interested in identifying the precise standard documents and capability maturity models that are applicable for GSD and which can help to map the various activities within the interim GSD Coordination Model.

The standard documents and software process models that were overviewed before the focus group discussion are Capability Maturity Model Integrated (CMMI), ISO and the Project Management Body of Knowledge (PMBOK® Guide, 2008).

**CMMI - Capability Maturity Model Integration** – CMMI models offer solutions to improve an organisation’s performance and ability to meet its business objectives. These models are collections of best practices and process improvement goals that organizations use to evaluate and improve their processes. The various CMMI models are CMMI for Acquisition (CMMI-ACQ), CMMI for Development (CMMI-DEV), CMMI for Services (CMMI-SVC) and People CMM.

- The CMMI for Acquisition (CMMI-ACQ) model provides guidance to organizations to manage the supply chain to acquire and integrate products and services to meet the needs of the customer (SEI, 2008).
• The CMMI for Development (CMMI-DEV) model is helpful for process improvement in organizations that develop products and services. It also provides guidance to improve the effectiveness, efficiency, and quality of the product and service development work (SEI, 2008).

• The CMMI for Services (CMMI-SVC) model provides guidance to organizations that establish, manage, and deliver services to meet business goals. Best practices in the CMMI-SVC model focus on activities for providing quality services to customers and end users (SEI, 2008).

• The People Capability Maturity Model (People CMM®) is helpful for developing and implementing human capital strategies and plans in the organizations, managing or developing the workforce, implementing advanced workforce practices, nurturing teams, and transforming organizational culture. It is especially useful for implementing workforce practices with primary objective to continuously improve the capability of an organization’s workforce (SEI, 2008).

**ISO Standards** – The ISO Catalogue includes more than 19000 published International Standards which are classified according to the International Classification for Standards (ICS) and by the Technical Committee (TC). Most ISO standards are highly domain and industry specific.

- From the ISO Standards by ICS, an overview of specific standards was taken. Following are the standards that were discussed with reference to the research work in the focus group meeting.

  • **35: Information technology-Office Machines** which further include
- **35.240: Applications of Information Technology** – includes ancillary series of standards on – Application of information technology in general (35.240.01), IT standards that are domain specific such as Banking (35.240.40), Transport and Trade (35.240.60) and many more.

The ISO standards from the TC series include standards that are domain specific. Amongst this series, JTC1 is on Information technology and includes ancillary standard – **JTC 1/SC7 on Software and Systems Engineering**. This series includes following additional Sub-Committee Standards. An overview of the following specific standards was taken and discussed with reference to the research work in the focus group meeting.

- **ISO/IEC 12207:2008 Systems and Software engineering -- Software life cycle processes**. This standard establishes a common framework for software life cycle processes, with well-defined terminology that can be referenced by the software industry. It contains processes, activities, and tasks that are to be applied during the acquisition of a software product or service and during the supply, development, operation, maintenance and disposal of software products. Software includes the software portion of firmware.

- **ISO/IEC TR 19759:2005(E) - Software Engineering -- Guide to the Software Engineering Body of Knowledge (SWEBOK)**. This standard includes knowledge areas related to Software requirements, Software design, Software construction, Software testing, Software maintenance, Software configuration management, Software engineering management, Software engineering process, Software engineering tools and methods and Software quality. It is identified that SWEBOK shares a common boundary with other disciplines such as Computer Engineering, Computer Science,

- **ISO/IEC/IEEE 16326:2009 Systems and software engineering -- Life cycle processes -- Project management.** This standard includes elements of the Project Management Plan (PMP). Clause 5 of the PMP refers to project planning which further includes; sub-clauses on –

  - **Staffing plan:** A sub-clause of the PMP, specifying the number of staff required by skill level, the project phases in which the numbers of personnel and types of skills are needed, and the duration of need.
  - **Resource acquisition plan:** A sub-clause, specifying plan for acquiring and releasing the various resources such as equipment, computer hardware and software and other facilities needed to successfully complete the project.
  - **Project staff training plan:** A sub-clause, specifying the training needed to ensure the necessary skill levels are available to successfully conduct the project.

- **ISO/IEC 16680:2012(E) Information technology -- The Open Group Service Integration Maturity Model (OSIMM) provides consultants and IT practitioners with a means to assess an organization’s Service Oriented Architecture (SOA) maturity level. It defines a process to create a roadmap for incremental adoption which maximizes business benefits at each stage along the way.**

**PMBOK Guide, 2008** – The Project Management Body of Knowledge, the PMBOK® Guide (2008), is the 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 recognised and applicable to projects and there is consensus about their value and usefulness (PMBOK® Guide, pg 4). There are three main sections in PMBOK Guide, 2008 – The Project Management Framework; The Standard for Project Management of a Project and The Project Management Knowledge Areas. Each section includes chapters that cover various topics.

5.1.2. Gap Analysis

Gap analysis was done to investigate and understand the existing body of knowledge for standard software processes, maturity and capability models that focus on the management of distributed software projects and in particular on Global Software Engineering (GSE). The Section 3.3.3.2 of Chapter 3 gives the details on the steps taken while performing the gap analysis in the stage 3 of the research study.

During the focus group, the areas and practices included in the selected standard documents were discussed in detail and their correlation with each other was mapped. This was subsequently compared with the strategies included in the interim GSD-COORD Model. The following facts emerged from the gap analysis –

- It was confirmed that while there are specific practices available for project management in software engineering (SE) in these standard documents, there is no particular focus on GSE. This argument is supported by the work carried out by Richardson et.al (2010, 2012) where they emphasize that the published software process models do not focus explicitly on GSE despite the recent growth in area of GSE internationally.
- Most of the standards listed in Section 5.2.1 share a common boundary with each other predominantly in the area of project management. In particular, ISO/IEC TR 19759:2005(E) - SWEBOK has identified various
Knowledge Areas-(KA) from the PMBOK Guide for project management and therefore shares a common knowledge on project management.

- It was analysed that the PMBOK® Guide, 2008 has more cognizance of coordination included as compared to the standards listed in Section 5.1.1 and were discussed in the focus group.

- It was also noted that the PMBOK® Guide, 2008 in comparison to other standards has more detailed account on the ‘good practices’ relevant to the strategies included in the GSD Coordination Model.

- In particular, the PMBOK® Guide, 2008 include the process that describes the plans, tools and techniques useful in the management of the human resource and communications required for the project which is not covered in any other standards.

While it is recognized that software engineering models have some cognizance of coordination included, following this focus group’s advice and taking into account the literature and existing practice, it was decided to choose the PMBOK® Guide as the basis to map the GSD coordination model that was under development in this research study. On the basis of this, this part of the research study resulted in the following sub-research question:

*What are the standard documents that support coordination GSD? Can the PMBOK® Guide, be used as the basis to support coordination strategies in GSD projects from the vendor perspective?*


The Project Management Body of Knowledge, the PMBOK® Guide (2008), is the 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 recognised and applicable to projects and there is consensus about their value and usefulness (PMBOK® Guide, pg 4). It is identified that the application of the PMBOK® Guide’s 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 management team to determine what is appropriate for any given project (PMBOK® Guide, pg 4).

There are three main sections – The Project Management Framework, The Standard for Project Management of a Project and The Project Management Knowledge Areas. Each section includes chapters that cover various topics.

A complete overview of the structure of the PMBOK® Guide was taken. From the GSD perspective, it was established that the two chapters of the PMBOK® Guide, 2008 namely the - Project Human Resource Management and Project Communications Management are important. The processes described in these chapters include the plans, tools and techniques that are useful in the management of the human resource and communications required for the project.

The sections such as project scope management, project cost management and project quality management are also of interest to me but do not answer my research question and are beyond the scope of this research study. As a researcher, it was necessary to focus on the primary topic under investigation within the limited timespan to carry out this research work.

**Project Human Resource Management** processes help organise, manage and lead the project teams that are collocated (PMBOK® Guide, 2008). The project team is comprised of the team members who are assigned specific roles and responsibilities for successfully accomplishing
the project. From GSD perspective this section of PMBOK® Guide is important because it includes plans, tools and techniques that are helpful to manage the human resources required for the project. Moreover the coordination activities in GSD happen between teams which comprise of team members who are either collocated or geographically distributed. This section will be referred to as S1 in the remainder of this chapter.

Project Communications Management processes ensure timely and appropriate generation, collection, distribution, storage, retrieval and disposition of project information (PMBOK® Guide, 2008). Effective communication is essential to create a bridge between diverse individuals who are involved in a project (PMBOK® Guide, 2008, pg243). Appropriate communication can help to plan and connect various levels of expertise, different cultural and organisational backgrounds and interests of team members that are necessary for the execution of the projects (PMBOK® Guide, 2008, pg243). In GSD, team members spend most of their time communicating with collocated and geographically distributed team members. Therefore, from the GSD perspective this section of PMBOK® Guide is significant because it helps to establish and classify key stakeholders for communication within the project while coordinating activities involved in the project. This section will be referred to as S2 in the remainder of this chapter.

I have carried out three different activities while mapping the interim GSD-COORD Model with the PMBOK® Guide. It was identified that –

- There are explicit activities mentioned in the PMBOK® Guide, 2008 that are practiced by the distributed software development teams in the GSD environment. These activities included additional practices in support of the functioning strategies within the GSD-COORD Model and were added to the existing list of practices which in turn has helped to enhance the GSD-COORD Model.
- There are certain activities mentioned in the PMBOK® Guide, 2008 but are not practised by the distributed software development teams in
order to coordinate tasks while functioning in the GSD environment. Such activities have become a further contribution in form of strategy to the ‘GSD-COORD Model’ to improve its acceptance in the GSD environment.

➢ There are certain activities that are not part of the PMBOK® Guide, 2008 but have emerged from the literature as well as case studies and are successful within different software companies to coordinate tasks between distributed software development teams while functioning in the GSD environment.

5.3 Mapping GSD-COORD Model and Human Resource Management

Human resource management is a fundamental aspect of any project. In the GSD projects teams and team members from both the client and vendor side are involved. The team members are geographically distributed and are assigned explicit roles and responsibilities for carrying out the project. Human resource management becomes significant in coordinating activities of the teams and team members that are involved in the GSD project. Therefore, it becomes necessary that a suitable plan is developed to manage human resources that are essential for the GSD projects. This plan helps to determine, identify and manage teams and team members with the necessary skills that are required for the GSD project.

Environmental and organisational factors influence project performance. Therefore these factors need to be taken into consideration while planning for team members especially during the initial phase of the project. As per the PMBOK® Guide, the following are the environmental and organisational factors that are imperative and influence human resource management from GSD perspective:

- Environmental factors for different geographical locations include -
- Organisational structure and culture
- Personnel administration policies
- Market conditions and process of hiring project team members.

- Organisational factors for different geographical locations include -
  - Organisational standard processes
  - Various organisational policies
  - Standardized role descriptions
  - Templates for organisational charts and position descriptions

The PMBOK® Guide illustrates a number of guidelines for human resource management which are of significance to the GSD projects. The PMBOK® Guide states that importance should be given to the following aspects when planning for the human resources required for the projects.

- Project teams and team member charts.
- Definition of roles and responsibilities of team members within various teams.
- Elaboration of competencies and skills essential for the project.
- Identification of various competencies and skill sets of the on-hand and available team members.
- Staffing management plans such as staff acquisition and timetable for release of teams and team members.
- Identification of training needs, team building strategies, motivation plans, recognition and rewards for team members.

The number and type of team members can change frequently as the project progresses. Therefore it is important that appropriate consideration is given to the availability of team members and proper staff acquisition planning is done in case of inadequate or limited human resources.

Different tools and techniques are also mentioned in the PMBOK® Guide that can be useful in managing human resource in the GSD environment. Also, the PMBOK® Guide proposes few other actions for successfully
managing projects which can be applied to the GSD projects. These actions can help to keep track of activities that are happening at various geographical locations in GSD projects.

<table>
<thead>
<tr>
<th>Process</th>
<th>Documented From</th>
<th>Significance in the GSD Projects</th>
</tr>
</thead>
<tbody>
<tr>
<td>S1.1: Organisational Charts</td>
<td>PMBOK® Guide</td>
<td>Can help project managers to track different activities of the geographically distributed teams and team members.</td>
</tr>
<tr>
<td>S1.2: Staff Acquisition &amp; Management Plan</td>
<td>PMBOK® Guide</td>
<td>Can be useful to have a clear plan of all the required team members both in collocated and geographically distributed teams.</td>
</tr>
<tr>
<td>S1.3: Resource Calendar</td>
<td>PMBOK® Guide</td>
<td>Can help to manage the available resources in GSD and overcome the issue of attrition.</td>
</tr>
<tr>
<td>S1.4: Roles and Responsibilities</td>
<td>PMBOK® Guide</td>
<td>Clear definition of roles and responsibilities can help planning and tracking of distributed project and team activities in GSD.</td>
</tr>
<tr>
<td>S1.5: Networking of team members</td>
<td>GSD Literature, Case Studies &amp; PMBOK® Guide</td>
<td>Helps to build relationship amongst various teams, provide a mechanism to create trust and transfer knowledge.</td>
</tr>
<tr>
<td>S1.6: Team Building activities</td>
<td>Case Studies &amp; PMBOK® Guide</td>
<td>Assist to build trust and establish good working relationships.</td>
</tr>
<tr>
<td>S1.7: Team Performance Assessments</td>
<td>Case Studies &amp; PMBOK® Guide</td>
<td>Helps to understand the need for specific training to develop essential team competencies, mentoring, assistance or changes required to improve team performance.</td>
</tr>
<tr>
<td>S1.8: Training</td>
<td>Case Studies &amp; PMBOK® Guide</td>
<td>Training programs help project managers to fulfil the inadequacy of skill set within the project and develop essential resources.</td>
</tr>
<tr>
<td>S1.9: Recognition and Rewards</td>
<td>Case Studies &amp; PMBOK® Guide</td>
<td>Teams and team members get motivated with appropriate recognition and rewards.</td>
</tr>
<tr>
<td>S1.10: Cultural Diversity</td>
<td>Case Studies &amp; PMBOK® Guide</td>
<td>Helps to manage cultural differences and focus on developing and sustaining the culturally diverse team throughout the project life cycle.</td>
</tr>
</tbody>
</table>

Table 13: Mapping GSD Coordination Model and Human Resource Management
Table 13 gives the summary of mapping the interim GSD-COORD Model and Human Resource Management from the PMBOK® Guide, 2008. It also illustrates the source from where the various strategies are documented.

### 5.3.1 Organisational Charts

Organisational charts can be used to document team member roles and responsibilities. They can also be used to explain the position of various teams and team members within the GSD project. Three types of organisational charts that are mostly followed in various organisations and are mentioned in the PMBOK® Guide are –

**Hierarchical-type Organisation Chart**

- To show positions and relationships in a graphic and top-down format.
- To show work breakdown structures.
- To show how project deliverables are broken down into work packages.
- To show high-level areas of responsibility.

The work breakdown of tasks and activities within the project can be arranged as per the organisational structure and must also include the resource (team) breakdown that can help tracking the available resources (team members) in order to align them as per the work breakdown (tasks and activities).

**Matrix-Based Responsibility Chart**

The Responsibility Assignment Matrix (RAM) (PMBOK® Guide, 2008) can be used to illustrate the connection between tasks or activities and project team members. In case of large projects RAMs need to be developed at various levels. At the higher level, each team’s responsibilities must be
specified while at the lower level within each team, the team members’ roles and responsibilities must be described. The matrix formats allow the exhibiting of all activities associated with each team member and all team members associated with one activity. The advantage of a matrix-based chart is that it ensures there is only one team member accountable for any one task to avoid confusion.

From GSD perspective matrix-based charts can be prepared across various distributed teams in order to keep track of activities performed in a distributed environment. Tracking of these activities can help project managers to monitor the progress of the project and take necessary steps in case of issues if they occur at various sites.

**Text Oriented Format**

Team member responsibilities that require detailed description can be specified in text-oriented outline form. The document must provide information such as responsibilities, authority, competencies and qualifications. These documents can also be used as templates for defining communication plans. They can also be helpful for future projects as the information can be updated by applying lessons learned throughout the current project.

The project charts must also include a graphic display of project team members and their reporting relationships. This can either be formal or informal, highly detailed or broadly framed based on the project needs. Mostly charts can be prepared for individual teams within the GSD project to facilitate detail information about the team members and their activities.

The technique of creating project charts is very rarely performed in GSD projects and was not seen in my case studies. In GSD, maintaining various projects charts can help project managers to track different activities while coordinating tasks of the geographically distributed teams and team members. These charts will also give an advantage to create an
appropriate project communication plan and track individual team members involved in the project. These charts can also help to keep a repository of available skills and competencies throughout the project duration which can be utilized effectively within the project.

5.3.2 **S1.2: Staff Acquisition and Management Plan**

The PMBOK® Guide asserts that the human resource plan must describe the requirements of human resource for the project. The plan must give proper details of—

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

From the GSD perspective these guidelines can be useful to have a clear plan of all the required team members both in collocated and geographically distributed teams.

5.3.3 **S1.3: Resource Calendar**

In relation to human resource 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 a description of all the team members involved in the project. The resource calendar can help to document the duration that each team member needs to work on the project. It can also help to identify proper times when team members can participate in team development activities. Further it can help to track every activity of the team members and the progress of the project. A resource calendar can help to understand each team member’s schedule, availability including personal holidays and requirements to work on other
projects. The resource calendar must be updated constantly during the project life cycle to guide the acquisition, release and development actions of team member.

Maintaining the resource calendar is not a regular activity that is documented in the GSD literature review and empirical research. A resource calendar can help to manage the available resources in GSD to overcome the issue of attrition. The project managers can track available resources within the project to build up in-house resources amongst the existing team members so that they can immediately take over new responsibilities from the team members who have left the project. A resource calendar can also assist the mobility of team members between various locations as per the project needs. A resource calendar can provide updated information on the available resources and help plan in advance for the mobility as well as acquisition and release of team members. It can be the basis for training and team building activities.

5.3.4 **S1.4: Roles & Responsibilities**

The human resource plan mentioned in PMBOK® Guide provides guidance on how project human resources should be staffed, managed and controlled. This plan in turn helps to define roles and responsibilities for every team member involved in the project and achieve project success. *Role* is the “label describing the portion of a project for which a team member is accountable” and each role must have clarity pertaining to “authority, responsibilities and boundaries” of each team member. 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 also be well informed about the acceptable quality standards and what responses they should make to project variances.
Responsibilities would mention the work that a team member is “expected to perform in order to complete the given 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, the performance of the project can be affected. When incompetence is identified, proactive approaches such as training, hiring new people, changes in schedule and scope 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 (e.g. 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.

My case study research has also shown that the software companies 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.
5.3.5 S1.5: Networking of Team Members

The PMBOK® Guide emphasizes the importance of networking between team members involved in a project. Formal or informal networking is a constructive way to understand various interpersonal factors that impact project performance (PMBOK® Guide, 2008, pg222). Networking between the team members is essential to manage and coordinate project activities resourcefully in collocated as well as distributed projects.

Networking has an influence on the effectiveness of projects (PMBOK® Guide, 2008, pg222). Networking can be a useful technique at the beginning of the project and also a helpful way to enhance project management activities as the project progresses. Various networking activities mentioned in the PMBOK guide include proactive correspondence, luncheon meetings, formal and informal conversations during meetings and events. Networking is also important in the GSD projects. The literature for GSD as well as the case studies that are analysed has revealed various strategies performed for collocated and distributed teams and team members involved in the GSD projects.

The activities that are helpful for collocated team members include team building exercises, team meetings and team motivation. Social activities and events such as occasional outings, celebrating birthdays and various religious festivals of team members, team luncheon and dinners together help develop interpersonal relations and exchange ideas for collocated team members.

Networking activities that are helpful for distributed teams and team members include onsite visits where team members from central site visit to any remote site and a member from any remote sites can go to central site or other remote sites for specific time period. This helps to build relationships amongst various teams, provide a mechanism to create trust and transfer knowledge and also communicate lessons learned as well as
set future direction for the project (Hogan, 2006). Social time spent together provides the visiting individuals with an opportunity to understand the other organization’s culture and also gives a coherent perspective of the goals, objectives and principles that guide actions and decisions in the organization (Bass et al. 2007; Krishnan & Ranganathan, 2009).

5.3.6 **S1.6: Team Building Activities**

The PMBOK Guide gives emphasis on team building activities. The team building activities are necessary to improve interpersonal relationships within the teams to help team members work together efficiently (PMBOK® Guide, 2008, pg232). Team building activities assist in building trust and establishing good working relationships. An appropriate agenda is key to facilitating effective team building efforts within teams. 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).

The PMBOK Guide states five stages of team activities which are as follows:

- **Forming** – The phase when the team members meet and learn about the project. The project manager also discusses what each team member’s formal roles and responsibilities are.
- **(Brain) Storming** – During this phase, the team members begin to address the project work, technical decisions, and the project management approach. The brain storming sessions are important because they help develop new project related ideas. If the team members are not collaborative and open to differing ideas and perspectives the team environment can become disparaging.
• Norming – In this phase, team members begin to work together and try to adjust work habits and behaviours that support the team activities. The team members begin to trust each other.

• Performing – Teams reaching this stage function as a well-organised unit. They are interdependent and work through issues smoothly and effectively.

• Adjourning - In this phase the team completes the project work and are ready to move on from the project. This phase is particularly applicable when team members are involved in the project for shorter durations.

The duration of a particular stage depends upon the team dynamics, team size and team leadership. Project managers should have a good understanding of team dynamics in order to move their team members through all stages in an effective manner.

As stated in the PMBOK® Guide, 2008 one of the most important outcomes of team building activities is that it helps in developing a team environment. This team environment comprises handling project team problems and discussing them as team issues and encouraging team members to work collaboratively to resolve any issues. In this research study I have succeeded in uncovering exactly the same strategy of team building that is carried out in most instances as part of the multiple case-studies when analysing the empirical data.

In the case-studies analysed, the software companies conduct regular team meetings to develop team dynamics. The agenda of such team meetings is to discuss various project related issues that team members have come across since the last meeting. Largely, the project issues are discussed in one of two ways, firstly if the problem is already resolved - then they discuss how it was resolved. Secondly, if the problem is not resolved then it is discussed in order to find if this problem has previously occurred and what is the key to resolve it. Once the project problem is successfully resolved, a full log of that problem is maintained for future
reference which also includes the time taken to resolve the issue. This strategy is discussed in more details under the identical heading in the data analysis chapter.

To build effective project teams, it is important that project managers have the top management support and also obtain the commitment of team members. Team building activities are specifically essential during the initial phase of a project. Also, team building is a never-ending process. Changes in the project environment are inevitable, and to manage them effectively, a continued or a renewed team-building effort should be applied. The project manager should regularly monitor team functioning and performance to determine if any actions are needed to prevent or correct various team problems.

5.3.7 S1.7: Team Performance Assessments

Team performance assessments are necessary to increase the probability of achieving project objectives in the desired timeframe (PMBOK® Guide, 2008, pg237). The performance assessment can be a formal or informal process. Conducting an evaluation of the team’s overall performance helps to gauge the existing competency within the team. It also helps to understand the need for specific training to develop essential team competencies, mentoring, assistance or changes required to improve team performance in order to achieve project success. Team performance assessment also helps to identify required resources and recommendations for team improvement (PMBOK® Guide, 2008, pg237).

The PMBOK Guide states that performance assessment must be carried out at the beginning and regularly during the project life cycle. Team performance assessment is also essential before and after conducting certain training programs as this helps to understand the effectiveness of the training. Having effective team development strategies and activities
can help to increase the team performance. The PMBOK Guide states that team performance assessment criteria must be determined in advance and may include indicators such as –

- Improvement in skills that allows individuals to perform assigned tasks more effectively.
- Improvement in competencies that help team members perform better as a team.
- Reduced staff turnover rate.
- Increased team cohesiveness where team members share information and experience openly and help each other to improve the overall project performance.

Team performance assessment strategy becomes particularly significant when teams and team members are distributed as in the case of GSD projects. Various team activities in GSD projects are inter-dependent. Therefore, it becomes essential that individual team performance is evaluated in order to take necessary steps to improve exact team performance. This in turn can help avoid consequences that may affect the overall project performance. This research has demonstrated that the vendor software companies conduct such performance assessments on a regular basis.

In the PMBOK® Guide this activity is mentioned for collocated team members. The analysis of multiple case-studies reveals that the software companies conduct similar performance assessment. Such assessments are conducted on a regular basis and on two levels. First, at the team level - for the entire team that is part of the GSD project and second on an individual level- for the team members who are part of such teams that operate in GSD environment.
5.3.8  **S1.8: Training**

Training as mentioned in the PMBOK® Guide, is important to improve team performance and consequently to achieve project success. Team performance assessment helps to understand the need for specific training that is essential to develop team competencies. Training includes all activities designed to enhance the competencies of the project team members. Training can be formal or informal. It can be a classroom session conducted by various training experts or by senior team members to mentor junior team members. If team members lack skills that are necessary for the achievement of the project, such skills can be developed with the help of different training programs. The project managers must be able to formulate a proper plan for scheduling training programs for the team members.

In the GSD situation, training is an important activity performed in all the software companies. This is indicated in the multiple cases studied for this research work. The case-studies have revealed that regular training activities are carried out for the team members working on the GSD projects. Most of the companies maintain training calendars in which the project managers are informed in advance about the upcoming training programs within the company. Project managers then make a plan so as to relieve the team members to undertake the training programs. The training sessions in the software companies are conducted at various stages within the project. One of the stages for conducting training programs is when new team members join the project. This training is specifically conducted to brief new team members on the project details and their roles and responsibilities. Other training programs are conducted regularly for enhancement of technical skills and communication skills of the team members. The training programs help project managers to fulfil the inadequacy of skill set within the project and develop essential resources. Training also helps team members to get ready to work on a project that involves specific technology. A few software companies have also made
training mandatory for their team members. Each team member has to undertake specific hours of training every year which helps them to work successfully on the projects.

In software projects, when certain mismatches are identified such as available skills not matching the required technical skills then the best proactive response is to give training to the team members who are working on the project. It can also be a better solution over hiring, scheduling or changing scope within the project (PMBOK® Guide, 2008, pg232). Training programs can be helpful to overcome attrition that hugely affects GSD projects.

### 5.3.9 S1.9: Recognition and Rewards

The PMBOK® Guide states that team development process must involve recognizing and rewarding performance of teams and team members (PMBOK® Guide, 2008, pg234). The PMBOK® Guide insists that ‘cultural differences should be considered when determining recognition and rewards’. This suggests that the project managers must be able to develop appropriate team rewards taking into consideration various factors that may affect the cultural dimension of the team structure. The PMBOK® Guide states that people get motivated if they feel they are valued in the organization and this value is demonstrated by the rewards given to them. Tangible rewards such as prize money as well as intangible rewards like a certificate of achievement with public recognition for good performance can be effective to motivate team members. An opportunity to rise; chance to accomplish and apply professional skills to meet new challenges during the project life cycle can be among other strategies to motivate team members (PMBOK® Guide, 2008, pg234).

Teams and team members of the GSD projects get motivated with appropriate recognition and rewards. This strategy is functioning in the
software companies operating in the GSD environment. Various work related motivational schemes are followed in software companies studied for this research work. As per the case-studies, reward based schemes are followed to motivate teams and team members. In team motivational schemes, the whole team is rewarded. Such team rewards help to create rapport within teams which otherwise is impossible when working in a GSD environment (Hinds and McGrath, 2006; Bradner et al. 2005). Individual team members within the teams are rewarded based on their performance in the team. Rewards are usually for the performer of the month, best team player and few more of these types. There are also surprise ‘spot awards’ given at the desk of team members. If the project is large then within the project, best team and best project managers are awarded.

Team members are also rewarded for undertaking specific training. This becomes an encouragement for other team members and helps in resource development. Monetary incentives or prizes for good work are given to teams and team members. Team members are given special remuneration for working in various time zones. One important care that project managers need to take while implementing recognition and rewards strategy is that the cohesiveness of the teams is not disrupted.

**5.3.10  S1.10: Cultural Diversity**

The PMBOK® Guide acknowledges that project managers while operating in global environment and working on projects have to manage cultural differences (PMBOK® Guide, 2008, pg230). Team members come from various cultural backgrounds, speak multiple languages and possess different industry experience. They operate in the ‘team language’ (often English) that can be different to their native language. The PMBOK Guide very specifically emphasizes that project managers should ‘capitalise on cultural differences’. Project managers must be able to manage cultural differences and focus on developing and sustaining the culturally diverse
team throughout the project life cycle. Further, 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. Creating team dynamics and cohesive team culture is important to improve individual and team productivity while working on projects in global environment.

This research shows how cultural diversity is managed at the popular location for outsourcing and offshoring software development (Geer, 2006; Kearney, 2009; Gonzalez et al. 2006). The software companies that are operating in a global environment from where the case-studies are derived are set up in India, which happens to be the most culturally diverse nation (Library of Congress, 2004). There exists cultural diversity at various geographical locations within the country. There are special zones for software companies in various cities within India. Professionals from all over the country move to such cities for career enhancement. Project managers have to deal with these professionals as they come from various parts of the country and are culturally diverse. They have to select appropriate team members in order to manage them efficiently. For the project managers to successfully accomplish global software development projects it is essential to manage the diverse cultural and religious background of team members. Comprehensive knowledge of the prevailing cultural diversity within the teams is necessary. This helps project managers to assess and leverage existing cultural differences in order to provide 24/7 support all round the year. It also helps to overcome the potential loss of support and communication during festive and religious holidays.

Project Managers from the researched software companies in India have revealed how they have set up backup teams to leverage this cultural diversity. To overcome the potential loss of support and communication during festive and religious holidays, they set up backup teams. These backup teams are formed both at national and international level to ensure
that 24/7 support is provided all 365 days a year, thus transforming cultural differences into strengths.

5.4 Mapping GSD Coordination Model and Project Communication Management

Communication is a process by which information is exchanged amongst stakeholders through a common set of symbols, signs, behaviour or tools. Project communication management plan is the process which assures timely and appropriate generation, distribution, storage and retrieval of the project information (PMBOK® Guide, 2008, pg243). Project communication management plan is significant to coordinate activities of various team members involved in the project. The plan is also helpful to establish and classify key stakeholders for communication within the project.

In GSD projects, team members from the client and vendor side are geographically distributed and are assigned explicit roles and responsibilities. They are generally recognised by their job profile and roles in the project. This distinct working environment that exists between these distributed team members provides them with less opportunity for face to face communication. Formal and informal communication between collocated team members during meetings and breaks in the work premises gives an opportunity to discuss project details and exchange personal information to create mutual association (Begel et al. 2009).

Communication is the key to team-based success (Battin et.al 2001) in GSD and it can make or break a project. Lack of experience in working together as well as lack of face-to-face interactions can reduce trust between remote partners (Raylte et al. 2008; Pyysilinen, 2003) thus affecting coordination of activities. Communication is a mediating factor affecting both coordination and control (Carmel & Agarwal, 2001).
Geographical distribution of software development projects in itself challenges formal and informal communication across distances (Herbsleb & Grinter, 1999). Complete and clear information needs to be exchanged between the sender and the receiver within the distributed projects in order to create a common project understanding. Augmented use of complex communication tools can degrade team performance, especially when work involves definite outcomes (Tushman & Katz, 1980).

<table>
<thead>
<tr>
<th>Technique</th>
<th>Documented From</th>
<th>Significance in the GSD Projects</th>
</tr>
</thead>
<tbody>
<tr>
<td>S2.1: Identify Stakeholders</td>
<td>GSD Literature, Case Studies &amp; PMBOK® Guide</td>
<td>Helps to determine whose interests need to be taken into account while communicating within the project</td>
</tr>
<tr>
<td>S2.2: Plan Communications</td>
<td>GSD Literature, Case Studies &amp; PMBOK® Guide</td>
<td>Allows to document the approach to communicate efficiently with stakeholders</td>
</tr>
<tr>
<td>S2.3: Communication Models</td>
<td>Case Studies &amp; PMBOK® Guide</td>
<td>Necessary to demonstrate how information is sent and received between stakeholders.</td>
</tr>
<tr>
<td>S2.4: Communication Outputs</td>
<td>PMBOK® Guide</td>
<td>Well planned communication output scheme that gives details of how to keep a record of the communication output</td>
</tr>
<tr>
<td>S2.5: Information Distribution</td>
<td>PMBOK® Guide</td>
<td>The process of making relevant and planned information available to all the stakeholders within the project.</td>
</tr>
</tbody>
</table>

Table 14: Mapping GSD Coordination Model and Project Communication Management

In GSD, project managers spend the majority of their time in communicating with their own team members and other project managers involved in the project (PMBOK® Guide, 2008, pg243). Therefore, it is necessary that a suitable project communication plan is developed to support continuous information flow within the GSD projects. Project managers can achieve high team performance by using open and effective communication and developing trust among team members. An
appropriate communication plan can help in managing conflicts in a constructive manner and encouraging collaborative problem-solving and decision-making (PMBOK® Guide, 2008, pg243). It can also help improve feelings of trust and agreement among team members in order to raise morale, lower conflicts and increase team work.

The PMBOK® Guide states that communication has several potential dimensions such as internal v/s external, formal v/s informal, vertical and horizontal, synchronous and asynchronous, written and oral. The PMBOK® Guide recommends certain techniques to achieve continuous communication necessary within a project. These communication techniques can be easily applied to GSD projects to keep track of different activities that are happening at various geographical locations. The following are the techniques mentioned in the PMBOK® Guide that can be useful to GSD projects and as a researcher I have made an effort to –

• Compare the techniques mentioned in the PMBOK® Guide with the identified strategies that are used for communication while coordinating various tasks in the GSD projects.

• Give an account of certain recognised techniques mentioned in the PMBOK® Guide that can be implemented within the GSD projects.

Table 14 gives the summary of mapping interim GSD Coordination Model and Project Communication Management Chapter from the PMBOK® Guide, 2008. It also illustrates the source from which the various strategies are documented from.

5.4.1 S2.1: Identify Stakeholders

The PMBOK® Guide suggests that it is essential to identify all key stakeholders within the project who are primarily influenced by the communication. The key stakeholders are mostly the members in the project who have active involvement and whose role can impact on the
execution, deliverables or completion of the project. Early identification of all such stakeholders is critical as it helps to analyse their level of interest while communicating within the project and the influence on the project success (PMBOK® Guide, 2008, pg 246). It is necessary to document the relevant information vis-à-vis their communication requirements, contribution and impact on the project success. The PMBOK® Guide states that an appropriate plan must be developed to determine the level of stakeholders’ involvement to maximize positive influences and mitigate potential negative impacts on various communication channels within the project.

As per the PMBOK Guide it is also necessary to classify all the stakeholders according to their role, interest and involvement in the project. This enables the project managers to focus on the relationships necessary to ensure the success of the project. After classification, the stakeholders must be analysed systematically by gathering their quantitative and qualitative information. Here quantitative refers to the intensity and qualitative refers to the insight/penetration to the information. This helps to determine whose interests need to be taken into account while communicating within the project. This can further help to identify stakeholder relationships that can be leveraged to build coalitions and potential partnerships to enhance the chance of project success. It is essential to identify and classify the potential impact or support each stakeholder could generate within the project to define an appropriate communication strategy. As per the PMBOK® Guide, the communication plan must be periodically reviewed in order to adjust the potential changes.

In GSD projects, there is an eternal need for constant communication between client and vendor team members. This research study has identified comparable communication strategies in the literature for GSD and in the software companies that are researched within the course of this study. As per the GSD literature, the important stakeholders within the distributed projects are identified. Team members within various teams also called as ‘panel points’ (Begel & Nagappan, 2008) take the responsibility of
communicating project information with the stakeholders of the project. Their role is to identify the information needs of stakeholders and to connect various teams in order to ease coordination and to be the main communication conduit to the non-collocated teams (Begel & Nagappan, 2008).

The case studies also suggest that teams and team members from various sites are classified as per their definite communication need. The vendor site team members are then assigned explicit role of ‘communicator’ wherein their responsibility is to communicate the right information to the assigned stakeholder within the project and monitor information flow within various geographical locations.

5.4.2  S2.2: Plan Communications

The process of determining the project stakeholder information needs and defining a communication approach is a communication plan (PMBOK® Guide, 2008, pg253). The PMBOK® Guide states that it is essential to analyse communication requirements within the project in order to plan communication requirements of each stakeholder. The plan should be able to specify who needs what information, when they will need it, how it will be given to them and by whom. It is important to identify the information needs of the stakeholders and to determine a suitable plan to meet those needs for the project success (PMBOK® Guide, 2008, pg251).

An effective communication plan can allow the project managers to document the approach to communicate efficiently with stakeholders. Such a definite communication plan illustrates that the information that is needed is provided in the right format, at the right time and with the right impact.

The PMBOK® Guide states that the communication requirements analysis helps to determine the information needs of the project stakeholders. The
project manager must consider the number of potential communication channels or paths essential for the project communications. A key component of planning the project’s actual communications is to determine and limit who will communicate with whom and will receive what information. The PMBOK® Guide states that while doing this the project manager must consider organisation charts, role and responsibility and their relationships along with the internal and external communication plan (PMBOK® Guide, 2008, pg 253). The use of precise communication technology to transfer information among stakeholders is significant.

The PMBOK® Guide states that various factors must be taken into consideration while planning for the project communication such as – urgency of the need for information, availability of technology, experience and expertise of the stakeholders to use the technology and the need of training and learning by team members. Also while planning for communication the project managers must bear in mind the change in technology used and the project environment.

This technique of creating a communication plan can be very helpful from GSD project management perspective as this will facilitate smooth and effective information flow within the distributed software development projects. In the software companies that are studied for this research work, the project managers have stated that they craft a comprehensive communication plan for the entire project. The GSD literature also states that there are various tools and techniques that are used for effective communication between various team members who are geographically dispersed. The understanding is that this technique is not a regular strategy that is followed within all software companies. If this technique is regular and employed as a part of the project, it can help both the client and vendor teams communicate easily throughout the project life cycle.
A basic communication model is necessary to demonstrate how information is sent and received between stakeholders. Various components in the communication models such as sender, receiver, medium, noise (interferences), input and output need to be taken into account when planning project communication. As part of the communications process, the sender is responsible for making the information clear and complete so that the receiver can receive it correctly and for confirming that it is properly understood. The receiver is responsible for making sure that the information is received entirely, understood correctly and acknowledged. A failure in communication can negatively impact the project.

There are various challenges that need to be overcome to effectively communicate within software projects. In a distributed and multinational project, for a team member to successfully communicate a technical concept to another team member in a different country can involve encoding the message in the appropriate language, sending the message using a variety of technologies, and having the receiver decode the message and reply and provide feedback. Any interruption introduced along the way can compromise the original meaning of the message.

Interactive communication can be the most efficient way to ensure a common understanding by all participants on specified topics and includes meetings, phone calls, video conferencing, etc. The project managers have to decide based on communication requirements what, how and when communication methods are to be used in the project.

Within the case studies, the software companies have various communication models which are planned and established as per client time zone and are kept open 24/7 for constant and effective communication. Such communication models are called ‘communication protocol’ that are
followed by all distributed teams and team members within the project for simple, clear, appropriate, credible and non-overlapping communication. Project managers monitor if team members are able to communicate productively and that proper information is exchanged within the available time. They also ensure that all team members can have continuous formal as well as informal communication with the client-side team members. Language and accent issues in oral communication for geographically distributed team members who are stakeholders within the communication plan are taken care of by giving appropriate training to team members.

5.4.4  **S2.4: Communication Outputs**

The PMBOK® Guide states that the project communication management plan must comprise details of the communication production. The communication outputs details must provide information on –

- Stakeholder’s communication requirements
- Information that is communicated. (Language, format, content and level of details).
- Reason for the distribution of that information.
- Person responsible for communicating the information.
- Person responsible for authorizing release of confidential information.
- Person or groups who will receive the information.
- Tools or technologies used to convey the information.

Project managers within the software companies that are studied for this research work, have stated that in the communication protocol there is a well planned communication output scheme that gives details of how to keep a record of the communication output. This technique is followed at random and none of such practices are revealed from the literature for GSD. Hence this is one of the important techniques that can be followed by the software companies operating in the GSD environment.
5.4.5  **S2.5: Information Distribution**

The PMBOK® Guide states that information distribution is the process of making relevant and planned information available to all the stakeholders within the project. As per the PMBOK® Guide effective information distribution must include techniques such as–

♦ **Sender-Receiver Models** – An appropriate outline of the chain of all senders and receivers within the model must be maintained. The model must also keep a feedback loop to record the response received on the information that is distributed and to understand the barriers to communication. The model can also include details of whether the information is distributed to individuals or in group meetings, video and audio conference, chats or if any other communication method will be applied.

♦ **Choice of Media** – The PMBOK® Guide suggests that information senders must be given a choice to use the medium to communicate information based on specific situations. Various communication tools, for instance telephone calls, email, etc. can be used to distribute the information. Details about when to communicate in writing versus orally or when to write an informal memo versus a formal report and when to communicate F-2-F or by emails must be familiar to the senders. The PMBOK® Guide also states that certain writing styles for example use of active v/s passive voice, sentence structure and word choice can also be applied while distributing the information to the stakeholders within the project.

♦ **Information Distribution Policy** – The PMBOK® guide states that certain rules must be followed while distributing information amongst the stakeholders within the project. For e.g., project performance and status information must be made available prior to project meetings and should be as precise and current as possible. This helps to ease the
communication and create better understanding about the scheduled meeting and discussions.

This technique of systematically distributing information can be very helpful in GSD projects as most of the issues that occur in GSD projects are because of improper communication and lack of precise process. Various research studies have proposed communication patterns and models for distribution of information which can be applied to both distributed and collocated teams (Al-Ani and Keith, 2008; Cataldo and Herbsleb, 2008). This technique and these models can help to set a standard process of communication within distributed teams across various sites in GSD project.

5.5 Results of Mapping GSD-COORD Model with PMBOK® Guide, 2008

The coordination strategies from Version One of the GSD-COORD Model are mapped with Project Human Resource Management and Project Communications Management chapters of the PMBOK® Guide. The mapping of the GSD-COORD Model with the PMBOK® Guide has helped:

* To identify explicit activities mentioned in the PMBOK® Guide, 2008 that are practiced by the distributed software development teams in the GSD environment. These activities were in support of the functioning strategies that already existed in the Version One of the GSD-COORD Model. For instance Networking, Team Building Activities, Training, Managing Cultural Diversity, and Structured Communication were the strategies existing in the Version One of the GSD-COORD Model. For these strategies, additional practices were revealed through the mapping activity and were added to existing list of practices which in turn helped to enhance the GSD-COORD Model.
To identify certain activities mentioned in the PMBOK® Guide, 2008 but are not practiced by the distributed software development teams in order to coordinate tasks while functioning in the GSD environment. The activities such as Organisational charts, Staff Acquisition and Management Plan, Resource Calendar, Roles and Responsibilities, Communication Output and Information Distribution became a further contribution in form of practices and strategies to the ‘GSD-COORD Model’ to improve its acceptance in the GSD environment.

As a result of the mapping activity, new practices and strategies along with the additional practices that supported the existing strategies of the Version One are revealed from the PMBOK® Guide, 2008. Accordingly, with these additional practices and strategies changes were made in the Version One of the GSD-COORD Model that has helped to develop the next Version Two of the GSD-COORD Model. All such strategies are presented in yellow colour in the Figure 7.

5.6 Summary

During the course of this research work I have identified various coordination strategies or practices. These practices are derived from the GSD literature and the case studies which include the software companies that effectively manage the GSD projects. It is understood that there is a need for a structured set of standards which can focus specifically on Global Software Development (GSD).

In this comparative analysis it was confirmed that in the standard documents there are specific practices available for project management in software engineering (SE) but there is no particular focus on GSD. However, these standards share a common boundary with each other predominantly in the area of project management.
It was assessed that the PMBOK® Guide, 2008 has more cognizance of coordination included as compared to various other standards. Also, it gives a more detailed account on the ‘good practices’ that are relevant to the strategies included in the GSD-COORD model. Hence, it was decided to choose the PMBOK® Guide as the basis to map the interim GSD coordination model that was under development in this research study.

Though the PMBOK® Guide is the standard document for project management activities, it does not take all the challenges and issues of GSD into account. 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. Thus the comparative analysis presented in this chapter proved a useful way to identify activities that will support coordination between geographically distributed software development sites.
Figure 7: GSD-COORD Model [Version 2]
Chapter 6: GSD-COORD Model Validation

Overview

This chapter details how an expert panel approach is used to validate the GSD-COORD Model. Specific questions are asked to a group of GSD experts to uncover the usefulness and relevance of each strategy mentioned in the GSD-COORD Model. This discussion with the experts is then analysed to validate the practices included under each strategy within the GSD-COORD Model. The validation proved helpful in highlighting strengths and weaknesses in the GSD-COORD Model and providing further directions for improving the model.

6.1 The Validation Process

The Research Methodology Chapter presents the rationale for choosing the expert panel method as the research tool for the validation of the interim GSD Coordination Model. In this study the validation phase was kept interpretive in nature to expect expert opinion on the proposed strategies within each process. The main objective in conducting the validation process was to know if the particular strategy included in the GSD Coordination Model is applicable in a client-vendor relationship and how it was performed while managing the GSD projects. The interviewees were asked to provide evidence or reasons such as experience in practice to support the basis for a strategy and the practices that are mentioned in the GSD Coordination Model. The responses from the discussion are mapped with the practices mentioned under each strategy in the model.
Table 15 gives the information about the experts who were involved and interviewed to validate the model. The Version Two of the GSD-COORD Model consists of 10 processes and 54 strategies. Section 3.3.4 in the Research Methodology Chapter gives the details of the research methods applied to conduct the validation of the GSD-COORD Model. Two questions were written based on each strategy and the standard questionnaire included 108 questions. A total of 330 questions were discussed with the experts since few questions were raised with more than two experts. Appendix J gives the summary of the questions asked to the experts in the panel.
<table>
<thead>
<tr>
<th>Process</th>
<th>Strategy No</th>
<th>Strategy Title</th>
<th>Validated by No. of Experts</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>P1: TEAM SETUP</strong></td>
<td>SP: 1.2</td>
<td>Team Selection</td>
<td>2</td>
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<td></td>
<td>SP: 1.4</td>
<td>Team Formation</td>
<td>3</td>
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<td></td>
<td>SP: 1.5</td>
<td>Roles &amp; Responsibilities</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>SP: 1.6</td>
<td>Resource Calendar</td>
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<td></td>
<td>SP: 1.7</td>
<td>Organisational Charts</td>
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<td>Team Meetings</td>
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<td>Team Performance Assessment</td>
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<td>Networking</td>
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<td>SP: 2.7</td>
<td>Team Knowledge</td>
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<td><strong>P2: TEAM DEVELOPMENT</strong></td>
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<td>Recognition and Rewards</td>
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<td>Managing Uncooperative Actions</td>
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<td>Role of the Project Manager</td>
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<td>SP: 3.7</td>
<td>Team Operations</td>
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<td>Techniques of Task Allocation</td>
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<td>Integration of Tasks</td>
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<td><strong>P4: TASK ALLOCATION</strong></td>
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<td>Social Time</td>
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<td>SP: 9.1</td>
<td>Managing Technical Issues</td>
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<tr>
<td></td>
<td>SP: 9.2</td>
<td>Managing Non-Technical Issues</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>SP: 9.4</td>
<td>Feedback and Opinion</td>
<td>3</td>
</tr>
<tr>
<td><strong>P7: MANAGING CULTURAL DIVERSITY</strong></td>
<td>SP: 10.1</td>
<td>Continuous Communication</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>SP: 10.4</td>
<td>Structured Communication</td>
<td>4</td>
</tr>
<tr>
<td><strong>P8: TEMPORAL DIFFERENCES</strong></td>
<td>SP: 11.1</td>
<td>Managing Time Zone Differences</td>
<td>7</td>
</tr>
<tr>
<td><strong>P9: MANAGING CLIENT-VENDOR RELATIONSHIP</strong></td>
<td>SP: 12.1</td>
<td>Managing Time Zone Differences</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>SP: 12.2</td>
<td>Managing Non-Technical Issues</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>SP: 12.3</td>
<td>Feedback and Opinion</td>
<td>3</td>
</tr>
<tr>
<td><strong>P10: COMMUNICATION AND COORDINATION</strong></td>
<td>SP: 13.1</td>
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<td></td>
<td>SP: 13.2</td>
<td>Structured Communication</td>
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<td>Process</td>
<td>Strategy</td>
<td>Description</td>
<td>Validation</td>
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<tr>
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<td>------------</td>
</tr>
<tr>
<td>P1:</td>
<td>SP: 1.1</td>
<td>Staff Acquisition &amp; Mgmt Plan</td>
<td>2</td>
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<tr>
<td>TEAM SETUP</td>
<td>SP: 1.3</td>
<td>Team Structuring</td>
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<td>P2:</td>
<td>SP: 2.1</td>
<td>Team Building Exercise</td>
<td>3</td>
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<tr>
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<td>Bridge Location Selection</td>
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<td>SP: 5.3</td>
<td>Managerial Level Bridge Model</td>
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<td>BRIDGING</td>
<td>SP: 5.7</td>
<td>Bridge Integration</td>
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</tr>
<tr>
<td></td>
<td>SP: 5.8</td>
<td>Delegation across Bridges</td>
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</tr>
<tr>
<td>P7:</td>
<td>SP: 7.1</td>
<td>Cultural Diversity</td>
<td>4</td>
</tr>
<tr>
<td>MANAGING CULTURAL DIVERSITY</td>
<td>SP: 7.2</td>
<td>Cultural Training</td>
<td>3</td>
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<td></td>
<td>SP: 7.4</td>
<td>Attrition</td>
<td>2</td>
</tr>
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<td>P8:</td>
<td>SP: 8.2</td>
<td>Hand-on &amp; Shake-off Sessions</td>
<td>6</td>
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<tr>
<td>TEMPORAL DIFFERENCES</td>
<td>SP: 9.3</td>
<td>Managing Cross Cultural Issues</td>
<td>3</td>
</tr>
<tr>
<td>P9:</td>
<td>SP: 10.2</td>
<td>Unfiltered Communication</td>
<td>3</td>
</tr>
<tr>
<td>MANAGING CLIENT-VENDOR RELATIONSHIP</td>
<td>SP: 5.1</td>
<td>Techniques for Establishing Bridges</td>
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<td>P10:</td>
<td>SP: 10.3</td>
<td>Urgent Request</td>
<td>2</td>
</tr>
<tr>
<td>COMMUNICATION AND COORDINATION</td>
<td>SP: 10.5</td>
<td>Distributed Pair Programming</td>
<td>2</td>
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<td>SP: 10.5</td>
<td>Urgent Request</td>
<td>2</td>
</tr>
<tr>
<td>COMMUNICATION AND COORDINATION</td>
<td>SP: 10.5</td>
<td>Distributed Pair Programming</td>
<td>2</td>
</tr>
</tbody>
</table>

Table 16: Summary of the Validation Process for the GSD-COORD Model

6.2 Validation Results for the GSD-COORD Model

The GSD-COORD Model is made up of 10 processes and 54 strategies. As per the discussion with the experts, all these 54 strategies are analysed
and classified as VALID, PARTIALLY VALID, CONTEXT SPECIFIC or INCONCLUSIVE in the validation process. However, due to the limitations on the size and volume of PhD thesis, Section 6.3 will reveal an abridged analysis of the validation of the GSD-COORD Model. Table 16 summarises the validation results for the interim GSD-COORD Model.

6.3 Validation of the GSD-COORD Model

As per the validation and the inputs given by the experts, there are 38 Valid strategies, 13 Partially Valid strategies, 2 CONTEXT SPECIFIC strategies and 1 INCONCLUSIVE strategy in the interim GSD-COORD Model as listed in Table 16. This section will present analysis of only 11 strategies out of the 54 strategies from the interim GSD-COORD Model. Amongst the 11 strategies that will be presented here –

♦ 4 are VALID – where experts are in full agreement of the strategy.
♦ 4 are PARTIALLY VALID – where experts are either fully or partially in agreement of the strategy
♦ 2 are CONTEXT SPECIFIC - where these strategies are applicable in a particular context.
♦ 1 is INCONCLUSIVE – where the experts are in disagreement of the strategy.

Following the validation process and analysis of each strategy, there are amendments made in the GSD-COORD Model to make it more acceptable while managing the outsourced GSD projects. This includes some amendments to those strategies which are fully valid.
6.3.1 Valid Strategies

*Strategy SP2.4: Training Programs*

Team performance assessment facilitates to understand the specific training needs which are essential while working on the GSD projects. The aim of training programs must be to improve team performance and consequently achieve project success (PMBOK® Guide, 2008). Training can facilitate team members to get ready to work on the GSD project that involves specific technology. This strategy was discussed with two experts to understand how various TRAINING programs are conducted for distributed team members working on the GSD projects.

The following questions were discussed with the experts to know more about the various training programs conducted for distributed team members working on the GSD projects –

**Can you explain how various TRAINING programs are conducted for team members working on the GSD projects?**

The experts stated that different TRAINING programs are conducted for the team members working on the GSD projects. The training programs mainly focus on the technical aspects of the project to enhance skills of team members. However there is less attention given to provide training on soft factors that are essential to work on the GSD projects. The other point that the experts stated is that the training programs are very informal and there is no ‘organised training’ as per the requirements of the projects. One of the experts very clearly stated that there is little concentration on training for team members working on the GSD projects. In line with the discussion, one of the other experts stated that they have two levels of training programs - internal and external that are conducted for their team members. The internal training would focus on technical knowledge and is mostly conducted by internal experts while the external training focuses on
managing teams and projects and is carried out with the help of management professionals. Both the experts revealed that the team members working on the GSD projects have to take-up specific hours of training to work on the GSD projects.

There is very little concentration on...what I want to refer to as the soft factors...so understanding lets say cultural differences...very little organized training is around that...which is a weakness...language barrier can be an issue on phone calls...we did not have any specific program to hit these points of training...so that type of human interaction, understanding...not talking about any of those technical problems of the project but more on the team level or interpersonal level...(Oisin)

**Can you explain what advantage do you gain by conducting these TRAINING PROGRAMS to improve coordination between teams and team members working on the GSD projects?**

In response to this question one of the experts stated that even if training is not given to team members, the project is going to progress. The training programs help to improve various aspects related to the projects and add to the probability of the success of the GSD projects. The other expert stated that training programs help to bring cultural awareness between the team members. It also helps to develop trust between various stakeholders within the project.

Training programs helps to bring cultural awareness between the team members...its just talking about the cultural differences...it is about knowing that there are differences embarrassing them and just learning to work together with that understanding and the understanding has to come from both sides...(Aine).

On the basis of the inputs from the two experts, Table 17 gives the results about the TRAINING PROGRAMS strategy-

<table>
<thead>
<tr>
<th>Strategy Performed</th>
<th>Performance</th>
<th>Compliance to the Model</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>Expert 1</td>
<td>Yes</td>
<td>Formal</td>
<td>In full Agreement</td>
</tr>
<tr>
<td>Expert 2</td>
<td>Yes</td>
<td>Formal</td>
<td>In full Agreement</td>
</tr>
</tbody>
</table>

Table 17: Validation Results of Training Programs Strategy
Amendments to the Model:

The following two practices were added to the GSD Coordination Model as a result of the validation.

Practices
- Training programs must focus on giving training on soft skills that are essential to work on the GSD projects.
- Emphasis must be given to bring cultural awareness between the team members and develop trust between various stakeholders within the project.

On the basis of the inputs given by the experts it can be stated that training is a vital strategy that is essential for enhancing various skills of team members working on the GSD projects. This strategy can be performed to improve coordination between distributed teams working on the GSD projects. Training programs strategy can help to bring cultural awareness between the team members. It can also help to develop trust between various stakeholders within the GSD project.

Strategy SP3.2: Team Cognition

Team cognition is a mental process in which awareness is gained by perception, intuition and reasoning. It helps team members to work together to achieve common goals. Technologies designed to support coordination and communications in GSD have a significant influence on the ability to develop healthy team cognition (Keith et al. 2009). Team cognition provides knowledge and capabilities to team members to use communication technologies to coordinate actions across space and time (Fuller et al. 2006; Keith et al. 2009). Team cognition positively influences team performance for knowledge coordination and to achieve quality of projects (Keith et al. 2009). This strategy was discussed with two experts to understand how Team Cognition is useful in team management while
coordination of activities amongst distributed team members working on the GSD projects.

Based on this strategy the following two questions were discussed with the experts –

**How do team members while working on the GSD projects try to gain TEAM KNOWLEDGE about distributed teams and team members? What mechanism is put in place so that team members become aware of other teams and team members working on the GSD project?**

In response to this question the experts stated that the project managers while effectively managing the teams can bring awareness between the team members about all the activities performed at various distributed sites. It is necessary that the project managers disseminate the relevant information related to the GSD projects with their team members. There should be certain procedures in place for the project to mention about the activities happening at various distributed locations within the GSD projects. The experts also suggested that there should be regular team meetings, project updates and video conferencing to share information to team members at all location.

*First of all if you are properly managing your team then you are aware of what’s happening in all locations…you have constant updates…there should be team meetings, there should be project updates, there should be video conferencing if possible…and you should disseminate the relevant information to these people at all locations…*(Valentine)

**Can you explain how TEAM KNOWLEDGE about distributed teams and team members helps for better coordination between team members working on the GSD projects?**

The experts stated that with the help of Team Knowledge distributed team members get to know what other team members are working on. Also, team members with the help of various tools such as WIKI can share the information and knowledge about the GSD project. Team knowledge helps
team members to communicate in a much better way as they are aware of the right person to contact.

On the basis of the inputs from the two experts, Table 18 gives the results about the TEAM COGNITION strategy:

<table>
<thead>
<tr>
<th>Expert</th>
<th>Strategy Performed</th>
<th>Performance</th>
<th>Compliance to the Model</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Yes</td>
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<td>In full Agreement</td>
<td>VALID</td>
</tr>
<tr>
<td>2</td>
<td>Yes</td>
<td>Formal</td>
<td>In full Agreement</td>
<td>Strategy</td>
</tr>
</tbody>
</table>

Table 18: Validation Results of Team Cognition Strategy

**Amendment to the Model:**

The following five practices were added to the GSD Coordination Model as a result of the validation.

- Team members must be made aware of the activities performed at various distributed sites.
- It is necessary that the project managers disseminate the relevant information related to the GSD projects with their team members.
- There should be certain procedures in place for the project to mention about the things happening at various distributed locations within the GSD projects.
- It is suggested that there should be team meetings, regular project updates and video conferencing to share information to team members at all locations.
- This strategy can be followed for team members working on both large and small projects that are distributed amongst various geographical locations.

It can be stated that TEAM COGNITION strategy is important because it helps to bring awareness amongst team members working on the GSD projects. It improves coordination and communication amongst team members while
working on the GSD projects. This strategy can be followed for team members working on both large and small projects that are distributed amongst various geographical locations.

**Strategy SP4.2: Techniques of Task Allocation**

Various techniques such as vertical task allocation, mirroring and chunking can be followed to allocate and coordinate tasks between teams and team members working on the GSD projects. A vertical task allocation technique encourages communication and improved coordination and yields larger productivity (Hogan, 2006). Mirroring is an approach similar to Dyad model/buddy system/paired programming that is followed in GSD projects (Espinosa & Carmel, 2004). (Hogan, 2006), (Begel A, 2008). Chunking is another technique that gives an opportunity to assign tasks to distinct development sites to work independently with less need of maintaining tight coordination between the smallest tasks involved in the project (Mokus & Weiss, 2001). In chunking, the tasks can either be allocated as per functional area or by localization or as per development Stage or even as per the maintenance stages of the project. This strategy was discussed with five experts to understand how various Techniques of Task Allocation help in coordination of activities amongst team members working on the GSD projects.

In reference to this strategy the following two questions were discussed with the experts –

**Can you explain which different techniques are followed to allocate tasks to distributed teams and team members while working on the GSD project?**

In response to this question all the experts stated that tasks must be primarily allocated as per the skills, experience and domain knowledge of teams and team members. When a new distributed location gets involved
in the GSD project then during the initial period a few easier tasks must be allocated so as to understand the skills and expertise of the team members at that site. The other opinion was that tasks must be allocated so as to avoid too many dependencies which in turn will help reduce the coordination that is essential in the distributed project. In line with this, the other expert stated that while allocating tasks not only too many dependencies should be avoided but also teams and team members must be able to work independently in different situations irrespective of coordination and time zones. One of the experts stated that they preferred allocating tasks in modules in which a set of functionality is allocated to a distributed location and then the local team would re-allocate it to its team members. In his opinion this approach helps promote the ownership of a particular piece of functionality and have clear interfaces between the components or modules within the project which is as per Conway’s Law. Moreover, this technique helps in better team coordination in which all interfaces are clear and team members have better understanding of their tasks. This also helps in reducing temporal problems and time zone differences.

_We try not to have a reasonable size task in a particular area and that they don’t have too many dependencies on the other area so that they can work away for a certain amount of time with certain amount of coordination …so I suppose its kind of break-up those tasks so as to reduce the dependencies between the remote teams….obviously dependencies within the teams is lot easier to handle than the dependencies between various teams who are remote and working in different time zones…_(Robert)

How do these different TECHNIQUES OF TASK ALLOCATION help to improve coordination and communication between distributed teams and team members working on the GSD project?

The expert opinion was that depending on the techniques of the task allocation there arises less need of communication and coordination between the distributed teams and team members. Basically the task allocation strategy decides the terms of coordination between and within
the distributed teams. Task allocation helps to clearly define the interfaces between the modules or components of the entire project which facilitates the integration phase of the project. Appropriate task allocation techniques help to give awareness of various tasks performed by each distributed team and team member and offer full clarity within the GSD project. Appropriate task allocation also helps to make regular updates on the progress within the project which can be viewed by all distributed teams and team members.

Typically in terms of task allocation …the rest of the team is fully aware that….that person is doing that piece of work… the rest of the team knows that the engineer is taking care of that…so any question that comes in that area they will know exactly who to go to, to be able to answer that question…we make strong efforts to make regular team updates…twice a week or might be once a week…where the full team comes together and talks about the current issues and each of the leads will spend some time updating the team on progress at that stage…. (Bryan)

On the basis of the inputs from the experts, Table 19 gives the results about the TECHNIQUES OF TASK ALLOCATION strategy:

<table>
<thead>
<tr>
<th>Strategy Performed</th>
<th>Performance</th>
<th>Compliance to the Model</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
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<td>In full Agreement</td>
</tr>
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<td>Expert 2</td>
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<td>Formal</td>
<td>In full Agreement</td>
</tr>
<tr>
<td>Expert 3</td>
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</tr>
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<td>Expert 4</td>
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<tr>
<td>Expert 5</td>
<td>Yes</td>
<td>Formal</td>
<td>In full Agreement</td>
</tr>
</tbody>
</table>

Table 19: Validation Results of Techniques of Task Allocation Strategy

**Amendment to the Model:**
The following five practices were added to the GSD Coordination Model as a result of the validation.

Practices
Tasks must be primarily allocated as per the skills, experience and domain knowledge of teams and team members.

When a new distributed location gets involved in the GSD project then during the initial period a few easier tasks must be allocated so as to understand the skills and expertise of the team members from that site.

Tasks must be allocated in order to avoid too many dependencies which in turn will help reduce the coordination that is essential in the distributed project.

While allocating tasks too many dependencies must be avoided and also teams and team members must be able to work independently in different situations irrespective of coordination and time zones.

Tasks can be allocated in modules in which a set of functionality is allocated to a distributed location and then the local team would re-allocate it to its team members.

There are various techniques that can be followed while allocating tasks to all distributed teams and team members within the GSD projects. The most important aspect that needs to be taken into consideration while allocating task is the skills and experience of the distributed teams and team members.

Task allocation promotes the ownership of a particular piece of functionality and clear interfaces between the components or modules within the project. It helps to clearly define the interfaces between the modules or components of the entire project that facilitates better team coordination during the integration phase of the project. Depending on the techniques of the task allocation there arises less need of communication and coordination between the distributed teams and team members. Task allocation helps to decide the terms of coordination between and within the distributed teams. Appropriate task allocation techniques help to bring awareness of various task performed by each distributed team and team member and offer full clarity within the GSD project.
**Strategy SP6.4: Duration of the Onsite Visits**

The duration of the onsite visits to other team sites made by a cross-site delegate is considered as an important feature for the GSD projects. A regular visit made by different team members for duration not less than 4-6 weeks facilitates project coordination (Bass et al. 2007). This strategy was discussed with three experts so as to understand more about how the onsite visits are planned for team members working on the GSD project.

The following questions were discussed with the experts to know more about the duration of onsite visits.

**What is the duration of the onsite visits?**

In response to this question the experts mentioned that onsite visits should not be planned for a duration of less than 4 weeks. Further, one of the experts stated that during the initial phase of the project the client or vendor site team members should visit each others’ site for a period between 6 months to 1 year. This helps to bring clear understanding of the project between the client and vendor team members during the initial phase of the project. The other expert mentioned that usually the duration of onsite visit would also depend on the objective of the visit. If the purpose is to get engaged in some formal change control board then the visits should be planned and made by senior executives for only 1-2 days per quarter of the project. The experts mentioned that as the project progresses the duration of the onsite visits can be reduced but it is important to have regular visits later especially during the ending phase of the project.

_I think you need at least 4 weeks...they could be longer...I think it depends on everybody’s family situation and cost things like that...you need to get your team to know each other...and know what’s going on...if its too short...just get there...and I think people don’t settle and learn...its always that you are on a stressful state...you need to be there long enough to get rid of the stress and feel comfortable about talking with the people..._. (June)
Do you believe that “Longer time spent together helps creating a personal connection between remote team members working on the GSD project”?

In response to this question all the experts agreed that it’s important for the visiting team members to spend some longer time with the host team members because it takes time to settle and learn things that may exist differently at this new location. The longer time spent helps the visiting team member to get rid of the stress and to fell comfortable while talking with the host team members.

 absol...to me and I think to many people it is very difficult to raise a problem to someone whom you don’t know...that you have not met before...you have never communicated before...and its kind of...you are not satisfied...its very difficult to communicate that complaint to someone whom you don’t know...if you have some experience with that person...I feel it’s much easier to say... (Daniel)

On the basis of the inputs from the two experts, the results of the strategy **DURATION OF ONSITE VISITS** are given in the Table 20.

<table>
<thead>
<tr>
<th>Expert</th>
<th>Strategy Performed</th>
<th>Performance</th>
<th>Compliance to the Model</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>Expert 1</td>
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<td>In full Agreement</td>
<td>VALID Strategy</td>
</tr>
<tr>
<td>Expert 2</td>
<td>Yes</td>
<td>Formal</td>
<td>In full Agreement</td>
<td></td>
</tr>
<tr>
<td>Expert 3</td>
<td>Yes</td>
<td>Formal</td>
<td>In full Agreement</td>
<td></td>
</tr>
</tbody>
</table>

**Amendments to the Model:**
The following practices were added to the GSD Coordination Model as a result of the validation process.

- **Practices**
  - Onsite visits need be planned for a duration of more than 2-3 weeks.
  - It is important for the visiting team members to spend longer time with the host team members as it takes time to settle and learn things that may exist differently at this new location.
If possible during the initial phase of the project the client or vendor site team members could visit each others’ site for a period of between 6 months to 1 year.

Visits made during the initial phase of the project can help to bring clear understanding about the project between the client and vendor team members.

If the objective of the visit is to get engaged in some formal change control board then these visits can be planned and made by senior executives for only 1-2 days per quarter of the project.

As the project progresses the duration of the onsite visits can be reduced but it is important to have regular visits later during the ending phase of the project.

As per the inputs given by the experts, it can be stated that it is important to decide the duration of the onsite visits that each team member may make during the project life cycle. These visits should be made for at least 4 weeks as it takes time for the visiting team member to settle down and feel comfortable at the hosting site. The advantage of the longer duration visits is that it helps to create personal contacts with the host team member that in turn helps with better communication and coordination between distributed team members. The longer time spent at the host site helps the visiting team member to get rid of the stress and feel comfortable while talking with the host team members.

### 6.3.2 Partially Valid Strategies

**Strategy SP1.1: Staff Acquisition and Management Plan**

The **Staff Acquisition and Management Plan** is helpful to determine the actual number of team members and their skills needed to work on the GSD projects. It also helps to formulate a clear strategy for the required team members both in collocated and geographically distributed teams and
avoid any uncertain situation that may arise in the GSD projects. During the validation process this strategy was discussed with 2 experts to understand what practices are followed to decide the number of team members needed to work on the GSD projects.

The following two questions were discussed with the experts to know more about –

‘Where has STAFF ACQUISITION helped in better coordination between the team members working on the GSD project?’

There was a mixed response to this strategy where the first expert stated that they performed this strategy in a very informal way and did not have any written plan for recruiting people. In further discussion about this strategy this expert stated that their approach was to recruit team members based on their expertise. Their objective was not to cut the cost of the project but to make use of the talent that is available in different countries. The second expert stated that they have a proper staff acquisition plan in place for the entire project life cycle. They would always try and go as per this plan throughout the project life cycle to acquire and release team members working on the GSD project.

Yes we would have the (Staff Acquisition) plan for the full life cycle of the project...which we think about at the start of the project. Well I guess at the start of the project...the company I am working for.... they go through the plan based on the stages of the project...the life cycle of the project they are going to go through and also what suits the client....(Aine)

Can you explain how ‘STAFF ACQUISITION AND MANAGEMENT PLAN’ is useful for scheduling the requirements of team members for the GSD Projects?

In response to this question the experts stated that this plan helps them to understand the overall picture when they need to acquire and release people working on the GSD projects.
On the basis of the inputs from the two experts, the results about the Staff Acquisition and Management Plan strategy are given in the Table 21.

<table>
<thead>
<tr>
<th>Expert</th>
<th>Strategy Performed</th>
<th>Performance</th>
<th>Compliance to the Model</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
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<td>PARTIALLY VALID Strategy</td>
</tr>
<tr>
<td>Expert 2</td>
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<td>Formal</td>
<td>In full Agreement</td>
<td></td>
</tr>
</tbody>
</table>

Table 21: Validation Results of Staff Acquisition & Management Plan Strategy

Amendments to the Model:

The following practice was added to the GSD Coordination Model as a result of the validation process.

Practices

- It is important to understand what exact talent and skills are essential to work on the project and make a plan to train or acquire people with those skills at various stages of the project.

On the basis of the discussion with the experts it can be stated that this strategy is partially valid and can be followed to understand the need to acquire and release team members working on the GSD projects. The Staff Acquisition & Management Plan helps the project managers to understand the overall picture about when to acquire and release team members working on the GSD projects. This strategy can be followed for both collocated as well as distributed teams that are working on the GSD projects.

Strategy SP7.2: Cultural Training

Gaining knowledge about national culture and religious values of clients and geographically distributed team members who interact daily with each
other is vital for the success of the GSD projects. Cultural training helps team members to interpret and understand each other’s behaviour and develop respect for one another. Providing cultural training to distributed team members can help to transform cultural diversity from being a weakness into strength. Cultural training helps to reduce frustration, anxiety and concern between team members which is part of team or group behaviour particularly when operating in the GSD environment. This strategy was discussed with three experts in order to understand if any cultural training is given to team members to bring awareness of the cultural diversity that exists between distributed teams working on the GSD project.

The following questions were discussed with the experts about cultural training strategy –

Can you explain how CULTURAL TRAINING is given to team members working on the GSD project?

In response to this question all the three experts stated that there is no formal training given to team members to bring awareness about the cultural diversity that exists between the distributed teams working on the GSD project. However, all the three experts mentioned that there is a need to conduct proper cultural training programs as it can help to learn how to work with team members from different cultural backgrounds. The experts explained that the team members who might have visited other sites informally share their experience with their own team members. This helps to bring a certain level of awareness between team members who could make such visits to other sites in the near future. One of the experts stated that their company gives presentations about culture to team members. This helps to bring a certain level of understanding about the cultural norms, customs and work approach that are followed at a particular distributed location in the GSD project.
The fact is that many of these teams and many of the work places today have a very international character...and therefore you should have these (training programs) on a regular basis...I think we can make some major activities, competence development, training courses and many other things... so you have to plan for that...you could do it when you setup your teams...I mean the team formation strategy can include cultural training itself... (Helena)

Can you give an example how CULTURAL TRAINING has helped team members to interpret and understand each other's culture while working on the GSD projects?

The experts stated that even if cultural training is not formal, cultural awareness helps team members to understand things in a better way. The work culture may vary from one distributed location to another therefore cultural training can help team members to interpret and expect things in a better way from various distributed teams while working on the GSD projects. Cultural training creates confidence in team members for effective communication as they become aware of various aspects related to culture.

On the basis of the inputs from the two experts, the results about the CULTURAL TRAINING strategy are given in the Table 22.

<table>
<thead>
<tr>
<th>Strategy Performed</th>
<th>Performance</th>
<th>Compliance to the Model</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>Expert 1</td>
<td>Yes</td>
<td>Informal</td>
<td>In Partial Agreement</td>
</tr>
<tr>
<td>Expert 2</td>
<td>Yes</td>
<td>Informal</td>
<td>In Partial Agreement</td>
</tr>
<tr>
<td>Expert 3</td>
<td>Yes</td>
<td>Informal</td>
<td>In Partial Agreement</td>
</tr>
</tbody>
</table>

Amendments to the Model:

The following two practices were added to the GSD Coordination Model as a result of the validation process.
Practices

- There is a need to conduct proper cultural training programs as it will help learn how to work with team members from different cultural backgrounds.
- Team members who might have visited other sites must informally share their experience with their own team which can help to bring certain levels of awareness between team members who might visit other sites.

Cultural training helps team members to interpret things in a better way as they become aware of what feedback they can expect from various distributed teams while working on the GSD projects. Cultural training is essential because it helps to create confidence in distributed team members for effective communication. Cultural training helps to bring a certain level of understanding about the cultural norms, customs and work approaches that are followed at various distributed locations in the GSD project. The project managers are aware of the need for cultural training and its impact on the GSD projects. This strategy is performed informally and the experts are partially in agreement of it.

**Strategy SP8.2: Hand-on and Shake-off Sessions**

‘Hand-on and Shake-off’ sessions are important and must happen during the overlapping hours between two distributed teams that are working on the GSD project. These sessions allow team members to address various issues related to the GSD project during the overlapping hours. In these overlapping hours team members must be all set to ‘hand-on’ the work to the next team that is located in the subsequent time zone and ‘shake-off’ their hands for the day. The process of ‘hand-on and shake-off’ sessions must be followed in the 24 hours cycle throughout the day between all the succeeding teams. To understand how these ‘hand-on and shake-off’ sessions are significant to coordinate GSD projects, this strategy was discussed with six experts from different countries.
The following two questions were discussed with the experts to know more about the Hand-on and Shake-off Sessions –

**Can you explain how HANDS-ON AND SHAKE-OFF SESSIONS are performed by the team members working on the GSD projects?**

In response to this question, two experts very clearly stated that they do not have these ‘hand-on and shake-off sessions’. The other four experts on the basis of their experience stated that it is important to have at least 3-4 overlapping hours between two distributed sites that are coordinating while working on the GSD project. They stated that these overlapping hours are used mostly for communication and to check if the project activities are happening as per the schedule. At the initial stage of the project, during these overlapping sessions various video or teleconference meetings are organised to get requirement specification. The experts also mentioned that they prefer to modularise the project or split it into components so that local team members are empowered to carry on the work individually with clear interfaces. In such cases the distributed teams can use the overlapping hours for scheduled hands-on and shake-off sessions or communication. To support and allow the teams and team members to carry on work on their own, one of the experts mentioned that they have setup a scheme for the project. This scheme mentions the structure of the emails that are to be written while communicating with other teams and how they would hand-off the tasks to the next team at the end of the day.

*All of this leads into my view that you are better off modularizing the work and empowering people and locales and actually then having clear interfaces and not having this idea that you can do this 24/7 around the world and follow the sun stuff.* (Expert Michael)

**What activities are carried out during the HANDS-ON AND SHAKE-OFF SESSIONS (overlapping hours) to coordinate tasks when working on the GSD projects? Which communication tools are used by the team members during the HANDS-ON AND SHAKE-OFF SESSIONS?**
In response to this question the experts stated that usually the discussion is about the project progress. During these overlapping hours there is discussion about the issues that may have occurred at a particular site. Team members convey to each other what they have done on that day and what needs to be done by the next team. At the initial stage of the project, requirement specifications are articulated by the business analyst to the project managers and senior team members working on the GSD project. Usually tools such as telephone, video conference, SKYPE calls or emails are used to communicate during the hand-on and shake-off sessions.

As per the inputs given by all the experts, the results about the strategy **HANDS-ON AND SHAKE-OFF SESSIONS** are given in the Table 23.

<table>
<thead>
<tr>
<th>Expert</th>
<th>Strategy Performed</th>
<th>Performance</th>
<th>Compliance to the Model</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>Expert 1</td>
<td>Yes</td>
<td>Formal</td>
<td>In full Agreement</td>
<td>PARTIALLY VALID Strategy</td>
</tr>
<tr>
<td>Expert 2</td>
<td>Yes</td>
<td>Formal</td>
<td>In full Agreement</td>
<td></td>
</tr>
<tr>
<td>Expert 3</td>
<td>Yes</td>
<td>Informal</td>
<td>In Partial Agreement</td>
<td></td>
</tr>
<tr>
<td>Expert 4</td>
<td>Yes</td>
<td>Formal</td>
<td>In full Agreement</td>
<td></td>
</tr>
<tr>
<td>Expert 5</td>
<td>No</td>
<td>NA</td>
<td>Context Specific</td>
<td></td>
</tr>
<tr>
<td>Expert 6</td>
<td>No</td>
<td>NA</td>
<td>Context Specific</td>
<td></td>
</tr>
</tbody>
</table>

**Table 23: Validation Results of Hands-On and Shake-Off Strategy**

**Amendments to the Model:**

The following practices were added to the GSD Coordination Model as a result of the validation process:

- **Practices**
  - It is important to have at least 3-4 overlapping hours between two distributed sites for coordination while working on the GSD project.
  - These overlapping hours can be used for communication and to check if the project activities are happening at all distributed sites as per the schedule.
The initial stage of the project can be used by the business analyst to articulate requirement specifications to the project managers and senior team members working on the GSD project.

Preference can be given to modularise the project or split it into components with clear interfaces so that local team members are empowered to carry on the work individually.

Certain schemes can be setup for the project to support and allow the distributed teams and team members to carry on work on their own.

During the overlapping hours discussion must happen about the project progress and the issues that may have occurred at a particular site.

Team members must convey to each other what they have done on that day and what needs to be done by the next team.

Tools such as telephone, video conference, SKYPE calls or emails can be used to communicate during the hand-on and shake-off sessions.

With the inputs given by the experts it can be stated that this strategy is performed for larger projects that are spread over various distributed sites. This strategy may not be performed for small projects and also may not be applicable for projects that are well modularized with clear interfaces. To carry out this strategy in a better way, it is important to have at least 3-4 overlapping hours between two distributed sites that are coordinating while working on the GSD project. Various tools such as telephone, video conference, SKYPE calls or emails can be used to communicate during the hand-on and shake-off sessions. Hand-on and shake-off sessions provide an opportunity to team members to address various issues related to the GSD project during the overlapping hours.

**Strategy SP9.3: Managing Cross Cultural Issues**

Cross-cultural issues can influence project performance when team members operate on a global platform. The cross-cultural issues can be analyzed as organisational work culture issues and personal culture issues. Organisational work culture is the difference in approach towards work by a
group of people from various organisations. A difference in organisational work culture and personal work culture at various distributed team locations creates an impact on the coordination strategies in the GSD projects. In an attempt to understand how project managers manage the cross-cultural issues, this strategy was discussed with three experts from different countries.

The following questions were discussed with the experts to know more about how cross cultural issues impact the functioning of distributed teams while working on the GSD projects.

**Can you explain in brief how CROSS-CULTURAL ISSUES impact coordination and influence project performance while working on the GSD projects? Do you analyse them as organisational work culture issues and personal culture issues?**

In response to this question the experts mentioned that it is important to classify the issues as work culture and personal culture issues. To mention the work culture issues, the experts stated that there can be a different approach in management style and the hierarchy within the organisation which needs to be understood by the other distributed teams and team members while working on the GSD projects. In certain cultures work can be very process oriented while in other cultures it may not. Some cultures can be extremely disciplined in their reporting, producing designs and protocols while others may not be, yet other teams have to work with them. It is important to understand these differences and deal with them to coordinate tasks for the success of the GSD projects.

Even concealing the fact if things are not happening at a particular site or if team members do not have sufficient knowledge to work on a particular technology or domain can create work related issues while managing the GSD projects. Another work culture issue that was mentioned by the experts between distributed teams is the adherence towards time. In some cultures people might be more used to working in a set time hours with
defined lunch hours while in other cultures it might not be the same. Therefore project managers need to be aware of these differences.

One major cross-cultural issue will be employees view towards hierarchy and the formality of the management...so that’s a serious one in my opinion...whereas you may be told that somebody is doing something but when in a fact they are not doing it because they don’t know how to do it...but they are not willing to tell that to their manager from another country that they don’t know how to do it. They would rather tell their own manager and have their own manager contact that other manager rather than point out that they are confused….(Michael)

How do you overcome organisational work culture issues and personal culture issues (CROSS CULTURAL ISSUES) that impact coordination while working on the GSD projects?

The experts stated that it is important for the project managers and senior executives to understand the explicit reasons of cross-cultural issues. Training helps to bring awareness about such issues within the distributed team members. The experts mentioned that appropriate training is planned to bring understanding and reduce cross-cultural issues between the distributed team members. Visits to various distributed sites or having a cross-site delegate who can be a conduit between various sites helps to overcome cross-cultural issues. In larger organisations a cultural manager is appointed to take care of such issues.

On the basis of the inputs from the experts, the results about MANAGING CROSS CULTURAL ISSUES strategy are given in the Table 24.

<table>
<thead>
<tr>
<th>Expert</th>
<th>Performance</th>
<th>Compliance to the Model</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Yes</td>
<td>Informal</td>
<td>Partially Valid</td>
</tr>
<tr>
<td>2</td>
<td>Yes</td>
<td>Informal</td>
<td>Partially Valid</td>
</tr>
<tr>
<td>3</td>
<td>Yes</td>
<td>Informal</td>
<td>Partially Valid</td>
</tr>
</tbody>
</table>

Table 24: Validation Results of Managing Cross Cultural Issues Strategy
Amendments to the Model:

The following three practices were added to the GSD Coordination Model as a result of the validation.

Practices

- Different approach in management style and the hierarchy within the organisation needs to be understood by the other distributed teams and team members while working on the GSD projects.
- Project managers need to be aware that in some cultures people might be used to working in a set time hours with defined lunch hours while in other cultures it might not be the same.
- Proper approach is important to schedule regular cultural training programs to bring awareness and overcome the cross-cultural issues.

As per the discussion with the experts it can be stated that there is an understanding about cross-cultural issues at the senior management level which needs to be imparted at the lower hierarchy within the teams. As per the inputs given by the experts, it is important to manage cross-cultural issues to have effective coordination between distributed team members. It is important to classify the issues as work culture and personal culture issues. In certain cultures, work can be extremely disciplined and very process oriented while in other cultures it is not. Some cultures may have much discipline in their reporting, producing designs and protocols while others may not yet other teams have to work with them. Concealing the fact if things are not happening at a particular site or if team members do not have sufficient knowledge to work on a particular technology or domain can create work related issues while managing GSD projects.
6.3.3  **Context Specific Strategies**

**Strategy SP5.1: Techniques for Establishing Bridges**

Precise techniques must be followed while establishing bridges in the GSD projects. Particular strategies are suggested in the literature as well as by the experts that can be useful to implement bridges in GSD. Establishing bridges facilitates coordination and knowledge management in the GSD projects (Milewski et al. 2008). Bridges are helpful when there is a high need for real-time interaction (Milewski et al. 2008). This strategy was discussed with three experts to identify if they have established any such bridge locations while managing the GSD project.

To understand more about Techniques for Establishing Bridges strategy, the following two questions were discussed with the experts –

**Can you explain how your team location is a Bridge site? Why your team is made a Bridge Site?**

In response to this question, two experts each from South and North America clearly stated that their site is not a bridge site. However one of the experts stated that they have bridge managers instead of bridge sites for each location within the distributed project. A bridge manager is someone who has lived or has previous experience of working at that particular site and understands the cultures of two sites. The third expert who was from Ireland explained how their team acts as a bridge within the GSD project. The time zone difference of 12-14 hours between US and Asian sites do not permit any communication to happen and therefore teams in Ireland act as a communication bridge between these two continents.

*Purely because of the time zone difference between US and Asia it doesn’t allow much communication ... because it is roughly 12-13 hrs out of sync...so in that case we have allocated team in Cork as the bridge location so that the communication with States happens from here*
and then any communication that needs to go from Cork to Asia is done in that manner so that’s limiting the direct communication that happens between US and Asia…(Bryan)

If your team site location is a Bridge site, what Techniques were followed while establishing this Bridge site? How are interdependencies of each site managed while establishing Bridge SITES?

The expert from Ireland explained that it is important to have a senior team member who can act as a bridge manager. It is essential that this senior team member has a very deep understanding of the project and also has a team of members who have good experience in deploying such projects. There has to be appropriate communication channels established between all sites. In addition specific strategies must be followed so that certain aspects within the project are not assumed or overlooked.

what we have found is that if the team is not that experienced then things might get overlooked…and maybe people making an assumption that something has been communicated is Ok and here in fact it hasn’t so we tend to put very senior people as part of the bridge team…(Bryan)

With the inputs from all the experts, the results about the Techniques for Establishing Bridges strategy are given in the Table 25.

<table>
<thead>
<tr>
<th>Expert</th>
<th>Strategy Performed</th>
<th>Performance</th>
<th>Compliance to the Model</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>Expert 1</td>
<td>No</td>
<td>NA</td>
<td>In Partial Disagreement</td>
<td></td>
</tr>
<tr>
<td>Expert 2</td>
<td>No</td>
<td>NA</td>
<td>In Partial Disagreement</td>
<td></td>
</tr>
<tr>
<td>Expert 3</td>
<td>Yes</td>
<td>Formal</td>
<td>In Partial Agreement</td>
<td></td>
</tr>
</tbody>
</table>

Table 25: Validation Results of Techniques for Establishing Bridges Strategy

Amendments to the Model:

As the strategy is Context Specific, the following practices were added to the GSD-COORD Model.
Practices

- Having bridge managers can also be a better option instead of creating bridge locations within the GSD projects.
- It is important to have a senior team member who can act as a bridge manager.
- It is recommended that a bridge manager can be a person who has lived or has previous experience of working at that particular site and understands the cultures of the two sites.
- There have to be appropriate communication channels established between all sites.
- Specific strategies must be followed so that certain aspects within the project are not assumed or overlooked.

On the basis of the discussion with the experts it can be stated that this strategy is not applicable to all distributed locations involved in the GSD project. This strategy is applicable to large projects with multiple distributed locations spread over various continents. Also, it can be followed only by the sites that are geographically between two distributed sites and have at least 2-4 overlapping hours for communication with other sites which are on the either side of their location. As this strategy implicates certain limitations, it is considered context specific and not applicable to all the GSD projects. However, bridging can help in minimizing risk within the GSD projects.

**Strategy SP10.3: Urgent Request**

Urgent request is setting up a communication or broadcasting mechanism for requesting information from all distributed teams with precise knowledge about the GSD project (Bass et al. 2007). A network of highly motivated volunteers from various distributed sites who have a wide variety of technical knowledge must be formed to provide this vital support. Urgent request promotes unplanned communication in a situation when a team
member of a project has an urgent need for information related to the distributed project that would benefit from quick response (Bass et al. 2007). This strategy was discussed with two experts to understand how communication or broadcasting mechanism is setup for requesting urgent information from all distributed teams.

The following two questions were discussed with the experts to know more about this strategy –

**Can you explain how is URGENT REQUEST for information related to the distributed project from various distributed teams managed?**

In response to this question both the experts very clearly stated that there is no broadcasting mechanism setup for requesting urgent information from the distributed team members. The experts stated that depending on how important the information is emails or phone calls will be made to team members from the distributed sites to ask for the urgent information.

**Can you explain how important is it to setup URGENT REQUEST or broadcasting mechanism for all distributed teams in order to coordinate tasks while working on the GSD project?**

In response to this question, the experts mentioned that it will depend on the context in the project. If the project is large and real-time then you may essentially need to setup such mechanism in order to avoid any situation that can stall the functioning of the project. The advanced communication technology can be used to keep all the key people working on the GSD project in a loop so as to contact them immediately whenever necessary.

As per the inputs given by all the experts, the results of the Urgent Request strategy are given in the Table 26.
<table>
<thead>
<tr>
<th>Expert</th>
<th>Performance</th>
<th>Compliance to the Model</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>No</td>
<td>NA</td>
<td>In Partial Disagreement</td>
</tr>
<tr>
<td>2</td>
<td>No</td>
<td>NA</td>
<td>In Partial Disagreement</td>
</tr>
</tbody>
</table>

**Table 26: Validation Results of Urgent Request Strategy**

### Amendments to the Model:

This strategy is Context Specific and no suggestions were given by the experts. Hence, as a result of the validation process there were no additional practices added to this strategy in the GSD-COORD Model.

As per the inputs given by the experts it can be stated that this strategy needs further research. This strategy is context specific and is best applicable to large and real-time projects that are spread over various distributed sites. It may not be applicable to small projects as the need for information is much less and few people are involved in the project who can be contacted easily. But both the experts agreed that it is essential that such mechanism must be set up for large and real-time projects for better communication and coordination. The advanced communication technology can help to keep all the key people working on the GSD project in a loop so as to contact them immediately whenever necessary.

### 6.3.4 Inconclusive Strategies

**Strategy SP10.5: Distributed Pair Programming**

Distributed pair programming is helpful when code with important dependencies is developed at another site to avoid delays with instant code inspection by the developers from either side (Bass et al. 2007). It is a functional strategy helpful to coordinate tasks in the GSD Projects and is also referred to as the dyad model (Espinosa & Carmel, 2004) or Two actors (Espinosa & Carmel, 2004) or Buddy System (Begel A, 2008) or...
Mirroring (Hogan, B, 2006) in the GSD literature. It takes the advantage of GSD where the corresponding geographic distance between two sites is equal while time separation is not (Espinosa & Carmel, 2004). This strategy was discussed with two experts to understand how distributed pair programming happens to coordinate tasks between distributed team members.

The following two questions were discussed with the experts to know more about the DISTRIBUTED PAIR PROGRAMMING strategy –

Can you give an example of DISTRIBUTED PAIR PROGRAMMING that gives an advantage to work on the same task sharing 24 hour work across time-zones and handing off the work to each other?

In response to this question both the experts mentioned that distributed pair programming has not been successful in their GSD projects. It is part of Agile development and cannot be implemented in the GSD environment as the project managers may have to put huge efforts to make it successful. One of the experts stated that the basic concept of GSD is prioritizing each task within the project so as to have less communication as possible to minimize the communication overheads.

No… because its nuts…I absolutely think trying to go into paired programming when 2 people are in different places is nuts…because with any Agile development like that you really have to be collocated…I just can’t see that working at all…and I think its an academic thing and people think that they can probably do with students…NO…I thoroughly as a PM wouldn’t have a bar of it…I really wont do that. I think every time you have to put in a huge amount of effort…NO-NO I just think its waste of time and space….(June)

Can you explain how DISTRIBUTED PAIR PROGRAMMING is helpful to coordinate tasks while working on the GSD project?

The experts mentioned that distributed pair programming is not useful in GSD environment because there is difficulty with sharing the development code. The experts further mentioned that there is huge amount of time
spent in pair programming. Instead the ‘hand on and shake off’ sessions can be used for communication or allowing individual team members to be more productive by carrying out their own tasks.

As per the inputs given by all the experts, the results of the DISTRIBUTED PAIRED PROGRAMMING strategy are given in the Table 27.

<table>
<thead>
<tr>
<th>Strategy Performed</th>
<th>Performance</th>
<th>Compliance to the Model</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>Expert 1</td>
<td>No</td>
<td>NA</td>
<td>In Disagreement</td>
</tr>
<tr>
<td>Expert 2</td>
<td>No</td>
<td>NA</td>
<td>In Disagreement</td>
</tr>
</tbody>
</table>

Table 27: Validation Results of Distributed Pair Programming Strategy

**Amendments to the Model:**

As a result of the validation process, this strategy needs further research and is eliminated from the GSD-COORD Model.

With the inputs given by the experts it can be stated that this strategy is inappropriate to the GSD projects. The basic concept of GSD is prioritizing each task within the project to have less communication as possible and minimize the communication overheads. There is difficulty with sharing the development code between distributed team members working in different time zones. Also, the huge amount of time that is spent in communication can be used by individual team members to be more productive by carrying out their own tasks. Distributed pair programming can not be successful in the GSD projects as it is part of Agile development and cannot be implemented in the GSD environment. Project managers may have to put in huge efforts to make it successful.
6.4 Summary

In summary, 14 experts with an average of 20 years of experience in software project management participated in the validation process. The entire validation process provided empirical evidence to back the model. The expert opinion and validation has helped to enhance the model to make it useful to manage the GSD projects. All the experts acknowledged that the methodology followed to develop this GSD-COORD Model was reasonable and well-founded. In addition, they also stated that they have not come across any similar model that will allow software companies to coordinate the GSD projects.

The model consists of 10 processes and 54 strategies of which 38 strategies are assessed to be fully VALID. The discussion with the experts has given a scope to further improve all these valid strategies. Next, as per the expert opinion, there are 13 strategies that are evaluated as PARTIALLY VALID. The main reason is, even if the experts are aware of these strategies, they do not carry out them formally and hence are evaluated as partially valid. Further, 2 strategies are evaluated as CONTEXT SPECIFIC. It is either because the strategy is applicable only to large and complex projects and may not be appropriate for small uncomplicated GSD projects. Also, the strategy can be situational and depend on various other attributes involved in the given GSD projects. Also, 1 strategy is considered to be INCONCLUSIVE since the experts are in disagreement of the strategy.

Finally, the entire validation process has given an opportunity to verify if the methodology followed to develop the GSD-COORD Model is valid, logical and if it makes sense to use the model while managing the GSD projects.
Chapter 7: *GSD-COORD: THE GSD COORDINATION MODEL*

**Overview**

This chapter introduces the GSD-COORD model that can be useful for coordination of tasks between distributed teams and team members working on the GSD projects. The GSD-COORD model is developed on the basis of literature review, case studies and the mapping done with the PMBOK® Guide, 2008. An expert panel approach is used to validate this version of the model. The validation process has helped to enhance the model and make it more pragmatic to manage the GSD projects. The model comprises of various processes and strategies. The subsections here will describe the processes and some strategies along with its significance for coordination and specific practices that can be followed while managing the GSD projects.

### 7.1 Structure of the GSD-COORD Model

In this research, precise coordination strategies have emerged from the literature, case studies and the mapping with the PMBOK® Guide. Through further analysis, significant themes with direct correlation have emerged while cataloguing the strategies. To make sense, these themes are synthesized further to form the processes in the GSD-COORD Model. These processes then comprise of various strategies in the GSD-COORD Model.
Figure 8:  GSD-COORD: The GSD Coordination Model
Resulting the validation approach, there are in total 10 processes and 53 strategies in the model as presented in Figure 8. The processes in the model are referred as P1, P2 up to P10 while the strategies are identified as SP1.1, SP2.1, SP3.2 up to SP10.3. On the basis of these processes and strategies, the model is structured in formation of different levels.

Level 1 in the model denotes the 10 key processes (P1 to P10) while level 2 corresponds to the strategies (SP1.1 to SP10.3) under each process. Additionally, some of the strategies in the model include ancillary strategies that form the level 3 within the model. However, this level 3 is not outlined in Figure 8 but is illustrated later in the Section 7.2 under each sub-section which gives detailed information about the strategies in the model.

Furthermore, the description of each strategy and sub-strategy in the model demonstrates its significance for coordination and the specific practices that can be followed to coordinate tasks while managing the GSD projects. This significance and practices for each strategy are described subsequently under the Section 7.2 of this chapter.

In the model, some of the processes and strategies are connected using arrows. These arrows are bidirectional and represent the correlation between the processes and strategies. The linked processes and strategies indicate that they are mutually associated and beneficial to one another. The description of the model highlights the details about the correlation with each other.

### 7.2 GSD-COORD: The GSD Coordination Model

The subsections here will reveal each process and some strategies that form the GSD-COORD model. The abridged form of the GSD-COORD Model is presented here due to the limitations on the size and volume of the PhD thesis. The complete GSD-COORD Model will be published as a
Technical Report and a version of this will be available on the web. As stated earlier in Chapter: 6, due to the limitations on the size and volume of PhD thesis I have presented here an abridged GSD-COORD Model. Out of the total 53 strategies, only 10 randomly selected strategies – one from each process will be presented here.

Additionally, in the GSD-COORD Model each strategy under a particular process includes its significance for coordination and specific practices that can be followed while managing the GSD projects. Therefore, the significance and the practices are described for each strategy presented here. The practices presented under each strategy are based on the combination of findings from the literature, case studies, mapping with the PMBOK Guide, 2008 and the expert evaluation as discussed in the previous chapters. The basis for the ‘Significance’ and ‘Practice’ within each strategy is cited while presenting that particular strategy.

7.2.1 Process: P1 – TEAM SETUP

A team can be defined as a group of people working together to achieve common goals. In GSD, the collective objective of all the geographically distributed teams and team members is to achieve GSD project success. This shared goal is typically achieved by means of continuous software development across distributed team sites. Hence, appropriate coordination strategies are essential to manage software development tasks and activities amongst collocated and distributed team members working on the GSD projects.

The distributed client-vendor teams may well take any form and size, yet maintaining the right team balance between them is important while coordinating tasks when they are separated by global distance. Team attributes such as team size, team structuring, team knowledge, team cognition and many other aspects need to be examined to facilitate an
effective coordination plan within the GSD project. Analysis of such team attributes suggests that various significant strategies can be followed to coordinate tasks between distributed teams and team members working on the GSD projects.

The P1: Team Setup Process includes 7 strategies – SP1.1: Staff Acquisition and Management Plan, SP1.2: Team Selection, SP1.3: Team Structuring, SP1.4: Team Formation, SP1.5: Roles and Responsibilities, SP1.6: Resource Calendar and SP1.7 Organisational Charts. The Figure 9 represents the Team Setup Process.

The significance and practices of ‘Staff Acquisition and Management Plan’ strategy is presented below.

**Strategy SP1.1: Staff Acquisition and Management Plan**

Staff acquisition and management plan strategy can be useful to determine the actual skills of team members needed to work on the GSD projects. It also helps to formulate a clear approach for the requirement of resources essential to work on the GSD projects.

**Significance**

- Helps to formulate a clear strategy for the resources that are essential to work on both collocated and geographically distributed teams and avoid any uncertain situation that may arise in the GSD projects (PMBOK® Guide, 2008).
- Helpful for the mobility of the team members to the various sites as per the projects requirements (PMBOK® Guide, 2008).
- Helps project managers to understand the overall picture about when to acquire and release team members working on the GSD projects (Expert Opinion).
Practices

- Formulate as per the actual requirements of team members essential to work on the GSD project (PMBOK® Guide, 2008).
- Provide proper details of how and when different team member requirements will be met as the project progresses (PMBOK® Guide, 2008).
- Include number and proper details of the team members expected to work all the time within the teams for the project (PMBOK® Guide, 2008).
- Understand what exact talents and skills are essential to work on the project and make a plan to train or acquire people with those skills at various stages of the project (Expert Opinion).

Figure 9: Team Setup Process and Strategies
7.2.2 Process: P2 – TEAM DEVELOPMENT

Teams are the basic building blocks for contemporary business organizations. Team development can help to build united and integrated software development teams for GSD projects. Team development is necessary to boost team spirit and bring homogeneity within the teams. It also helps to bring cohesiveness and stability within the teams that facilitates effective coordination and successful completion of the GSD project.

The Team Development process includes 7 strategies - SP2.1: Team Building Exercise, SP2.2: Team Meetings, SP2.3: Team Performance Assessment, SP2.4: Training Programs, SP2.5: Networking, SP2.6: Team Issues and SP2.7: Team Knowledge. The Figure 10 represents the Team Development Process.

The significance and practices for ‘Training Programs’ strategy is presented below.

**Strategy SP2.4: Training Programs**

Team performance assessment facilitates to understand the specific training needs which are essential while coordinating various tasks in the GSD projects. The aim of training must be to enhance the competencies of the team members while working on the GSD projects.

**Significance**

- Overcomes attrition (Case Studies).
- Facilitates team members to get ready to work on projects that involve specific technology (Case Studies).
- Fulfils the inadequacy of skill set within the project and develop resources for the achievement of the GSD project (Case Studies).
- Best proactive response to match the required skills (Case Studies).
- Brings cultural awareness between the team members (Expert opinion).
- Develops trust between various stake holders (Expert opinion).

Practices

- Conduct formal as well as informal training sessions (PMBOK® Guide, 2008).
- Involve training experts and senior team members to ensure mentoring of new team members (Case Studies).
- Maintain training calendars (Case Studies).
- Inform project managers in advance about the upcoming training programs (Case Studies).
- Formulate and schedule training programs to increase team competencies (Case Studies).
- Include specific hours of mandatory training for team members every year (Case Studies).
- Prepare agenda to relieve team members to undertake the training (Case Studies).
- Conduct training sessions at various stages within the project (Case Studies).
- Brief new team members with the project details and their roles and responsibilities (Case Studies).
• Conduct frequent training programs to enhance technical and communication skills (Case Studies).
• Focus on soft skills that are essential to work on the GSD projects (Expert opinion).
• Emphasize to bring cultural awareness and develop trust (Expert opinion).
• Conduct team mentoring exercises (Case Studies).

Figure 10: Team Development Process and Strategies

7.2.3  Process: P3 - TEAM MANAGEMENT

It is important to successfully manage and coordinate globally distributed software development teams. Managing geographically distributed teams is different from managing collocated teams. Various team issues subsist while functioning in the GSD environment. It is therefore necessary to understand all such issues and overcome them with effective team
management strategies. Different team management strategies must be followed to keep all the distributed teams interconnected with each other while working on the GSD project.

The Team Management process includes 7 strategies – SP3.1: Team Motivation, SP3.2: Team Cognition, SP3.3: Recognition and Rewards, SP3.4: Shared Mental Model, SP3.5: Managing Uncooperative Actions, SP3.6: Role of the Project Manager and SP3.7: Team Operations. The Figure11 represents the Team Management Process.

The significance and practices of ‘Team Cognition’ strategy is presented below.

**Strategy SP3.2: Team Cognition**

Team cognition is distinct from Team Knowledge as it is a mental process in which mutual awareness is gained by perception, intuition and reasoning. Team cognition helps team members to work together to achieve common goals. Technologies designed to support coordination and communications in GSD have a significant influence on the ability to develop healthy team cognition (Keith et al. 2009). The performance of distributed teams depends on the knowledge and capabilities to use communication technologies to coordinate actions across space and time (Fuller et al. 2006; Keith et al. 2009).

**Significance**

- Brings awareness amongst team members while working on the GSD projects (Expert opinion).
- Gives ability to use a range of technologies to gain awareness and achieve common goals (Keith et al. 2009).
- Allows harnessing knowledge about other teams and team members (Keith et al. 2009).
- Improves coordination and communication amongst team members.
- Positively influences team performance for knowledge coordination (Keith et al. 2009).
- Helps to achieve quality of projects (Keith et al. 2009).

Figure 11: Team Management Process and Strategies

Practices

- Essential when projects are new and team members are not familiar with the new project domain (Keith et al. 2009).
- Employ different types of team cognition mechanisms (Espinosa et al. 2005).
- Assign roles to develop a high level of team cohesiveness and team cognition (Keith et al. 2009).
• Control the use of multiple coordination mechanisms to coordinate highly dependent tasks (Espinosa et al. 2005).
• Bring awareness about all activities performed at various distributed sites (Expert opinion).
• Disseminate the relevant information related to the projects (Expert opinion).
• Put procedures in place to inform about the things happening at various distributed locations (Expert opinion).
• Regularly organise team meetings, project updates and video conferencing to share information (Expert opinion).

7.2.4 Process: P4 - TASK ALLOCATION

Task allocation is the process in which teams and team members are engaged in specific tasks. A task in software projects can be viewed as the smallest unit of work that is well defined with its function and interface with other tasks. The objective of task allocation must be to assign tasks to the available resources so as to complete the project in shortest duration. Task allocation can be a moderating variable to improve coordination between teams in GSD projects (Amrit, 2005).

The Task Allocation process includes 3 strategies – SP4.1: Scheduling Task Allocation, SP4.2: Techniques of Task Allocation and SP4.3: Integration of Tasks. Figure 12 represents the Task Allocation Process.

The significance and practices of ‘Techniques of Task Allocation’ strategy is presented below.

Strategy SP4.2: Techniques of Task Allocation
There are various techniques that can be followed while allocating tasks to all distributed teams and team members within the GSD projects. The most important aspect that needs to be taken into consideration while allocating task is the skills and experience of the distributed teams and team members.

VERTICAL TASK ALLOCATION

Vertical task allocation encourages communication and improved coordination and yields higher productivity (Hogan, 2006).

Significance

- Allows each team to run in loose synchrony and meet other teams at the cluster (task) integration points. (Battin et al. 2001).
- Gains efficiency by avoiding unnecessary communication (Hogan, 2006).
- Promotes ownership of a particular piece of functionality (Expert opinion).
- Allows clear interfaces between the components or modules to give better understanding of tasks for team coordination (Expert opinion).
- Helps define the interfaces between the modules or components that facilitate the integration phase of the project (Expert opinion).
- Helps with reducing temporal problems and time zone differences (Expert opinion).

Practices

- Split project vertically where each team can work on an entire feature including user-interface and other components (Hogan, 2006).
- Allocate tasks vertically instead of horizontal or component based allocation (Case Studies).
• Allocate tasks to avoid dependencies and allow teams and team members to work independently in different situations irrespective of time zones (Expert opinion).

• Allocate tasks in modules in which a set of functionality is allocated to a distributed location and then the local team would re-allocate it to its team members (Expert opinion).

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MIRRORING

Mirroring is another approach that is followed for task allocation in the GSD projects. Mirroring is similar to Dyad model/buddy system/pair programming that are followed in the GSD projects (Espinosa & Carmel, 2004; Hogan, 2006; Begel A, 2008).

Significance

➢ Allows extending the bridging relationships between individual team members (Hogan, 2006).
➢ Facilitates rich communication between the teams by making it part of the day to day task completion activity (Case Studies).
➢ Decides the terms of coordination between and within the distributed teams (Expert opinion).

Practices

• Structure teams with less team members at each distributed site of the GSD projects (Espinosa & Carmel, 2004; Hogan, 2006; Begel, 2008).

• Allocate each team member parallel roles to work closely with their remote counterpart on the same tasks doing 24 hour work across time-zones and handing off the work to each other (Hogan, 2006).
• Suggest team members to spend less time during overlapping hours to explain progress and issues within the project (Case Studies).

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CHUNKING

This is another technique where the entire GSD project can be split into sub-system.

Significance

- Gives an opportunity to assign tasks to distinct development sites to carry on a task independently (Mokus & Weiss, 2001).
- Less need to maintain tight coordination between the smallest tasks (Case Studies).
- Reduces need for communication and coordination between the distributed teams and team members (Expert opinion).

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Practices

• Allocate tasks primarily as per the skills, experience and domain knowledge (Expert opinion).
• Allocate tasks to various sites as per the functional area, localization or even as per the development or maintenance stages (Mokus & Weiss, 2001).
• Organize the project into subsystems to split further where only one task can be allocated to each team member (Mokus & Weiss, 2001).
Figure 12: Task Allocation Process and Strategies

**TASK ALLOCATION AS PER FUNCTIONAL AREA**

**Practices**

- Brings awareness of the various tasks performed by each distributed team and team member (Expert opinion).
- Offers full clarity within the GSD project (Expert opinion).
- Ensure that each site has a small-to-medium-sized development team with domain expertise or can be trained quickly as per the functional need (Mokus & Weiss, 2001).
- Bring experts from several sites together while adding new functionality to the project (Mokus & Weiss, 2001).
- Easier tasks must be allocated during the initial period to team members to understand the skills and expertise when new distributed locations get involved in the current GSD project (Expert opinion).
TASK ALLOCATION BY LOCALIZATION

Practices

- Develop or modify the product locally as per the need of the local market (Mokus & Weiss, 2001).
- Local development team must be highly aware of its customer needs and the nature of the locality-specific features (Mokus & Weiss, 2001).
- Maintain local experts when adapting the system to the local market (Mokus & Weiss, 2001).

TASK ALLOCATION AS PER DEVELOPMENT STAGE

Practices

- Allocate tasks as per the development stage (Mokus & Weiss, 2001).
- Perform design, coding and system testing activities at different locations (Mokus & Weiss, 2001).
- Allows development stage experts to be at a single site (Case Studies).
- Higher communication and coordination needed between sites to proceed to the next development stage (Case Studies).
- Assists to make regular updates which can be viewed by all distributed teams and team members (Expert opinion).

TASK ALLOCATION AS PER THE MAINTENANCE STAGE

Practices

- Transfer older releases to other sites for the maintenance when it is not anticipated to add any new features to the release (Mokus & Weiss, 2001).
• Allow availability of more resources for developing new functionality at the site that is not involved in the maintenance phase (Mokus & Weiss, 2001).

• Increase communication between sites because the maintenance site may not have participated in the design and implementation of the product (Mokus & Weiss, 2001).

7.2.5 **Process: P5 – BRIDGING**

Bridges are identified as groups of heterogeneous workforces available within a reasonably shorter geographical and temporal distance from where they can become a node to manage two or more separated work sites that exist on either side of their location (Milewski et al. 2008). In GSD, specific sites can function as bridge when

- They exist in the center of two or more distributed sites and have overlapping working hours with teams on either side in the GSD setup.
- They outsource work further to other sites and experience being both customer and vendor in two-stage offshore sourcing relationships (Holmström et al. 2008)

Being a bridge site allows team members to understand various issues that help when dealing with relations of both client and vendor sites. To propose the bridging strategies we have adopted the bridging guidelines provided by Milweski et.al (2008) for GSD.

After validating, the Bridging process includes 8 strategies – SP5.1: Bridge Location Selection, SP5.2: Managerial Level Bridge Model, SP5.3: Bridgeheads, SP5.4: Role of Bridgeheads, SP5.5: Tactics to Manage Bridgeheads, SP5.6: Bridge Integration, SP5.7: Delegation across Bridges
and SP5.8: Bridging Approach. The Figure 13 represents the Bridging Process.

The significance and practices for ‘Techniques for Establishing Bridges’ strategy are presented below.

**Strategy SP5.2: Bridge Location Selection**

Selecting appropriate bridge location is considered as an important building block while establishing bridges. Several other elements apart from geographical and temporal proximity need to be measured ahead of choosing bridge location.

**Significance**

- Gives an opportunity to leverage the advantage of physical closeness to interact easily with other sites (Battin et al. 2001).
- Helps to reduce the temporal distance by positioning workgroups in the same time zone (Milewski et al. 2008).
- Facilitates to decrease the huge time zone differences that impact communication and coordination (Expert opinion).
- Helps to reduce lead time and issues that arise in communication due to distance and time zone differences (Expert opinion).

**Practices**

- Select a particular bridge location on the basis of the existing or real availability of the experienced staff that can support the resource requirements and not on the option of hiring new resources (Battin et al. 2001).
• Proposed sites must have overlapping hours with teams which are on both sides to communicate during different hours to help the flow of information between the two sites.

• Consider domain expertise and the technical experience while selecting bridge locations (Battin et.al 2001).

• Select bridge locations to decrease distances and help create shorter paths among non co-located team members or workgroups (Milewski et al. 2008).

• Select bridge locations in countries with overlapping working hours that will permit real-time communication between the remote sites (Milewski et al. 2008).

• Manage non-overlapping hours to have real time communication between teams from both the side of the bridge (Expert opinion).

• Understand the request from either side of the bridge and keep a flow of information between all non-overlapping sites (Expert opinion).

Figure 13: **GSD-COORD**: Bridging Process and Strategies
Visits made by members of client companies to the vendor companies and vice versa are denoted as onsite visits. Ideally all the team members from each team must be encouraged to visit the sites of other teams with whom they daily coordinate to know each other well. Scheduling such visits to the location of the other teams serves to improve understanding between teams and team members (Begel & Nagappan, 2008). It makes them aware of the work practices, priorities and environment in which other team members carry out their project tasks (Begel & Nagappan, 2008). Onsite visits allows team members to establish relationships amongst team members from different geographic locations (Bass et al. 2007) and thus resolve issues and misunderstandings (Begel & Nagappan, 2008) that may perhaps have happened prior to meeting each other. Having appropriate connection amongst the teams has a positive impact on team performance as compared to disconnected teams (Cataldo & Herbsleb, 2008). Onsite visits allow visiting team members to make key contacts around the globe who are subject-matter experts in their field (Begel & Nagappan, 2008). Onsite visits help to resolve issues related to cultural differences and socio-cultural distance which consequently helps in effective coordination of distributed software development teams. The onsite visits help to ‘put faces to roles’, otherwise team members are mostly known by their roles or profiles and help to set expectations better than the teleconferences (Begel & Nagappan, 2008). Various strategies can be followed while planning onsite visits.

The Onsite Visits process includes 5 strategies that are – SP6.1: Planning the Visits, SP6.2: Role of Cross-Site Delegates, SP6.3: Social Time, SP6.4: Duration of the Onsite Visits and SP6.5: Cultural Differences. The Figure 14 represents the Onsite Visits Process.

The significance and practices for the ‘Duration of the Onsite Visits’ strategy is presented below.
Strategy SP6.4: Duration of the Onsite Visits

The duration of the onsite visits to other team sites made by a cross-site delegate is measured as an important feature for the GSD projects.

Significance

- Regular visits made by different team members for a duration of 4-6 weeks facilitate project coordination (Bass et al. 2007).
- Longer time spent together helps with creating a personal connection between remote team members (Begel et al. 2009).
- Longer time spent at the host site helps the visiting team member to relieve stress and feel comfortable while talking with the host team members (Expert opinion).
- Results in faster turnaround time on emails as compared with someone you do not know and leads to become an obvious partner for a buddy system (Begel et al. 2009).
- Initial phase visits help to bring clear understanding about the project between the client and vendor team members (Expert opinion).

Practices

- Plan visits for longer duration which is more than 4 weeks to two years (Bass et al. 2007).
- Spend longer time with the host team members as it takes time to settle and learn things that may exist differently at this new location (Expert opinion).
- During the initial phase of the project the client or vendor site team members could visit each others site for a period between 6 months to 1 year (Expert opinion).
• Project manager or senior members of the project can visit the remote sites once every 6 - 8 weeks at the starting phase of the GSD project (Bass et al. 2007).
• Senior executives can plan short term visits of only 1-2 days during every quarter of the project (Expert opinion).
• Reduce the duration of the onsite visits as the project progresses (Expert opinion).
• Important to have regular visits later during the ending phase of the project (Expert opinion).

Figure 14: GSD-COORD: Onsite Visits Process and Strategies

7.2.7 Process: P7 – MANAGE CULTURAL DIFFERENCES

With the emergence of technologies in a world which has become increasingly globalized, the relationship between culture and management of remote work has become an unavoidable issue that needs to be
addressed (Watson et al. 1994). Cultural diversity has an impact on coordination of activities and tasks within the GSD project. Globalization of software projects has increased demographic and cultural diversity obstructing smooth team functioning (Beise, 2004.) and geographic and temporal distance limits opportunities for direct contact and cooperation (Carmel E, 1999; Prikladnicki et al. 2003).

The Managing Cultural Diversity process includes 5 strategies - while SP7.1 Cultural Diversity, SP7.2: Cultural Training SP7.3: Gender, SP7.4: Attrition and SP7.5: Festive Holidays. The Figure 15 represents Managing Cultural Difference Process.

The significance and practices of ‘Cultural Training’ strategy is presented here.

**Strategy SP7.2: Cultural Training**

Gaining knowledge of different national cultures and the religious values of clients and geographically distributed team members who interact daily with each other is vital for the success of the GSD projects.

**TRAINING FOR CULTURAL AND RELIGIOUS VALUES**

Training helps to bring awareness of the diverse culture and religious values that exist at various geographic locations while operating in GSD environment.

**Significance**

- Helps to interpret and understand each other’s behaviour and develop respect for one another (Case Studies).
- Brings certain level of understanding about the cultural norms, customs and work approach that are followed at various distributed locations (Expert opinion).
- Helps to transform cultural diversity from being a weakness into strength (Case Studies).
- Creates confidence in team members for effective communication (Expert opinion).
- Brings awareness of various aspects related to the culture (Expert opinion).
- Helps team members to interpret things in a better way (Expert opinion).
- Brings awareness of what feedback can be expected from various distributed teams (Expert opinion).
- Helps to reduce frustration, anxiety and concern between team members which is part of team or group behaviour (Case Studies).
- Helps employees to avoid the consequences related to cultural differences and other matters (Case Studies).

Figure 15: GSD-COORD: Manage Cultural Differences Process and Strategies
Practices

- Facilitate cultural training with the help of experts from national and international level (Case Studies).
- Conduct proper cultural training programs to help learn how to work with team members from different cultural background (Expert opinion).
- Conduct ‘Orientation courses’ about various cultures to create a better level of understanding (Case Studies).
- Encourage team members to informally share their experience with their own team as it helps to bring certain level of awareness between team members who might next visit to other sites (Expert opinion).
- Aim for cultural training to bring awareness about conduct and practices followed within various countries and religions (Case Studies).

LANGUAGE AND ACCENT TRAINING

The language issue can surface when team members have to deal with team members from different countries and geographic locations. Language can turn into a communication issue regardless of huge technical knowledge. Team members working on the GSD project by and large speak different native languages hence they need to be trained in appropriate dialect and communication styles.

Significance

- Necessary when team members from diverse cultural backgrounds have difficulty in communication with other team members working on the GSD projects (Case Studies).
- Language ineptness can bring reluctance in both written and oral communication (Case Studies).
Certain level of command over English language helps in effective communication with distributed team members (Case Studies).

Practices

- Essential to enhance their English language skills when the language proficiency differs and the project demands a more comprehensive knowledge of English (Case Studies).
- Basic aptitude level of English language can be one of the criteria while selecting team members to work on GSD projects. (Case Studies)

7.2.8 Process: P8 - TEMPORAL DIFFERENCES

The separation of two geographic locations based on different time zones is referred to as temporal difference. The revolution in the availability of various communication tools has made it possible to derive new tactics to address temporal differences and successfully coordinate GSD projects.

The Managing Temporal Differences process includes 2 strategies – SP8.1: Managing Time Zone Differences strategy and SP8.2: Hand-on and Shake-off Sessions. The Figure 16 represents the Temporal Differences Process.

The significance and practices for ‘Hand-on and Shake-off Sessions’ strategy is presented below.

**Strategy SP8.2: Hand-on and Shake-off Sessions**
These sessions are important and must happen during the overlapping hours between two distributed sites that are working on the GSD project.

Significance

- Provide an opportunity to address various issues during the overlapping hours (Case Studies).

![Diagram](GSD-COORD.png)

**Figure 16: GSD-COORD: Temporal Differences Process and Strategies**

Practices

- Allow at least 2-4 overlapping hours to conduct ‘hand-on and shake-off’ sessions (Case Studies).
- Use overlapping hours for communication (Expert opinion).
• Check if the project activities during overlapping hours at all distributed sites are happening as per the schedule (Case Studies).
• Business analysts can use the initial stage of the project to articulate requirement specifications to the project managers and senior team members (Expert opinion).
• Give preference to modularise the project or split it into components with clear interfaces (Expert opinion).
• Empower local team members to carry on the work individually (Expert opinion).
• Setup certain schemes to support and allow distributed teams and team members to carry on work on their own (Expert opinion).
• Discuss the project progress and the issues that may have occurred at a particular site (Expert opinion).
• Update all other team members what they have done on that day and what needs to be done by the next team (Expert opinion).
• Use tools such as telephone, video conference, SKYPE calls or emails to communicate during the hand-on and shake-off sessions (Expert opinion).
• Conduct these sessions when the preceding teams are about to finish their daily working hours and the succeeding team is about to start their work (Case Studies).
• Allow team members to be all set to ‘hand-on’ the work to the next team located in subsequent time zone and ‘shake-off’ their hands for the day (Case Studies).
• Follow the process of ‘hand-on and shake-off’ sessions in the 24 hours cycle throughout the day between all the succeeding teams (Case Studies).
• Communicate about the work being carried out and what needs to be done further by the next incoming team member (Case Studies).
• Raise concerns about the issues confronted while working on the GSD projects (Case Studies).
• Communicate issues without any delay to resolve them instantly (Case Studies).
• Place onsite coordinators at various distributed team sites to monitor the ‘follow the sun’ model of time zone and temporal differences (Case Studies).
• It is essential to have team members available for communication during their working hours to coordinate the tasks effectively (Case Studies).
• Highly essential to have team members who can provide support apart from their daily working hours of work in office (Case Studies).

7.2.9  Process: P9 - MANAGING CLIENT-VENDOR RELATIONSHIP

There are several key issues that vendor side project managers confront while dealing with clients from various countries. These issues can be classified as technical, non-technical or cross-cultural issues. The technical issues are differences in technology, variation in development process, changes in requirement specification, and contrast in code verification. Non-technical issues are mainly associated with communication, coordination and time zone management. Cross-cultural issues are related to differences in organisational work culture and personal culture. All these issues get aggravated due to physical distance between client and vendor team locations in the GSD projects.


The significance and practices for ‘Managing Cross Cultural Issues’ strategy is presented here.
**Strategy SP9.3: Managing Cross Cultural Issues**

Cross-cultural issues can influence project performance when team members operate on global platform. The cross-cultural issues can be analyzed as organisational work culture issues and personal culture issues.

**Organisational Work Culture Issues**

Differences in organisational work culture at various distributed team locations can affect coordination strategies in the GSD project.

**Significance**

- Implies the difference in approach towards work by a group of team members (Case Studies).
- Social and native cultures have an impact on the organisational culture (Case Studies).
- Differences at distributed team locations can create an impact on the coordination strategies (Case Studies).
- Classify the issues as work culture and personal culture issues (Expert opinion).
- Work can be extremely disciplined and very process oriented in certain cultures (Expert opinion).
- There can be discipline in reporting, producing designs and protocols in some cultures and other teams have to work with them (Expert opinion).
- Concealing the fact about insufficient knowledge to work on a particular technology or domain can create work related issues (Expert opinion).
- Impart understanding about cross-cultural issues up to the lower hierarchy within the teams (Expert opinion).
Practices

- Inform the project managers about the variations in organisational work culture at distributed team location while coordinating team activities (Case Studies).
- Maintain shared work processes and standard quality levels to overcome organisational work culture differences within distributed teams (Case Studies).
- Understand different approaches in management style and the hierarchy within the organisation at other distributed locations (Expert opinion).
- Make project managers aware that in some cultures people might be used to working in a set time hours with defined lunch hours while in other cultures it might not be the same (Expert opinion).
- Understand issues related to differences in technology while setting up collaboration between distributed teams so that team members do not endure these issues while coordinating the tasks (Case Studies).
- Take a holistic approach to manage organisational work culture when team members are not accustomed to working at international levels (Case Studies).
- Impart appropriate training to team members to conform and get them accustomed to the diverse professional or work culture environment that exists in the GSD projects (Case Studies).

PERSONAL CULTURE

Personal or individual work culture has an impact on the client-vendor relationship while coordinating task in GSD projects.

Significance
- Evident differences get exposed when client teams are from developed countries and vendor teams are based in developing countries (Case Studies).
- Personal culture or personality trait has an impact on the GSD projects (Case Studies).
- Vendor side team members may hesitate to communicate the negative aspects of the project and can be reluctant to say ‘NO’ to any task assigned by their client side team members (Case Studies).
- They may easily agree to take over this extra burden of work related to the project which client team members may not be willing to do (Case Studies).

Figure 14: GSD-COORD: Managing Client-Vendor Relationship Process and Strategies

**Practices**

- Make an effort to clarify to team members not to agree to takeover an extra burden of work as this can increase their workload and override the project duration (Case Studies).
• Bring awareness of the socio-culture aspects between both client and vendor side team members (Case Studies).

• Involve onsite-coordinators or cultural liaisons to try and resolve issues that arise while working on the GSD projects (Case Studies).

• Necessary to understand the difference in communication style as it has an impact on coordination in GSD projects (Case Studies).

• Conduct cultural training that includes a brief introduction to native language, traditions, culture and social behavioural patterns for visiting team members (Case Studies).

• Cultural training helps visiting team members to easily deal with the native team members and overcome any cultural issues (Case Studies).

• Make plans for training executives to travel between various geographical locations to train team members working on the GSD projects (Case Studies).

• Regularly schedule cultural training programs to bring awareness and overcome the cross-cultural issues (Expert opinion).

7.2.10 Process: P10 – COMMUNICATION FOR COORDINATION

Communication is a process by which information is exchanged between individuals through a common system of symbols, signs, behaviour or tools. Communication is the key to team-based success (Battin et.al 2001). In GSD, communication is important because it can either make or break any project (Deshpande & Richardson, 2009). Communication is a mediating factor affecting both coordination and control (Carmel & Agarwal, 2001).

For distributed teams, complete and clear information needs to be exchanged between the sender and the receiver to have a common understanding about the project in GSD. To achieve parallel understanding
amongst geographically distributed teams and team members various coordination strategies that are beneficial to improve communication across teams are followed by the companies engaged in the GSD projects.

Good coordination is a subtle mixture of explicit and implicit coordination (Godart, 2001). Explicit coordination includes formalizing standard process across all distributed sites with appropriate workflow systems and shared spaces (Godart, 2001). In implicit coordination there is good awareness of each distributed teams work despite standard process due to the communication that happens between the distributed team members (Godart, 2001).

The Communication for Coordination process includes 3 strategies – SP10.1: Continuous Communication, SP10.2: Unfiltered Communication and SP10.3: Structured Communication. Figure 18 represents the Communication for Coordination Process.

The significance and practices for ‘Structured Communication’ strategy is presented here.

**Strategy SP10.4: Structured Communication**

Structured communication allows coordinating GSD projects with the aim to transmit the right information to the right person at the right time (Godart et al. 2001). It helps to block unnecessary information that certain teams and team members may not require while working on the GSD projects.

**Significance**

- Helps to transmit the right information to right person at the right time (Godart et al. 2001).
Permits to preserve confidentiality and allows maintaining selectivity and quality of information that team members need (Godart et al. 2001).

Helps to block unnecessary information that certain teams and team members may not require (Case Studies).

Helps to create a link to configuration management within the GSD project (Expert opinion).

Allows maintaining certain standards to manage the coordination and structured communication amongst the distributed team members (Expert opinion).

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**Practices**

- Properly plan communication channels (Case Studies).
- Establish communication channels as per client time zone (Case Studies).
- Keep these channels open 24/7 hours for constant communication (Case Studies).
- Partition team members in groups based on their roles and tasks (Godart et al. 2001).
- Allow multi-membership for effective group interactions (Godart et al. 2001).
- Prepare a definitive plan about the meetings, mode and frequency of communication along with technology to be used (Expert opinion).
- Define use of proper tools for synchronous and asynchronous communication in advance to avoid any uncertainty between distributed teams and team members (Case Studies).
- Set up an appropriate ‘communication protocol’ which presents guidelines about tools and techniques to be used for formal as well as informal communication (Case Studies).
• Insist project managers to regularly monitor if team members are able to communicate productively and there is proper information exchange within the available time (Case Studies).

![Figure 18: GSD-COORD: Communication for Coordination Strategies](image)

7.3 Summary

This chapter describes some strategies of the GSD-COORD model which satisfies the objective of this research. This model has explored the need to build on a structured set of practices which focus specifically on coordination of tasks in GSD projects and thereby, contributing to the established knowledge on Global Software Engineering (GSE). It has also proved useful to identify processes and strategies that will support coordination between geographically distributed software development sites. The adoption of the practices mentioned in the GSD-COORD model could help enhance the probability of success in achieving GSD projects.

The development of the GSD-COORD model highlights the need for further research in this area particularly from the vendor perspective. An integrated
approach to research could solve many of the problems associated in the GSD area that are cumbersome in nature.

The GSD-COORD model may benefit smaller organisations with limited resources to minimize the investment required to manage the GSD projects. Alternatively, the GSD-COORD model can be beneficial to larger organisations as it is expected to benefit project managers in overcoming coordination challenges while managing the GSD projects.
Chapter 8: Conclusion

Overview

The purpose of this chapter is to summarise the findings of the research by discussing how the research objectives have been accomplished while answering the research questions. The chapter highlights key aspects and discusses the main findings of the research. Further, the chapter will also describe the contribution of the research to theory and practice and its implications for both researchers and practitioners in the GSD area. Finally, the limitations of the study are discussed and potential areas for future research are suggested.

8.1 Review of the Research Objectives

Coordination is ‘the act of working together harmoniously and managing interdependencies between activities to achieve goals in which several actors are involved and multiple activities are performed’ (Malone and Crowston, 1990, 1994). Coordination is an interdisciplinary subject and regular studies are carried out in various disciplines such as management, computer science, organization theory, operations research, economics, linguistics, and psychology. GSD researchers have conducted various studies to understand the coordination issues that impact successful execution of the GSD projects. However, prior to the research presented in this thesis, such studies are rarely undertaken to represent coordination solutions based on both a client and vendor perspective. Further, this is the
first research in GSD that incorporates the practices from the PMBOK® Guide, 2008.

8.1.1 Primary Objective

The primary objective of the research study was —

*To develop a model that incorporates strategies from a vendor perspective to facilitate coordination between client-vendor teams working on outsourced GSD projects.*

The study effectively meets the primary objective through the development of the GSD-COORD model. This is achieved through extensive review of the GSD literature and analysis of multiple case studies conducted in vendor software companies which are further integrated and mapped with two relating sections of the PMBOK® Guide. Subsequently, on account of this, the GSD-COORD Model is developed and validated to make it acceptable for managing the outsourced GSD projects.

8.1.2 Secondary Objectives

A secondary objectives set for this study were to –

- To identify strategies followed in vendor companies for successful coordination between client-vendor teams from the GSD perspective.

The literature review presented in Chapter 2 has revealed that most of the research on GSD is conducted from the client perspective. The strategies that are revealed from the literature are from the studies conducted in client companies. Conversely, this study has focused to ascertain the strategies from the vendor perspective. Therefore, a three phase multiple-case study
was conducted in the vendor companies based in India to help recognize the strategies followed for coordination of task between client and vendor teams working on the GSD projects. The empirical research conducted from the vendor side has given the opportunity to identify strategies that are followed to overcome the coordination issues which the vendor project managers and team members have to deal with while working on the GSD projects.

The next objective of this study was

- To add to the established knowledge on GSD.

The development of the GSD Coordination Model has on its own added to the established knowledge on GSD. The GSD Coordination Model presented in Chapter 7 includes processes and strategies which further comprises of specific practices that could help enhance the probability of success in achieving GSD projects. The adoption of the GSD Coordination Model can support GSD practitioners in successfully managing GSD projects.

Thus, the empirical research and the development of the GSD Coordination Model have helped to meet the secondary objectives of this research study.

8.2 Answering the Research Questions

The research objectives were positioned in the form of research questions. On the basis of these objectives, the primary research question formulated to conduct the study was -
RQ: *Can a model be developed based on the strategies followed by vendor companies to facilitate coordination between client-vendor teams when operating in a GSD environment?*

This question was examined with a focus on investigating various coordination strategies and building a model for coordination of tasks that can be successfully followed in different software companies who manage the GSD projects. The research methodology Chapter 3 illustrates the research design and the Multi-Method research approach (Woods et al. 1999) adopted for various stages of the study to answer the research question. Thus with the clear research objective and well designed research methods this main question was successfully answered by developing the GSD-COORD Model.

To strengthen this main research question, this research study subsequently focused on the following sub-question -

- **SRQ1: What are the strategies identified in the literature for successful coordination between client-vendor teams while operating in the GSD environment?**

The literature revealed several effective strategies used for coordinating tasks and activities in GSD projects. These strategies are successfully followed by software companies. Some strategies are innovative but not established and their occurrences vary according to the situation in the project. All such strategies uncovered from the literature are further categorised and clustered together to form a useful conceptual framework for the coordination of GSD projects.

The literature review has revealed that most of the studies in GSD are from client perspective with less focus to carry out research from the vendor viewpoint. Taking this fact into consideration the second supplementary research question was formulated to conduct the next stage of the study.
SRQ2: What are the strategies followed by the vendor companies to overcome the coordination barriers when operating in a GSD environment?

To answer this question, case study research was conducted in Indian software companies. The data was analysed and resulted in the identification of functional coordination practices. These practices were organised in a specific format to form the interim GSD-COORD Model.

To make the model more relevant to the GSD environment all the coordination practices documented in the model are compared with recognised software development processes and project management standards that are applicable to the software industry. Hence the third sub-research question was considered for this research study -

SRQ3: What are the standard documents that support coordination GSD? Can the PMBOK® Guide, be used as the basis to support coordination strategies in GSD projects from the vendor perspective?

The use of the PMBOK® Guide to map the coordination strategies has made it possible to make further changes and suggest new guidelines in the GSD-COORD Model. These changes were validated and the validated GSD-COORD model is presented in Chapter 7 of the thesis. Thus on the basis of the research objectives using appropriate research methods, this research study has successfully answered the primary as well as the secondary research questions.

8.3 Assessment of Research Design

An important aspect of this research study is that it is broad and exploratory with limited established research currently available. Hence, to achieve the research objectives a multi-method research approach was
undertaken (Morse, 2003). The use of a multi-method research approach allowed investigation into the phenomenon in a progressive manner. This approach helps to counter balance the strengths and weaknesses of the research methods adopted in the study as each method can be complementary and support the findings of another. Hence this approach has helped to limit the effect of threats to investigational validity which in particular is a problem in human-intensive research areas like software engineering (Wood et al. 1999).

To validate the GSD-COORD model, an expert panel technique is followed in this research study. The validation process has helped to extract the information from the experts about the coordination strategies included in the GSD-COORD Model.

8.4 Discussion

This research study has collated significant strategies from the literature, empirical research and the mapping activity performed with the PMBOK® Guide, 2008. This has helped to develop the GSD-COORD Model which includes pivotal processes and strategies for coordination of tasks to manage outsourced GSD projects. In the structure of the GSD-COORD Model, each process includes specific strategies with its significance and practices.

The literature review presented in Chapter 2 has revealed that there are several effective coordination strategies implemented within software companies engaged in GSD but very little is known about them. This research study has drawn together less known but associated coordination strategies implemented in software companies. The review of literature has helped to recognize the correlation between the strategies and their impact on one another. The Onsite Visits, Bridging, Task Allocation and Communication for Coordination are important processes that have
emerged from the GSD literature. Other strategies related to Team Setup, Team Development and Team Management have also emerged from the literature.

There is less evidence to setup teams to work on GSD projects in the literature or in the standard processes and models applicable to software engineering. However, the PMBOK Guide, 2008, has particular practices that suggest setting up teams to work on the GSD projects. Vendor software companies based in India follow specific practices to setup teams during the initial phase of the GSD projects. The case-studies suggest that for GSD projects success, when setting up teams, it helps to have an exact composition of teams at various geographical locations. This research has drawn together specific strategies that can be followed while setting up teams for the GSD projects such as team selection, team structuring and team formation from literature and case-studies. The strategies - staff acquisition & management plan, defining roles and responsibilities, resource calendar and organisational charts strategies followed in the vendor companies are mentioned in the PMBOK Guide, 2008.

The team development process within the GSD-COORD Model helps to bring cohesiveness and stability within the teams. This facilitates effective coordination to support successful completion of GSD projects. The team development process is necessary to boost team spirit and bring homogeneity within the teams. Various strategies such as team building exercises, team meetings, training programs, team performance assessment and team issues are included under this process in the GSD-COORD Model. These strategies help to build united and integrated software development teams for GSD projects. The strategies have emerged from the literature, case-studies and are defined in the PMBOK Guide, 2008. There is frequent mention about these strategies in the GSD literature but no specific practices are revealed on how and when to follow these strategies. The development of the GSD-COORD Model has brought together such practice that can be followed while managing GSD projects.
The team management process includes the strategies that help to successfully manage and coordinate distributed teams working on GSD projects. Team cognition, shared mental models and managing uncooperative actions are strategies that have emerged from the GSD literature while team motivation, role of project managers, recognition and rewards and team operations are strategies that have emerged from the empirical research and are corroborated in the PMBOK Guide, 2008.

Many research studies, give an account on how Onsite Visits are helpful for coordination in GSD. However, there is no specific evidence on how ‘onsite visits’ can be put into practice. In addition, the standard processes and models that are applicable to the software engineering environment do not refer to any such practices. This research study in conjunction with the case-study research has helped to bring together similar studies which have reported on the onsite visits and provide specific strategies and practices that can be followed while planning the onsite visits.

The bridging process has emerged from the GSD literature. There is no specific evidence on bridging in the PMBOK Guide, 2008 or any other standard processes and models applicable to the software engineering environment. The bridging process has shown that a particular distributed site working on the GSD project can act as a bridge to overcome various coordination issues. This can ease the communication and overcome temporal differences between the distributed teams working on GSD projects. The case-study research has revealed evidence in the form of specific practices in support of the bridging process.

Task allocation is a process in which teams and team members are given specific tasks. The GSD literature suggests that the proper allocation of tasks to distributed teams and team members allows the harnessing of the potential of the 24-hour software development model, thus, minimizing the completion time of GSD projects. The case-study research has revealed that vendor companies follow different innovative practices while allocating tasks to teams and team members working on GSD projects. These
practices along with those identified in the literature, have helped to construct this process. However, there is no specific evidence on task allocation in the PMBOK Guide, 2008 or any other standard processes or models applicable for software engineering.

The literature review made it possible to perform the groundwork for the empirical research. The processes and strategies that emerged from the GSD literature became the basis to conduct the next stage of this research study. The adoption of inductive research methods helped to uncover various coordination strategies followed by vendor companies that manage outsourced GSD projects.

The empirical research from the vendor perspective has made it clear that there are different issues that the vendor side project managers have to deal with while managing the GSD projects. These issues are not highlighted in the GSD literature as there are few studies from the vendor perspective. The case-studies have divulged how project managers from the vendor companies implement novel strategies to coordinate the tasks between distributed teams working on GSD projects. This research study has not only helped in understanding the issues that the vendor side teams have to deal with but it has established some functional coordination strategies which are followed while managing GSD projects. Managing Cultural Diversity, Temporal Differences and Managing Client-vendor relationship are important coordination processes that have emerged from the case-study research.

Cultural difference is considered as one of the major issues in GSD projects. Many research studies have highlighted that various issues in GSD get aggravated due to cultural differences. However, fewer efforts are taken to understand and overcome this issue. The study presented in this thesis is successful in providing specific practices to manage and overcome cultural issues that exist in the GSD environment. The PMBOK® Guide, 2008 acknowledges that project managers operating in global environments have to manage cultural differences, but does not provide
any specific practices for these. India happens to be culturally traditional as well as a high-technology IT economy. The analysis of the multiple-case studies has helped to bring to light some pioneering strategies that are implemented in Indian software companies to manage team members from various cultural and religious backgrounds. The analysis has demonstrated that having culturally and religiously different members in a team helps to provide 24/7 support all round the year.

The temporal differences process included in the GSD Coordination Model describes various strategies to coordinate and manage time zone differences between distributed teams working on GSD projects. The impact of time zone difference is discussed in the GSD literature yet specific practices to manage the temporal differences were not previously discussed there. The PMBOK Guide, 2008 is useful to manage collocated projects, but, there is no reference for the temporal differences process which is part of the GSD Coordination Model. However, the empirical research has helped to unveil specific strategies and practices that can be followed to manage existing time zone difference. The explicit practices followed to manage the temporal difference by vendor companies in India are now part of the GSD Coordination Model and can be followed by other vendor companies.

Managing Client-Vendor Relationship is an important process that has emerged from the empirical research. There are several key issues that vendor side teams confront while coordinating tasks with the client team. These issues are technical, non-technical and cross-cultural and need to be addressed for effective coordination. The major technical issue that the vendor teams have to deal with is the frequent changes in the requirement specifications. This research study suggests that there is a need of standard procedure for both client and vendor teams. This allows them to avoid issues and to coordinate tasks effectively while working on GSD projects. The strategies and practices mentioned in this process can help to address these issues.
The Communication and Coordination process in the GSD Coordination Model is essential for coordination of tasks between distributed teams. This process includes various strategies that are based on the practices identified from the literature, case-study research and have reference in the PMBOK Guide, 2008. The strategies included in this process suggest specific practices that can be followed to manage communication channels between distributed sites for effective coordination. These strategies help in to distribute clear and contextual information amongst all distributed sites. The experts, while validating the GSD-COORD Model, have stated that it is essential that the communication is clear, unambiguous and accurate at certain levels and stages of the project.

The contribution and key findings of the research study along with the basis of the evolution of different processes and strategies has been discussed in this section. The practices and the relevance of each strategy included in different processes are highlighted. The GSD-COORD Model is then validated by GSD researchers and experts from software companies within various countries. This validation helped to access the significance of each strategy in the model to enhance its applicability. The GSD-COORD Model is an adaptable approach to project management where the processes and strategies can be tailored to suit different global and organizational settings.

8.5 Research Contribution

In reference to the primary and secondary research questions, this research has made a number of contributions:

♦ The literature review has uncovered various strategies for effective coordination between client-vendor teams. Additionally, the literature review has indicated that most of the research on GSD is carried out from the client perspective. Section 2.3 in Chapter Two gives results that
suggest the need to conduct more and more such studies from the vendor point of view to overcome the tangible issues of GSD.

♦ The research study conducted from the vendor perspective has helped to understand the various issues that exist between client-vendor teams working on GSD projects. This empirical research conducted in the vendor companies has revealed various innovative strategies implemented by vendor companies to resolve coordination issues and successfully manage GSD projects.

♦ In the course of this research study, it is identified that the prevailing body of knowledge in software engineering (SE) for project management does not focus on Global Software Engineering (GSE) to ensure benefits to the organisations that manage the GSD projects. It implies that there is a requirement to develop a structured standard which can focus specifically on Global Software Engineering.

♦ In accordance with the research activities performed, the collated strategies from the literature and empirical research are mapped with the PMBOK® Guide, 2008. The mapping activity performed with the PMBOK® Guide, 2008 has helped to develop the GSD-COORD Model for coordination of tasks between distributed teams working on outsourced GSD projects.

♦ For academia, the research results provide understanding of GSD project coordination. This work can act as a roadmap to identify additional challenges that impede GSD projects. It is not claimed that the results presented are complete but the steps taken to conduct this study offer a starting point to other researchers to conduct further research. At various stages of the research, scientific papers were written about the knowledge and lessons learned from the research. These papers were peer-reviewed and accepted for publication in order to add to the established knowledge on GSD.
The new model, GSD-COORD is evaluated with a group of experts, some of whom were practitioners operating in a GSD environment. The GSD-COORD Model includes processes and strategies that can be followed to manage outsourced GSD projects. These processes and strategies are adequate, inclusive and adaptable:

- Adequate – includes specific strategies essential for coordination of the GSD project.
- Inclusive – includes strategies that can be followed to manage different stages of the GSD project.
- Adaptable – can be adapted by small as well as large software companies for both collocated as well distributed teams.

This indicates that only pivotal processes and strategies are included in the GSD-COORD Model. Each process in the GSD-COORD Model includes strategies with specific significance and practices that can be followed while managing outsourced GSD projects. The significance of each strategy implies the importance for coordination of tasks within that process. Conversely, the practices stated are the measures that can be taken to coordinate tasks while working on GSD projects.

8.6 Limitation

This research study primarily focused on the creation of a process model to support the coordination of tasks between distributed teams and team members working on GSD projects. There are certain limitations that have influenced the development of the GSD-COORD Model. It is essential to point out that I did not conduct a full systematic literature review (SLR) therefore there may be some strategies that were not included in the model. Further, there are certain stand-alone practices which were revealed during the literature review. These practices are innovative and successfully implemented in the organisations that manage the GSD projects. As they
are reported for the first time the evidence is limited. The fact is that all these practices are successfully followed to coordinate GSD projects and also answer the main research question. Hence, they are considered in this synthesis of literature.

The scope and time limitation to carry out this research study has influenced the inclusion of several other important related areas of research. The constraint on the possible number of case studies has an impact on the results of the study. The study is conducted in only one vendor country. Although India is a major outsourcing destination country, it does not represent all vendors. Also the sample is relatively small, opportunistic and not random. To verify the results of this study, it is essential to conduct similar studies in other countries where vendor software companies manage outsourced GSD projects. The research study has narrowed its focus to study only coordination strategies for GSD projects. There are various tools developed to coordinate tasks between distributed teams. However the usefulness of these tools for managing GSD projects was outside the defined scope of the research. Future work could be carried out to include the different tools to support the model. The PMBOK® Guide is the standard document for the project management process. The results of the comparative analysis focusing on coordination strategies indicates that its scope is limited when applied to GSD projects, as it does not take all the challenges and issues of GSD into account.

The GSD-COORD model described in this thesis is minimally sufficient, definitive and adaptable. It includes fundamental strategies and practices that can be used to manage GSD projects. Although this model is based on empirical evidence and has been evaluated by a group of experts, it may not meet all organisational needs. Also some aspects may not prove useful outside the context in which the model has been developed. Individuals with an interest in GSD can find some aspect with which they may not agree. The model is presented as a step to support coordination in GSD projects and is intended to form a foundation on which further research study can be built.
8.7 Research Validity

In this research study –

♦ The confidence about the internal and external validity is achieved through ‘prolonged and intense engagement’ in the field study. This has helped to build trust about the findings and to check the effect of multiple influences (Marshall, 1990).

♦ ‘Multiple source triangulation’ (Pretty, 1994) is used to strengthen the reliability about the information in this research. In relation to this, the literature review and the empirical data from multiple case studies was integrated to develop the initial framework of the model.

♦ Further, the research design also includes a focus group and expert opinion for cross-checking the information. The validation process was conducted with the experts to strengthen the credibility (Lincoln and Guba, 1985) of the research.

8.8 Future Work

There are several topics that have emerged from this research work which need to be examined further. Amongst these topics, managing cultural diversity needs further probing. It is important to validate whether the strategies followed to manage cultural diversity in Indian software companies can be implemented in other settings. The idea is to evaluate the strategies amongst the culturally diverse countries based in Europe. Along with this the Distributed Pair Programming strategy which is stated as Inconclusive needs further research. The next topic under consideration for further research is to integrate various tools that are available for coordinating tasks between distributed teams with the GSD-COORD model.
The future plan is to develop an interactive tool which will propose practices that need to be followed while implementing specific strategies suggested in the GSD Coordination Model. The tool will also demonstrate the relation of various strategies and how they are beneficial to one another.

During the validation process, the experts raised their concern about the cost factor involved while implementing the strategies from the GSD-COORD Model. As part of future research it will be important to mention the cost while suggesting the processes and strategies from the model. The Project Cost Management section of the PMBOK® Guide, 2008 can be referenced to respond to this.

The PMBOK® Guide, 2008 also includes other sections such as Project Time Management and Project Quality Management which can be studied to enhance the applicability of the GSD-COORD Model.

8.9 Evaluation of the GSD-COORD Model

The current GSD-Model is validated following an expert panel approach. As the case-study research was carried out in India which is a major outsourcing destination country, a decision was taken to conduct the validation from client’s perspective. However, the experts involved in this process were from the client country or the bridge country where the company acted as both client and vendor. To make the model more adaptable, it is important to understand the vendor’s point of view. Hence, as part of the future work, this model will be evaluated in the vendor companies.

To achieve this, the plan is to approach the software companies based in India. My working experience in India can help me to contact professionals from various software companies who can be involved in this process. The
next step will be to present the model to the professionals using the interactive tool mentioned earlier. To evaluate the processes and strategies included in the model, I aim to perform participatory observation in the vendor side software companies. Also, I wish to design a questionnaire to conduct face-to-face interviews. This will allow me to compare and discuss the processes and strategies within the model. As stated earlier the cost-factor involved in implementing each process and strategy will also be taken into consideration while evaluating the current model. Analysis of this evaluation process can help to refine and update the existing GSD-COORD Model.

The next edition of PMBOK® Guide will be published in 2014. The plan is to map the evaluated GSD-COORD Model with this new edition of PMBOK® Guide to identify any additions that can support the GSD-COORD Model.

8.10 Concluding Remarks

The development of the GSD-COORD Model is based on an extensive review of information on GSD. The information is gathered from a variety of sources both academic and industrial. The process undertaken systematically went through a well defined series of activities to extract the relevant information.

It is an important contribution to the GSD field, as it has commenced the development of a model integrating GSD with established project management practices. As a researcher I believe this study is a significant contribution to this vast and complex field of research.
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APPENDIX - A

Empirical Studies Reporting on Effective Coordination Strategies
(Derived from a Mapping Study of the Related Literature)


Theoretical Studies Reporting on Coordination Strategies
(Derived from a Mapping Study of the Related Literature)


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Appendix: C

Profile of Organisations Researched

**SysInfo Technologies Ltd.**

SysInfo Technologies Ltd. is a global leader of information technology and consulting. The company designs and delivers technology-enabled business solutions to many top companies and also provides a complete range of services by leveraging domain and business expertise and strategic alliances with leading technology providers. Their services include business and technology consulting, systems integration, product engineering, custom software development, maintenance, re-engineering and business process outsourcing. SysInfo has over 40 offices and development centers in India and internationally with over 100,000 employees. I interviewed 2 Senior Project Managers and a Junior Project Manager from this organisation.

**Dream Moon Software**

Dream Moon Software is one of India’s top twenty software companies. It was established over twenty years ago and its focus is software development for global financial services market. It has built expertise on Investment Banking, Retail Banking, Credit Cards, Corporate Banking and Life Insurance. Its corporate headquarters is in India and it has 14 worldwide offices with more than 110,000 employees internationally. I interviewed both the Vice-President and Assistant Vice-President (Financial Software Projects), two Senior Project Managers and a Software Engineer (Team Lead). One of the Senior Project Managers and Software Engineer were females.

**Mega Technology Software**

Mega Technology Software is a joint venture between an Indian company and large U.K. corporate group specialising in telecommunication. Its headquarters are located in India and has international offices and development centers with more than 70,000 employees. It is amongst the top ten software exporters in India and provides a wide variety of services including information technology strategy, consulting, design, application development, implementation, maintenance and product engineering. I
interviewed a Principal Consultant, Software Engineer (Project Manager) and Junior Software Engineer (Team Lead) from this Organisation.

**FJ Software**

FJ Software is a leading provider of IT-based business solutions for the global marketplace. They are the leading provider of customer-focused information technology and communications solutions for the global marketplace and also the world’s fourth largest provider of IT services. They employ over 160,000 employees supporting customers in 70 countries. They have a global base, particularly in the development of computing and communications products and advanced microelectronics. I interviewed one Senior Project Manager and one Junior Software Engineer (Team Lead) in FJ Software.

**Vision India Software**

Vision India Software is a small first generation Indian software company mostly handling small outsourced projects in various sectors. This company is owned by two partners. The number of employees ranges from 25-30. I interviewed female Senior Project Manager who is also the Founder Partner of this company.

**Cyber Epoch India Ltd**

This is an offshore software services company based in India which has CMMI level 5 and ISO 27001 certification. The services offered by Cyber Epoch include software development, software maintenance, software re-engineering, quality assurance, testing, customer support and establishing dedicated offshore software development centers. The company has more than 12,000 employees. It is ranked amongst the top 20 best employers in India. The business opportunity taken up by this company is that it provides flexible options to its clients to start and establish a successful relationship that helps them take maximum advantage of offshore development economics. Their offshore model is suitable to all kind of customer requirements, be it reducing the risk of developing a new product, round the clock working to reach the milestone quickly, assembling high-end and newer technology teams, reducing the cost of development or acquiring a complete technology partner. I interviewed a female Software Engineer (Project Manager) from this organisation.
Appendix: D

Web-based Questionnaires for Online Data Collection

1. Company:  

2. Name:  

3. Job Title:  

4. Number of Projects Managed:  

5. Current Project Title:  

6. Current Number of team members:  

7. Number of Male and Female team members.  

8. Common Language of Formal communication among team members:  

9. Common Language of Informal communication among team members:  

10. Classify your team members as per different part /states of India:  

11. What are the key elements which are required for a successful Indian based team:  

12. What are the most important factors you look for when selecting your team members?

13. When selecting team members which of the following factors are considered the most important.

- Domain Knowledge
- Technical Requirement
- Knowledge of English
- Cultural background
- Professional skills
- Technical Experience
- Other Language Skills
- Gender

14. What are the key activities that need to be undertaken when establishing a cohesive Indian based team? (E.g. Training)

15. What positive strengths are built on?

16. What negative issues have to be addressed?
17. What key skills do you require to coordinate and manage your team successfully?

18. Which of the following skills are of importance for managing an Indian based team?

- Technical Ability
- Knowledge of language
- Management Skill
- Knowledge of culture

19. How do female team members perform when compared to their male colleagues?

20. Is there a common language used for communication among your team members and or do they switch between languages?

21. Please state common language (If applicable):

22. Other languages used (If applicable):

23. What are the key issues you as Project Manager have to address when working with Western/Remote colleagues?
24. Do Western/Remote colleagues clearly articulate their requirements?

25. Do Western/Remote colleagues provide adequate feedback?

26. Do you feel your skills and experience has been undervalued when dealing with Western/Remote colleagues?

27. Do Western/Remote colleagues make an effort to understand Indian cultural?

28. What socio-cultural differences have you and your team experienced when dealing with Western/Remote colleagues?

29. How have you dealt with these issues?

30. How are temporal differences managed? (For e.g. Time Zone difference)
31. What advantages and skills do you and your team provide when working with Western/Remote colleagues?
Appendix: E

Questionnaires for Telephonic Interviews

1. How are the teams working on the outsourced GSD projects structured for better coordination in your organisation?

2. Do you prefer forming small, large, multidisciplinary, etc types of teams to work on the GSD projects for better coordination?

3. How are roles and responsibilities defined for each team member working on the GSD projects?

4. Do you maintain Resources Calendar and Organisational Charts for the team members working on the GSD projects?

5. How often are the team building activities carried out for the members working on the GSD projects?

6. How are team meetings organised for the distributed team members working on the GSD projects?

7. What activities are conducted for networking team members working on the GSD projects?

8. What are the different training programs conducted for the GSD team members?

9. How is the performance of teams and team members working on the GSD projects being assessed?

10. Do you need to motivate team members to work on the GSD projects?

11. Do you see any uncooperative behaviour amongst distributed teams and team members while coordinating tasks on the GSD projects? How is uncooperative behaviour managed?

12. Can you describe the role of project managers managing the outsourced GSD projects? How do project managers manage the operations of distributed teams?

13. How are various tasks allocated to distributed teams and team members working on the GSD projects? How are these tasks integrated during the ending phase of the GSD project?
14. How are visits by team members to client site and other distributed locations planned in your organisation? How long are such visits planned for?

15. How do you manage temporal differences?

16. How is the cultural diversity amongst the team members in India managed while working on the GSD projects?

17. What different cultural training programs are organised for team members working on the GSD project?

18. How do you manage the attrition that impacts the teams working on the GSD projects?

19. Is there a need to manage male and female team members differently while working on the GSD projects?

20. How do you manage the holiday’s calendar for the team members working on the GSD projects? How are the religious calendar managed for the teams and team members working from various geographical locations?

21. What are the different issues that you have to manage while dealing with the clients and distributed team members from various countries?

22. What are the technical and non-technical issues that need to be managed while working with client as well as distributed team members from various locations?

23. What are the cross-cultural issues faced while working with clients and distributed team members from various countries? What efforts are taken to overcome these issues?

24. What are different communication methods followed for coordinating tasks between client and distributed team members working on the GSD projects?

25. What are the different tools used for communication while coordinating tasks between clients and distributed team members working on the GSD projects?
Appendix: F

Questionnaires for Face-to-Face Interviews

1. Does appropriate structuring of teams help better coordination between distributed teams and team members working on the GSD projects?

2. How do different team formations (small, large, multidisciplinary, etc.) impact coordination of task between distributed teams and team members working on the GSD projects?

3. Do defining roles and responsibilities of each team and team member help improve coordination between them while working on the GSD projects? Do defining roles and responsibilities of each team and team member help to outline proper Organisational Charts?

4. Can you explain how Organisational Charts are drawn for various teams working on the GSD projects? How do Organisational Charts help improve coordination between distributed teams and team members?

5. What positive strengths are built on and what negative issues have to be addressed during the team building exercise?

6. How do team meetings help improve coordination between distributed teams and team members working on the GSD projects?

7. How does networking helps to improve coordination between distributed teams and team members working on the GSD projects?

8. How often are the training programs conducted for team members working on the GSD projects? What is the impact of training programs on coordination of task between distributed teams?

9. How are team issues between distributed teams and team members resolved? In particular the project related issues and team member related issues?

10. In what way does the performance of teams and team members affect coordination of tasks while working on the GSD projects?

11. What activities are conducted to motivate teams and team members while working on the GSD projects? How does motivation help to coordinate team members working on the GSD projects?
12. What extra efforts have Project Managers to take while managing the outsourced GSD projects? What major issues does PM have to resolve while coordinating tasks between distributed teams and team members?

13. Does appropriate task allocation help to improve coordination between distributed team members working on the GSD projects?

14. Why are onsite visits important for the GSD projects and how they help to improve coordination between distributed team members?

15. What all aspects are taken into consideration while planning onsite visits? Is there any cultural training given to team members before their visit to client site or other distributed locations?

16. Do have training on cultural and religious values of other distributed team members? Is there any language and accent training given to team members working on the GSD projects? How does such training help for better coordination between distributed team members?

17. Can you explain which different coordination activities are conducted during the Hand-on-Shake-Off Sessions? What difficulties occur while managing these sessions?

18. What extra efforts need to be taken while managing the cultural diversity of team members within a team working on the GSD projects? What facts need to be taken into consideration while managing cultural differences?

19. How does attrition impact coordination of task between distributed team members working on the GSD projects? What efforts are taken to overcome attrition?

20. How are work shifts or Time Zone difference with client teams and distributed teams managed when having female team members working on the GSD projects?

21. What all issues arise when having female team members working on the GSD projects?

22. Are the client team members aware of the issue that the vendor side team members face while working on the GSD projects? Do client side team members make any efforts to resolve such issues with the vendor team members?

23. What is communication protocol? How is it helpful while coordinating tasks between clients and distributed team members working on the GSD projects? Can explain how these Communication protocols are planned for the GSD teams?
Appendix: G

List of Codes generated for Content Analysis

1. TEAMS

1.1 TMSTRUCT Team Structure
   1.1.1 TM-SIZE Team Size
   1.1.2 TM-DEMO Team Demographics
   1.1.3 TM-FEML Female team members
   1.1.4 TM-CLTSD Team members on Client site

1.2 TMSELECT Team Selection
   1.2.1 TM-KEYELM Key Elements for Team Selection
   1.2.2 TM-IMPFAC Important Factors to select team members

1.3 TMBUILD Team Building
   1.3.1 TM-KEYACT Key Team Building Activities undertaken
   1.3.2 TM-KEYACTTM Team Meetings
   1.3.3 TM-KEYACTTRG Training
   1.3.4 TM-KEYACTINTS Interactive sessions
   1.3.5 TM-KEYACTBRS Brainstorming Sessions
   1.3.6 TM-KEYACTSOA Social Activities and Events
   1.3.7 TM-KEYACTIND Induction Program

1.4 TMSKALLO Task Allocation
   1.4.1 TM-TASKALLAM Task Allocation Methods
   1.4.2 TM-TASKALLTS Task Scheduling
   1.4.3 TM-TASKALLVH Vertical v/s Horizontal Task Allocation
   1.4.4 TM-TASKALLMB Mirroring/ Buddy System

1.5 TMISSUE Team Issues
   1.5.1 TM-NGISSUE Negative Issues
   1.5.2 TM-PRISSUE Personal Issues

1.6 TMMGMT Team Management
   1.6.1 TM-KSKLPM Key Skills Required by PM
   1.6.2 TM-KSKLIN Key Skills to Manage Indian based teams
   1.6.3 TM-OTHISS Other issue PM have to deal with teams
   1.6.4 TM-KISSRC Key issues with remote colleagues
   1.6.5 TM-MOT Team Motivation

2. CULTURE
2.1 CULLANG Languages
   2.1.1 CUL-FORLNG Formal language used for communication
   2.1.2 CUL-INFORLNG Informal Language used for communication
   2.1.3 CUL-ENGPROM English Language Proficiency

2.2 CULBKGD  Cultural Background
   2.2.1 CUL-BGNDTS Cultural Background and Team Selection
   2.2.2 CUL-BGNDTM Cultural background and Team Mgmt
   2.2.3 CUL-STRN Cultural background and strength
   2.2.4 CUL-WEKN Cultural background and weakness

2.3 CULFMGND Gender
   2.3.1 CUL-FMMSLT Female team member selection
   2.3.2 CUL-FMMARR Married and unmarried female members
   2.3.3 CUL-FMPRBGN Personal background of female members
   2.3.4 CUL-FMPERFORM Performance of female team members
   2.3.5 CUL-FMPERSMATT Personal issue & performance of team members

2.4 CULATTRI Attrition
   2.4.1 CUL-ATTRILVL Level of attrition
   2.4.2 CUL-ATRRIFMM Unmarried female members and level of attrition

3. TEMPORAL DIFFERENCES

3.1 TDTIMEZN Time Zones
   3.1.1 TD-TZDISTZ Time Zone and Distance
   3.1.2 TD-TZFLWTSN Time Zone and Follow the Sun

3.2 TDFESTTIME Varying Festive Calendar
   3.2.1 TD-FSTIND Managing festive calendar of India
   3.2.2 TD-FSTINT Managing international festive calendar

4. CLIENT ISSUES

4.1 CUSISSUE Key Issues
   4.1.1 CUS-KYISS Key issues while dealing with customers.
   4.1.2 CUS-CULISS Cultural Issues with customers
   4.1.3 CUS-REQISS Requirements Issues with Customers
   4.1.4 CUS-FEEISS Feedback from customers

4.2 CUSWKRLT Work Related
   4.2.1 CUS-WKSTR Is the work stereotypical
   4.2.2 CUS-WKRES Deserved Respect
   4.2.3 CUS-WKUNCOP Uncooperative Behaviour
   4.2.4 CUS-VENCULMNG Manage culturally diverse teams
   4.2.5 CUS-WKCLTEXP Experience of working with Clients
4.2.6 CUS-SITVISIT  Experience of visits at client site

5. VENDOR ISSUES

5.1 VENCUSISS  Vendor and Customer Issues
5.1.1 VEN-SKEXP  Vendor Skills and Experience
5.1.2 VEN-CUSADV  Advantages dealing with Customers
5.1.3 VEN-CUSCUL  Customers and Indian Culture
5.1.4 VEN-CUSSOCUL  Socio-Cultural differences with Customers

5.2 VENOTHER  Vendor and Customer Other Aspects
5.2.1 VEN-TRAIN  Training to Vendor Team Members

6. COMMUNICATION

6.1 COMMISSCUS  Communication Issues
6.1.1 COM-CUSISS  Communication Issues with customers
6.1.2 COM-LNGISS  Language/Accent issues in communication

6.2 COMMTOOL  Communication Tools
6.2.1 COM-POPTOL  Popular tools used for communication
6.2.2 COM-TOLEXP  Experience with the tools.
Appendix: H

Questionnaire: Demographic Details of the Expert

1. Name: 

2. Company Name: 

3. Address: 

4. Email ID: 

5. Job Title: 

6. Total Work Experience: 

7. Current Project Title: 

8. Number of Outsourced Projects Managed: 

9. How long have you been involved in the current outsourced project? 

10. When has the current outsourced project started? 

11. How many countries are involved in this project? 

12. When do you expect the completion of the project? 

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Appendix: I

Questionnaire: To Validate the GSD Coordination Model

Process: P1 – TEAM SETUP

1. Can you give an example where **STAFF ACQUISITION PLAN** has helped in better coordination between the team members working on the GSD project?

2. Can you explain how ‘**STAFF ACQUISITION AND MANAGEMENT PLAN**’ is useful for scheduling the requirements of team members for the GSD Projects?

3. Can you give details of specific **TEAM SELECTION** practices followed while selecting team members to work on the GSD project?

4. Can you describe how **TEAM SELECTION** helps in better coordination between the team members working on the GSD project?

5. How are **TEAMS** working on the GSD projects **STRUCTURED** in your organisation?

6. How does **TEAM STRUCTURING** help to improve coordination and competency of the distributed teams working on the GSD projects?

7. Can you give an example of how **TEAMS** are **FORMED** to work on the GSD projects in your company?

8. Which **TEAM FORMATION** method do you prefer in order to have better coordination between the team members working on the GSD project? Why?
9. How do you define **ROLES AND RESPONSIBILITIES** of each team member while working on the GSD project?

10. Can you explain if defining **ROLES AND RESPONSIBILITIES** of each team member helps for better coordination between the team working on the GSD project?

11. Can you explain how details of each team member (**RESOURCE CALENDAR**) are maintained while working on the GSD project?

12. How does the **RESOURCE CALENDAR** help for better coordination between the team members working on the GSD project?

13. How do you explain the position of various teams and team members within the GSD project? Are **ORGANISATIONAL CHARTS** used to document team member roles and responsibilities within the GSD project?

14. How are **ORGANISATIONAL CHARTS** useful to show positions and relationships within the project for better coordination between the team members working on the GSD project?

**Process: P2 – TEAM DEVELOPMENT**

15. What **TEAM BUILDING EXERCISES** are conducted so as to help team members work together efficiently on the GSD project?

16. How and when are the **TEAM BUILDING EXERCISES** conducted for the team members working on the GSD projects? How does Team Building exercise help team members to coordinate work on the GSD projects?

17. When are **TEAM MEETINGS** organized for team members working on the GSD project?

18. How are **TEAM MEETINGS** helpful in coordinating tasks for team members working on the GSD project? What activities are conducted for team members during these team meetings?
19. Can you give an example how PERFORMANCE ASSESSMENT is conducted for teams and team members working on the GSD projects?

20. Can you explain if PERFORMANCE ASSESSMENT helps to identify the strengths and weaknesses of team members working on the GSD project? Does PERFORMANCE ASSESSMENT helps to understand the need for specific training that is essential to improve team performance?

21. Can you explain how various TRAINING PROGRAMS are conducted for team members working on the GSD projects?

22. Can you explain what advantage do you gain by conducting these TRAINING PROGRAMS in order to improve coordination between teams and team members working on the GSD projects?

23. Can you explain what activities are carried out for NETWORKING (distributed) team members working on the GSD projects?

24. How do these NETWORKING ACTIVITIES help to improve coordination between teams and team members working on the GSD projects? Does Networking help to reduce cultural differences between team members working on the GSD projects?

25. Can you explain how various TEAM ISSUES can affect coordination between distributed team members working on the GSD projects?

26. How do you manage various TEAM ISSUES that arise between teams and team members working on the GSD projects?

27. How do you maintain TEAM KNOWLEDGE i.e. every team and team member’s information that is working on the GSD projects?

28. Can you explain how this information or TEAM KNOWLEDGE is helpful to coordinate work between team members working on the GSD projects?

Process: P3 - TEAM MANAGEMENT
29. Can you explain how do you **motivate** teams and team members working on the GSD projects?

30. Can you explain how **motivation** is helpful to coordinate work between team members working on the GSD projects?

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Team cognition is distinct from Team Knowledge as it is a mental process in which awareness is gained by perception, intuition and reasoning.

31. How do team members while working on the GSD projects try to gain **team knowledge** awareness about distributed teams and team members? What mechanism is put in place so that team members get aware of other teams and team members working on the GSD project?

32. Can you explain how **team knowledge** awareness about distributed teams and team members helps for better coordination of between team members working on the GSD projects?

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33. Can you explain what all **recognition and reward** schemes are followed for teams and team members working on the GSD project?

34. How do various **recognition and reward** schemes help team and team members to coordinate better while working on the GSD project?

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A shared mental model is the knowledge that team members should have in common about the various tasks that need to be performed for the GSD project (Rasmussen et al. 2008).

35. Do you think that distributed teams and team members have appropriate common knowledge (**shared mental model**) about the various tasks that need to be performed while working on the GSD project?

36. How does this common knowledge (**shared mental model**) about the various tasks that need to be performed while working on the GSD project help in better coordination between team members?

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37. Can you explain how an **uncooperative actions** (if any) within teams obstructs team coordination for GSD projects?
38. What steps are taken to resolve **UNCOOPERATIVE ACTIONS** between teams and team members working on the GSD project?

39. Can you explain how **PROJECT MANAGERS** play an important **ROLE** in team management?

40. What definite skills should **PROJECT MANAGERS** have to manage and deal with various issues that may arise within the GSD project?

41. How are all activities (**TEAM OPERATIONS**) between the distributed teams and team members synchronised with one another for better coordination in the GSD projects?

42. How do appropriate **TEAM OPERATIONS** help to gain proper control over distributed team activities in order to maintain project schedule within the GSD project?

**Process: P4 - TASK ALLOCATION**

43. Can you explain how **SCHEDULING OF TASKS** is important before allocating them to teams and team members working on the GSD project?

44. Can you explain how appropriate **SCHEDULING OF TASKS** helps for better coordination between distributed teams and team members while working on the GSD project?

45. Can you explain which different **TECHNIQUES** are followed to **ALLOCATE TASKS** to distributed teams and team members while working on the GSD project?

46. How do these different **TECHNIQUES OF TASK ALLOCATION** help to improve coordination and communication between distributed teams and team members working on the GSD project?
47. Can you explain which different methods are followed to integrate tasks that are allocated to distributed teams and team members while working on the GSD project?

48. Can you explain how team meetings are important during the integration of tasks? How often are team meetings carried out during this phase of the GSD project?

**Process: P5 – Bridging**

49. Can you explain how your team location is a Bridge site? Why your team is made a Bridge Site?

50. If your team site location is a Bridge site, what techniques were followed while establishing this Bridge site? How are interdependencies of each site managed while establishing Bridge sites?

51. How does your team site (Bridge Location) help to decrease distances and help create shorter paths among non co-located team members or workgroups working in the Bridge network?

52. How does your Bridge Location help to reduce the temporal distance and provide overlapping working hours that permit real-time communication between the remote sites?

53. Can you explain the role of project managers in the bridges? Are managerial level bridges created so that managers can interact with other managers working on the GSD project?

54. Can you explain how in managerial level bridges managers communicate with one another and if this helps to reduce the communication overheads that exist at the bridge site?

55. Can you explain how are bridgeheads incorporated at the bridge sites?

56. Can you explain how bridgeheads are selected for the Bridge locations?
57. Can you explain the role of **BRIDGEHEADS** at the Bridge location? How do they facilitate coordination in the GSD projects?

58. Do **BRIDGEHEADS** perform informal role of ‘cultural liaisons’ to bridge the cultural and linguistic differences between teams and facilitate organizational flow of communication?

59. Can you explain what **TACTICS** are followed to manage **BRIDGEHEADS** while working on the GSD projects?

60. Do **BRIDGEHEADS** often travel to other sites to improve coordination between teams working on the GSD projects?

61. Can you explain what Bridge integration strategies are followed to bring together two or more bridge locations when necessary?

62. Do you agree that ‘Maintaining joint development process documents allow for closer integration of two sites in the GSD projects’?

63. Can you explain how **DELEGATION OF WORK** is done across distributed sites in the GSD projects?

64. Can you explain how the delegation role and channels of delegation in the bridge model help in better coordination for GSD projects?

65. Can you briefly explain various other bridging approaches followed for the GSD projects?

66. What benefits do you gain in communication by establishing bridges within the GSD projects?

**Process: P6 – ONSITE VISITS**

67. Can you explain how are **ONSITE VISITS** planned for team members working on the GSD projects?
68. Can you explain how **PLANNING ONSITE VISITS** helps in coordination of the GSD project?

69. What role do the **CROSS SITE DELEGATES** (visiting team members) perform during Onsite visits for the GSD project?

70. Can you explain what role do the **CROSS-SITE DELEGATES** perform when they return back to home sites after onsite visits?

71. Can you give an example of how free and **SOCIAL TIME** is spent by visiting team members?

72. Can you explain how the **SOCIAL TIME** is important for the team members working on the GSD project? How do host team members assist on the social time for the visiting team members?

73. What is the **DURATION OF THE ONSITE VISITS**?

74. Do you believe that “Longer time spent together helps creating a personal connection between remote team members working on the GSD project”?

75. Can you give an example on how Onsite visits help to reduce cultural differences that exist between teams and team members located within various countries?

76. Can you give overall benefits of Onsite visits and how do they help in effective coordination within the GSD projects?

**Process: P7 – CULTURE**

77. Can you explain how **CULTURAL DIVERSITY** that exists between team members creates an impact while working on the GSD projects?

78. How do you **MANAGE CULTURAL DIVERSITY** that exits between team members working on the GSD projects?
79. Can you explain how **CULTURAL TRAINING** is given to team members working on the GSD project?

80. Can you give an example how **CULTURAL TRAINING** has helped team members to interpret and understand each other’s cultural while working on the GSD projects?

81. Can you explain what roles do **MALE AND FEMALE TEAM MEMBERS** perform while working on the GSD projects?

82. Can you explain how **MALE AND FEMALE TEAM MEMBERS** contribute to the GSD projects? What all difficulties do you face with female team members working on the GSD project?

83. According to you what are the main reasons of **ATTRITION** within the GSD projects?

84. How do you manage high level of **ATTRITION** that exits within GSD projects?

85. How are **FESTIVE HOLIDAYS AND CULTURAL EVENTS** from various distributed sites managed while coordinating tasks on the GSD projects?

86. How do you maintain details of the **FESTIVE HOLIDAYS AND CULTURAL EVENTS** while coordinating tasks to provide 24/7 support in GSD projects?

**Process: P8 - TEMPORAL DIFFERENCES**

87. Can you explain how various **TIME ZONE DIFFERENCES** are managed for your team and team members while working on the GSD projects?

88. How do **TIME ZONE DIFFERENCES** impact coordination of the GSD projects? Can you explain how managing these **TIME ZONE DIFFERENCES** is important to coordinate tasks while working on the GSD projects?
89. Can you explain how **HANDS-ON AND SHAKE-OFF SESSIONS** are performed by the team members working on the GSD projects?

90. What activities are carried out during the **HANDS-ON AND SHAKE-OFF SESSIONS** (overlapping hours) to coordinate tasks when working on the GSD projects? Which communication tools are used by the team members during the **HANDS-ON AND SHAKE-OFF SESSIONS**?

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**Process: P9 - MANAGING CLIENT-VENDOR RELATIONSHIP**

91. Can you explain what issues do you confront while dealing with clients from various countries? Do you classify them as **TECHNICAL AND NON-TECHNICAL ISSUES**?

92. How do you manage the **TECHNICAL ISSUES** that are confronted while dealing with clients from various countries?

93. What are the **NON-TECHNICAL ISSUES** that impact coordination while working on the GSD projects?

94. How do you manage **NON-TECHNICAL ISSUES** that are confronted by team members while dealing with clients from various countries?

95. Can you explain in brief how **CROSS-CULTURAL ISSUES** impact coordination and influence project performance while working on the GSD projects? Do you analyze them as organisational work culture issues and personal culture issues?

96. How do you overcome organisational work culture issues and personal culture issues (**CROSS-CULTURAL ISSUES**) that impact coordination while working on the GSD projects?

97. Can you explain why it is “essential that every distributed team and team member receives appropriate **FEEDBACK AND OPINION** on regular and cyclic basis with respect to the quality of the deliverables of the tasks in the GSD projects”?
98. What efforts are made to get regular **FEEDBACK AND OPINION** from various clients while working on the GSD projects? Are team members working on the GSD projects updated with this feedback?

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**Process: P10 - COMMUNICATION AND COORDINATION**

99. How is **CONTINUOUS COMMUNICATION** setup between the sites engaged in GSD project?

100. What is the role of cross-site delegates when they return back to their home teams after visiting different sites within the GSD project? How do cross-site delegates help in **CONTINUOUS COMMUNICATION**?

101. How is clear and contextual information (**UNFILTERED COMMUNICATION**) distributed amongst all distributed sites working on the GSD project?

102. Can you explain how **UNFILTERED COMMUNICATION** is helpful to teams and team members working on the GSD project?

103. Can you explain how is **URGENT REQUEST** for information related to the distributed project from various distributed teams managed?

104. Can you explain how important is it to setup **URGENT REQUEST** or broadcasting mechanism for all distributed teams in order to coordinate tasks while working on the GSD project?

105. Can you explain what process is followed for **STRUCTURED COMMUNICATION** i.e. to transmit the right information to right person at the right time while working on the GSD project? How does this help in effective coordination of tasks while working on the GSD project?

106. How are guidelines set about the tools and techniques to be used for formal as well as informal communication while working on the GSD project? Do you follow any ‘communication protocol’ for **STRUCTURED COMMUNICATION** while working on the GSD projects?
107. Can you give an example of DISTRIBUTED PAIRED PROGRAMMING that gives an advantage to work on the same task sharing 24 hour work across time-zones and handing off the work to each other?

108. Can you explain how DISTRIBUTED PAIRED PROGRAMMING is helpful to coordinate tasks while working on the GSD project?
## Appendix: J

### Summary of Questions asked to Experts

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(Note: The table continues with all experts and their responses marked 'Y' for Yes.)
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