# Team Interaction Space Effectiveness for Globally Dispersed Teams: Theory and Case Studies

by

Sanjeev Vadhavkar

Submitted to the Department of Civil and Environmental Engineering
in partial fulfillment of the requirements for the degree of

Doctor of Science in Information Technology

at the

MASSACHUSETTS INSTITUTE OF TECHNOLOGY

June 2001





Author .....
Department of Civil and Environmental Engineering
June 1, 2001

Certified by .....
Feniosky Peña-Mora
Associate Professor of Civil and Environmental Engineering
Thesis Supervisor

Accepted by .....
Oral Buyukozturk
Chairman, Department Committee on Graduate Studies

# Team Interaction Space Effectiveness for Globally Dispersed Teams: Theory and Case Studies

by

Sanjeev Vadhavkar

Submitted to the Department of Civil and Environmental Engineering
on June 1, 2001, in partial fulfillment of the
requirements for the degree of
Doctor of Science in Information Technology

## Abstract

Groups of geographically and/or organizationally dispersed members are increasingly being assembled to accomplish a wide range of organizational tasks using a combination of telecommunication and information technologies. The emergence of such technologically savvy globally dispersed teams has also heralded a complex and largely uninvestigated area of interaction practices of such team members. By enabling team interactions via non-traditional media, information technologies have actually expanded and transformed the conventional team interaction space. This merger of physical space with digital space has created a new kind of team interaction spaces, one where organizational, technological and spatial dimensions play significant roles. This research assesses the impact of team interaction space on perceived team performance using qualitative and quantitative research techniques. To collect qualitative data, interviews were conducted with 82 members from globally dispersed teams from three Global 500 companies. 45 audio, video and face-to-face team interactions between these team members were observed and analyzed. A survey on team interaction space was administered to the team members to substantiate the research hypotheses with quantitative data. Triangulating the qualitative and quantitative data, the research discovered significant correlation between the effectiveness of the team interaction space and perceived team performance. Factor, path and qualitative analysis demonstrated that organization protocols, communication technologies and spatial setup positively affect interaction space effectiveness. To explain the impact better, statistical evidence indicates that the impact of technology needs to be considered in multiple dimensions: ability, capability, reliability, accessibility and support. The research introduced team interaction space as a mediating variable to explain the role of technology, organizational processes and spatial setup on perceived team performance. The research also developed a team interaction space framework.

Thesis Supervisor: Feniosky Peña-Mora
Title: Associate Professor of Civil and Environmental Engineering

# Acknowledgments

"We, the unwilling,
led by the unknowing,
are doing the impossible
for the ungrateful.
We have done so much,
for so long,
with so little,
we are now qualified to do anything
with nothing." ... *Graduate Student Anthem*

Sincere and grateful acknowledgements to the *"We"*, the *"Unknowing"* and more importantly the *"Ungrateful"*. Special thanks to all my friends and family - in the broad, Indian sense of the words.

This dissertation is dedicated to my nephew - in the foolhardy hopes of inspiring him to a lifetime of learning.

# Contents

# List of Figures

# List of Tables

# Chapter 1

# Preface

> *You have no choice but to operate in a world shaped by globalization and the information revolution. There are two options: adapt or die... You need to plan the way a fire department plans. It cannot anticipate fires, so it has to shape a flexible organization that is capable of responding to unpredictable events.*
>
> *Andrew S. Grove*

Most of the organizational challenges in recent decades have been to design, develop, and implement new systems of a type and complexity never before attempted. The creation of these systems with performance capabilities not previously available, and within ever shrinking schedules and budgets, has required the development of new organizational methods of planning, organizing, and monitoring the teams that develop these systems. Increasingly, organizations across the globe are viewing teams as value-added partnerships where specialists with diverse expertise share knowledge, skills and access to information repositories, thereby increasing the overall effectiveness of the organization. In today's business environment, members of project teams may be dispersed across many physical locations and time zones and even organizations. It is no secret that a key component of successful, twenty-first century organization will be the effective use of globally dispersed teams.

Fortunately, this period of radical organizational change has been accompanied by an equally radical change in communication technologies. Thanks to video conferencing systems, project web sites and real-time application sharing, among others, teams can now be effectively reconstituted from formerly dispersed members across the globe. Globally dispersed teams with groups of geographically and/or organizationally dispersed coworkers are increasingly being assembled using a combination of telecommunications and information technologies to accomplish an organizational task. Global teams are also being conceived to address evolving inter-organizational challenges that occur when organizations outsource some of their key processes to more specialized firms. By creating globally dispersed teams, firms can ultimately realize the competitive synergy of teamwork and exploit the burgeoning revolution in telecommunications and information technology.

Significant advances in communication technologies have opened a vast array of electronic environments at the disposal of such globally dispersed team members. In addition to traditional phone or voice mail, there are web-based collaborative tools and video conferencing systems offering a plethora of choices for synchronous and asynchronous interactions. The emergence of technologically savvy globally dispersed teams has also heralded a complex and largely uninvestigated area of interaction practices of such team members. By enabling team interactions via non-traditional media, unrestrained by geographical and temporal constraints, communication technologies have actually expanded and transformed the conventional team interaction space. This merger of physical space (for example meeting rooms, lecture halls) with digital space (for example, project web sites, electronic mail, computer environments) has created a new era of team interaction spaces, one where organizational, technological and spatial dimensions play a significant role. The team interaction space can support and enhance how the globally dispersed team actually performs work. Taken together, organizational, technological and spatial dimensions constitute a dynamic team interaction system: a change in any one of the dimensions requiring a reinforcing change in the others. Achieving, maintaining and sustaining these reinforcing change

loops between the various dimensions of the team interaction space has become a requirement and a challenge for globally dispersed teams.

Despite the ever-growing number of globally dispersed teams, we are nevertheless brought up short by the realization that there is still much to be learned about the art of measuring and monitoring effectiveness of such teams. We now understand many of the anecdotal rules to create the proper team interaction space in which global teams can blossom and flourish; yet we remain unable to "guarantee" that any given team will reach its goals or be anything more than modestly successful. There is no template for the evaluation of team effectiveness that can be adequately applied across every conceivable instance of a global team. Impacts of a structured team interaction space on the overall effectiveness of such teams remains anecdotal and filled with recipe-driven to-do lists. To address the issue of effectiveness of globally dispersed teams, this dissertation highlights a framework based on team interaction space and presents case studies highlighting the theoretical foundations for the framework. The effectiveness framework in this dissertation presents key concepts from the research on team interaction space that team members and team leaders should consider when developing the program of evaluation of team effectiveness, including questions about the why, when, how, who, and what to evaluate. The focus of this framework is to provide a structured look at the team interaction space on the whole and increase the effectiveness of the team interaction space to affect the perceived team performance.

The elements of the effectiveness framework for globally dispersed teams are based on a key hypothesis that team interaction space can be controlled to increase the effectiveness of globally dispersed teams. The research hypotheses on the team interaction space are hierarchical and grouped together under individual, team, organization, technology and infrastructure. From an individual perspective, it is hypothesized that the recognition and performance appraisal at the functional or local level on the individual's role on a global team moderates the individual's performance on the global team. For the team, it is hypothesized that structured team interactions are neces-

sary for increasing the effectiveness of globally dispersed teams. From an organization perspective, there are two key hypotheses. Firstly, it is hypothesized that there are hierarchical differences in the way team effectiveness is perceived, which negatively affects perceived team performance. Secondly, in globally dispersed teams, a strong organization culture is expected to subsume underlying ethnic and national cultures. Organization culture is perceived as the glue that ties different ethnic and national strings together for an effective globally dispersed team. In term of technology used to communicate in globally dispersed teams, it is hypothesized that technology impact to global team effectiveness needs to be considered on different fronts: technology ability, technology capability, technology compatibility and technology availability. From an infrastructure standpoint, it is hypothesized that management of the intersection of digital and physical spaces is an integral part of the roadmap for increasing perceived team peformance.

The sequence of chapters in this dissertation essentially revolves around the various elements of the effectiveness framework for globally dispersed teams based on team interaction space. In addition, the chapters in the dissertation are grouped together in four parts. The first part of the dissertation concentrates on the origins of globally dispersed teams presenting some data reported on the effectiveness of globally dispersed teams from a number of different sectors.

The second part of this dissertation introduces the team interaction space framework. The chapters in this part deal with the basic elements of the effectiveness framework. The framework starts with the identification of the team interaction space and identifies three components: organizational processes, communication technologies and the spatial setup. Team context and team processes identified from the team interaction space help identify the barriers to team effectiveness which are covered next in Chapter 4. Data from the team interaction space and the identification of barriers to team effectiveness helps in positioning the team under review in a team effectiveness continuum. The chapter on effectiveness continuum identifies some of

the effectiveness measures prevalent in academic as well as non-academic settings. As part of the effectiveness framework, a new spiral effectiveness continuum model is proposed along with steps to help position global teams in the continuum.

Third part of the dissertation presents detailed case studies carried out by the Massachusetts Institute of Technology (MIT) research group on globally dispersed teams. The research group looked at a number of cross-functional globally dispersed teams at multiple organizations and tested some of the hypotheses presented in the effectiveness framework in this dissertation. Observations and data analysis from three different teams is presented as case studies. "Engineering and Operations Team" has members in United States, Asia and Central America looking at engineering, manufacturing and quality operations of a family of hi-tech components. "Tools and Methodologies Team" has members in United States, Europe, Mexico and South America looking at next generation of information technologies and protocols and procedures to support the introduction of these technologies all across the organization. "Intra-Organizational Logistics Team" has members in United States and Japan from two organizations looking at logistics issues of supplying parts to manufacturing plants of the two organizations.

The last part of the dissertation concentrates on diffusing the learning from the research group's efforts on global team interaction space. In particular, efforts and activities that need to be carried out to measure, monitor and increase effectiveness of globally dispersed teams by observing, maintaining and sustaining an effective team interaction space.

In the interaction space arena, some of the key questions are: How do we better understand the systematic ambiguity of the work environment and use it as a positive force in designing the workplace? How do we make the work space complete enough to satisfy needs but not so complete as (perhaps) wrongly to anticipate them? How do we make work visible, to the actor and the observer alike, from many perspectives

and distances? How can we avoid overlooking the uses of "low" technology? How do we help people to overcome old images of the workplace (unless appropriate)? How do we structure privacy and community, or withdrawal and return phrase? What are the qualities of physical proximity in work and how do we manage them? How do we better provide for the mobile workplace? How do we blur boundaries in the interest of multiple use and flexibility? How should we present the resources necessary for those interested in conceptualizing, designing, and building contemporary workplaces, using the Internet for this purpose? What are the physical embodiments of the data interface that will support the perceptions and interactions characteristic of the virtual workplace? What does it mean to build electronic appliances as intrinsic to the workplace, not appendages to it? How do we extend our concern with diversity to accommodate many work styles and circumstances? (Horgen, Schon, Porter & Joroff 1998)

This dissertation could be of benefit as a reference for concepts and methods for global teams as well as a framework for increasing the effectiveness of globally dispersed teams. With this mind, the dissertation services three audiences. The first audience is low- to mid level managers who are increasingly faced to operate, manage and successfully implement teams with members who are in geographically separated locations. This dissertation could also be used as a reference for the practitioner who is aware of team building techniques, but would like to gain a surer footing, considering the distributed nature of the global teams.

The second audience is universities and colleges that are beginning to understand the importance and implications of the global teams. Universities and colleges are introducing courses with the students separated across geographical and temporal boundaries. This dissertation is intended to teach the students, techniques that allow teams to evaluate effectiveness of globally dispersed teams by looking at the team interaction space. With the help of the dissertation, the students will develop a practical and deeper understanding of the advantages and limitations of team interaction

space, and will be able to implement improvements in order to minimize the limitations.

The third audience for this work is university and educators exploring distance learning in a project context. The dissertation could benefit the distance learning endeavor as it highlights a framework to identify and increase the effectiveness of team members that are separated across geographical boundaries by looking at the team interaction space.

# Chapter 2

# The Origins of Globally Dispersed Teams

*Coming together is a beginning. Keeping together is progress. Working together is success.*

*Henry Ford*

Rapid advances in communication technologies and globalization of products, processes and markets is fueling a transition toward new organizational forms. One such form is the virtual organization (Ahuja & Carley 1998), (Byrne 1993), (Davidow & Malone 1993), (Grenier & Metes 1995), which consists of individuals collaborating and working out of globally dispersed locations (Fulk & DeSanctis 1995). Virtual organizations, thus, rely on globally dispersed virtual teams for obtaining member participation and coordinating individual effort in productive work. Technology and the availability of information are both drivers of, and driven by, these radical changes. A recurrent theme in organizational design throughout the 1990s has been the use of global teams to achieve greater levels of performance on tasks: "... *teams and good performance are inseparable: you cannot have one without the other...*" (Katzenbach & Smith 1993).

Hartman & Guss (1996) provide a preliminary view of a new era of organiza-

tional investigation into these virtual organizations and their functional units, virtual teams. The question posed is whether a shift to virtual organization is constrained more by technology or by corporate culture. Discussion of key factors for success and known technical and cultural challenges provide some practical ideas for making virtual teams work. A preliminary conclusion on the basis of a literature review suggests that the social and corporate cultural barriers are more significant than technological barriers in promoting the growth of virtual teams (Hartman & Guss 1996). These pressures have forced the focus on organizing principles in a traditional organization to shift towards electronic interaction to demand interactive, knowledge intensive participation (Andriessen 1995).

Despite the optimistic settings for globally dispersed teams, it should be noted that such teams do not just happen (Jarvenpaa & Ives 1994). The dispersion between team members in location, time, language and culture makes common issues of communications, team interactions, team building and productivity a significant challenge to most organizations. Cases abound where management struggles with pressures unique to this type of organizational structure (Kurland & Bailey 1999). Integration aspects of globally dispersed teams are often overlooked resulting in well-documented team failures. Team leaders and members are faced with the delicate tasks of setting up goals and responsibilities, managing the team interaction process, managing diverse cultural expectations, and monitoring the team for accountability. In addition, pressure from cost, quality and schedule issues exist for virtual teams as well (Lindstaedt & Schneider 1997).

## 2.1 Globally Dispersed Virtual Teams

This dissertation relies on Katzenbach & Smith's (1994) definition among the many definitions of 'team': "*... a team is a small number of people with complementary skills who are committed to common purpose, performance goals, and approach for which they hold themselves mutually accountable...*" There are several definitions

for globally dispersed virtual teams. "*... virtual teams are cross-functional teams that operate across space, time, and organizational boundaries with members who communicate mainly through electronic technologies...*" ((McShane & Gilnow 2000), p. 271). There are several types of virtual teams, depending upon task, membership, and role (Duarte & Snyder 1999). Virtual teams are more complex than regular teams because they cross boundaries of time and distance and because communication relies entirely on technology . Virtual teams must over communicate; team leaders must be much more deliberate and structured in their communication and coordination efforts (Duarte & Snyder 1999).

## 2.2 Case for Collaboration

"*... one of the thorniest problems... how to get all those individuals working together compatibly and productively, even though face-to-face contact was limited...*" (Gerber 1995).

Gerber (1995) highlights virtual team members' real experiences and challenges from Hewlett Packard, Price Waterhouse, Lotus Development, Eastman Kodak and Whirlpool. These corporate giants had similar advice:

- Working face-to-face is necessary to form relationships and to become familiar with one another's work style and temperament.
- Valuable and informal team-building sessions occur outside business hours.
- Informal meetings help team members' size up each other.
- "It's important to develop some level of trust and relationship before you can move into electronic communication."
- Some companies regularly have a face-to-face "bonding fest" to kickoff a new project that will be completed by virtual team members.

Hamlin (1994) discusses the successful redesign of Apple's global procurement system into a network of globally dispersed teams. McGarry (1994) highlights the importance of global-local tensions while presenting the case about Xerox Canada's efforts and successes in redesigning operations to produce global product development teams. Melymuka (1997) presents the organizational need for virtual teams with a brief description of virtual teams at ARCO Alaska, Lockheed Martin and General Electric. Maruca (1994) uses an interview with the CEO of Whirlpool to highlight the key differences between "realizing a strategy locally" versus "going global". Maruca (1994) suggests the difference is fundamental (in the way the business functions in each of the subsidiaries as well as in the nature of the relationships between the headquarters and the subsidiaries).

To emphasize the importance of applying learning across different industries, Hartman & Ashrafi (1996) present findings from a pilot study on globally dispersed teams in seven different industries: product development, utilities, oil and gas, entertainment, infrastructure (traditionally government), systems development and construction.

## 2.3 Challenges facing Global Teams

Grenier & Metes (1995) address the complexity of initiating and establishing globally dispersed teams in organizations, and deals directly with challenges facing executives, managers and team members themselves. Grenier & Metes (1995) present a model for globally dispersed team operations that includes: work processes or tasks; teaming; team interactions and learning. Henry & Hartzler (1998) list three challenges to increasing the effectiveness of globally dispersed teams:

- Challenge # 1 is to provide direction and focus for the team.
- Second challenge deals with the team processes. This pertains to establishing a set of values/principles and operating agreements/expectations so that au-

tonomous team members know what kinds of decisions to make, what methods to use for consistency, and how to support other team members.

- Challenge # 3 is to keep the synergy and creativity flowing without day-to-day interaction and use communication as the vehicle for creating this synergy.

Henry & Hartzler (1998) provide 24 designs of synchronous team interaction spaces that any team leader or facilitator can follow to directly address the three challenges listed above. Kostner (1996) uses the background of King Arthur's round table to identify the three enemies to managing globally dispersed teams: geography, isolation and history. Building trust and communication processes are identified as the essential underpinnings for effective globally dispersed teams (Jarvenpaa, Knoll & Leidner 1998b), (Jarvenpaa, Knoll & Leidner 1998a).

Coutu (1998) found that globally dispersed teams with the highest levels of trust tended to share three traits. First, they began their interactions with a series of social messages-introducing themselves and providing some personal background-before focusing on the work at hand. This initial period of electronic "courtship," as Coutu (1998) calls it, appears to be particularly important in establishing knowledge-based trust in globally dispersed teams. In the absence of day-to-day interaction, Kostner (1996) emphasizes establishing group norms that emphasize the roles of social contact during team interactions. Lipnack & Stamps (2000) focus on team process, structure and communication to understand how a globally dispersed team operates. To understand the dynamics of globally dispersed teams, Lipnack & Stamps (2000) consider the basic principles of effective globally dispersed teams to be threefold: people - purpose - links. O'Hara-Devereaux & Johansen (1994) address the complexity of globally dispersed teams by looking at five different dimensions of language, context, time, power and information flow. O'Hara-Devereaux & Johansen (1994) provides a seven-stage model of team development, and specific content, decision and communication considerations in each of the seven stages, from orientation to renewal.

## 2.4 Dispersion in Globally Dispersed Teams

Using Ancona & Caldwell's (1992) definition, globally dispersed teams are designed with deliberate differences in demographic diversity and technical specialization. Diversity in groups and teams is often portrayed as a positive force leading to effective functioning of the team. Focusing on a wide number of dimensions of diversity including differences in age, education, organizational tenure and functional background, Armstrong & Cole (1995) found that diversity leads to greater variance in ideas, creativity and innovation, thus generating better team performance.

Studies have also found that demographic diversity can influence group processes. In fact, diversity can influence group processes in contradictory directions. For example, diversity has been shown to have negative effects on both group cohesion (III, Snyder & Boothe 1993) and the frequency or quantity of communication (Smith & Kearny 1994). However, diversity can also lead to enhanced creativity and innovation by generating greater variance in decision-making alternatives (Armstrong & Cole 1995). Heller (1994) urges that mid to senior level managers need to develop genuine global outlook towards dispersion to effectively oversee organization functions and markets.

## 2.5 Team Interaction Space

Globally dispersed teams are characterized by a considerable amount of interaction that is conducted synchronously and asynchronously using communication technologies (Monk & Watts 1998). While geographic dispersion or temporal displacement among team members typically drive these interactions, it is the degree of online interactions, not the dispersion or displacement of the team, that characterizes a team as virtual. This means that a group that is collocated but still conducts the majority of their interaction online may be considered a virtual team.

There is a large body of research that suggests globally dispersed teams interact less effectively than face-to-face groups (Chidambaram & Jones 1993), (Hightower & Sayeed 1996) and (Warkentin, Sayeed & Hightower 1998). This research proposes that the lack of social cues: paraverbal (tone, inflection, and volume) and nonverbal (body language such as eye contact, facial expression, and hand gestures) in computer-mediated communications significantly degrades the flow, context, and content of team interactions. McGrath & Hollingshead (1994) suggests that interactions among globally dispersed team members differ in several key areas from face-to-face teams. Researchers frequently observe more equal participation among members of globally dispersed teams. This equality of participation is attributed to lower status members being less inhibited in computer-mediated interaction environments. In the absence of the interaction context and a failure to develop strong personal relationships, global team interactions also tend to be more focused on task execution and less on social behaviors. Studies have also found that individuals express more negative and uninhibited messages during computer-mediated interactions. Finally, globally dispersed teams have more difficulty in reaching consensus than face-to-face teams. Researchers attribute this finding to a lack of interpersonal feedback and reduced concern with social norms.

Critics of this research argue that the findings are limited because the groups in the studies were ad hoc, and the time period was not sufficient to establish effective working relationships. "*... as workers increasingly interact in a virtual mode, it is imperative that they rebuild the interpersonal interaction necessary for organizational effectiveness...*" (Townsend, DeMarie & Hendrickson 1998). Recent research on this topic suggests that the differences between global and face-to-face teams may not be as predominant as earlier implied. Studies have found that globally dispersed teams may communicate as effectively as face-to-face groups provided they have sufficient time to develop strong relationships and adapt to the use of collaboration technologies (Townsend et al. 1998), (Chidambaram & Jones 1993), (Warkentin et al. 1998). Townsend et al. (1998) believes that although a virtual working needs to overcome

a few challenges it can also recreate the way work is done. "... *within the virtual connection lies an opportunity for efficiencies and team synergy unrealized in traditional work interaction...*". In Scharlott & Christ's (1995) study, computer-mediated communication was found to "... *help users overcome relationship-initiation barriers rooted in sex role, shyness, and appearance inhibitions...*" Computer-mediated communication was found to be beneficial in helping some individuals meet and form relationships, especially those who have had difficulty doing so because of cultural, gender or appearance inhibitions (Scharlott & Christ 1995).

Members of globally dispersed teams face many challenges, however. They must communicate the detail and the nuances of much communications in written text, without the assistance of paraverbal and nonverbal cues (Sproull & Kiesler 1991), (Kielser, Siegel & McGuire 1984). Members of internationally dispersed teams may not share a common first language or business culture (Davison 1994), (Davison, Hambrick, Snell & Snow 1996), (Henry & Hartzler 1998) and (Davison & Ward 1999).

The fact remains that facilitating interaction space for globally dispersed team members requires all the finesse and skill of facilitating a face-to-face meeting or workshop experience. "... *When you get online, remember everything you've ever known about designing and facilitating group process. Just ask yourself: How can we move these virtual chairs into a circle?...*" (Eunice & Kimball 1997).

### 2.5.1 Communication Technologies

"... *A technology that spans space and time causes us to rethink what we meant by the terms organizational boundaries and organization...*" (Goodman & Sproull 1990). Over the last decade, business organizations have used advances in communication technologies to transform their organizational processes. "... *virtual teams must over communicate; team leaders must be much more deliberate and structured in their communication and coordination efforts...*" (Duarte & Snyder 1999). To identify the communication needs for globally dispersed teams, Finley (1995) describes the

technologies that support the four Time/Space dimensions: Same Time/Same Place, Same Time/Different Place, Different Time/Different Place and Different Time/Same Place. Miller, Pans & Naude (1996) discuss the use of communication technologies to address the interaction needs of globally dispersed teams. Alavi, Wheeler & Valacich (1996) found that learning can occur among and across globally dispersed team members using technology-based communications. Alavi & Yoo (1997b) used two alternative communication technologies: an asynchronous e-mail system and a synchronous technology called Beta system in a controlled study of 206 executives. The executives worked in small virtual teams over a ten-week period to complete a complex and realistic project designed to enhance their individual learning. None of the team members were collocated-located and therefore no face-to-face interactions occurred during the project execution. The study showed that learning is impaired if the team members have not mastered the communication technologies used by the teams. There has been considerable discussion of the role of computer-supported communication technologies in supporting and enhancing the work of global teams (Ives & Jarvenpaa 1996) and (Nohria & Eccles 1992). Networked communication technologies have the potential, if used appropriately, to improve coordination-ordination among members of project teams (Allen & Hauptman 1990), (Gorton & Motwani 1996) and (Keen 1987).

While fostering information sharing, communication technologies must also help globally dispersed teams create a shared social reality (Boland, Tenkasi & Te'eni 1994). Krauss & Fussell (1990) define shared social reality as the set of norms, behaviors, and understandings team members have about the task, work, contexts, jargon, and assumptions necessary for effective and successful collaboration. However, it should be noted that complete reliance on communication technologies for information-sharing has its own set of problems. For example, unevenly distributed information, private communication that leaves other participants uninformed or mistaken in their assumptions, and a tendency to fail to communicate information about context (Cramton 1997); insufficient richness to convey context and socio-emotional issues (Kydd & Ferry 1991), (Rice & Gattiker 1999); and information sharing that

makes decision processes too explicit, accountable, and ones that can be monitored by others (Bowers 1994).

### 2.5.2 Group Processes

Previous studies have examined the relationships between team performance and a variety of group processes. These include comprehensiveness and speed of the strategic decision-making process (Frederickson & Iaquinto 1989) and training (Adelman, Christian, Gualtieri & Bresmick 1998). Group processes have also been shown to intervene in the relationship between diversity and group performance (Smith & Kearny 1994). The central arguments behind the study of group processes pertain either to group processes that provide greater efficiency (for example, reducing costs or increasing speed in decision-making) or greater effectiveness (for example, making better decisions).

"The structures and methods that managers use to achieve their goals will have to change. Perhaps the most fundamental transition in group processes will be the shift that management will have to make from directing action to ensuring the smooth function of group process" (Davidow & Malone 1993). Traditionally, much of middle management's function has been to serve as an information channel from top management. This function is greatly reduced while managing globally dispersed virtual management. Top management, more and more, must become coaches and cheerleaders. "Hierarchical and directive management will turn into a management fiasco for the virtual corporation" (Davidow & Malone 1993). Management will still set goals, measure results, direct strategy, put work processes in place, and establish the environment to ensure these group processes work effectively.

Coaching becomes more important in virtual team settings as team membership spawns different regions, departments and even organizations. "... *Coaching is unlocking a person's potential to maximize their own performance. It's helping them learn rather than teaching them...*" (Whitmore 1996) presents the GROW model for

coaching: set goals, discover current reality, generate options, and establish accountability for a way forward. Whitmore (1996) identifies five basic coaching skills:

- Asking leading questions
- Following the team's interest
- Listening to the team's voice and tone
- Reflecting back
- High personal self-awareness

### 2.5.3 Support Systems for Global Team

One of the main reasons for the popularity of global teams in today's organizations can be traced to the fact that global teams provide a mechanism to deal with the complexity in the environment (Manz & Sims 1993) and (McShane & Gilnow 2000) allowing for a more participative or democratic approach (Bass 1990) and (Eunice & Kimball 1997). Organizations of the future will be those that find "*new ways of working across boundaries, through systems, processes, technology, and people*" (Duarte & Snyder 1999) and those that develop teams which allow more efficient means of allocating resources (Manz & Sims 1993).

A vast amount of the literature on global teams discusses the critical role of the team leader (Sarker, Lau & Sahay 1999) and (McShane & Gilnow 2000). Virtual teams rely heavily on the leader, one typically outside of the group, to assist members in achieving a high degree of coordination, a shared understanding among members of the overall goals to be achieved, and an understanding of individual members' values and belief systems (Sarker et al. 1999). Based on Mattessich & Monsey's (1992) review of the research on collaboration, shared vision constitutes a key factor in the success of global teams. Mattessich & Monsey (1992) found that the success of the collaboration will depend on the degree to which members have the ability to compromise and view the work of the team as being in their self-interest. Howell, Bowden,

Dorfman, Kerr & Podsakoff (1990) recognized that there are certain attributes of the follower, organization, or task that can negate the leader's ability to enhance or decrease a follower's performance in a team. A leader may be able to enhance follower performance if the leader chooses a directive style and provides initial guidance for the employee. The leader can possibly adopt a more participative style as the follower gains expertise. Snow, Snell, Davison & Hambrick (1996) describes a two-year study of international teamwork at thirteen companies and provides a model for team leadership that includes a changing role from advocacy at team startup, to a catalyst as the team evolves, to integration as the team matures.

Another team of researchers also stresses the importance of the leader's role in the virtual team interaction space. Duarte & Snyder (1999) emphasize that although many traditional leadership theories and practices can be applied in a virtual environment, global team leadership will experience unique situations and challenges. They find that a successful global leader will understand the fundamental principles of team output and accountability. The team leader will not allow time and space to modify the importance or completion of task goals. Autonomy, participation, and empowerment are important objectives, but the team must not lose sight of the task. The team leader must be able to match technology to the task, the team life cycle, and the team members' backgrounds.

Traditional models of leadership emergence have identified task-related contribution, speaking behavior, and power orientation as key predictors of leadership emergence in face-to-face environments. However, while looking at the interaction space of globally dispersed teams, an individual's skill in using communication technologies and the use of the technology could become important predictors of leadership emergence. Indeed, the role of speaking behavior in predicting leadership emergence would be diminishing in interactions between globally dispersed team members. Alavi & Yoo (1997a) propose a leadership emergence model for globally dispersed teams based on a data set collected from twenty-eight virtual teams working over a period of

ten weeks. The model suggests that for team leaders to be influential, they must excel in electronic communication technologies besides traditional communication skills.

Management controls the resources required for teams to be effective. While little previous research relates directly to management support (Campion, Medsker & Higgs 1993) and (Shea & Guzzo 1987), it seems clear that the level of management support is positively related to the ability of teams to perform. Sundstorm, Meuse & Futrell (1990) demonstrated a positive relationship between an organizational culture that is supportive of teams and team effectiveness, although for a collocated team.

Just as the organizational culture must support global teams to ensure their effective performance, management support for cultural diversity should also be positively related to the performance of culturally diverse global teams. For example, Cox (1993) suggests that the climate for diversity influences individual affect, which in turn impacts employee contributions to the organization. Research that shows the importance of the value congruence between the firm or management and its employees (Meglino, Ravlin & Adkins 1989) is consistent with the notion of the effect of a supportive climate on individual and team performance.

In the context of globally dispersed teams, training becomes even more important to the corporation, as employees must be competent with communication technologies and teamwork skills required to make teams effective. The adequacy of training, including technical and team skills, has been shown to be significantly and positively related to both employee satisfaction and managerial judgments of team effectiveness (Campion et al. 1993). Data indicated that variables both "internal" to the team (e.g. workload sharing) and "external" (e.g. managerial support) could significantly predict team effectiveness (Campion et al. 1993). The key learning point is that for teams to be maximally effective, attention must be paid not only to what is happening inside the team (e.g. team development, process, conflict management, etc.), but also to what is happening outside of the team (e.g. support from formal

leaders, relations with other teams, etc.) Pearce & Ravlin (1987) suggest that initial training for teams should include training in group decision making and the job skills necessary for accomplishing multiple skill tasks. Despite the intuitively obvious need for team training and a significant amount of research, the empirical evidence in support of the link between the level of team training and team effectiveness is not conclusive (Campion et al. 1993) and (DeMuese & Liebowitz 1981). Hequet, Lee, Picard & Stamps (1996) urged that the best way to accommodate geographic diversity in globally dispersed teams is to give all team members the same training, regardless of location, and then turn them loose to learn how to work together.

### 2.5.4 Collaboration-Enabling Infrastructure

Winston Churchill once said "... *There is no doubt whatever about the influence of architecture and structure upon human character and action. We make our buildings and afterward they make us. They regulate the course of our lives...*" (Brand 1995). One of the most difficult things for globally dispersed teams is for members to "see" and "feel" what's happening above and around them in the organization. In the absence of physical contact to key parts of the organization, team members often feel disconnected which may adversely affect their effectiveness. When teams are collocated-located, members often sit in on briefings, company announcements, and meetings of related teams. This problem is exacerbated when there is a critical mass of members in one location and smaller groups elsewhere who will always feel that they are missing out on the action (Latane, Liu, Nowak, Bonevento & Zheng 1995).

Workplaces continue to get more crowded, noisy, and distracting as globally dispersed team members deal with varying conditions at local workplaces. Team performance is therefore greatly influenced by the physical workplace. Both the body and the mind are affected by workplace factors (Li & Williams 1999). The sensory environment consisting of sights, sounds, and physical sensations, can quickly overload an individuals' information processing capacity and reduce productivity. Variables such as the complexity of work and individual coping behavior must be dealt with as the

physical workplace is set up. Individual and team workspaces must allow users some flexibility and control if organizations wish to optimize the "*intellectual capital*" they have invested in developing.

With all the literature devoted to change in the workplace, discussing either the role of technology or the need to restructure organizations, little attention has been paid to the physical workplace and how space can limit or shape both work and the application of technology. Becker & Steel (1995) look at workflow patterns, the status and identity aspects of space and location, the need for flexibility, the growing role of teams, health factors, and the unique characteristics and technological requirements of globally dispersed team members. With graphic illustrations and examples from Levi Strauss, Chrysler Corporation, Steelcase, Chiat/Day and others, Becker & Steel (1995) show how to plan, design, and manage a total workplace in which space is a tool for achieving business goals, not a drain on profits.

Based on a four-year research project of the Space Planning and Organization Research Group (SPORG) of MIT's School of Architecture and Planning, Horgen et al. (1998) explores how to impact work processes through workspace — processes that are already impacted by the company's culture, resources and technology. Furthermore, Horgen et al. (1998) explores how the workplace interacts with work practices, introducing proven strategies and providing a sound framework for creating the workplace of the future. Horgen et al.'s (1998) "process architecture" framework presents a design development approach that responds to an organization's request for a changing workplace, or "workplace-making." Using cases from MIT Research Building, Somerville Hospital, Ainsley Building, and Pensacola Project, (Horgen et al. 1998) provide a comprehensive explanation of the approach and framework "Process architecture" has four characteristics: 1) It moves toward the objective of dynamic coherence - Space, Organization, Finance and Technology are in sync. 2) It extracts benefits from uneven development - cause and effect of innovation from one part of an organization to another. 3) There is an ongoing process of design inquiry - does

not begin with a clear objective & proceed systematically, a coherence between workplace and work processes are followed by a benefit from the "workplace – making" process to the entire organization. 4) Its participants are collaboratively engaged - management and stakeholders benefit more to needs of the organization when they are involved in the "workplace-making process."

Zelinsky (1998) presents "alternative workplaces" to cater to globally dispersed team members. Using examples, plans, designs, and photographs of twenty major corporations - from IBM to Pacific Bell Zelinsky (1998) identifies the following steps for creating "alternative workplaces": is the first design guide to the newest trends in office design today. Designers, facility managers, executives and real estate professionals will find the most cutting edge information on: sell the concept to senior management; deal with up-front technology expenditures; provisions the telecommuter's home office; apply traditional policy and law in the environment. Kurland & Egan (1999) suggest that the challenges of teleworking may be addressed through specified guidelines, including an outline of scheduling, communication expectations, telecommuting eligibility, performance expectations, expense policies, and how to maintain healthy collegial relationships.

Smith & Kearny (1994) show readers how to design workplaces so they support good performance, instead of getting in the way by drawing on research from environmental and cognitive psychology, workplace design, human factors, organizational behavior, and performance technology. Starting with the premise that mental and physical workloads can cause overloads in teams, Smith & Kearny (1994) illustrate the connections between physical and sensory work environments and team performance. Overloads typically affect people in different ways. For example, individuals that are known to be high screeners (employees that can filter out distracting noises while working), can normally work in noisy work areas without having any problems stemming from mental overload. In contrasting, low screeners are employees that have more difficulty filtering out distracting work noises, and typically have more

stress related illnesses. Once it is determined how a person deals with distracting work environment noises, they can be more closely matched with work environments that minimize mental overloads.

Human performance is greatly influenced by the physical workplace. Both the body and the mind are affected by workplace factors. The sensory environment consisting of sights, sounds, and physical sensations can quickly overload individuals' information processing capacity and reduce productivity. Workplaces continue to get more crowded, noisy, and distracting as cost-saving measures pack people closer and closer together. Variables such as the complexity of work and individual coping behavior must be dealt with as the physical workplace is set up. Individual and team workspaces must allow users some flexibility and control if organizations wish to optimize the "intellectual capital" they have invested in developing. All workers need adequate work surfaces to spread out materials, storage space, adequate lighting, and furnishings that fit their bodies. To work productively, knowledge workers need the ability to remove or postpone interruptions. Workers with routine tasks need visual and auditory stimulation to stay focused on their work.

## 2.6 Information Sharing in Global Teams

In many organizations, there is a cultural bias against information sharing. Ash (1997) talks about information silos in every company; Myers & McLean (1997) note that individual performance evaluations don't generally consider information sharing, that many managers lack the commitment to share information, and that staff see too few role models to emulate. Allee (1997) reports data from companies like Chevron that are now realizing that the development and sharing of best practices (information about activities which led to knowledge that was applied to a given situation) leads to a dramatic, positive impact on the business bottom line. Davenport (1997) includes information from more than 30 major firms to contend that in today's information rich environment, organizations must create organizational behavior, information systems

and team processes to combine and integrate the wide and diverse sources of data and information.

## 2.7 Team Performance

There are a number of theories that discuss the developmental stages of team performance. One of the most widely used team performance theories, advanced by (Tuckman 1965) is comprised of five stages: forming, storming, norming, performing, and adjourning. Initially, during the socialization phase of team formation, members are just beginning to learn about one another. The group then moves into the storming stage, where members become more proactive and take on specific tasks and roles. A real sense of cohesion in the group develops in the norming stage. During the performing stage there is an increase in task performance as deadlines approach. Finally, like most teams, the task ends and the team adjourns.

Lacoursiere (1980) developed a five-stage model that portrays the group as being a living organism that responds to stresses in the environment and either matures as a result of the stress or dies. Lacoursiere's (1980) model states that teams progress through orientation, dissatisfaction, resolution, production, and termination stages and the model shares many similarities with Tuckman & Jensen's (1977) model.

Both of these theories were initially applied and tested in traditional team settings. Sarker et al. (1999) designed a team development model for globally dispersed teams. They propose that global teams progress through four stages of development: initiation, exploration, integration, and closure. The first stage, initiation, is similar to the first stage of other models and describes the period during which the group forms. During the exploration stage, team interaction is of paramount importance. Interactions can be either uni-directional or bi-directional. Teams that interact uni-directionally tend to operate in a sporadic manner and are unable to communicate content between team members. During the integration stage, members involved in

bi-directional communication relationships respect each member's abilities and have open and meaningful interactions. Finally, the group reaches the closure stage. Once again, depending upon the performance level, group members may face a number of different emotions.

## 2.8 Team Effectiveness

Although *effectiveness* has been defined in several ways, there has been general agreement on its fundamental characteristics. For example, McGrath referred to effectiveness as the *functions* that a team performs, labeling them the production function, the member-support function, and the group well-being function. Hackman (1987) used a similar framework, describing an effective team as containing:

- productivity meeting or exceeding customer expectations,
- capability for working together in the future, and
- satisfaction of group members.

Using Hackman's (1990) definition, this dissertation suggests that effective teams can be defined using three criteria. First, the outcomes of the team effort must meet or exceed the standards for quantity and quality as set by the organization. Second, the team experience must satisfy the personal needs of team members. And third, the social processes that allow the team to function must maintain or enhance the capability of team members to work together. Sundstorm et al. (1990) adopt a definition of team effectiveness that incorporates productivity, satisfaction, and sustainability. Primarily, teams are organized to accomplish the objectives of the organization. Therefore, any evaluation of the effectiveness of a team must include the degree to which the team accomplishes its work. The productivity of a team is defined as the degree to which the team "*... meets or exceeds the expectations of the performance standards of the people who receive and/or review the output...*" (Hackman 1987). Teams also serve an individual function in the lives of their members (McGrath & Hoole 1992). Cohen, Ledford & Spreitzer (1996) test a theoretically-driven model of

self-managing work team effectiveness. Four categories of variables are theorized to predict self-managing work team effectiveness: group task design, encouraging supervisor behaviors, group characteristics, and employee involvement context.

In order for a team to be effective, it is necessary that the process of working together satisfies the social and task needs of the group members, resulting in their being satisfied with their experience in the team. Team member satisfaction also is a likely prerequisite for team sustainability. Team sustainability represents the team's capacity to successfully work together in the future. For example, a team may be productive and deliver a high quality product but the process of accomplishing the task may destroy the group's ability to continue working together. Such a team would obviously be considered less effective than a team that had interacted in such a way as to allow for future productivity.

# Chapter 3

# Team Interaction Space

*How well we communicate is determined not by how well we say things but how well we are understood.*

*Andrew Grove*

The literature review from Chapter 2 indicates that there are are diverse issues related to bridging temporal, cultural, organizational barriers for teams to make a successful change from a "local" to a "global" environment. This multi-diverse nature of global teams makes the process of collaboration complex and difficult to manage. One of the key issues for globally dispersed teams is therefore to set the bounds of their interaction space (Vadhavkar & Peña-Mora 2000). To effectively use this interaction space, the individual components which make up this space, must be identified and their importance to the interaction process understood. For globally dispersed teams, this boundary or interaction space for virtual teams is made up of three components as shown in Figure 3-1.

The interaction space encompasses the following four primary elements:

- Communication involves the exchange of information, events and activities in any globally dispersed team. Effective communication is a necessary, though not a sufficient condition to meaningful collaboration in a global team.

- Collocation involves dealing with the infrastructure to provide seamless communication among geographically distributed team members.
- Coordination involves control of the workflow and communication process, allowing efficient control mechanisms to coordinate team efforts. Coordination involves managing the various interdependencies between activities and events in any global team.
- Collaboration describes the process of sustainable value creation that creates a shared understanding within the team.

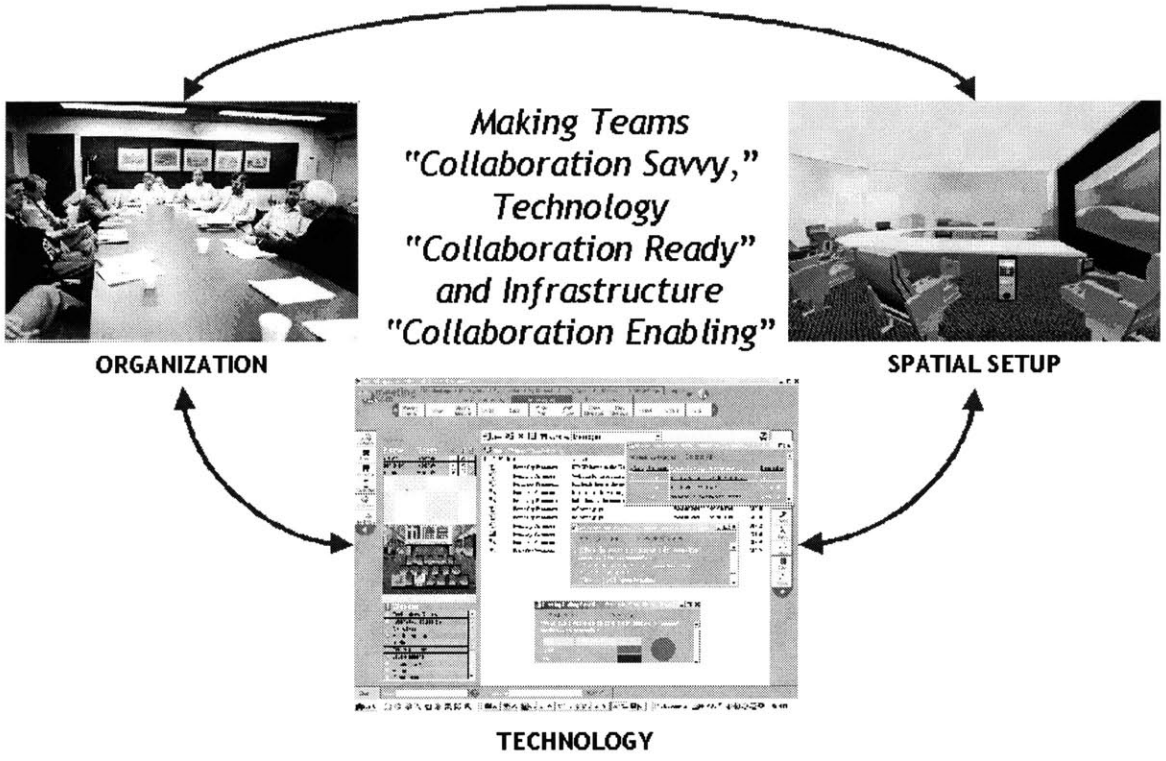



Figure 3-1: Pictorial Representation of the Interaction Space

## 3.1 Importance of Team Interaction Space

The distributed nature of global teams imposes a major constraint on group interaction. Interaction is discussed in this context based on the group activity it supports and its modality. It is critical in analyzing the various forms of interaction to make a clear distinction between acquiring information and developing knowledge. The two concepts are linked yet require distinct modalities of interaction to achieve the appropriate purpose of the communication.

Team activities engender different modes of interaction within the team. Understanding these activities and the varied modalities they require is a prerequisite to creating an effective interaction space. A classification of interaction needs for globally dispersed teams is presented below (Hussein 1998):

- Information dissemination is transmitting information from one team member to another. The information itself may be in a variety of media formats.

- Knowledge Sharing/Building is the process by which a team leader and team members through discussions achieve a shared understanding of a particular concept. It should be noted that the formal knowledge sharing interactions must necessarily be supported by the other interactions discussed below in order to make the interaction space more effective.

- Group Cohesion is a prerequisite in supporting globally dispersed teams. Interactions among group members that are unintentional and unstructured provide a basis for such cohesion. These include informal social discussions over lunch, at a coffee break or in the hallway. They are crucial and defining interactions that provide a sense of team and create a shared motivation among members of the team

- Group coordination interactions are critical in the effective functioning of teams. These include notifications of meetings, agreements and responsibilities. These interaction forms comprise a large percentage of collaborative group interaction.

- Decision making is another critical class of interaction that provide mechanisms for groups to reach a shared direction, goal or vision. These interactions include a large degree of conflict (which is healthy) and provide a critical mechanism for incorporating individual viewpoints within the team.

- "Building Networks" is a broad category of interactions that encompass communications between team members and others outside the boundaries of the team. These interactions may be for the purpose of enlisting support, integrating additional members or seeking expert opinion or information.

The following is a list of the four modes identified in addition to brief descriptions and examples (Hussein 1998):

- Synchronous/Asynchronous Interactions can be classified according to the temporal relationship between the information sender and receiver. Synchronous interaction refers to communications that are immediate and whose expected response is immediate. These include face-to-face meetings, audio calls and video conference interactions. Asynchronous interaction consists of exchanges of information through multiple media – documents, videotapes or audio tapes - i.e. communication that is stored in some form before transmission to the receiver of the information.

- Structured/Unstructured The degree of structure in an interaction is a more difficult concept to define. Structured interaction involves time critical discussions with explicit or implied agendas and explicit or implied facilitation processes. Unstructured interactions do not have an explicit or implied process associated with them. Examples of structured interactions are board meeting (synchronous) and change orders (asynchronous), while unstructured interactions are characteristic of lunch chats or for-your-information memos.

- Intentional/Unintentional Intentional interactions are those that are planned beforehand and have an explicit objective. Unintentional interactions occur in coincidental meetings such as coffee breaks or hallway encounters.

- Committal/Non-committal Interactions are meant to illicit a particular response or state of mind in the sender and receiver. The degree to which an explicit interaction response is expected defies the amount of commitment in the interaction form. The degree of commitment is generally defined by the environment of the interaction.

Information dissemination typically exhibits asynchronous, unstructured, intentional and marginally committal interactions. Knowledge sharing and building, on the other hand, requires dynamic interaction among the team members which necessitates synchronous, structured, intentional and committal interaction processes. Interactions that are responsible for group cohesion activities are typically unintentional, non-committal and unstructured with varying degrees of synchronicity. Coordinating tasks requires clear definitions of process and hence is generally structured. The coordinating process is also intentional and requires a high degree of commitment from the receiving party. Synchronicity in coordinating process varies with purpose of the coordination activity. Decision making activities also require high degrees of communication among the group members and hence require synchronous, intentional and highly committal interaction. These activities are also typically structured. Finally "Building Networks" can take on any of wide range of modalities depending on the nature of the activity performed by the outside parties to the interaction.

## 3.2 Elements of Team Interaction Space

The elements of team interaction space can be summarized as shown in Figure 3-2. The three elements are:

- **Organizational Processes** – trust building, team culture, meeting processes, team processes and team members' behavior
- **Communication Technology** – audio/video conferencing systems and computer supported communication processes

- **Spatial Setup** - the intersection of physical space comprising of meeting room layouts, office environments, and workspaces with the digital space comprising of collaborative application spaces, team web sites and collaborative software applications.

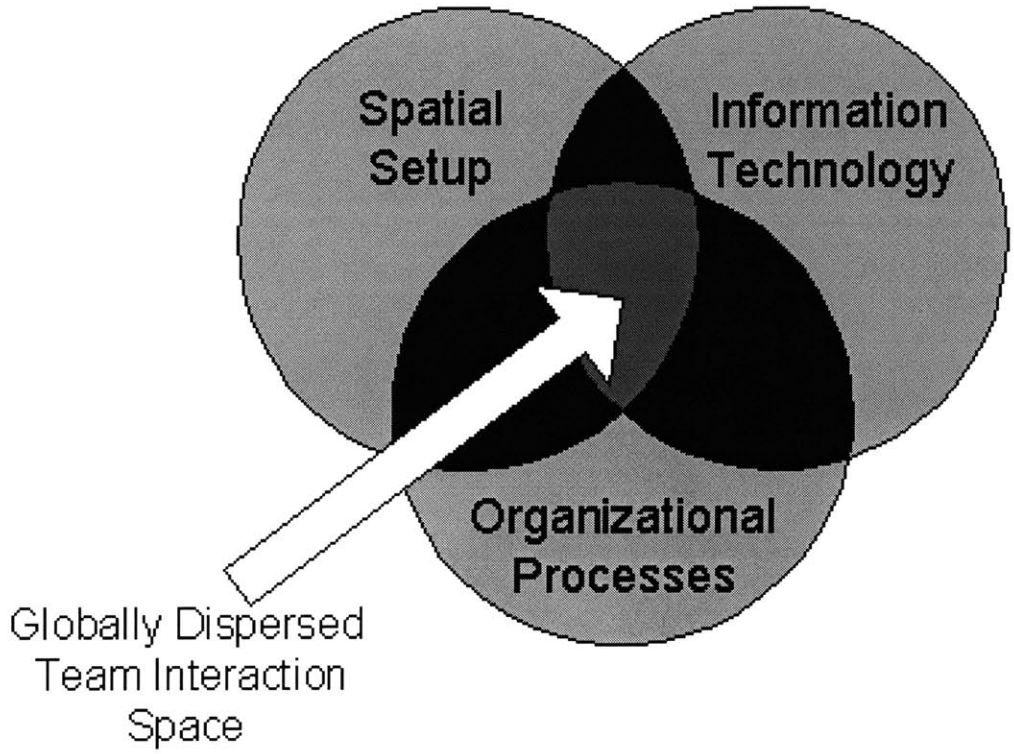



Figure 3-2: Interaction Space

### 3.2.1 Organizational Processes

For most global teams, effectiveness barriers crop up because of incorrect usage of the facilities that are being used to facilitate the interaction process. Organizational processes and interaction space protocols help facilitate the team interaction process by prescribing processes to leverage the communication infrastructure to eliminate or marginalize effectiveness barriers. The processes and protocols potentially serve as:

- Facilitators of the team interaction process.

- Support systems for the development of trust and team culture.
- Mechanisms for storing:
  - Group memory
  - Interaction history
  - Decision
  - Team learning

Most communication theories propose that conflicts in teams is the result of poor communication in either quality, quantity, or form. The theory postulates that if quality of the information exchanged can be improved, the right quantity of the communication be attained, the causes of the dispute will be addressed and the team members will move toward resolution. To address the needs for conflict resolutions in teams, McGrath (1964) has defined a framework based on the modes of the processes that teams engage in:

1. Mode I inception and acceptance of a project (goal choice)
2. Mode II solution of technical issues (means choice)
3. Mode III resolution of conflict (policy choice)
4. Mode IV execution of the performance requirements of the project (goal attainment)

Implementation methodologies link modes together in a systematic manner through defining and structuring the activities within each mode. As the literature review from Chapter 2 shows, most attention has been limited to Mode II, in the form of problem solving and decision making research. DeSanctis & Monge (1998) show that computer-mediate interactions simplify the handling of information, organize group processes and procedures that enable the team to deal with internal group dynamics. Evidence from prior research also supports the notion that formalizing group processes is critical to improving team interactions and increasing group performance.

Figure 3-3 shows a conceptual model that includes the team activities and their impact on team interaction. This model suggests that formalizing organization processes improves team interactions which increases team performance.

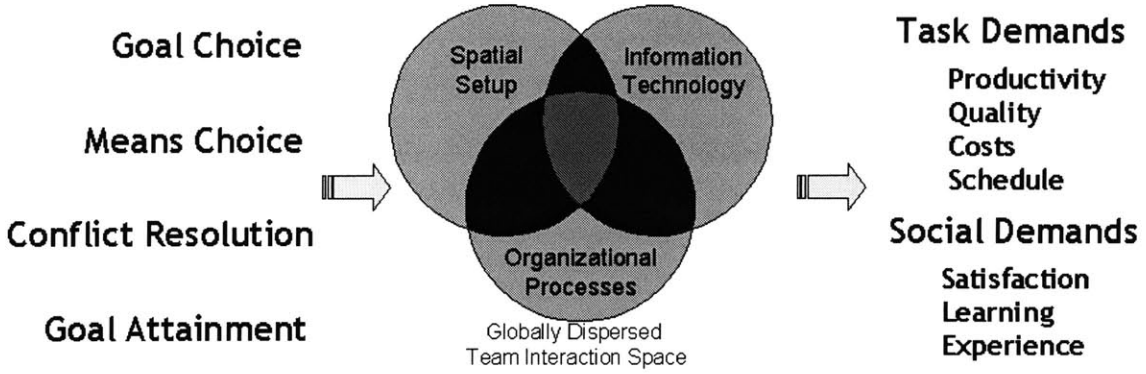



Figure 3-3: Organization Processes and Interaction Space

### 3.2.2 Communication Technologies

Multiple types of communication technologies are used to keep a global team together and in alignment (Duarte & Snyder 1999). ]Teams communicate regularly by telephone, fax, videoconferencing, shared databases, web sites and a myriad of technologies. The most important issues that relate to the use of communication technology and communication can be summarized as (Duarte & Snyder 1999), (Haywood 1998) and (Sen 2001):

- Use technology you need to use
- Use technology you know how to use and are comfortable with.
- Use technology you perceive as fastest relative to what you want to achieve.
- Use technology that works
- Do not assume that others think like you on these issues.

The term computer-mediated interaction technologies describes the entire category of electronic options available to a globally dispersed team. The broad term covers a wide spectrum of electronic systems that integrate software and hardware to enable communication and collaborative work. Such technologies can be classified into two main categories:

- Asynchronous
    1. E-mail
    2. Group calendars and schedules
    3. Bulletin boards and web sites
    4. Non-real-time database sharing and conferencing
    5. Work-flow applications
- Synchronous
    1. Desktop and real-time data and application conferencing
    2. Electronic meeting systems
    3. Video conferencing
    4. Audio conferencing

The different synchronous and asynchronous technologies mentioned above all have their advantages and disadvantages and no particular technology can be described as the one ideal for having an effective interaction space. Sen (2001) presents a table highlighting the advantages and disadvantages of each technology based on the needs of the global team.

### 3.2.3 Spatial Setup

The day-to-day working environment of global team members is highly determined by the physical, architectural space around. This physical space also constitutes a rich information space (Horgen et al. 1998) either as direct information sources (for

example, calendars, maps, charts hanging on the walls, books and memos lying on the desks), or by providing ambient peripheral information (for example, sounds of people passing by). However, with the advent of information age, more of this information has become available to team members in the digital space (for example, project web sites, discussion boards, web-based calendars). As shown in Figure 3-4, Streitz, Geibler & Holmer (1998) considers the spatial setup to be made up of:

- Cognitive space of the individual processing content in order to solve the tasks,
- Social space reflecting work practices and organizational context.
- Physical space including the architectural components of the building, the room and the surroundings, and
- Information space provided and mediated by networked information devices providing the functionality needed for working on the task.

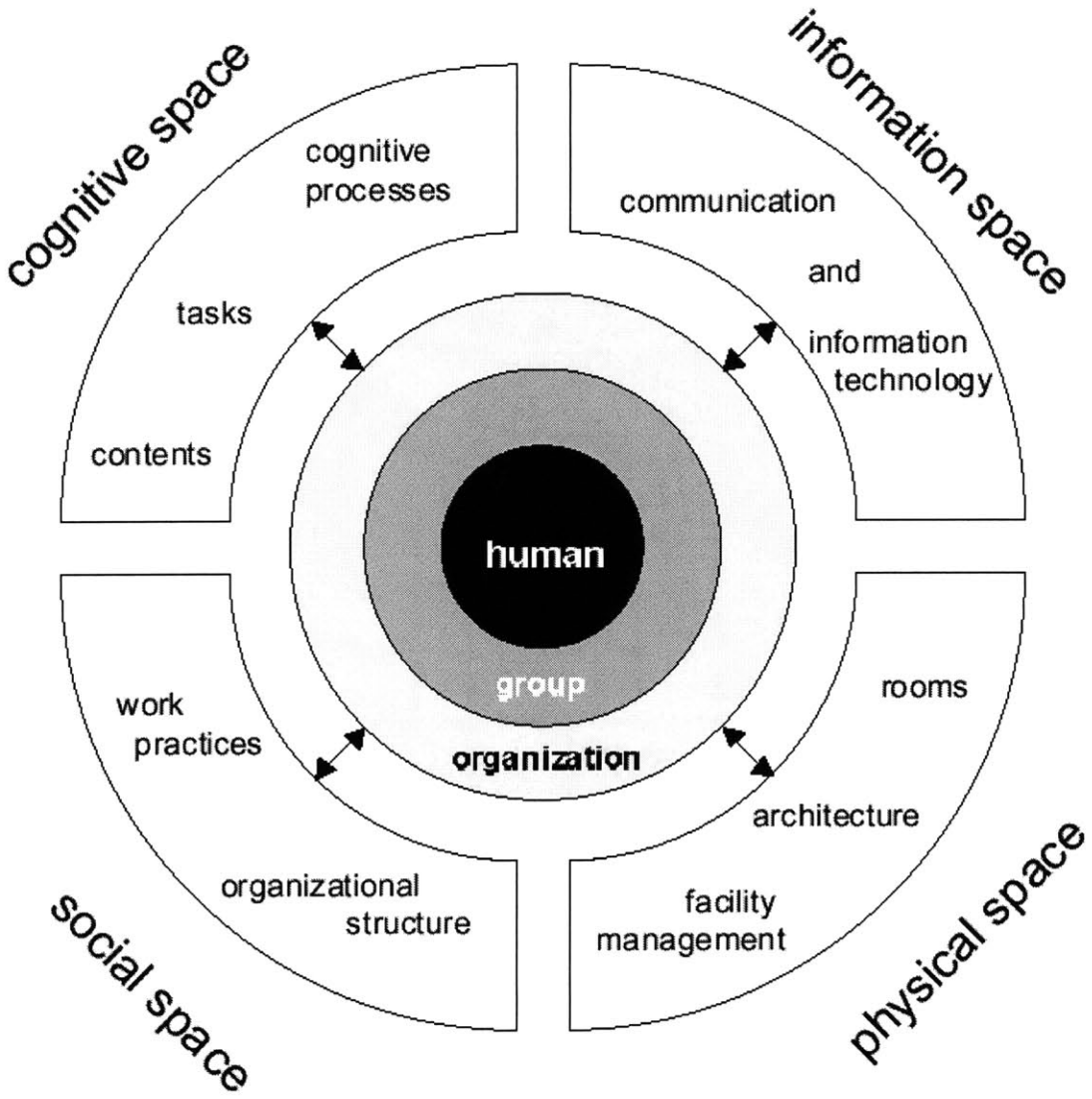



Figure 3-4: (Streitz et al. 1998)'s Design Spaces

To enable efficient collaboration and to provide support for a globally dispersed team, both the aspects of spatial setup mentioned above need equal attention. Spatial setup for a globally dispersed team can be broadly subdivided into:

- Physical Space – meeting room layout, office environment, computer/TV positioning, screen layout, placement of audio and video equipment, placement of chairs.
- Digital Space – web-based team interaction spaces such as collaborative application spaces, team web sites, central repositories, and data conferencing servers.

### Physical Space

The physical setup is important when the emphasis is on synchronous communication, as in meetings. The physical setup of rooms used for meetings should engender the spirit of collaboration. Elements of the physical space significantly affect the effectiveness of the distributed interaction (Hussein 1998). The physical space must be structured to promote distance collaboration and to ensure that communication locally and remotely are on relatively equal footing. Otherwise, local interaction dominates and distributed communication is primarily used for notification of local discussion results rather than for actual group discussion. Figure 3-5 shows two layouts of the rooms used by members from a global team (Hussein 1998). The layout on top is not suitable for global teams as remote team members feel they are mere observers in the interaction (Hussein 1998) and (Peña-Mora 1999).

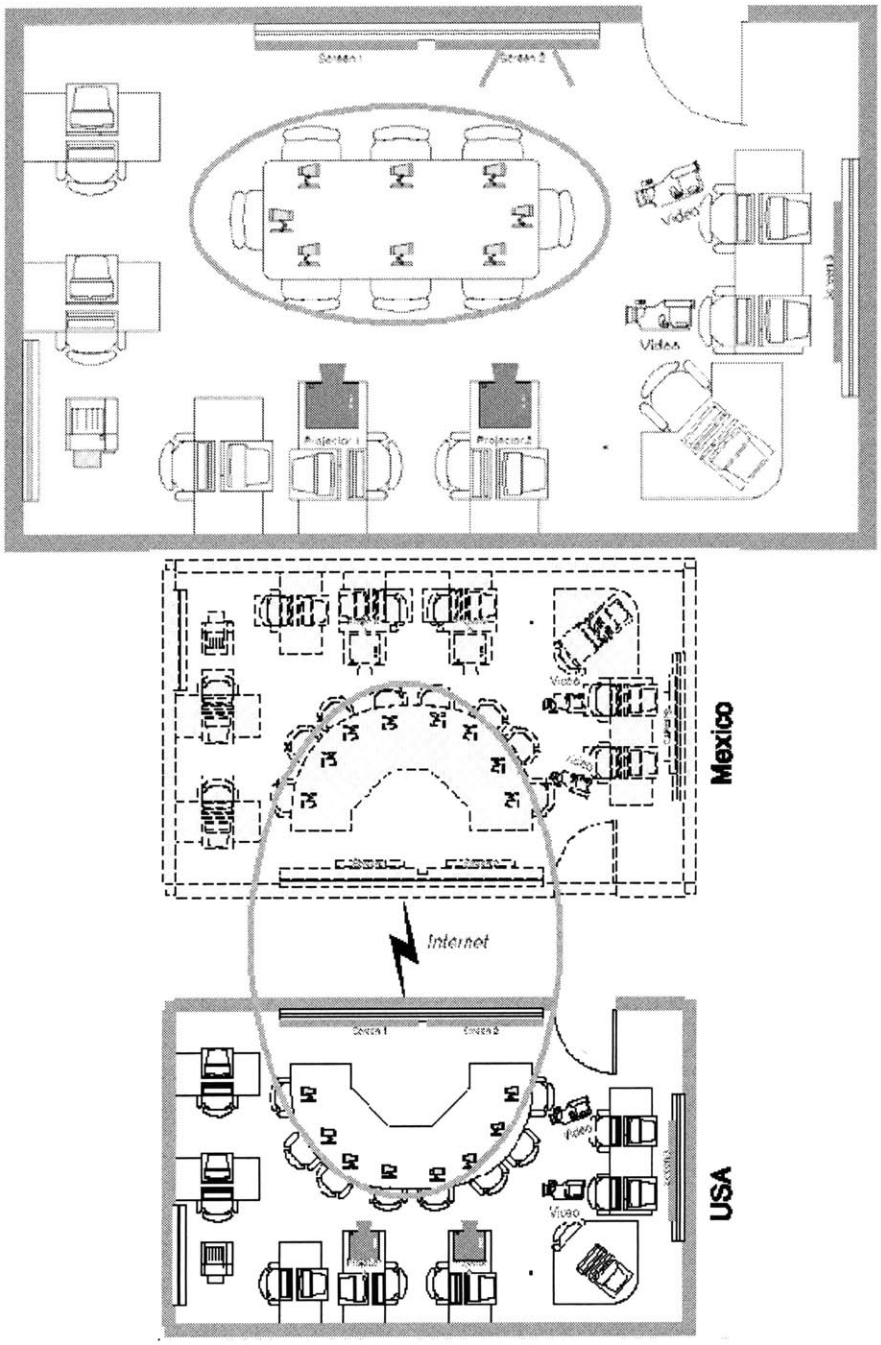



Figure 3-5: Physical Space Layout for Global Team Interactions

### Digital Space

A personalized team web site can play a very important role in the team dynamics. The team web site can help to define a common goal definition, common understanding of usage of communication channels and a better knowledge of remote locations. The team web site can be used as an effective information dissemination tool in the digital space by providing team and individual information. Sen (2001) provides a detailed architecture for building a team web site for globally dispersed teams including samples for what information should be stored on the team web site and recommends layouts for the team web site depending on the task at hand. Figure 3-6 shows a sample team web site.

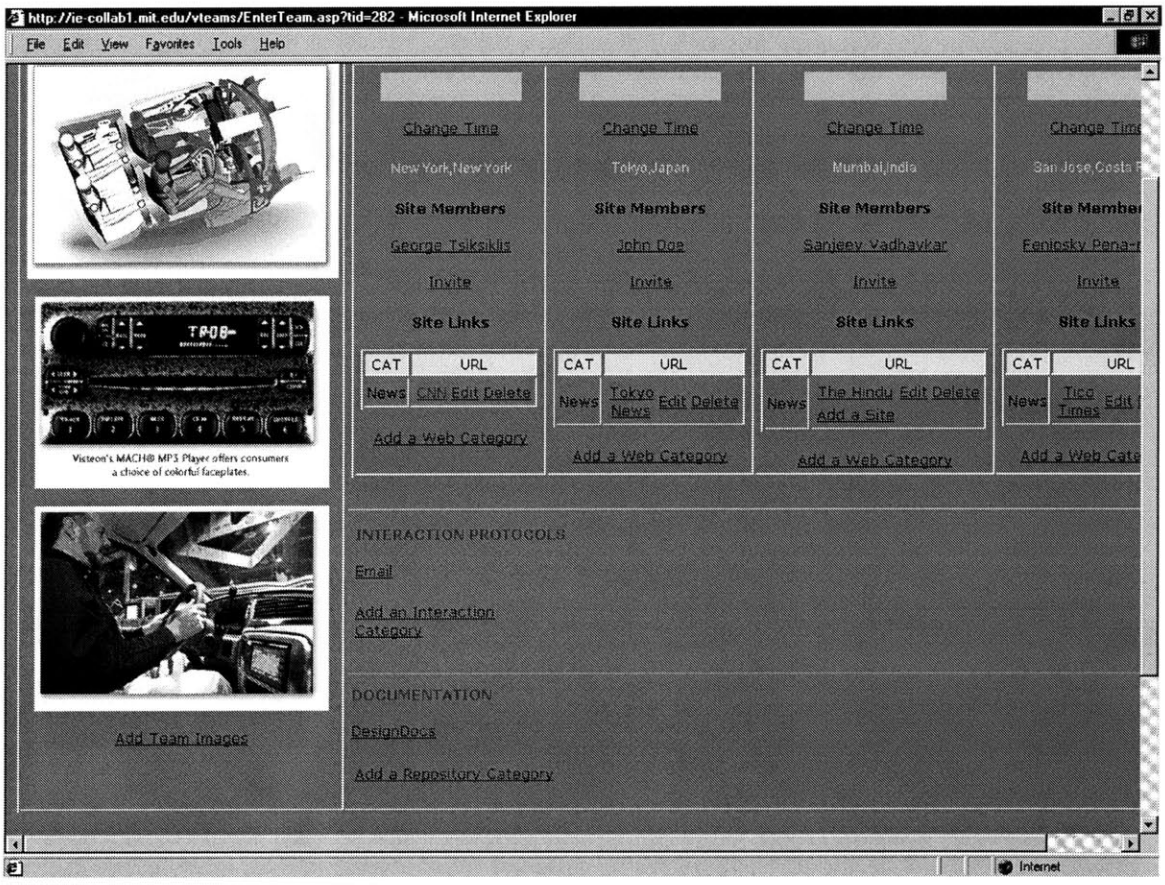



Figure 3-6: Global Team Web site adapted from (Sen 2001)

## 3.3 Systems Approach to Interaction Space

From a systems approach, the team interaction space can be analyzed by looking at the information protocols and the interaction modality. Specifically, there are two main protocols:

- Communication Protocol : A set of rules for information transmission across a medium or a network.
- Interaction Protocol : A set of rules and algorithms that govern the accessibility of other dispersed team members in an interaction. These include rules for proximity, addressability (controls over the ability to interact with others in the interaction environment) and presence in an interaction space.

Interaction Modality defines the variety of information structures and media available to the interaction. These may include audio transmission, video transmission, image transmission, text transmission and structured data (in the form of documents, presentations, spreadsheets, schedules, CAD drawings, formatted text). As shown in Figure 3-7, the interaction space can be visualized as the individual team member's interface to the computer and other networked team members (Hussein 1998). The interaction modality defines the input and output devices by which information is displayed within each individual's interaction environment. Communication protocols enable the transmission of information from one machine to another through the network. Finally, interaction protocols enforce order on the communication over the network collaboration by controlling the ability to address particular individuals.

The model of each team member engaged in a team interaction is composed of several states ranging from observer to speaker (as opposed to dyadic conversation where individual roles are classified in a two state model of listener and speaker). An observer is defined as a member of a team interaction who is not directly engaged in the interaction process. This is generally physically represented by leaning back from the table or by engaging in activities not directly related to the team activity. A speaker in this model is a team member who has the attention of others involved

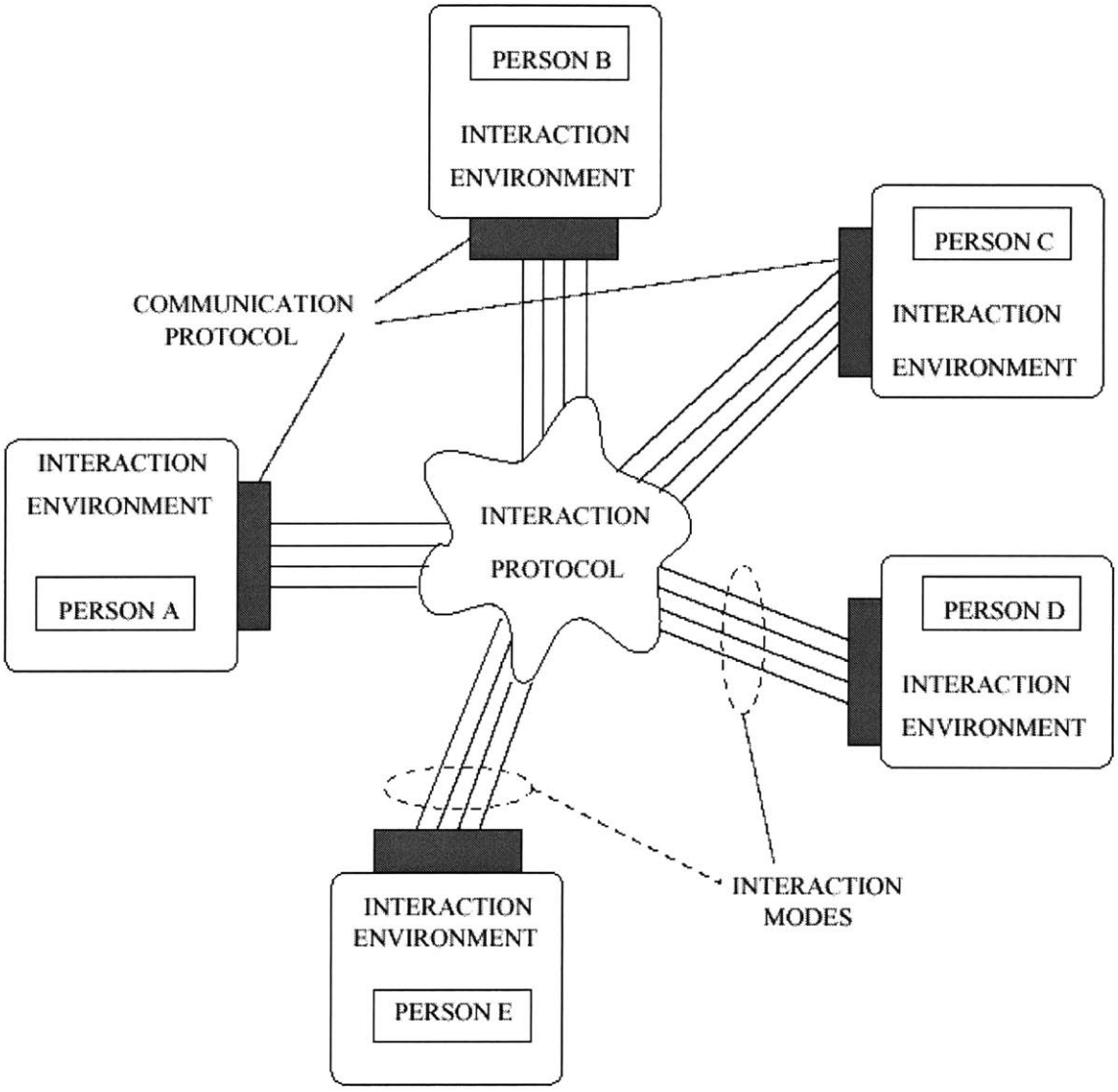



Figure 3-7: Interaction Space - Systems View adapted from (Hussein 1998)

in the interaction. A speaker is not necessarily engaged in vocal conversation and can be the focus of attention in the interaction space by other cues. Figure 3-8 shows the intermediate states between observer and speaker consisting of: engaged listener, focal interruption, and vocal interruption (Hussein 1998) and (Sen 2001). An engaged listener is characterized by gaze direction and dorsal extension to attract attention. Focal interruption is a subsequent state of engagement in which the team member interrupts the focus of attention through manipulation of the interaction space. Manipulation of the interaction space varies in degrees, from simple gestures in the space to physically moving, writing on, or tapping on the shared space. The last intermediate state is vocal interruption. This is the most disruptive form of engagement which involves the use of verbal techniques to acquire the attention in the interaction space. This involves use of verbal interject ions such as "Oh" "But" and "Excuse me." It is important to note that these states are not clearly delineated and there is clearly a continuum of states from observer to speaker. The transition between the different states is not linear. As shown in Figure 3-8, a team member in a team interaction may go through all stages in the model or alternatively may skip over several states.

## 3.4 Team Interaction Space Framework

The previous sections dealt with the fundamental constructs of the team interaction space. It is hypothesized that global teams function inside a virtual team interaction framework (Vadhavkar & Peña-Mora 2000), which captures the interactions in a holistic sense. The interaction framework includes the whole range of activities: from interactions carried out in the interaction space; to observing the barriers to effective interaction in the interaction space by comparing them with the desired state; to making adjustments to remove these barriers and mapping team performance to a team interaction effectiveness continuum; to identifying areas of improvement as well as evaluating the team's performance. Each of these steps is detailed in the next few chapters. The interaction framework also captures the iterative nature of the

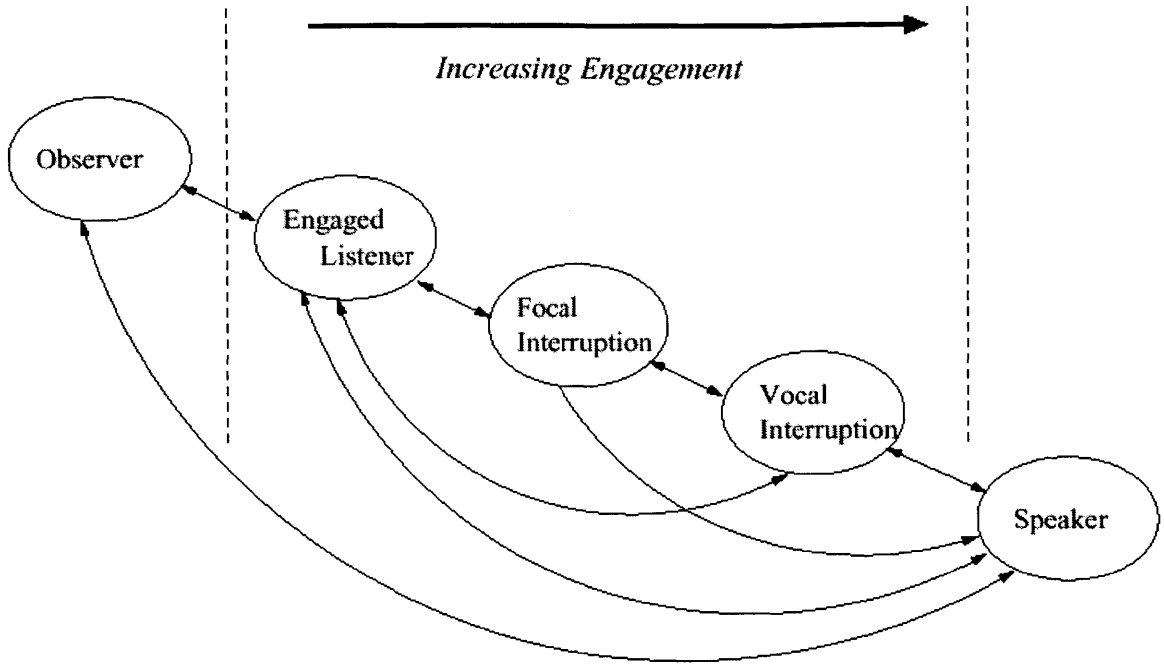



Figure 3-8: Participant States in the Team Interaction Space adapted from (Hussein 1998)

interaction process. The iterative steps as shown in Figure 3-9 are:

- Identify barriers to team interaction space effectiveness through observation of the interactions carried out in the interaction space (deviation from desired state as indicated by effectiveness targets)
- Position the team in the team interaction space effectiveness continuum
- Evaluate the revised team interaction space effectiveness targets after positioning the team on the team interaction space effectiveness continuum
- Enhance/provide goals for further interaction in the interaction domain/space

Iterate the cycle over time, as the interactions are dynamic and as the framework shows the cycle is repeated over time.

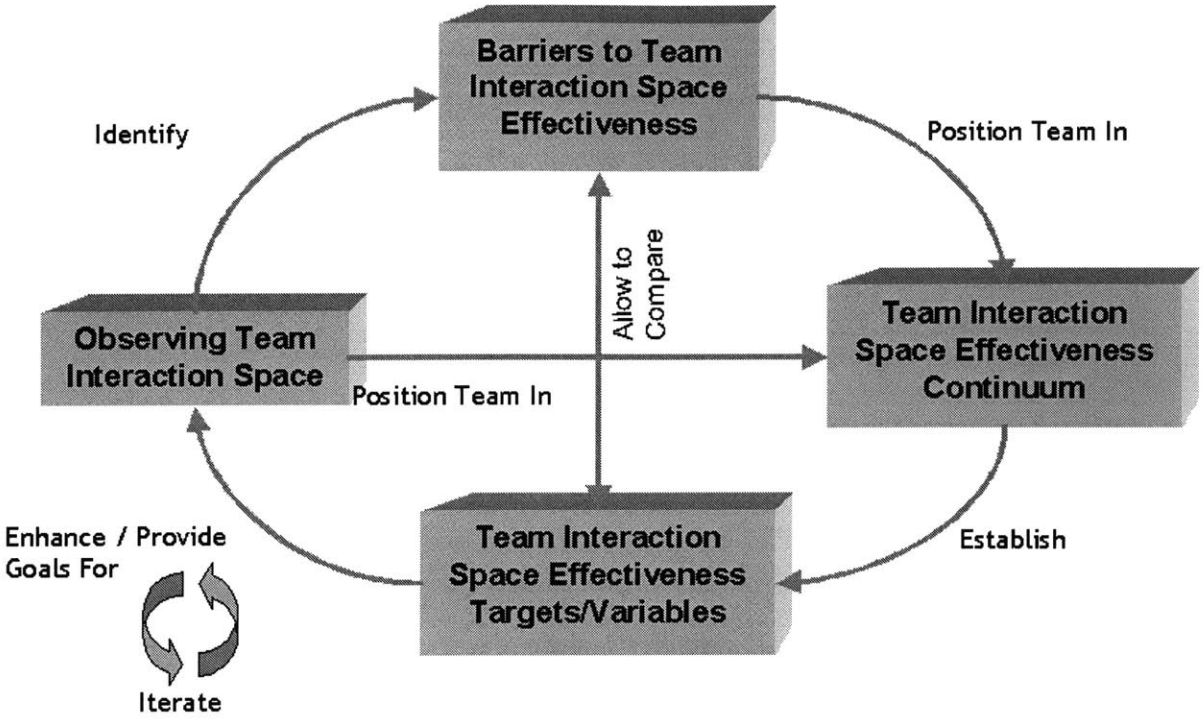



Figure 3-9: Team Interaction Space Framework

### 3.4.1 Team Interaction Space Barriers

Chapter 4 identifies the risks/problems/challenges that global teams face when using the interacting space. Barriers to team interaction space can be summarized as follows:

- Barriers due to Individual characteristics
- Barriers due to missing Organizational/Team Processes
- Barriers due to incompatible Technology
- Barriers due to inadequate Interaction Processes
- Barriers due to insufficient Spatial Setup

Once the teams know what are the barriers hindering their efforts, they can try to improve their interactions inside the framework proposed in this chapter. This will

allow globally dispersed team members to identify current problems that they face, suggest way/means in which these problems might be handled in a self-sustaining iterative manner.

### 3.4.2 Continuum of Team Interaction Space Effectiveness

The interaction space effectiveness continuum described in Chapter 6 is a spiral curve mirroring the real life growth of a globally dispersed team from its inception when it is just a collection of combative people with conflicting ideas to an optimized group with efficient processes for effective use of the virtual team interaction space. What needs to be stressed however is that a team newly formed, can join the spiral curve at any level of proficiency on the team interaction space effectiveness continuum. Even small deviations in team composition or the environment can move the team up or down the team interaction space effectiveness continuum. The effectiveness continuum relates the team to the effectiveness barriers, which hamper the team from a more effective interaction, to the effectiveness targets that they would expect to achieve as they improve their interaction process over time. The effectiveness targets are the indicators of the team interaction performance and are measures/deliverables that the interaction process would have at specific and defined checkpoints. The metrics/checkpoints that serve as indicators of what is wrong or what are the barriers to their interaction, which they need to consider and eliminate.

### 3.4.3 Team Effectiveness Outcome Variables

Chapter 5 presents an interaction space model to estimate the effectiveness of the team interaction space. The team interaction space effectiveness is estimated by looking at the following variables (Sen 2001) and (Vadhavkar & Peña-Mora 2000):

- Communication Technologies: The global team will typically use a suite of communication technologies to facilitate their interaction with dispersed team members. There are a number of issues pertaining to the use of these communication technologies. Some of the broad issues are

  - The needs of the team and the relevancy of the communication technologies in fulfilling these needs
  - The capability of these technologies in terms of usability, functionability and reliability
  - Facilitation of team interaction processes by using adequate communication technologies
  - Support for the team in using these technologies
  - Adequacy of the technologies used in providing reliable and correct information adequately for working purposes

- Team Interactions: The global team interacts predominantly through synchronous and asynchronous interactions. The important issues in team interaction processes are
  - The degree of interest in team processes among local and remote team members
  - The effectiveness of face-to-face and virtual team meetings
  - Capability of global team members in running virtual meetings
  - The adequacy of the agenda in virtual meetings
  - Reconciliation of local versus global needs
  - Process in which lessons learned are shared and assimilated
  - The distribution of tasks amongst team members

- Individual Perceptions: The value of individual perceptions about the team and the organization directly affect the effectiveness of interaction processes carried out by the team members. The key issues are
  - Belief in organizational culture
  - Understanding about the teams goals and objectives
  - Trust in local and remote team members

  - Assessment of performance evaluation mechanisms
  - Team member participation in decision-making processes

- Team structure and processes: This pertains to the team skills and mechanism for sustaining the team. Broad issues are
  - Cumulative and matching technical and social competencies of team members
  - The importance of language in team interaction processes
  - Norms for team member behavior
  - Transitioning of global team members on or off the team
  - The mechanisms for knowledge sharing
  - How the time difference of remote team members affect team bonding and interaction
  - Information flow mechanisms from team members to team leaders

- Team/Organizational Outcomes: A global team is usually brought together for a specific project to achieve a particular goal. The evaluation of team performance and the criteria on which such judgments are based influences the team interaction space. The issues are
  - Agility in decision-making
  - Team performance evaluation in terms of deliverables
  - Relative improvement of technical skills after participation in global teams
  - Career advancement through global team performance
  - Performance evaluation metrics based on local versus global performance

- Team Support: The organization needs to provide a lot of support both in terms of infrastructure as well as high-level support for the team. The issues are
  - Identification of global teams as appreciated/valued by company

- Performance evaluation and reward processes
- Local perception about global team processes
- Sharing lessons from team level to a broader organizational level
- Level of support from a high level strategic viewpoint to global teams as opposed to more traditional and standard local teams.

# Chapter 4

# Team Interaction Space Barriers

*Overcoming barriers to performance is how groups become teams.*

*Katzenbach & Smith (1994)*

The last chapter identified the boundaries of the interaction space in which globally dispersed teams conduct their interactions. It also identified the three key components that make up the global team interaction space. However, what is needed is to relate the components of the team interaction space or "where teams interact" to the work process that they follow to achieve their goals or "how they interact". This is only possible if the risks/problems/challenges that these teams face in doing the "how to interact" part are clearly identified before and during the interaction process. Once the teams know what are the barriers hindering their efforts, they can try to improve their interactions inside the framework proposed in Chapter 3. This will allow globally dispersed team members to identify current problems that they face, suggest way/means in which these problems might be handled in a self-sustaining iterative manner. This chapter attempts to address the barriers to team interaction space faced by globally dispersed team members.

In summary, the key benefits and barriers to globally dispersed teams can be highlighted as shown in Table 4.1 adapted from (Jude-York, Davis & Wise 2000).

Table 4.1: Benefits and Barriers of Globally Dispersed Teams

| Benefits | Barriers |
|---|---|
| Flexibility in balancing personal and professional lives | Work may occur outside normal business hours |
| Cost savings on central office space | Limited opportunity for daily interactions |
| Work goes everywhere employee goes | Less focus and more distractions |
| Access to data is quick due to widespread use of technology | Greater investments in training, support and infrastructure |
| "Just in Time" feedback | Increased difficulty for team leaders to motivate employees |
| Shared accountability with team members | More difficult to establish team spirit |
| Increased knowledge base (access to information and experience of others) | Technological challenges and associated steep learning curve |
| Potential decrease in travel costs | Cultural barriers may be difficult to overcome |
| High autonomy and self-direction | Social isolation |
| Dynamic membership | Team members may feel less connected to the organization and overall vision |
| Interaction is predominantly written leading to easy storage and retrieval | Few non-verbal cues in the interaction could result in miscommunication and misinterpretation |

## 4.1 Barriers due to Individuals

Working in the digital world is not comfortable for many people, although with training and coaching most people can adapt to new ways of working. Although various research suggests that social isolation is a problem, this is often a perception of those who do not yet work virtually. Those who do, rarely cite it as an insurmount-

able problem. What does concern them the lack of the extra richness of interaction through face-to-face contact with team members. Therefore work needs to be optimized around types of task and types of interaction. Several aspects need attention:

- Restructuring of tasks and work e.g. dividing digital and physical components; matching the type of work to the skills and situation - which is best done individually and which is best done as a team.
- Personal skills - developing cyberskills, especially the ability to interact effectively via computer media; this is sadly lacking in most organizations.
- Remote management - making traditionally trained managers comfortable with managing remotely. Management by outputs and outcome not inputs (i.e. presence of people at their workplace) is a significant shift for many.
- Interaction skills - develop mutual respect and trust for other's knowledge and contribution.
- Information and knowledge management - organizing, collating and making accessible information that has been generated by the team.
- Reward systems - bringing these into line for the networked and collaborative organization.

It is the bringing of these individual elements into harmonious alignment with the tasks and technology that determines the degree of success in the outcome of globally dispersed teams.

When interaction among globally dispersed team members require several rounds of turn taking, the expectation for what constitutes a complete action sequence is often interpreted differently. In most audio and video conferences, for example, a question or suggestion from a remote team member will often receive no response. This is often because team members make the assumption that being silent and refraining from answering would be the same as saying "agree". However, in the

event the remote team member is expecting a feedback, this could lead to the member feeling ignored. It is important to stress here that "no feedback" in global team interactions means no information at all because the taken-for-granted face-to-face cues like facial expressions, voice intonation and body movement are clearly lacking. These individual preferences need to be further diagnosed under: Personality, Cultural Background and Trust.

### 4.1.1 Personality

For decades, understanding the concepts of personality type and temperament has helped us improve our communication skills and build more effective relationships. Understanding and appreciating various personality types can individuals and teams discover their patterns of behavior, create and interpret a team's profile, and design performance improvement strategies customized to the team. Addressing interactions between teams, both within and between organizations, and the special dynamics of globally dispersed teams, Nash (1999) defines five critical characteristics essential to effectiveness–strategy, clear roles and responsibilities, open communication lines, rapid response to change, and effective leadership –and details how each is influenced by the personality types and temperaments of the team members as individuals.

Another popular approach to accounting for different personalities in teams involves using the Myers-Briggs Type Indicator (MBTI) (Hirsh & Kusnserow 1990). MBTI is a detailed test to measure psychological type and includes four dimensions:

| | | |
|---|---|---|
| Extraversion (E) — | | — Introversion (I) |
| Sensing (S) — | | — Intuition (N) |
| Thinking (T) — | | — Feeling (F) |
| Judging (J) — | | — Perceiving (P) |

The above four dimensions yield 16 personality types (all the possible combinations of the four dimensions) (Keirsey & Bates 1984):

- Extroverts – focus their attention and energy on the world outside of themselves; need to experience world to understand it; are interested in people and events, external, blurt out thoughts, interactive, do-think-do.

- Introverts – focus their attention and energy on the world inside of themselves; need to understand world before experiencing it; internal, reflection, think-do-think, depth, concentration, ideas.

- Sensors – concentrate on what can be seen, heard, felt, smelled and tasted; focus on what is real and concrete; practical, factual, resist radical approaches, step-by-step, the five senses, implement ideas, determine realistic constraints.

- Intuitives – interested in meanings, relationships, and possibilities based on facts; focus on implications and inferences; innovative, theoretical; brainstorm alternatives, consider the future, hunches, insights, look at trends and patterns.

- Thinkers – prefer decisions that make sense logically; make decisions by analyzing and weighing the evidence; justice, logical, critical, reasonable, firm but fair, principles, objective.

- Feelers – make decisions on how much they care or what they feel is right; view themselves as empathetic and compassionate; heart, subjective, mercy, empathy, compassion, mercy, harmony, compliment, empathy.

- Judgers – seek to regulate and control life; like to have issues resolved;regulate, control, goal-oriented, decisive, organized.

- Perceivers – seek to understand life rather than controlling it; spontaneous, flow, adapt, tentative, open, flexible, let life happen.

### 4.1.2 Cultural Background

By their very definition, globally dispersed teams include team members that are from culturally and nationally different backgrounds. Perhaps the greatest obstacle facing global teams is an inadequate understanding of team members "cultural" differences;

this is an extreme problem for global teams whose members hail from different parts of the world, with different backgrounds, histories and cultures. However, the diversity of cultures can be a source of competitive advantage, provided the team knows how to use cultural differences to create synergy. The most important aspect of understanding and working with cultural differences is to create a team culture in which problems can be surfaced and differences discussed in a healthy manner (Duarte & Snyder 1999).

Hofstede's (1991) dimensions of culture are:

- Power Distance: Extent to which members accept that power is unequally distributed
- Uncertainty Avoidance: Degree to which people feel threatened by ambiguity
- Individualism/Collectivism: Primary concern being the individual or the group
- Masculinity/Femininity: Visible success (money & power) versus "caring values" such as sharing and group success.

Individualism-Collectivism is a major dimension of nationalistic cultural variability (Hofstede 1980). The degree to which a culture is individualistic or collectivistic affects how team members share information amongst themselves. Individualistic cultures favor the needs and values of individual, while collectivistic societies favors goals and needs of the group. (Jarvenpaa et al. 1998a) indicates that this cultural dimension affects teams' expectations about how rewards and praise are handled. Members from collective cultures may prefer team-based rewards to individual recognition (Duarte & Snyder 1999).

It is very important for the team and the larger organization to rise above the different cultural dimensions and believe/trust in a team/organizational culture, which precedes all of them. Globally dispersed teams usually work under a time constraint and thus, the awareness of different cultures is essential as it can be the cause of a

lot of angst and miscommunication. The interactions in the team interaction space helps in solving cultural issues by:

- Development of team norms for interaction.
- Development of a team culture different from national cultures and unique to the team which helps propagate understanding amongst team members from different cultural backgrounds.
- Cultural exercises to come at an appreciation of the varied thinking/perception of people from different cultural backgrounds.
- Team member competencies usually include an ability to work across cross-cultural boundaries.
- Establishment of team processes ensuring role and goal clarity and understanding in terms of expectations from team members irrespective of cultural differences.

### 4.1.3 Trust

The issues of trust and identity are crucial for the effective formation and functioning of globally dispersed team. Identity plays a critical role in communication where knowing the identity of those with whom you communicate is essential for understanding team interactions. Yet, when team members are separated by spatial and temporal borders, identity is ambiguous. Many of the basic cues about personality and social roles that we are accustomed to in the physical world are absent. In the physical world, there is an inherent unity to the self. The body provides a convenient definition of identity: the norm is one body, one identity. Though the self may be complex and variable over time, the body provides a stabilizing anchor. The globally dispersed world is different. It is composed of information rather than matter. Information spreads and diffuses; there is no law of the conservation of information. The inhabitants of the electronic space are diffuse and free from the body's unifying

anchor. One can have as many electronic persona as one has time and energy to create. Similarly, trust is also an important enabler of co-operative human action. Many authors highlight the importance of trust in the success of teams (Larson & LaFasto 1989), (Handy 1995) and (Katzenbach & Smith 1993). Without trust, the management of a globally dispersed organization cannot be conceived (Katzenbach & Smith 1994). Jarvenpaa et al. (1998a) conducted a study about the creation and maintenance of trust in globally dispersed teams whose members transcend time, space and culture. Following different forms of trust were observed: deterrence-based trust, knowledge-based trust, identification-based trust and swift-trust. The study identified various actions and communication behaviors that favored the creation of trust in globally dispersed teams (see Table 4.2 adapted from (Jarvenpaa et al. 1998b)).

Table 4.2: Trust Processes in Globally Dispersed Teams

| Form of Trust | Factors Evoking Trust in F-F Teams | Challenges to Trust in Global Teams | Opportunities for Trust in Global Teams |
|---|---|---|---|
| Deterrence based Trust | -Amount of invested resources<br>-Reputation<br>-Small tight knit network<br>-Length of Relationship | -Temporal and short-lived teams<br>-Membership in multiple teams<br>-Non overlapping social and professional networks<br>-Lack of access or knowledge of these networks | Very limited opportunity for deterrence-based trust |

*Continued on next page*

Table 4.2 – continued from previous page

| Form of Trust | Factors Evoking Trust in F-F Teams | Challenges to Trust in Global Teams | Opportunities for Trust in Global Teams |
|---|---|---|---|
| Knowledge based Trust | -Length of Relationship<br>-Frequency of task based interactions<br>-Amount of Social Dialog | -Temporal and short-lived tenure<br>-Slow rate of task and social information exchange | High levels of virtual team interactions allows members to gather information over time |
| Identification based Trust | -Explicit words and behavior illustrating motives<br>-Length of Relationship<br>-Similarity in perceived backgrounds<br>-Amount of Social Dialog | -Lack of information identifying motives and values<br>-Short-term relationship<br>-Dispersion in team membership across geography, time, functions, organizations | Hyper personalization of resources |
| Swift Trust | -Role based stereotypes | -Less emphasis on well defined roles within the team<br>-More focus on broad-based knowledge and expertise | Stereotyping based on member's own past team experiences |

Jarvenpaa et al. (1998a) observed that those teams that were not focussed on a task reported low levels of trust, but recognized that task focus existed in parallel with a social focus. They also highlighted the importance of the first "online-impression", because the first messages of the team members appeared to set the tone for how the

team interrelated. Greater trust was developed at the early stages of globally dispersed teams through a balanced mix of social and task communication, enthusiasm, optimism and initiative. In the longer term, trust was greater in teams that developed set patterns of communication and responded promptly to other team members. The key point is not that different forms of trust exist, but the observation that face-to-face interactions in physical space foster social-based trust that carries into the digital space. To summarize, trust-enabling factors in the globally dispersed team context are: performance/competence, integrity and concern for the well being of other team members. Table 4.3 adapted from (Lipnack & Stamps 2000) and (Haywood 1998), summarizes the trust factors and suggestions for global teams.

Table 4.3: Trust Factors in Global Teams

| | Trust Factors | Examples |
|---|---|---|
| Performance and Competence | Develop and display competence | Focus on individual and team results<br>Acquire new skills keeping in sync with new trends<br>Allow others to be experts<br>Foster expertise and share learning. |
| | Follow through on commitments and show results | Keep a log of commitments and make them visible to teammates.<br>Keep commitments in cost, schedule and technical areas even if situations change. |
| Integrity | Consistency in speech and action | Align your behavior in meetings, reviews and at other critical times. |
| | Stand up for your convictions | Be able to say "I don't agree" even in disagreeable situations.<br>Continue to do the right thing even in crisis situations. |

*Continued on next page*

Table 4.3 – continued from previous page

| | Trust Factors | Examples |
|---|---|---|
| | Stand up for the team | Keep up-to-date to prevent having to defend the team.<br>Don' say negative things about the team unless you are sure about the reasons. |
| | Communicate and keep everybody informed about progress | Hold regular audio/video conferences and have agenda covering both bad as well as good news. |
| | Show both sides of issues | Present both pros and cons of issues.<br>Start discussion forums to debate issues. |
| Concern for others' well being | Help team members during transitions | Rotate both "good" and "bad" jobs.<br>Have uniform processes for selection, rewards and sharing of information |
| | Be aware of your impact on others | Take your role seriously.<br>Take time to develop interpersonal contacts with team members.<br>Ask others how they perceive your reliability in crisis situations and remedy possible faults objectively. |
| | Integrate team needs with personal, local and organizational needs. | Map your decisions on other functional areas so as to reduce the impact of adverse actions in team situations on other spheres of work life. |

A globally dispersed team may evaluate itself on how it fares in showing commitments and showing results, by asking the team members to answer the following questions adapted from (Sen 2001):

Team members meet all deliverable cost and schedule requirements.

a) Never b) Rarely c) Sometimes d) Mostly e) Always

In case of not being able to meet commitments, prior notification to others' is given.

a) Never b) Rarely c) Sometimes d) Mostly e) Always

The team is committed to sharing knowledge and information as speedily as possible.

a) Never b) Rarely c) Sometimes d) Mostly e) Always

Whenever circumstances change, all team members are notified immediately.

a) Never b) Rarely c) Sometimes d) Mostly e) Always

## 4.2 Barriers due to Teams

Organizational processes form just one of the three critical aspects of having an effective interaction space for virtual teams. The manner in which virtual teams and indeed their parent organizations implement their team / organizational processes is critical to their success. And a new twist on the classic tension between differentiation and integration is now playing itself out in this virtual arena, as organizations attempt to develop corporate-wide processes across globally dispersed sites while encouraging local innovation and adaptation. The dilemma is particularly apparent in globally dispersed teams, comprised of part-time team members pulled from their daily jobs at local sites, which are charged with developing common processes. Once the standard processes are determined, individual team members are expected to facilitate the implementation of those processes within their local sites. As such, team members must take the viewpoint of their home location as they move into the global team and, similarly, carry the viewpoint of the global team back to their home sites. Team members develop a shared global perspective of organizational conditions or competitive factors that is often not understood or appreciated by their local supervision and co-workers (Klein & Barrett 2000).

Globally dispersed teams may define their team needs and goals correctly from

an organizational perspective, use established team norms and communication protocols, but the application of best practices around team processes and collaboration practices are insufficient if the natural tension between global and local priorities is ignored. Aligning priorities across multiple levels of the hierarchy are essential as is a supportive organizational context. As an example, two extreme scenarios are shown in Table 4.4 (Klein & Barrett 2000).

Table 4.4: Barriers due to Global Push and Local Pull

| | Tug of War | Global/Local Alignment |
|---|---|---|
| Headquarters | Standardize local practice | Headquarters/Local Change |
| Local | Protect local interests:<br>-PR<br>-Scout<br>Implement piecemeal change<br>Local Optimization | Share best practices<br>Learn best practices<br>Translate/implement best practices<br>Global Optimization |
| Global Team | Frustration:<br>-Uneven sharing<br>-Distrust<br>-"Lies"<br>Narrow shared knowledge base | Increased levels of interdependence<br>Expanding shared knowledge base |

The effectiveness barriers that a team faces in the organizational/team processes domain is usually a subset or a combination of the barriers enumerated in Table 4.5.

Table 4.5: Effectiveness Barriers - Organizational/Team Processes

| |
|---|
| Language barriers. |
| Cultural barriers. |
| Distance barriers. |
| Insufficient team member motivation. |

| |
|---|
| Ineffective organizational information flow. |
| Improper group composition and lack of complementing competencies and inadequate combined skill set. |
| Insufficient role and goal clarity and definition. |
| Ineffective task control. |
| Lack of management support. |
| Lack of group norms. |
| Lack of trust. |
| Inadequate organizational/job tenure and instability of membership because of inadequate transition management. |
| Inadequate size of team. |
| Inappropriate amount of employee empowerment. |
| Reconciliation of quantity of work versus the quality of output from team members. |
| Congruency between personal and team evaluation of work both formal and informal. |
| Structured and agile decision-making. |

## 4.3 Barriers due to Dispersion

The traditional literature concerning the impact of proximity and geographical distance on interpersonal and social relationships suggests that there are positive relationships between physical proximity, frequency of interaction and the development of friendly feelings (Athanasiou & Yoshioka 1973). It is evident that attraction increases with opportunities for interaction because people discover similarities in their attitudes. Allen & Hauptman (1990) found that team members who are either physically or functionally distant, communicate with each other less frequently than people who

are proximate. The findings concerning barriers due to geographical dispersion and development of friendly feelings are weaker in work than non-work settings.

In addition, it should be noted that working in teams that span the globe poses problems not usually encountered when a group of people work together in the same building. Some are obvious. An important dimension of globalization has been the standardization of time in work and social life. By changing the nature of the friction of distance, the question of time and its significance in work and everyday life has been reopened. If members of global teams work in different time zones, then responses to queries or requests for information needed to get on with a task will be delayed. And if team members in Asia are 12 hours ahead of those in North America, they will have less overlap with work hours, thereby reducing the opportunity to call one another during normal business hours. Many companies use time differences to their advantage by transacting business around the clock. Globally dispersed teams can pass work-in-progress around the clock among the three main economic centers (America, Europe and Asia). Global Teams of bond traders can trade their book of US government issues in London, then New York, followed by Tokyo or Singapore, before returning to London the next morning. Microsoft does round-the-clock software development with software developers in United States and India. Even in the same time zone, work-in-progress can be suspended in time (stored) which gives globally dispersed team members the chance to organize individual time more effectively.

## 4.4 Barriers due to Organizations

Empirical research on functional diversity in management teams has presented a complex picture. On one hand, researchers argue that by broadening the range of experience and expertise available to a team, functional diversity can promote team effectiveness. Consistent with this argument, empirical studies have found that functionally-diverse management teams are more innovative (Bantel & Jackson 1989),

develop clearer strategies (Bantel 1993), respond more aggressively to competitive threats (Hambrick, Cho & Chen 1996), and can be quicker to implement certain types of organizational change (Katzenbach & Smith 1993), than functionally homogeneous management teams. On the other hand, researchers argue that because functional diversity is associated with differences of opinion and perspective, functional differences can inhibit team process and/or effectiveness. Empirical research also seems to support this argument, finding that functional diversity can increase conflict (Pelled, Eisenhardt & Xin 1999), slow competitive response (Hambrick et al. 1996), and even compromise performance (Simons, Pelled & Smith 1999). Given this pattern of results, management team researchers have concluded that functional diversity is simply a double-edged sword, that it has positive implications in some contexts and for some process or performance variables but negative implications in other contexts and for other process or performance variables.

It should be noted that the positive or negative effects of functional diversity may not just be a function of the dependent variable or context examined but may also be a function of the way in which functional diversity is conceptualized and measured. Existing research on functional diversity in management teams has conceptualized functional diversity primarily as the distribution of team members across the range of relevant functional categories, overlooking the extent to which the individuals who comprise the team are narrow functional specialists or broad generalists with experience in a range of functional areas. Global teams composed of "specialists" from different functional areas may be unable to exploit their diverse expertise because of cross-functional communication and coordination problems. In contrast, global teams composed of individuals with a breadth of functional experiences may be better able to overcome interaction barriers (i.e., because team members can relate to one another's function) while still realizing the performance benefits of diverse functional experiences.

Empirical research on functional assignment diversity suggests that it is positively related to external communication (Ancona & Caldwell 1992), performance in turbu-

lent environments (Keck 1997), and, when accompanied by open debate and dialogue, firm profitability (Simons et al. 1999). It should be noted that most of the research on functional diversity in management teams has adopted some form of the basic input-process-outcome model of group effectiveness (Shea & Guzzo 1987). In the simple form of this model, group characteristics and context factors (e.g., functional diversity, nature of the task) influence patterns of behavior and interaction within a group (e.g., conflict, communication, cohesion) which, in turn, affect the outcomes achieved by the group (e.g., competitive responses, innovation, performance).

## 4.5 Barriers due to Technology

Barriers to interaction space effectiveness due to technology can be considered under two categories:

1. Lack of team consensus on the use of communication technologies

   In the absence of an agreement or discussion for how to use the different technologies, team members will eventually end up using different tools to accomplish the same task. From a coordination mechanism perspective, the globally dispersed team has the necessary technologies at its disposal, but no agreed upon procedures for how to use the technologies, and no explicit procedures or conventions for this were developed.

2. Asymmetry of ability to use the technologies

   In the absence of procedures for how to use the technologies, the use of technologies for interacting with global team members is most often than not dependent upon the team members own prior skills. However, this can sometimes lead to extra work in the case of global teams. For example, consider two team members putting a lot of effort into using a message board for two-way communication while a third team member using E-mail to convey ideas to the group since the member is not aware of the procedure for using the message board. This shows an asymmetry of ability to use the technologies. Each team member developed

his or her own personal style of working with the technology.

Since globally dispersed team members typically use advanced communication technologies, it is especially important to examine technology barriers and their impact on the spectrum of interactions, interaction quality and practices, information exchange and team outcomes.

### 4.5.1 Spectrum of Interactions

There is a vast difference between face-to-face interaction and computer-mediated interaction. The control of the interaction makes a huge difference upon the impact of the communication, collaboration and coordination. Without a proper collaborative atmosphere the effectiveness of computer-mediated interaction will be hindered. The concept of the control of interaction, which plays a big role in determining the effectiveness of the collaboration effort in large measure, is shown in Figure 4-1 adapted from (Chernier & Picasso 2000) and (Haywood 1998).

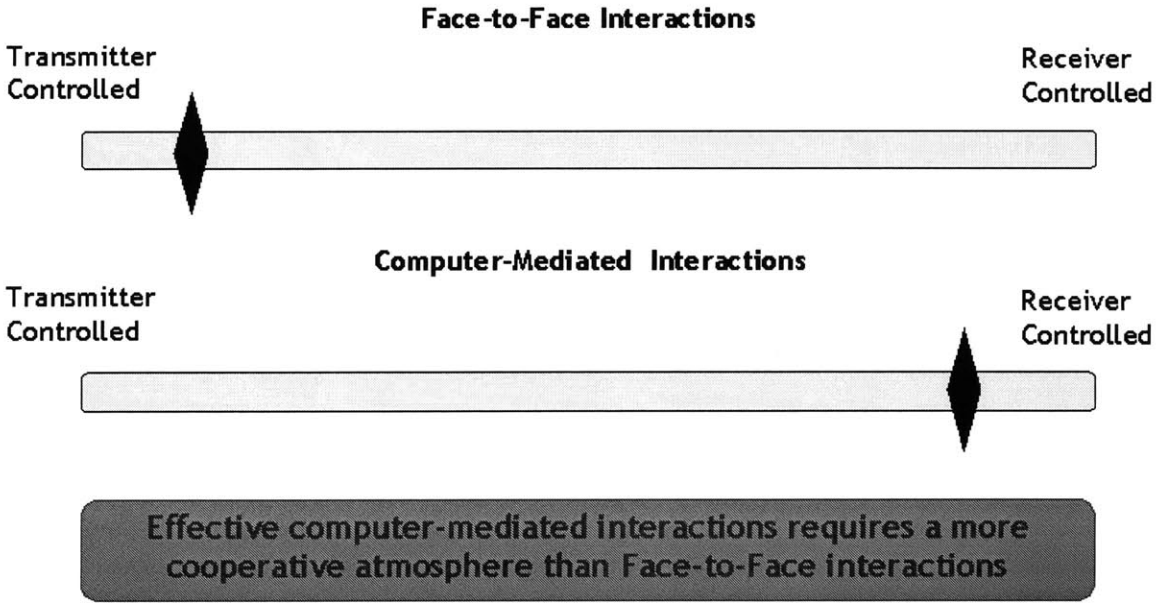



Figure 4-1: Interaction Control adapted from (Chernier & Picasso 2000)

To utilize computer-mediated interactions effectively, it is essential that the proper

environment in which such interaction is carried out exist. One technique to ensure effective interaction is to utilize the *spectrum of interaction.* The spectrum of interaction adapted from (Chernier & Picasso 2000) can be divided into 5 categories:

- Conversation of relatedness
- Conversation of possibility
- Conversation of opportunity
- Conversation of action
- Conversation of closure

Table 4.6 from (Chernier & Picasso 2000) summarizes the spectrum of interactions.

Table 4.6: Spectrum of Interaction

| Relatedness | Possibility | Opportunity | Action | Closure |
|---|---|---|---|---|
| Building common ground. Deeper understanding | Create ideas and possibilities | Converting possibilities into realities | Commitment to actions and results | Commitment to have nothing holding you back |
| **Signs It Is Missing** | | | | |
| Lack of understanding<br>Working at cross-purposes<br>Background conversations, not talking | Lack of vision<br>Business as usual<br>Low energy, cynicism and arguing for doubts<br>Resignation | Limited choice<br>Unfulfilled expectations<br>Indifferent and lack of alignment | Piecemeal implementation<br>Lack of results<br>Explanations not forthcoming about what is going on<br>Things disappearing into a hole | Frustrations<br>Hesitancy<br>Lack of satisfaction,<br>re-work |

### 4.5.2 Interaction qualities and practices

"*... the right words at the right time can make all the difference in the world. Language matters... It is the raw material of collaboration...*" (Schrage 1995). It is evident that computer mediation affects the content of interaction and the rate at which it proceeds. There is considerable evidence that interaction using communication technologies operates at a different rate than face-to-face communication (Straus & McGrath 1994). In addition, teams relying on communication technologies for a majority of interaction tasks, take longer to complete tasks than groups working face-to-face. When comparing the content of computer-mediated interactions with that of face-to-face, researchers have observed a filtering out of static and dynamic social context cues and differences in the frequency of types of interaction, particularly an emphasis on task-related rather than social relational information. Static social context cues are aspects of the physical environment that define the nature of the social situation and the individual's relative status; such as the chair at the head of a conference table or the wearing of a business suit (Sproull & Kiesler 1991). Dynamic cues emanate from a members' behavior and includes activities such as head nodding or hesitation before a response. It has been argued that when these types of cues about the social order are filtered out by the communication medium, people feel anonymous, distant from others, uninhibited and self-absorbed (Kielser et al. 1984).

Concerning differences in the frequency of types of interaction, some studies have suggested that teams that interact electronically are more task oriented and less likely to exchange social relational information than those that communicate face-to-face (Kielser et al. 1984). However, other studies have found either no difference or greater relational orientation (DeSanctis & Monge 1998). Mixed evidence regarding these media effects on the content of communication has been reinterpreted in recent years by taking into account the slower rate at which computer-supported interaction tends to operate. Straus & McGrath (1994) found that teams using communication technologies to interact had a higher proportion of task communication and disagreement and more equal participation than teams working face-to-face.

### 4.5.3 Information exchange

McGrath & Hollingshead (1994) observed that if status effects are minimized and participation is more equal, information exchange is better when teams interact using communication technologies than traditional face-to-face methods. However, experiments conducted by Hightower & Sayeed (1996) showed information exchange to be less complete and discussion more biased in teams using communication technologies for interaction than in those interacting face-to-face. In addition, such computer-mediated teams were less likely than those working face-to-face to discover information uniquely held by one member. Moreover, Hightower & Sayeed (1996) found that information load - the size of the pool of information available to the group - strongly and negatively affected the work of teams using communication technologies.

### 4.5.4 Team Outcomes

Past research suggests that productivity is lower for globally dispersed teams than traditional face-to-face teams since globally dispersed teams take longer to perform tasks. In addition, affective outcomes such as group cohesion, member satisfaction and social presence showed trends that were significantly lower levels in globally dispersed teams than face-to-face teams.

In a 2 x 2 factorial design, Chidambaram & Jones (1993) compared globally dispersed and collocated groups using an electronic meeting system, dispersed groups using audio-conferencing, and collocated groups meeting face-to-face without computer support. They found no significant differences in decision quality on the basis of either the use of computer or geographical dispersion. However, members of globally dispersed teams did report less sense of the social presence of their fellow group members than members of collocated teams. In addition, a sense of team identity was consistently lower in computer-mediated than face-to-face groups. The effectiveness barriers that a team faces due to communication technology are usually a subset or a combination of the barriers enumerated in Table 4.7.

Table 4.7: Effectiveness Barriers - Communication Technology

| |
|---|
| Inadequate technical accessibility |
| Inadequate technical expertise |
| Insufficient protocols for use of communication channels |
| Power/functionality offered by technical resources |
| Lack of commonly available technical resources |
| Insufficient expertise of using shared resources |
| Inadequate use of technical facilities |
| Insufficiency of information notification system |
| Inadequacy of technical training |
| Language/cultural influence in interpreting information coming through information channels |
| Ease of use of technical facilities |
| Reliability of technologies used |
| Speed of communication |

## 4.6 Barriers due to Infrastructure

The convergence of computing and telecommunications has led to core activities being reorganized around information. An essential aspect of globally dispersed teams is their ability to exploit the features of this new interaction space (Li 1995). Goddard (1992) concludes that to understand the new spatial dynamics of corporate activities we need to shift our focus from the geography of space (geographical separation) and place (the unique characteristics of particular socio-cultural setting) to the geography of flows.

Therefore, the locational patterns of the (networked) information cannot truly represent the geographical patterns of its use. Li & Williams (1999) argue that with the rapid development and proliferation of communication technologies, organizations increasingly have to operate in two spaces simultaneously - the physical space and the electronic space. These two spaces are not mutually exclusive and they sometimes overlap with each other. However, many of the rules governing these two spaces are fundamentally different. To survive in the information economy organizations must not only exploit geographical differences and overcome geographical constraints in the physical world, but they also have to exploit opportunities and face threats in the new electronic space. Our notion of time is significantly affected by the emergence of the electronic space.

With the emergence of the digital space, the nature and characteristics of the physical space has been radically redefined. This is not to say that the physical place is no longer relevant to individuals, teams and organizations. On the contrary, local characteristics will continue to affect the effectiveness of interactions between team members from different places, even in the globally dispersed place. Indeed, although in the electronic space the friction of distance has been eroded, other frictions of distance derived from differences between place (e.g. local culture and language) will continue to work. The effectiveness barriers that a team faces in spatial setup domain are usually a subset or a combination of the barriers enumerated in Table 4.8.

Table 4.8: Effectiveness Barriers - Spatial Setup

| Space | Barriers |
|---|---|
| Physical Space | Dissatisfaction with the current setup of chairs, tables, cameras, and computer/TV screens at *primary location.* |
| | Dissatisfaction with the current setup of chairs, tables, cameras, and computer/TV screens at *remote locations.* |
| | Physical setup creates the feeling that remote team members are mere observers in the interaction. |
| | Improper meeting room layout. |
| | Inadequate resources – lights, microphones, screens, speakers. |
| | Improper positioning of technical resources. |
| | Meeting room capabilities are asymmetric at different sites. |
| | Meeting rooms are not accessible. |
| | Inadequate skills of members to use the infrastructure for better use of physical space. |
| Digital Space | Inadequate utilization of online resources. |
| | Online resources are not readily accessible from multiple locations (for example, office, cubicles, meeting rooms, home, airport). |
| | Insufficient technological reliability, ease of use, excessive response time to access online resources. |
| | Inadequate technical training of team members to use the online resources. |
| | Improper layout of the digital space making it difficult to access the information. |
| | Improper mobilization of team web site or common web repository. |
| | Inadequate usage of digital resources for meetings. |

## 4.7 Discussion on Barriers

Working in globally dispersed teams poses problems not usually encountered when groups of people work in the same building. Examples include the constraints (and advantages) of time zones, lack of non-verbal cues, cultural differences between team members and problems of trust and identity. Globally dispersed team members often need to share work-in-progress with others, which may require team members to adopt new attitudes. Developing a team culture and common procedures are essential for the development of credibility and trust among team members in a globally dispersed environment. To be effective globally dispersed teams have to develop new ways of sharing knowledge and understanding in the digital space. The implications of the interaction space for globally dispersed teams are profound, and many lessons can be learned from new theories on the geography of information economy. Instead of living in the physical space and place, and overcoming distance by transportation, organizations and individuals now have to deal with different combinations of physical and digital spaces and places. These spaces and places can co-exist with one another and can be integrated flexibly. The geographical and organizational flexibility derived from these combinations implies that organizations have to adapt the way they manage their internal activities and external relations. How to exploit the interaction space by overcoming the barriers identified in this chapter will be a significant challenge for globally dispersed teams.

The interaction space framework developed in earlier chapters merged the physical space with the digital space to make some inroads in tackling the complexities and barriers facing globally dispersed teams. If a strong relationship is developed in the physical environment, team members are more likely to "go the extra half-mile" for each other in the digital space and vice-versa. The feelings of identity and trust developed in this way provide a sound basis for subsequent computer-mediated interaction. Finally, many of the barriers identified in this chapter derive from a lack of understanding of the exact working of globally dispersed teams. The emergent digital interaction space significantly increases the complexity of the business envi-

ronment and the geographical flexibility of organizations. Globally dispersed teams must therefore be seen in this broader context of the interaction space and their effectiveness be evaluated in a systemic manner involving the interaction space. Figure 4-2 summarizes the barriers identified in the above sections.

- **Organizational/Team Processes**
  - Cultural Differences (C)
  - Language Differences (L)
  - Distance (D) - geography versus time zones
  - Organizational (O)
  - Ineffective Interface with External Organization (EI)
- **Technology**
  - Technical Expertise (TE)
  - Technology Accessibility (TA)
  - Technical Resources (TR)
    - Inadequate functional ability (IFA)
    - Bad transmission speed (BTS)
    - Inadequate reliability (IR)
    - Not comparable in different sites (ITR)
  - Inadequate Information Notification System (INS)
- **Interaction Processes**
  - Inadequate communication - not using the entire spectrum of interaction (ISC)
- **Spatial Setup**
  - Insufficient use of team website (ISS)
  - Inadequate physical setup for meetings (IPS)

Figure 4-2: Barriers to Interaction Space Effectiveness Summarized

## 4.8 Suggestions on Overcoming the Barriers

Some suggestions based on past research include:

1. Engage the team in setting expectations about behavior and performance and record the team's decisions and commitments to each other.

2. Determine, as a team, how conflict will be addressed and resolved.

3. Clearly define member responsibilities (Jarvenpaa et al. 1998a).

4. Use rigorous project management disciplines to ensure clarity (Gerber 1995).

5. Proactive behavior, empathetic task communication, positive tone, rotating leadership, task goal clarity, role division, time management, and frequent interaction with acknowledged and detailed responses to prior messages (Jarvenpaa et al. 1998b).

6. Strive for a good faith effort in complying with the team norms and commitments, be honest in team negotiations, and don't take advantage of others or of the situation (Jarvenpaa & Ives 1994).

7. Encourage social communication that accompanies task completion.

8. Provide more formal communication than in traditional same time/same place team (Gerber 1995).

9. Focus team learning on the tacit as well as the explicit knowledge. Document the tacit and embed the process into the organizational structure (Grenier & Metes 1995).

10. Match desired activities with performance evaluation factors; reward the desired performance (Myers & McLean 1997).

11. Design and integrate communication technologies that fit the team environment; don't force the team to adapt its behavior to the "latest" technologies.

12. Provide training support for communication technologies to all team members.

# Chapter 5

# Team Interaction Space Effectiveness Models

*Customer Enthusiasm; Integrity; Teamwork; and Innovation*

*General Motors' Corporate Values as put forth by CEO Jack Smith*

The previous chapters have delved in detail into what are the constituents of the team interaction space, what kind of effectiveness barriers exist before the interaction space can be used effectively and efficiently. In the team interaction effectiveness framework, one of the activities includes evaluation of the team interaction space effectiveness. Additionally, in previous chapters, there have been attempts to evaluate specific aspects of the team interaction space effectiveness by observing the team interaction space. This chapter combines the different team interaction space observation sources to translate into a position on the team interaction space effectiveness continuum.

## 5.1 Evaluating Virtual Team Interaction Space Effectiveness

The positioning of the team on the team interaction space effectiveness continuum is indicative of the health of the team interaction space. This positioning helps in

providing solutions to the team regarding what it should be doing to improve the team's interaction space effectiveness. This is achieved through the team interaction space effectiveness model described herein. The team interaction space effectiveness model comes up with a number on a scale of ten as indicative of team interaction space effectiveness. This number will map to a specific evaluation of the team by its positioning on the team interaction space effectiveness continuum

## 5.2 Review of Effectiveness Models

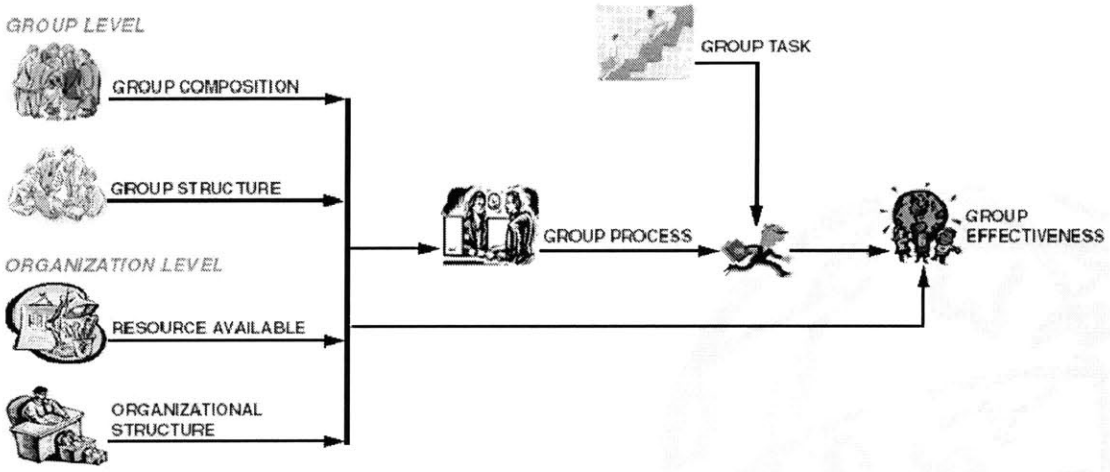
Hackman's (1990) model of organizational work group effectiveness, which uses an input-process-output format, identifies the "ingredients" of work group effectiveness: a conducive group structure involving task structure, group composition, and "core norms that regulate member behavior" (Hackman 1990); organizational-level factors such as the educational, reward, and information systems; and coaching and process assistance to help the group minimize process losses (Steiner 1972) and maximize synergistic process gains (Steiner 1972). Hackman (1990) includes "adequate material resources" as an enabler referring to the extent of material support a group receives to complete the task. The likelihood of team effectiveness increases when all these ingredients are present. Conversely, "when one or more of them is absent, the likelihood of effectiveness diminishes" (Hackman 1987). Drawing on early work by (McGrath 1964), Gladstein's (1984) model also uses an input-process-output format: inputs -group composition and group structure, available resources and organizational structure - affect group effectiveness (outputs) through group process variables. Direct effects of Inputs on Outputs are also predicted by the model. Group task is shown as moderating the relationship between process variables and group effectiveness. Hackman and Gladstein include group performance and group member satisfaction under group effectiveness.

### 5.2.1 Gladstein's Model

The Gladstein Model presented graphically in Figure 5-1 proposes that four inputs - group composition, group structure, resources available and organizational structure - define a group process that, moderated by group task, results in maximum group effectiveness. There are three components of team effectiveness: group performance, satisfaction of group-member needs, and the ability of the group to exist over time. The other variables are:

- Group Composition = $f$(Adequate skills), (Heterogeneity), (Organizational Tenure), (Job Tenure)
- Group Structure = $f$(Role and goal clarity), (Work Norms), (Task Control), (Team Size), (Formal Leadership)
- Resource Availability = $f$(Authority), (Accountability), (Money), (Equipment), (Facilities), (Information) (Time)
- Group Process = $f$(Communication), (Supportiveness), (Conflict Management), (Involvement), (Trust), (Commitment), (Boundary Management)
- Organizational Structure = $f$(Reward structure), (Supervisory control), (Management buy-in), (Culture)
- Group Task = $f$(Task complexity), (Environmental/Market uncertainty), (Interdependencies)
- Group Effectiveness = $\Sigma$ (Team Performance) (Team Satisfaction) (Team Sustainability)
- Team Performance – refers to how well the team as a whole, satisfies/meets the goals and objectives that were set for the team.
- Team Satisfaction - refers to the sense of accomplishment felt by individual team members and collectively shared by all team members, if the team goals or parts of the team goals were deemed to have been completed successfully.

- Team Sustainability – refers to the ability of the team to sustain over the life of the team




**Group Effectiveness = Σ (Team Performance) (Team Satisfaction) (Team Sustainability)**

Team Performance - how well the team as a whole, satisfies/meets the goals and objectives that were set for the team.

Team Satisfaction - sense of accomplishment felt by individual team members

Team Sustainability - ability of the team to sustain over the life of the team

Figure 5-1: Graphical Overview of Gladstein's Effectiveness Model

### 5.2.2 Discussion on Gladstein's Model

Looking at Gladstein's (1984)'s model, the following notes are summarized below:

- Gladstein believes that common commitment is part of the overall team objective. This is actually one of the assumptions in the Gladstein model.
- Gladstein suggests an effective team ranges between two and six team members, although provides no concrete reasoning for that choice.
- The Gladstein model does not differentiate between different types of teams, team tasks or how long the team is together.

- The first component of the Gladstein Model is group composition. Although the specification of team size was different, the level of skills and abilities were both noted as important to complete the tasks. Gladstein mentions that adequate skills and technical knowledge are essential to team effectiveness.

- Gladstein mentions that group structure, one of the components of inputs at the group level, contains the important element of goal understanding and agreement (Ancona & Caldwell 1992).

- At the organizational level of the Gladstein Model, training and technical assistance as well as rewards for group achievements are given higher priority. Gladstein believes that group rewards and technical assistance cause "self-reported effectiveness". In light of this, the research study described in Chapter 8, team member self-report on team performance was used.

- The input level of the Gladstein Model leads to the group process stage. At this stage Gladstein model mentions that wider communication channels result in open discussion which in turn leads to effective use of the teams' time and resources. Gladstein mentions that each member needs to be proactive in the team process. Collective work and open communication are driving forces for obtaining team goals.

- Gladstein Model seems to imply that for a team to be effective, it must identify the major needs and address them at the outset. This is contrary to the observations from global teams described in Chapter 8, since the process stage of team formation was where most needs were addressed and resolved to the team's best ability.

- Gladstein Model is a single step linear model. To be effective, the effectiveness model should be a circular or spiral model incorporating inputs and processes throughout and continually allowing for team feedback.

The Hackman and Gladstein models share may similarities: they both employ individual, group and organizational-levels of analyses to understand group work;

both use the input-process-output format. Both share a focus on group process, and define the dimensions of group effectiveness in similar fashion. However, there are also differences between the two. A model integrating concepts from these two model could provide the following advantages:

1. Gladstein's (1984) model differentiates between task and maintenance process behaviors, while Hackman (1990) only looks at process criteria. Hence, integration would allow the study of the effects of the process variables on the process criteria.

2. Gladstein's (1984) model classifies tasks using information processing criteria, while Hackman's (1990) model incorporates the role of task motivation. Integration would allow the consideration of motivational as well as information processing factors in the context of the group task;

3. Integration allows the use of multiple indicators and measurement strategies to be applied to the phenomena under study. But for objective performance measure, Gladstein (1984) largely used group member self-report measures in her study. Following this, for the research study described in Chapter 8, team member self-report on team performance was used.

### 5.2.3 Team Effectiveness Models from Consulting Community

There are a number of team effectiveness models proposed by the consulting community. This section includes a discussion on the team effectiveness model (see Figure 5-2 proposed by Lotus Corporation. (Source: `http://www.lotus.com/`).

Figure 5-3 suggests the following approach to implementing effective teams:

- Describe the team situation, including its task, mission, and other inputs or constraints.

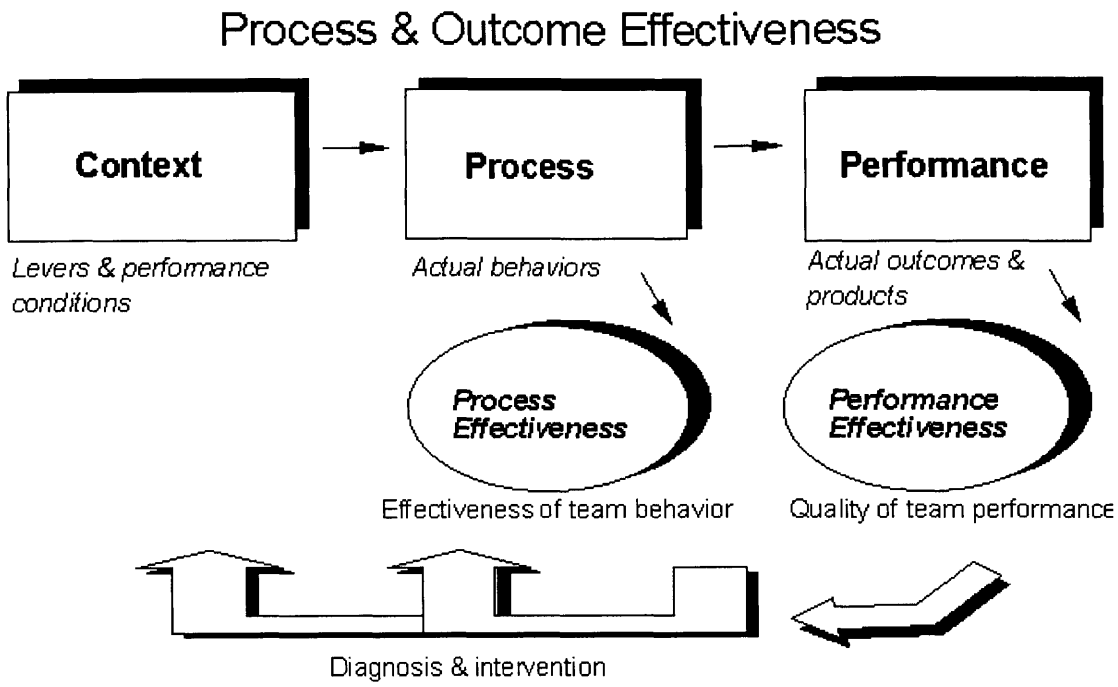



Figure 5-2: Process and Outcomes based Effectiveness Model (Adapted from Lotus Corporation)

- Diagnose the given performance conditions such as the culture, power structure, norms and social climate of the team and compare to the ideal.
- Diagnose the performance conditions, including the aspects of the team and its task and compare to the ideal.
- Design and perform interventions as needed.
- Align the technology's functionality to support the tenets of effective teamwork, and to accommodate the given contextual factors.
- Facilitate the team in implementing and integrating the use of the technology into the team processes.
- Continually monitor the team process and performance conditions, especially its use of the technology. Intervene as needed.


Figure 5-3: Strategy for Implementing Effective Teams (Adapted from Lotus Corporation)

## 5.3 Effectiveness Variables

After reviewing the literature from (Gladstein 1984), (Hackman 1987), (Hackman 1990) and (Ancona & Caldwell 1992), the following effectiveness model variables were identified:

- Organizational/Team Processes – these variables relate to the team and the organization as a whole. They are subdivided into
- Group Composition – this variable relates to the team composition which is affected by
    1. Adequate Skills – the skill set of the team members
    2. Heterogeneity – the degree of heterogeneity of the team members

3. Organizational Tenure – the time for which the team members have been part of the organization
4. Job Tenure – the time at the current job for team members

- Language Barriers – this relates to the difficulties faced by team members as the language of interaction is often not the language in which team members are comfortable in
- Cultural Barriers – the cultural differences amongst team members
- Group Structure – this relates to the way the work gets done in the team. This variable encompasses a number of sub-variables like
- Role and Goal Clarity – the degree of clarity amongst team members about assigned tasks
- Work Norms – the process in which tasks are done
- Task Control – the allotment of tasks and the relative importance
- Team Size – the size of the team including core and auxiliary team members
- Leadership – the kind of leadership that the team is using, the degree of empowerment of the team members, the presence of a team coach during team interactions
- Management Support – the degree of support that the team receives, whether it is being micromanaged by upper-tier management
- Technology – this is the second aspect of the team interaction space. The variables are

1. Capability – the technology capabilities of used communication technologies: Synchronous and Asynchronous Communication facilities
2. Accessibility – the degree of access to technical facilities to team members

3. Ability – the degree to which team members know how to use the technology they have at their disposal
4. Resources Utilization
5. Inadequate expertise in handling and using shared facilities
6. Insufficient information notification system
7. Insufficient protocols for use of communication channels
8. Ease of Use – usability of technologies used
9. Technical Training – the presence and the adequacy of technical support training to team members; The degree of support provided to the team members for using the technology

- Physical Setup variables (Peña-Mora 1999) are:

1. Capability – the adequacy of facilities available for use
2. Infrastructure layout – the layout of rooms and equipment
3. Interaction of digital and physical space – the way digital and physical space interface with each other
4. Accessibility - the level of access to physical setup facilities
5. Ability
6. Collaborative climate
7. Ease of manipulation

- Group Process variables (Gladstein 1984) and (Hackman 1990) are:

1. Motivation – the team member involvement in the team interaction process
2. Trust – the degree of trust that team members have for each other
3. Open communication channels – the degree of openness of communication channels
4. Supportiveness – the degree of support that team members receive in their daily functioning from the team

5. Conflict management – the manner in which conflicts are managed in and outside the team
6. Collective decision-making ability – the ability of the team members to take decisions as a team
7. Boundary management – the way the team interfaces with the larger environment both within the parent organization and the external world.

- Group Task variables (Hackman 1990) and (Ancona & Caldwell 1992) are:

1. Task complexity – the degree of complexity of the task to be done
2. Impact of environmental factors – the way the environment affects the nature of the task
3. Task interdependencies – the dependencies of the task on external factors
4. Task uncertainty – the degree of uncertainty in the task in terms of whether it can be done or not
5. Task sensitivity
6. Task reliability – the requisite reliability of the task required

- Output measures are:

1. Team performance – internal team-metric based evaluation as well as external managerial/organizational evaluation
2. Internal evaluation – team metric based
3. External validation – from upper level management and formal organizational evaluation processes
4. Member Satisfaction: Individual, Team, Organization
5. Process Satisfaction
6. Learning: Individual, Team, Organization

## 5.4 Team Interaction Space Effectiveness Model

Figure 5-4 shows the global team interaction space effectiveness model in its conceptual form. Quantitative and qualitative data analysis is currently under way and out of the scope of this dissertation. The analysis will establish some of the numerical relationships amongst the variables in the models which will allow the model to be used to obtain team interaction space effectiveness. This will allow globally dispersed teams to position the team in the team effectiveness continuum identified in Chapter 6.

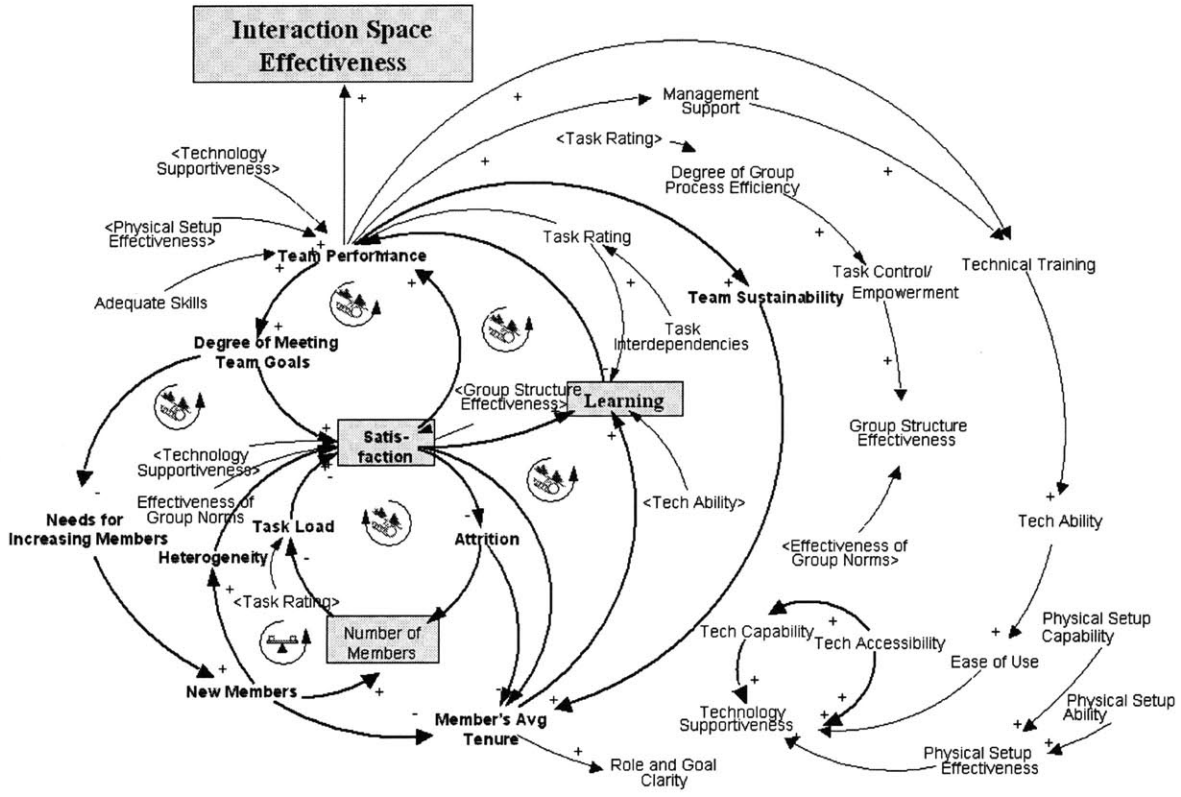



Figure 5-4: Team Interaction Space Effectiveness Model

## 5.5 Leveraging the Intangibles

This section underlines the intangible outcomes and how team interaction space can be used effectively to realize some of the intangibles.

### 5.5.1 The Intangibles

The success of organizational processes encapsulated by a team as well as organizational culture, is usually expressed/embodied by a number of intangible factors, which are generally never formally measured nor recognized (Sen 2001). However, it is important for the success of virtual teams that they learn to identify these factors as well as learn how to leverage these factors for the success of the team and the larger organization and increased effective performance. These factors (Sen 2001) are

1. Social capital
2. Intellectual capital
3. Human capital
4. Traditional capital

### 5.5.2 Team Interaction Space and the Generation of Capital

The team interaction space acts as an enabler for the global team to contribute the intangibles or the capitals mentioned above to the organization as members of the organization. The success of a project that a global team is assigned depends on how effectively the team eco-system (Sen 2001) namely the team interaction space is utilized. The team interaction space essentially comprises variables, and acts as a life-support to the overall project. Proper interactions carried out in the team interaction space not only manages the explicit goals of satisfying cost and schedule criteria but is also responsible for generating several intangibles which are outcomes of the team interaction processes none the less. The project eco-system is the environment in which the team interaction space develops. Sen (2001) uses project management

principles to show how the team interaction space relates with the different aspects of the project in related to the project identifiers (see Figure 5-5).

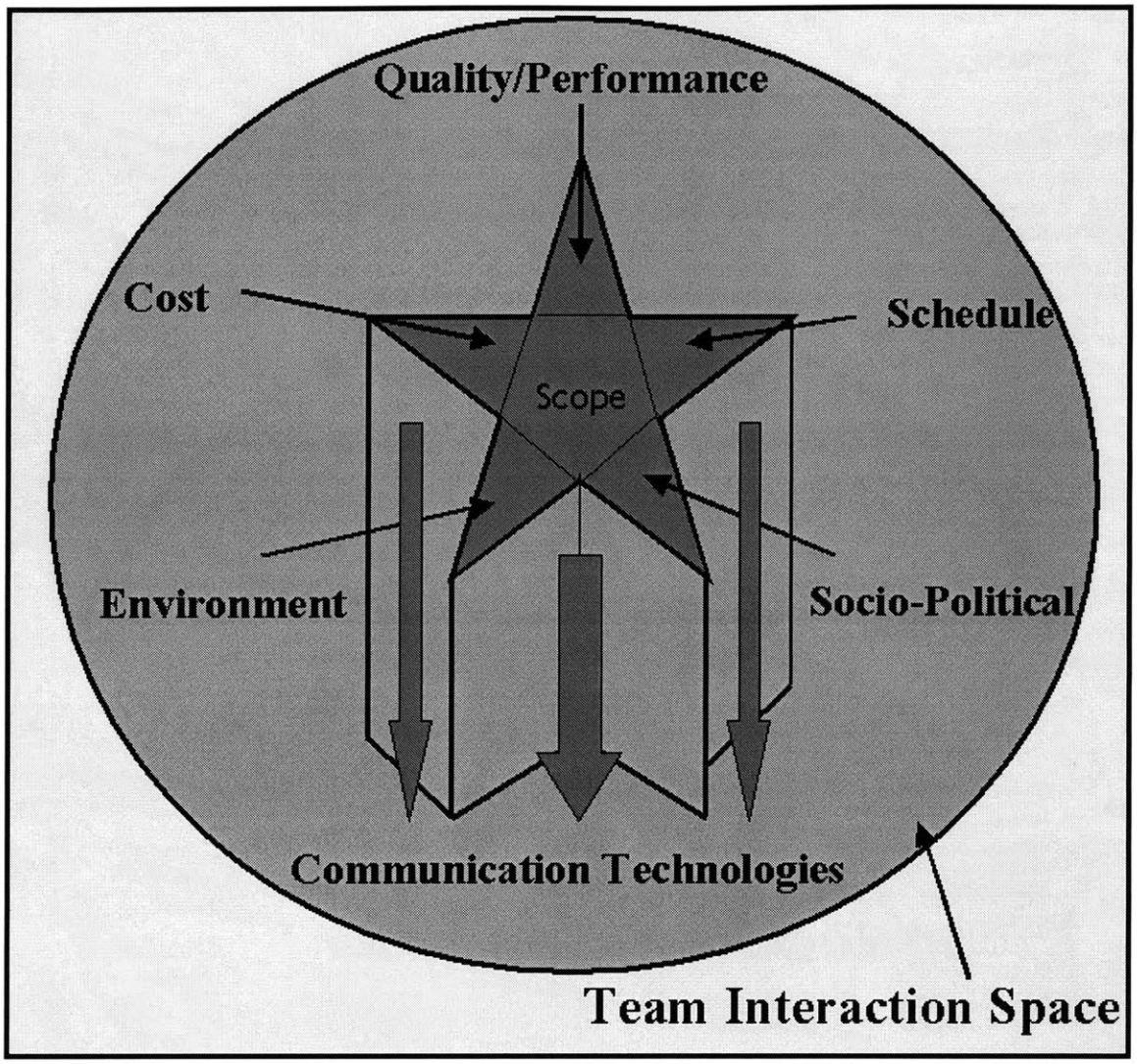



Figure 5-5: Project Eco-System and Team Interaction Space

The project that a global team is brought together for can be usually divided into:

- Scope – the project objectives and the direction in which the project begins, the point it ends and the explicitly defined project goals.
- Quality/performance – the criterion for measuring the performance or the amount of rework required before the project is assumed to be complete.
- Schedule – the time aspect.
- Cost – the cost of completion for the project.
- Environment – the environment in which team members interact, in a way their virtual team interaction space and a reflection of the team interaction space dimension of the team spatial setup.
- Socio-political – the area in which the project is being executed and its relevance in the organizational context.

The project goals directly tie back to the intangible deliverables that the team contributes to the organization. Realizing the team project deliverables in time (meeting time to market deadlines, keeping infrastructure costs low through proper utilization and allocation of resources in the team interaction space) results in the generation of traditional capital in terms of revenue for the organization. Executing the project generates valuable intellectual capital as team members grow in technical knowledge and the overall skill of the team as an organizational entity improves. Embedded ways and means to share the knowledge generated helps in creating a greater organizational knowledge capital. Team interactions in the process of meeting the explicit project deliverables help in generating social capital as the team comes up with ways and means to formalize the team interaction process so that communication processes are robust and prevent miscommunication. Trust is engendered and social capital is generated. The team members share in the production of the team outputs. The alignment of the team objectives with personal/individual expectations results in satisfaction – in terms of rewards for work well done as well as professional satisfaction. The team contributes to the growth to human capital of the organization.

### 5.5.3 Generating Social Capital

Global teams are dynamic and susceptible to a lot of change through transitioning of team members. Also, as global teams come together for a specific purpose they aggregate and disperse quite quickly. However, that is a potential source of leveraging the technical skills and expertise for the better of the organization. Team members can propagate learning through the organization by taking the knowledge that they have gained to new teams. When team members who have worked earlier together come together, they can already build upon the understanding and the trust that they have. These advantages can be leveraged by building social capital in a virtual world. (Klein & Barrett 2000). For creating and sustaining social capital in a virtual world, teams should ensure that:

- There is alignment both within the team amongst the team members as well as alignment of the team with the broader goals/objectives of the organization as a whole.
- Teams should help build and propagate globally developed learning practices.

Figure 5-6 (Klein & Barrett 2000) shows the different skill-sets that need to be leveraged to generate social capital and to transform the global team culture.

The skill-sets that must be leveraged in an efficient manner (Sen 2001) and (Klein & Barrett 2000) are:

1. Global Alignment – Establishing a compelling, cross-cultural, cross-functional reason for being by inspiring and communicating a relevant picture of where the team is headed in terms of goals/objectives in an organizational context.
2. Unified Vision – the interactions carried out in the team interaction space helps in creating the right processes, balances and mechanisms (global team norms) for effective exchange of information to enable the formulation of a unified direction and momentum.

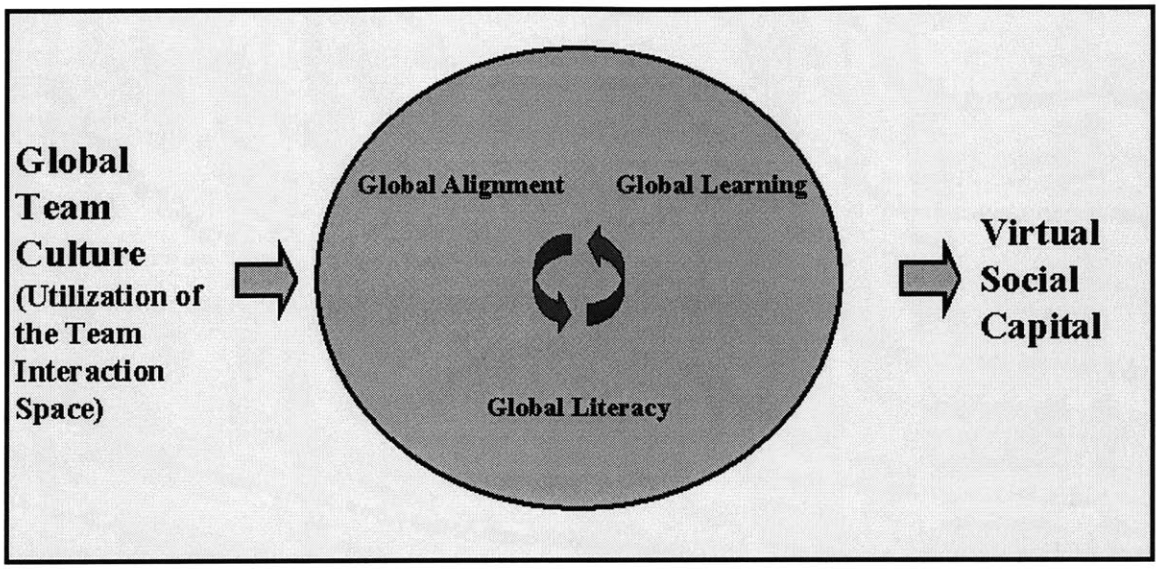



Figure 5-6: Generating Social Capital (Adapted from (Klein and Barrett, 2000))

3. Global awareness – through interactions carried out in the team interaction space, team members have an acute awareness about cultures. Team norms build their own team culture cutting across national cultures which helps engender a particular form of global literacy.

4. Context – situational interpretation as well as developing the ability to assess the complex and interdependent factors of multi-cultural interchanges.

5. Global Learning – Integration and Cross-Fertilization of Knowledge - actively facilitating the dissemination of knowledge throughout global structure; moving intellectual capital (in the form of ideas, people, resources) to where they are most needed in an organizational context.

### 5.5.4 Generating Intellectual Capital

An important aspect of having effective teams is to leverage the intellectual resources in the team for a better performance-enabling situation. Knowledge is increasingly regarded as an essential growth factor in most progressive organizations. Teams contribute to the knowledge capital of the organization by generating knowledge and

technical expertise, which makes the organization, advanced and better equipped to handle challenges. For virtual teams, knowledge sharing is critical for engendering trust and making things happen in a positive manner. Thus, it is essential that virtual teams understand the concept of "intellectual capital" and leverage it effectively to its ends. The components of Intellectual Capital are (Brooking & Motta 1996):

- Human-centered assets - Human-Centered Assets comprise the collective expertise, creative capability, leadership, entrepreneurial and managerial skills embodied by the team members.
- Infrastructure assets - Infrastructure assets are those technologies, methodologies and processes, which enable the team to function (global team norms). Basically the elements, which make up the way the team works.
- Market assets - Markets assets define the potential of the team in terms of market-related intangibles.

Knowledge of intellectual capital is a rich source of information about the team, and is of particular value in the following scenarios (Brooking & Motta 1996):

- Validating the Team's Ability to Achieve its Goals.
- Planning /scheduling project based on realistic estimation of team member capabilities
- The team contributes to the knowledge enhancement of the organization and thus increases the assessment of the organization through increased value of the team in the organizational context.
- Increasing Organizational Learning by sharing/dissemination of knowledge.

### 5.5.5 Generating Human Capital

Human Capital is a concept developed in the early 1960s to describe the value of the people part of the work equation, the skill and knowledge and the will to work together

of individuals. However, there is a subtle difference between human and intellectual capital. Human capital is essentially about people being innovative, creative and loyal to the cause of the team. Interactions in the team interaction space engender trust and team bonding and thus contribute to the cause of the team by generating human capital.

With economic, social and technological change all calling for constant flexibility and adaptation, teams and team members alike are increasingly aware of the importance of lifelong learning; similarly, they share a common interest in renewing and increasing the skills base of the greater organization as a whole and thus contributing to the cause of the organization. The empowerment of team members through knowledge sharing not only helps in producing intellectual capital but also helps in building team feeling and thus is an effective way of leveraging human capital.

Proper utilization of the team interaction space helps engender human capital. The team contributes to building human capital for the organization through its team norms. Team interactions in the interaction space helps in building (Sen 2001):

- Trust based on team culture developed through mutual agreement of team members (global team norms).
- Alignment of team member expectations implies satisfaction in developed processes for performance evaluation and reward structure inside the team.
- Learning/ personal growth and increase in technical expertise through knowledge sharing using developed team processes.
- Enhanced communication processes facilitate team member interactions and promote trust and personal (outside of professional interactions) team member interactions.
- Free information sharing and transparency of communication protocols help in building trust

### 5.5.6 Generating Traditional Capital

All firms whether collocated or virtual always target "traditional capital". It is the representation of the asset-based calculations of the team's productivity. It reflects directly on the team's effectiveness/performance and is usually the purely result-oriented and totally tangible measure of the team's productivity. Some of the factors, which embody the traditional capital of a team (Sen 2001) are:

- Infrastructure Resources
- Time to market
- Revenue generation
- Market size
- Environment

Teams work together to produce capital. There are a number of levels of capital that is produced by virtual team interaction and these "capitals" are a high level indicator of the team's performance. Traditional capital is the most basic level of the different capitals produced and helps in shaping the team structure and processes and their dynamics in many ways. The global nature of the team makes it imperative that the basic issues like time to market (which is related to scheduling), revenue generation (which is an indicator or measuring stick of the efficiency of cost reduction) and the market size (representative of the quality of its competitors' offerings and market share) are monitored closely as these metrics of evaluation of the team performance help in determining the team and organizational processes, one of the core foundations of the team interaction space, in large measures.

## 5.6 Benefits of the Team Interaction Space Effectiveness Model

The main objective for creating a team interaction space effectiveness model is to increase the team's effectiveness by its positioning in the effectiveness continuum. The other benefits of the team effectiveness model are:

- Providing team metric – identifying the level of team collaboration and providing guidelines to increase the overall team collaboration.
- Requesting and providing feedback – informing the team and individuals of observations and the effect of their behavior in meetings and indeed in their use of available media of communication.
- Identifying information technologies – aiding synchronous and asynchronous communication.
- Recommending a supportive physical setup – aiding in synchronous communication in meetings.
- Establishing team structure – defining distributed team structure and controls.
- Establishing and maintaining team focus – controlling the attention of the distributed team and maintaining a common line of reasoning.
- Monitoring and controlling – providing metrics to control and calibrate team performance through the means of the effectiveness continuum.

# Chapter 6

# Continuum of Team Interaction Space Effectiveness

*... If we accept the premise that world-class performance, in any endeavor, requires practice and dedication, it is surprising the haphazard way many teams are formed, educated, and developed...*

*Rayner (1996)*

Continuing with the team interaction framework from Chapter 3, observing the team interaction space can help position the team in a team effectiveness continuum. This chapter starts with the need for effectiveness continuum for globally dispersed teams and identifies the potential use of an effectiveness continuum. In addition, in Section 6.2, two popular effectiveness from the academic and consulting communities are reviewed. Section 6.3 presents the spiral team interaction space effectiveness continuum based on the observations and data collected as part of this research endeavor.

## 6.1 Need for Effectiveness Continuum

One of the key questions facing managers of global teams is how does one go about improving overall team performance? To provide guidance to organizations that want to improve the way they address team-related issues, the academic and consulting

communities have developed team effectiveness continuum. Most continuum are focussed on improving the management and development of the overall team assets of an organization. The continuum are designed to provides guidance on how to continuously improve the ability of organizations to attract, develop, motivate, organize, and retain the teams needed to steadily improve organization capability. In summary, the goals of team effectiveness continuum are to help organizations to:

- characterize the maturity of their team practices
- guide a program of continuous team development and improvement
- integrate team development with process improvement
- identify potential strengths and weakness in team practices against a standard
- build consensus around fundamental team problems
- set priorities for improvement needs
- provide guidelines to teams on improving team performance

## 6.2 Review of Effectiveness Continuum

A number of team effectiveness continuum have been developed by the academic and consulting communities.Haywood's (1998) Team Maturity Model has been developed for managers of globally dispersed teams based on formal surveys designed to characterize common attributes of successful globally dispersed teams. Curtis, Hefley & Miller's (1995) People Capability Maturity Model has been designed to provide software organizations with an assessment and diagnostic tool to improving their software teams.

Haywood's (1998) Team Maturity Model gives the managers a framework for assessing their team's maturity level and assistance in determining the next steps to improve their team's effectiveness. The Maturity Model (see Figure 6-1) for globally dispersed teams consists of four levels, with each level demonstrating certain

characteristics and problem areas. For the Maturity Model, Haywood (1998) defines "effectiveness" as a team's record for meeting project or organizational objectives on time and on budget.

Globally dispersed teams performing at the ADHOC level are typically out performed by teams that are physically collocated. Teams at the BASIC level typically achieve performance comparable to teams that are collocated. Teams at the STANDARDIZED and OPTIMIZING levels consistently out-perform teams that are physically collocated.

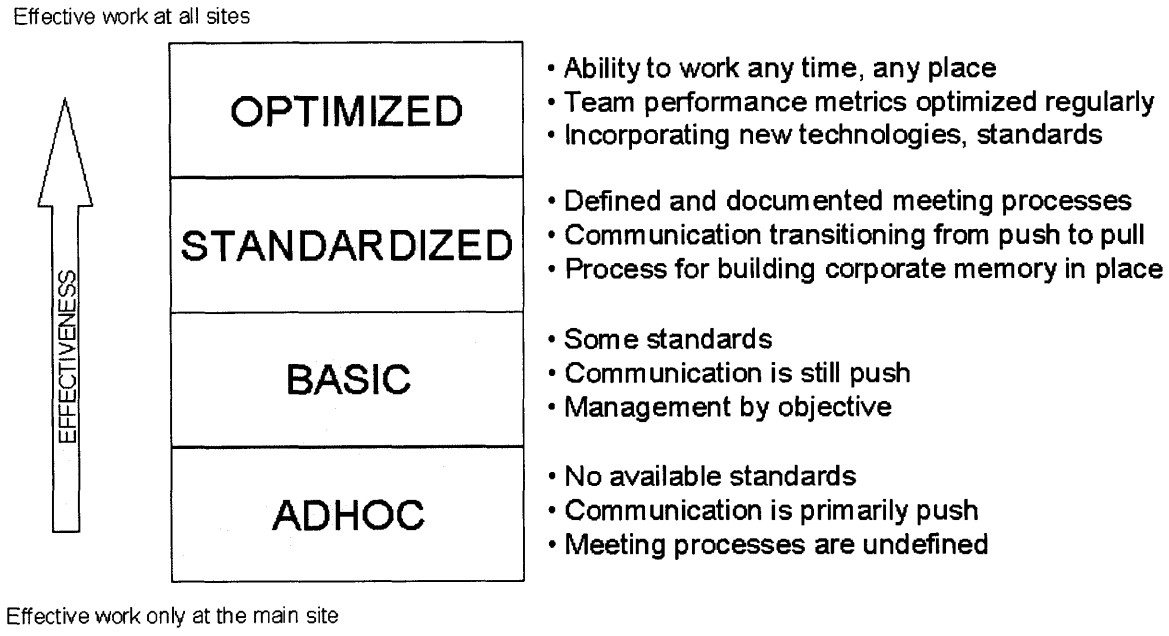



Figure 6-1: Team Maturity Model adapted from (Haywood 1998)

The People Capability Maturity Model (P-CMM) is a maturity framework that guides an organization in managing and developing its workforce (Curtis et al. 1995). It uses the same architectural principles and structural formatting as the Capability Maturity Model for Software (SW-CMM) developed at the Software Engineering Institute, Carnegie Mellon University (Humphrey 1997). This model (see Figure 6-2) focuses on the human aspects within the organization and describes the elements of managing and developing an organization's workforce. The P-CMM provides a maturity framework that describes how an organization can improve the ability of its workforce. The workforce is given the chance and ability to change from ad-hoc, inconsistently performed projects to a mature, disciplined organization with a higher level of knowledge, skills and motivation among the work-force.

The P-CMM can characterize the maturity of the workforce practices that are being used in the organization. The P-CMM indicates which areas that should have the highest priority for immediate actions. With help from P-CMM the workforce development can be integrated with process improvement and a culture of excellence can be established. When the P-CMM framework has been established in the organization this results in an environment where practices can be repeated and the best of them quickly can be transferred to other groups. This involve that the variability in the performance decreases and that the work practices can be improved continuously to enhance capability. Table 6.1 presents an overview of the themes and key process areas of P-CMM.

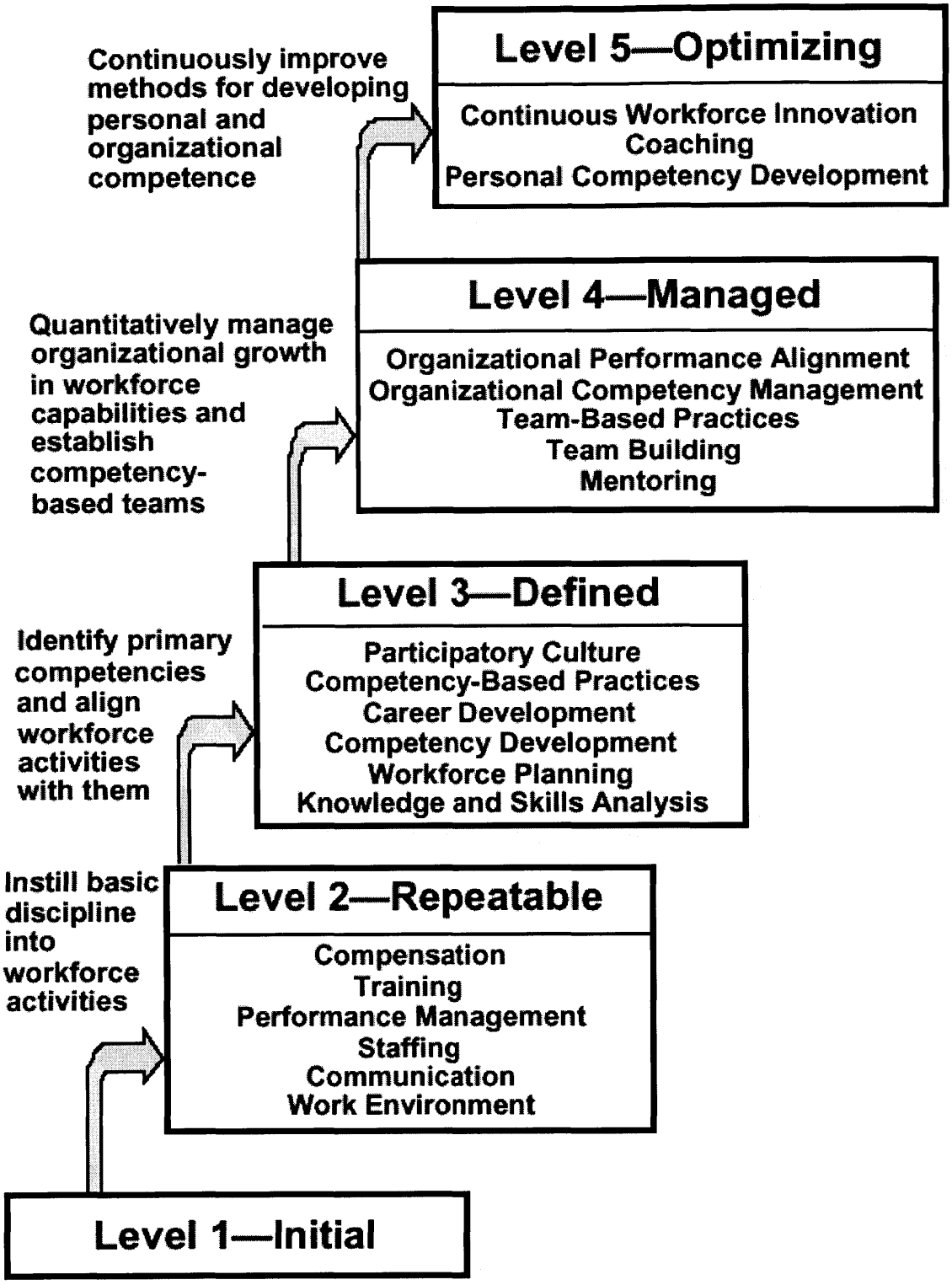



Figure 6-2: People Capability Maturity Model adapted from (Curtis et al. 1995)

Curtis et al. (1995) identify the following four themes or process categories for the P-CMM model:

- *Developing capabilities*: Describes which actions to make in order to improve and develop the capabilities of the work force.
- *Building teams and culture*: Strives to improve how people are organized and interact within the organization.
- *Motivating and managing performance*: Focuses on the motivation and performance of the workforce.
- *Shaping the workforce*: Concentrates on the improvement of the workforce and the processes that are being used.

Table 6.1: Process Areas for People Capability Maturity Model

| Levels | Developing Capabilities | Building Teams and Culture | Motivating and Managing Performance | Shaping the Workforce |
|---|---|---|---|---|
| 5 Optimizing | Coaching Personal competency development | Continuous workforce innovation | | |
| 4 Managed | Mentoring | Team building | Organizational performance alignment Team-based practices | Organizational competency management |

*Continued on next page*

Table 6.1 – continued from previous page

| Levels | Developing Capabilities | Building Teams and Culture | Motivating and Managing Performance | Shaping the Workforce |
|---|---|---|---|---|
| 3 Defined | Competency development Knowledge and skills analysis | Participatory culture | Competency based practices Career development | Workforce planning |
| 2 Repeatable | Training Communicate | Communicate | Compensation Performance Management Work environment | Staffing |
| 1 Initial | No key process areas are defined | | | |

Professor Robert Sleeth of Virginia Commonwealth University has popularized a web-based tool for estimating the team effectiveness.

(Source: `http://www.people.vcu.edu/~rsleeth/TEAMRATE.html`)

The Team-Effectiveness Inventory technique uses a 20 question survey format with a 5-point Likert Scale ranging from strongly disagree (1) to strongly agree (5). The survey questions cover the topics of team mission, goal achievement, empowerment, open communication and positive roles and norms. The Team-Effectiveness Inventory survey is shown in Table 6.2.

Table 6.2: Team-Effectiveness Inventory Survey

| Topics | Survey Questions |
|---|---|
| Team Mission | 1. Everyone on my team knows exactly why the team does what it does. |
| Goal Achievement | 2. The team leader consistently lets the team members know how we're doing on meeting our customers' expectations. |
| Empowerment | 3. Everyone on my team has a significant amount of say or influence on decisions that affect his or her job. |
| Open Communication | 4. If outsiders were to describe the way we communicate within our team, they would use such words as "open," "honest," "timely," and "two-way." |
| Positive Norms | 5. Team members have the skills they need to accomplish their roles within the team. |
| Team Mission | 6. Everyone on the team knows and understands the team's priorities. |
| Goal Achievement | 7. As a team, we work together to set clear, achievable, and appropriate goals. |
| Empowerment | 8. I would rather have the team decide how to do something rather than have the team leader give step-by-step instructions. |
| Open Communication | 9. As a team, we were able to work together to solve destructive conflicts rather than ignoring conflicts. |
| Positive Norms | 10. The role each member of the team is expected to play makes sense to whole team. |
| Team Mission | 11. The team understands how it fits into the organization. |
| Goal Achievement | 12. If my team does not reach a goal, I'm more interested in finding out why we have failed to meet the goal than I am in reprimanding the team members. |

*Continued on next page*

Table 6.2 – continued from previous page

| Topics | Survey Questions |
|---|---|
| Empowerment | 13. The team has so much ownership of the work that, if necessary, we would offer to stay late to finish a job. |
| Open Communication | 14. The team leader encourages every person of the team to be open and honest, even if people have to share information that goes against what the team leader would like to hear. |
| Positive Norms | 15. There is a good match between the capabilities and responsibilities of each person on the team. |
| Team Mission | 16. Everyone on the team is working toward accomplishing the same thing. |
| Goal Achievement | 17. The team has the support and resources it needs to meet customer expectations. |
| Empowerment | 18. The team knows as much about what's going on in the organization as the team leader does, because the team leader always keeps everyone up-to-date. |
| Open Communication | 19. The team leader believes that everyone on the team has something to contribute- such as knowledge, skills, abilities, and information- that is of value to all. |
| Positive Norms | 20. Team members clearly understand the team's unwritten rules of how to behave within the group. |

## 6.3 Effectiveness Continuum Spiral

Based on the observations of the interaction spaces from a number of different teams, the linear approach adopted by earlier continuum was found to be misleading. Most globally dispersed teams appeared to improve in a spiral fashion, with frequent iterations between each state. In view of this, a spiral team interaction space effectiveness continuum is proposed in Figure 6-3.

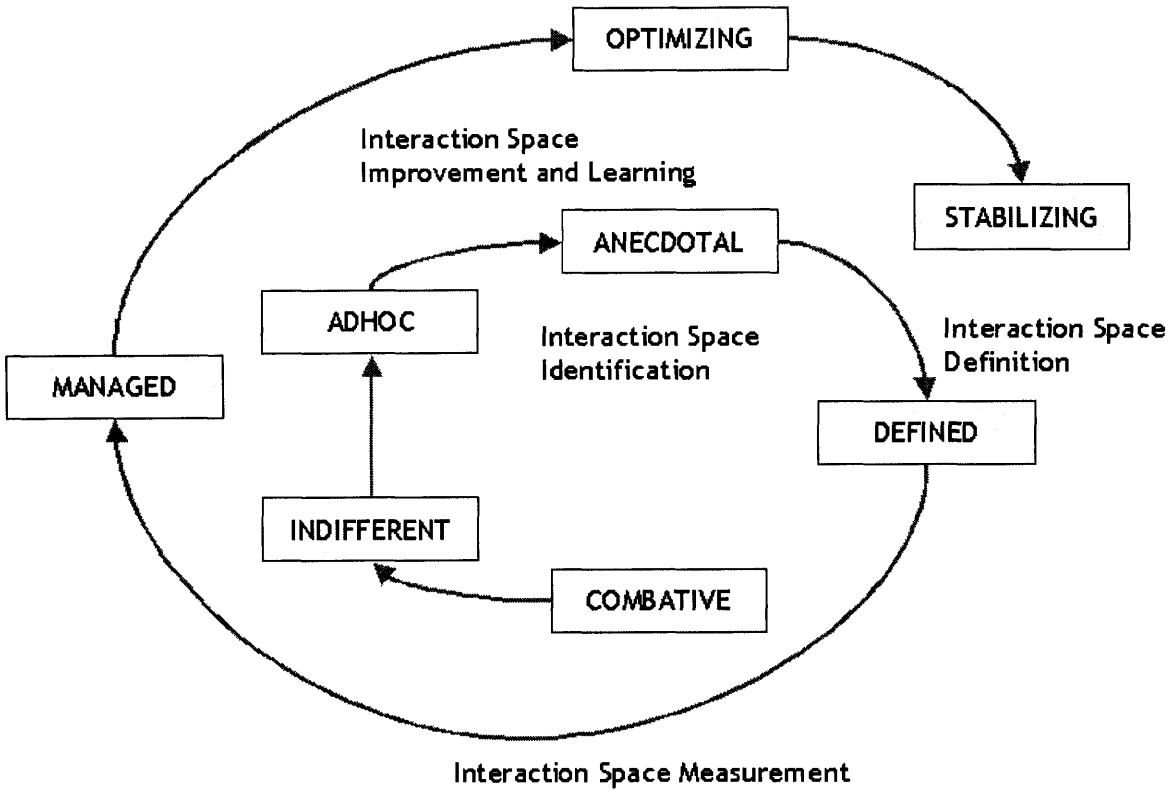



Figure 6-3: Interaction Space Effectiveness Continuum Spiral

Based on earlier continuum described in Section 6.2, the spiral continuum is expressed as a leveled road map with a number of key areas. The individual levels and characteristics of each key area are also defined. These characteristics could be developed into P-CMM like goals and key practices, but this would require further research outside the scope of this project. The road map is based upon a combination of a staged and a continuous architecture similar to the one adopted by P-CMM (Curtis et al. 1995). Eight different levels and their corresponding key areas are defined. In addition, some of the different levels are further characterized based on:

- An Organization theme that defines how the organization can establish and maintain a framework that supports its teams.
- A Process theme that defines the nature of the work processes and team needs.
- A Tools theme that describes the tools and technologies used by the team.

### 6.3.1 Combative

*Combative* level is characterized with a complete lack of team alignment within team members. Team members demonstrate high levels of interpersonal conflicts and disregard for other team members. In addition, communication technologies are often misused and stress the disenchantment of members in the interaction process.

### 6.3.2 Indifferent

*Indifferent* level is characterized by a significant number of team members demonstrating total lack of disregard for team issues. There is a general lack of interest in team welfare with significant number of personal agendas being covered under the team umbrella. The following recommendations are for moving to the next level of the spiral:

- Develop a written team vision and get the buy-in from all team members.
- Develop team goals and individual roles of team members.

- Standardize on the communication tools to be used by the team members. Ensure a right blend of synchronous and asynchronous communication tools are used by the team.
- Begin performance logging to facilitate the creation of team and individual metrics at a later level.
- Develop organization-wide training classes for team members to help working with other cultures.

### 6.3.3 Adhoc

*Adhoc* level is characterized by teams trying to work together with no available organization or team standards. Teams might be effective in reaching goals and milestones by chance. However, chances of successful replication of team efforts are remote.

Characterizing the Adhoc level further:

Organization:

- No clear direction or team vision from the organization.
- Team objectives are not clear to individual team members.

Process:

- There are no available standards for team to follow.
- Business processes are not clearly defined.
- Team interaction process is undefined.
- Performance metrics for team members are not clearly outlined.

Tools:

- Communication is through primarily push technologies.
- Ability to use communication technologies in the interaction space is limited or non-existent.
- Team interaction process is undefined.

### 6.3.4 Anecdotal

Teams at the *anecdotal* level are relying on some team standards, mostly borrowed from the past experiences of certain team members. Communication amongst members at the anecdotal team level are primarily push. Team members from local site often experience disenchantment since the interaction space is often governed by select few team members from a leading site.

### 6.3.5 Defined

*Defined* teams have their own set of standards and protocols which are understood by a majority of the team members. In addition, defined teams have identified some barriers and their relation to team effectiveness and are documenting the key lessons learned from their interaction.

Characterizing the defined level further:

Organization:

- Team goals and individual team member objectives exist but are not sufficiently detailed.
- Minimal infrastructure support provided by the organization to the team to reach the goals.

Process:

- There are some standards for team to follow.
- Team interaction process is undefined.
- Performance histories for team members are being maintained.
- Corporate memory systems are inadequate or non-existent.

Tools:

- Communication is migrating from push to pull.

- Majority of team members have the ability to use communication technologies efficiently.
- Accessibility to communication technologies from multiple locations is still limited or restricted.

### 6.3.6 Managed

*Managed* teams have defined and documented interaction processes. In addition, infrastructure and organizational support for building and utilizing corporate memory is in place. The following recommendations are for moving to the next level of the spiral:

- Define, document and align business processes.
- Take into account interpersonal skills and past history of working with global teams when selecting team members.
- Analyze information flow by observing the team interaction space.
- Based on the information flow, choose and popularize synchronous and asynchronous communication tools.
- Standardize on the communication tools to be used by the team members.
- Develop team and individual performance metrics based on performance histories.
- Develop organization protocols and communication technologies to allow teams to learn from each other.

### 6.3.7 Optimized

*Optimized* teams are characterized by their availability to work anyplace and anytime. Furthermore, team learning occurs at the global level. In addition, individual and team metrics are monitored and optimized at regular intervals.

Characterizing the optimized level further:

Organization:

- The organization is striving to be a learning organization and can control the development and use of teams in a systematic way. When the environment and conditions change, the organization can be redesigned to adapt to the new conditions.
- The organization tries to learn from the experiences already made and follows up the work of the teams.
- The experiences made by the organization and its teams are collected and used as an experience bank to solve similar issues and avoid making the same mistakes.
- Proactive infrastructure support provided by the organization to the team to reach the goals.

Process:

- The competence and knowledge of teams and individuals are continuously evaluated and improved. Experiences and knowledge are exchanged both within the team and between different teams and corrective actions are made to eliminate problems.
- The capacity and knowledge of each team member are continuously improved.
- As an incentive for the team members, promotions and reward structures take into account the overall team results.
- Team interaction process is well defined and documented.
- Leadership and responsibility are system-atically shared within the team.
- Team members have established a sense of mutual accountability for each others work.

- Processes to facilitate interaction between different teams are defined.
- Corporate memory systems are inadequate or non-existent

Tools:

- Team is using both push and pull technologies to communicate with local and remote team members.
- All team members have the ability to use communication technologies to share knowledge.
- Team members are able to access communication technologies from multiple locations.

### 6.3.8 Stabilization and Improving

*Stabilization and Improving* level refers to a steady state, which can be impacted by several disturbances thus bringing the team interaction space effectiveness down to any of the above stages. At this level, the competence and knowledge of teams and individual team members are continuously evaluated and improved. Experiences and knowledge are exchanged both within the team and between different teams and corrective actions are made proactively to eliminate problems. New team members are easily integrated and released within the team. The primary method for improving performance is the incorporation of new technologies and sharing of lessons learned to other teams.

# Chapter 7

# Case Studies

*The strength of the team is each individual member... the strength of each member is the team.*

*Basketball Coach Phil Jackson*

The use of globally dispersed teams is becoming more prevalent in large multi-national corporations. Earlier chapters in this dissertation presented a theoretical framework for team interaction space. To test the research theories and framework presented earlier in the dissertation, this research effort tested key concepts of the framework by studying a number of globally dispersed teams from large multi-national companies. The companies studied as part of this research effort represent different vertical markets: semiconductor and flash memory, automotive components, traditional and digital photography and auto maker. This chapter presents a case study of a fictitious company called *GlobalCo*, a composite of several companies studied as part of this research effort.

The teams were chosen for three reasons. First, by studying teams from different organizations handling seemingly both and process and product related work loads, we avoided the traditional debate of team task composition. Indeed, one of the most fundamental and widely accepted facts about teamwork is that the type of task really matters when studying teams (McGrath & Hollingshead 1994). Which factors affect team interaction will not only depend on the nature of the task, but also on the

amount of interdependencies among team members and sub tasks based in a single organization. Second, in this setting, interactions from a number of teams in various stages of development could be observed with significant cooperation from the management of the respective organizations. For each of the multi-national companies, global teams had been operating for as long as three years in response to globalization trends in their specific line of business. Senior management from the GlobalCo divisions knew their future industry position depended in large part on these teams' performance, and they were interested in learning how to promote effective performance. Third, given the increase of strategic alliances in global organizations, most teams studied in this case study had multiple types of boundary-spanning (for example, language, function, culture and organization) thereby providing some data on the barriers identified in previous chapters in this dissertation.

Using a theoretical replication logic with multiple cases (Yin 1994), senior managers from each of the organization helped in identifying the globally dispersed teams to study. A number of different teams fit the general research criteria and the management, team leader and individual team members were willing to provide access. Case studies included the following teams from various GlobalCo "divisions":

- Assembly and Test Teams
- Tools and Methodologies Tea
- Intra-Organizational Logistics Team
- Global Engineering Horizontal Teams
- Chemical Process Teams

## 7.1 Assembly and Test Teams

GlobalCo's Assembly and Test teams are part of their high volume manufacturing business unit with design, engineering, manufacturing and test capabilities for several product lines. With a customer base that includes over 25 high tech companies in the

world, and over $30 billion in sales in 2000, ClobalCo's Assembly and Test teams are clearly an important asset to the future of GlobalCo. Over the past three decades, Assembly and Test division of GlobalCo has tried to strengthen its position as a leading supplier to the high tech industry by increasing its manufacturing presence in emerging markets such as the Asia/Pacific region and Central/South America. Assembly and Test teams consists of sub-teams created based on the functional needs of the product development. In particular, Assembly and Test teams have Engineering, Manufacturing, Operations, Finance and Quality teams consisting of engineers and managers from various sites. These sub-teams consists of smaller teams and work-groups created to address specific tasks at hand. While most of the top-level teams are considered on-going, most of the smaller teams and work-groups have clear time lines and life expectancies. Figure 7-1 gives an extent of the geographical dispersion of the Assembly and Test teams of GlobalCo.

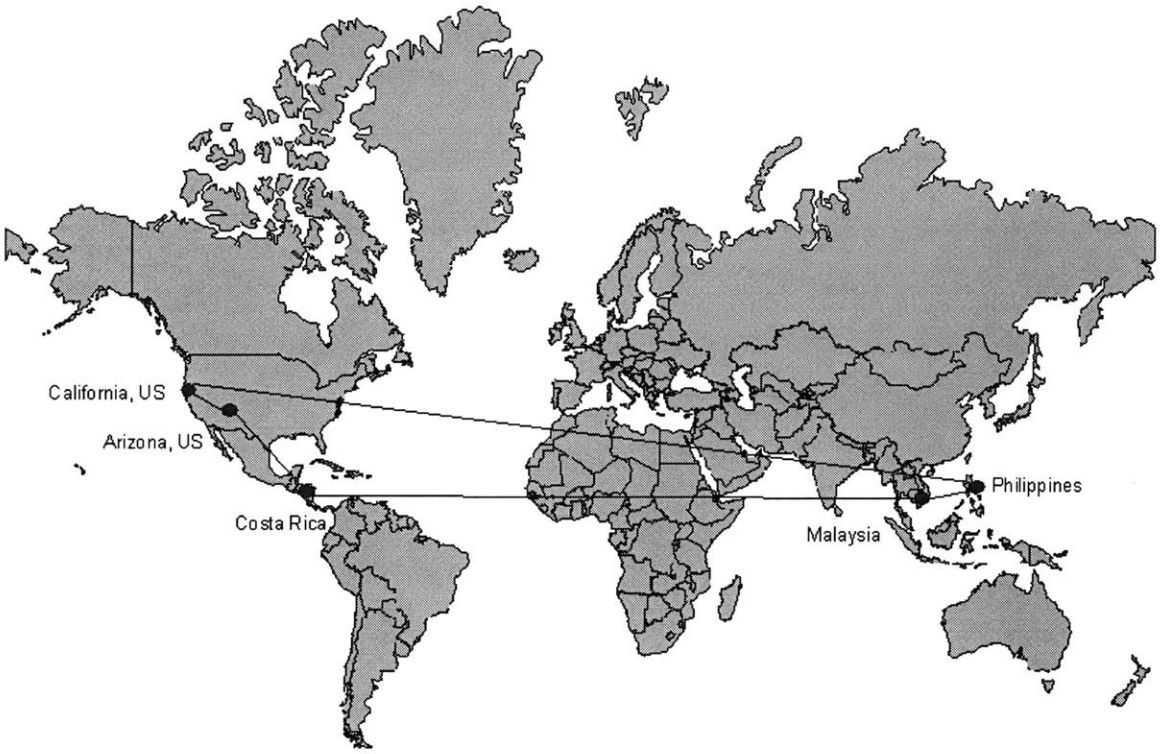



Figure 7-1: Global Dispersion of Assembly and Test Teams

## 7.2 Tools and Methodologies Team

The Tools and Methodologies team is part of GlobalCo's business unit that has been providing components to meet customer needs in the automotive industry for over 90 years. The business unit has a comprehensive product line and was one of the early adopters of the systems approach to product development. Tools and Methodologies team members are part of a 75,000+ employee base with significant global presence. In 2000, the business unit had 93 manufacturing locations and 52 technical centers and offices in 22 countries in 5 continents. Senior management of the business unit see two main issues facing global teams: NOT learning how to be effective while globally dispersed; NOT capitalizing on global opportunities presented my multiple customers in multiple locations. Tools and Methodologies team was identified as a typical global team with significant computer-mediated interactions between 10+ globally dispersed team members. Tools and Methodologies team is involved in standardizing technology tools and processes across the various manufacturing plants and technical centers. Figure 7-2 gives an extent of the geographical dispersion of GlobalCo's Tools and Methodologies team.

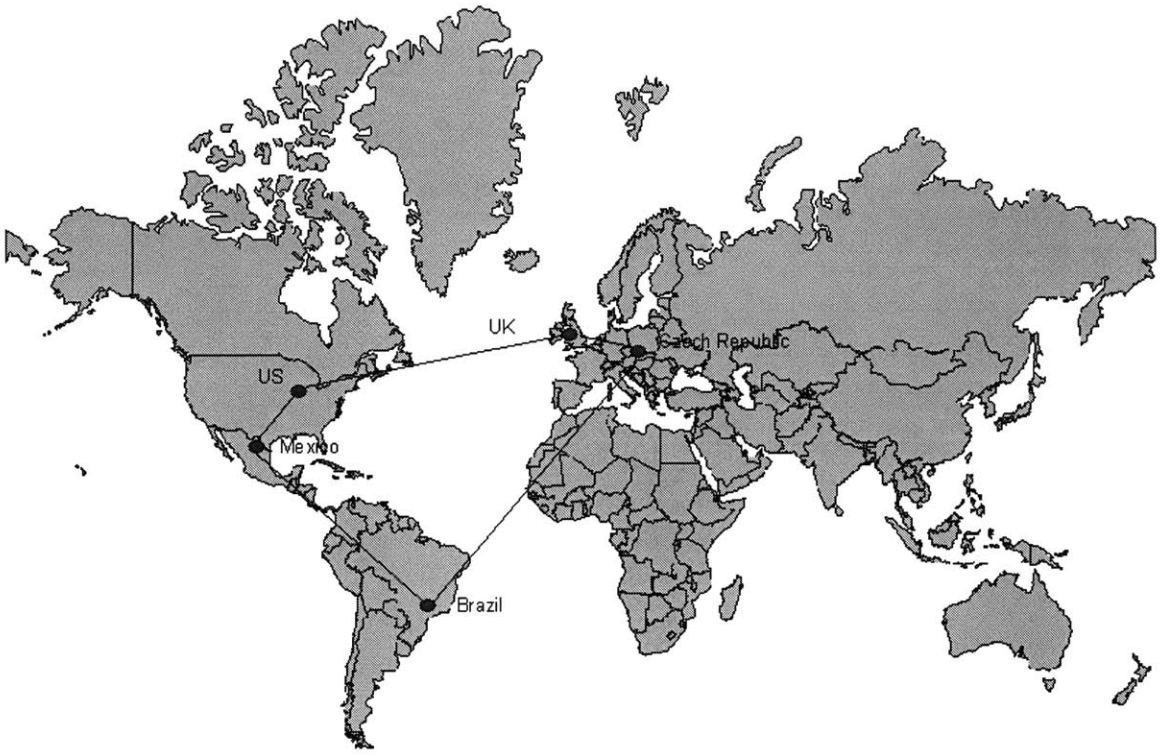



Figure 7-2: Global Dispersion of Tools and Methodologies Team

## 7.3 Intra-Organizational Logistics Team

The Logistics team consists of members of GlobalCo's business unit involved with the logistics and supply chain operations with GlobalCo's global partners and customers. The Logistics team also includes members from GlobalCo's partner in Asia involved in the engineering and manufacturing operations. Only recently GlobalCo invested in the partner operations and holds controlling interest in the Asian partner. Logistics team members are involved in effectively managing the planning, ordering, storing and distribution of parts to the assembly operations of GlobalCo and the partner manufacturing plants. Logistics team members interface with external suppliers, warehouse owners, distributors and custom officials on a frequent basis. The team uses the financial muscle of GlobalCo and the local knowledge and expertise of the partner members to minimize the losses in the parts supply chain. It should be noted that some GlobalCo team members of the Logistics team have physically collocated to Asia to work in the same building as the partner team members. Logistics team has met face-to-face once-a-year for 2 years, but carries out most of its interactions in the digital space with videoconferences, audioconferences and email. Figure 7-2 gives an extent of the geographical dispersion of the Intra-Organizational Logistics team.

## 7.4 Global Engineering Horizontal Teams

GlobalCo's Electric Systems division is a full service power and signal distribution systems supplier, with design and manufacturing capability for several product lines, including wiring assemblies, electrical centers, switches, fiber optics, sensors, ignition products, connection systems, and integrated electronics. With a customer base that includes 40 major companies in the transportation industry and over $ 5 billion in sales in 1999, ClobalCo's Electric Systems division is one of the world's largest suppliers of vehicle power and signal distribution systems. Over the past decade, Electric Systems division has been moving to expand its product line beyond wiring assemblies to include products that have a greater potential for growth. These new

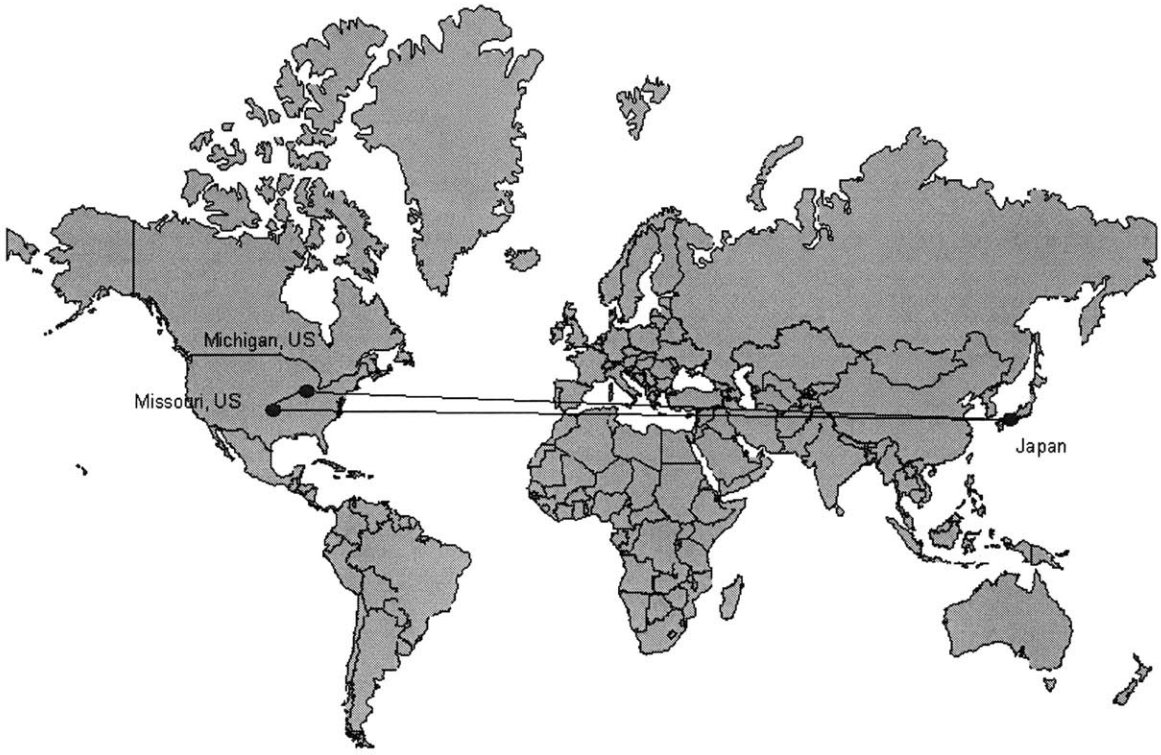



Figure 7-3: Global Dispersion of Intra-Organizational Logistics Team

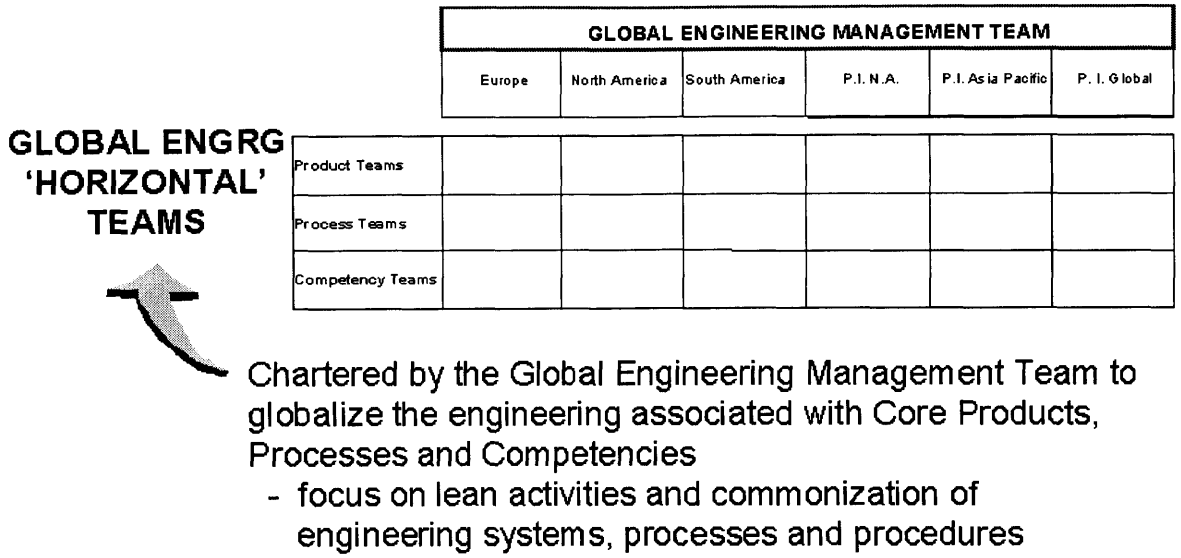



Figure 7-4: Global Engineering Horizontal Team Charter

offerings include electrical centers, switches, fiber optics, sensors, advanced connection systems, and integrated electronics. At the same time, the company has tried to strengthen its position as a wiring assembly supplier by reducing costs and increasing its presence in emerging markets such as South America, Eastern Europe, and the Asia/Pacific region where strong growth in wiring assembly demand is expected to continue.

Figure 7-4 shows a summary of the structure for the engineering organization within GlobalCo's Electric Systems Division. The global engineering organization consists of both the global support people and the regional people that are reporting directly to the regional directors. Engineering managers are located in each region outside North America and have responsibility for all engineering activities in that region. These engineering managers report to both the regional director and the director of engineering.

In North America, there are other global engineering managers, who have responsibility for product development for various product lines. There is also a global manufacturing engineering manager, an advanced engineering manager, and a manager in charge of general engineering support activities (executive engineer). All of

these managers report to the director of engineering.

In the mid 1990's, the engineering director at GlobalCo's Electric Systems division wanted to improve the overall global engineering effort through the creation of a series of global teams. The purpose of the teams was to improve engineering globally through the discussion and adoption of best common practices in the area of engineering systems, processes, and procedures. Engineering representatives at the middle management levels from various regions of the world were assigned to teams that focused on improving certain products, processes, or engineering competencies. Specific objectives were developed for each global horizontal team by the global engineering management team.

## 7.5 Chemical Process Teams

GlobalCo's Photography division is a global entity with manufacturing capability in several regions of the world including North America, Europe, South America, Australia, and Asia. It is estimated that consumers create over 40 billion new images annually, with 20 billion of those produced in the United States. Photography division also provides film, paper, processing equipment and related products for traditional and digital photography for a number of commercial market segments.

There are currently a number of Chemical Process teams that primarily support the manufacturing side of GlobalCo's Photography division. Each of the Chemical Process teams is a virtual team; in that its members are widely separated geographically, communicate primarily through telephone or computer-based technologies (e.g., conference calls, electronic mail) and additionally face-to-face interactions. Each process club consists of approximately 20 members from different organizations and functional areas within GlobalCo including manufacturing, engineering, and research and development. Members participate in the club on a part time basis, with primary reporting responsibility to their functional organizations and matrix reporting responsibility to the process club. The overarching goals of the process clubs are to improve manufacturing equipment reliability and reduce product waste in the entire

manufacturing process.

Such Chemical Process teams have been prevalent in GlobalCo for over 10 years. The initial motivation for starting these teams was to establish a communications network that could be used for information sharing and leveraging technology between worldwide manufacturing plants. These teams were organized by process technology and consisted of technical representatives from each manufacturing site, Engineering, and Research and Development. Historically, the Chemical Process teams were considered to be very successful as they provided an organized network for information sharing and building teamwork among site manufacturing process engineers, who had historically been relatively isolated to their individual manufacturing sites. Although, the benefits of these Chemical Process teams were difficult to quantify, these teams were perceived as providing a valuable source of leverage in manufacturing through their technology sharing and network building activities.

Despite their perceived success between the late 1980's and mid-1990's, process clubs experienced significant difficulty developing both credibility and leverage within the larger manufacturing organization. The clubs were generally not effective at addressing common manufacturing problems, such as human errors, due to the lack of accountability of its members and the absence of a global management perspective. Manufacturing sites were reluctant to fully share information with one another due to a perception of "helping the competition." In addition, site managers lacked a corporate vantage point and held similar parochial views toward their individual manufacturing sites. The management team, consisting of individual site manufacturing managers, was also evolving during this period and was experiencing its own team identity and organizational issues. The lack of collective management sponsorship combined with the parochial attitudes of both club members and site managers prevented the process clubs from developing into a high trust, high performance team with credibility and influence in the larger organization. There was also a high level of churn in process club membership, which made unity within the clubs difficult to achieve and maintain.

The inclusion of Research and Development and Engineering, both centralized

organizations at GlobalCo, helped to promote cohesiveness within the clubs due to the more global perspective of these organizations. Much of the process understanding in the different technology zones represented by the clubs was not well codified and, in many cases, was considered more "art" than science. The process clubs provided a convenient source for Research and Development to learn and understand the needs of manufacturing and develop internal communications networks for future work. The stronger link between manufacturing and Research and Development provided by the process clubs helped to drive more fundamental understanding of the different process technologies through experimentation, development of models, and other methods. Thus, learning could be more easily leveraged among all manufacturing sites.

In 1998, the role of the Chemical Process teams was strengthened significantly through increased management sponsorship and support. Changes in the business environment, particularly increased competitive pressures in the marketplace, drove the need to make substantial reductions in GlobalCo's manufacturing costs. The Chemical Process teams provided a vehicle to facilitate a more global approach to manufacturing improvement and help shift away from an individual profit center mentality. Specific goals and deliverables were identified, such as the implementation of process verification strategies for each process zone, to improve accountability of process clubs to the management team. The role of process team leader was more formally recognized and shifted from a part time to a full time position. Site involvement, although still not mandatory, increased sharply as a result of the strengthened management commitment and all manufacturing plants currently participate. Communications between the process teams and manufacturing management has increased through activities such as regular status reports and participation of process club leaders in management team activities. These changes have moved the process teams from passive information sharing organization to an empowered working team with specific deliverables, improvement goals, and accountability to management. It has become normal to expect that ideas and improvements will result from the diverse backgrounds and cultures around the world. Benchmarking with the other manufacturing plants to identify best practices before trying to invent a technical solution is

now the culture. The technical experts and guardians of different technologies are far more knowledgeable of the processes and practices used in individual plants and are more likely to consult the worldwide manufacturing community regarding potential changes and improvements. The process teams have harnessed the capability and cultural diversity around the world and communicated the best practices throughout the corporation, contributing to the substantial manufacturing productivity gains made at GlobalCo during the last 10 years. There are currently 4 active Chemical Process teams each aligned along a different technology zone within the sensitizing process.

Each Chemical Process team consists of approximately 20 members from different organizations and functional areas. Table 7.5 shows an approximate breakdown of club membership:

Table 7.1: Approximate Breakdown of Process Club Membership

| *Description* | Approximate number of members |
|---|---|
| Process Club Leader | 1 |
| Manufacturing Site Engineers | 13-15 (1-2 from each site) |
| Engineering & Design Organization | 2 |
| Research & Development Scientists | 2 |

Process club members have primary reporting responsibility to their individual functional organizations and less than equal matrix reporting responsibility to the process club. The organization design is similar to the lightweight project organization, where links to the project are weak relative to the functional links. Figure 7-5 shows a simplified version of the process club organization design.

The process club leader is responsible for coordinating and leading the activities of the team, but does not have authority and control in the organization. Process club leaders have primary reporting responsibility to their functional organization and are also responsible to the management team, consisting of managers from each manufacturing site, Engineering, and Research and Development. Primary management responsibilities of the process club leader include setting agendas, establishing priorities, and developing appropriate performance measures. Primary leadership

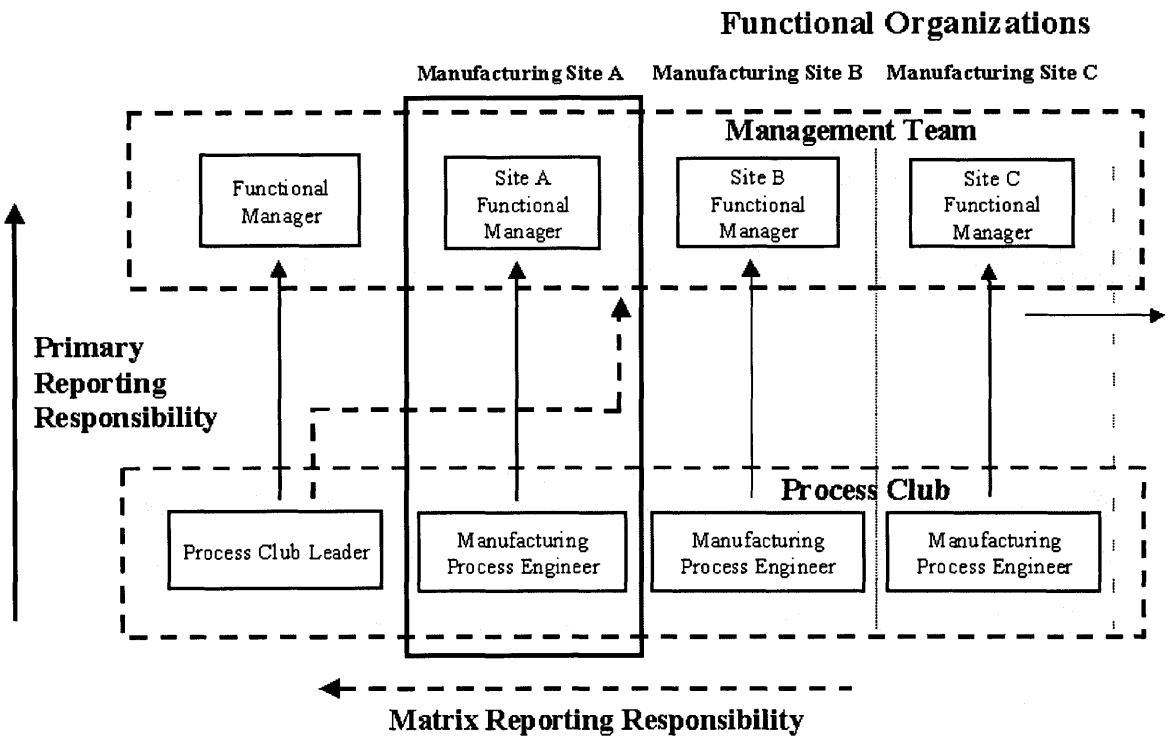



Figure 7-5: Simplified Melt/Coat Process Club Organization Design

responsibilities include setting direction for the team, influencing others, and helping to create new networks by acting as both an information and resource broker. Process club leaders are also members of the management team and participate in team activities, which consist of monthly conference calls and biannual conferences. Administrative support is used to organize and facilitate the calls and conferences, manage the flow of information, and compile information and data into an electronic database.

# Chapter 8

# Research Methodology

> *... The organizations that will truly excel in the future will be the organizations that discover how to tap people's commitment and capacity to learn at ALL levels in an organization...*
>
> *Peter Senge*

Earlier chapters in this dissertation presented a theoretical framework for team interaction space. To test the research theories, the present research explored what constitutes team interaction space and the combined effects of technology, organizational processes and spatial setup on the effectiveness of team interaction space. The exploratory nature of the research question reflects the observation from the literature review in Chapter 2 that the literature lacks an understanding of how globally dispersed cross-functional teams interact and overcome the barriers to becoming effective. The research objective of trying to understand and generate new theory about team interaction space in this setting required a research methodology that combined qualitative and quantitative aspects. To summarize the work from earlier chapters, Figure 8-1 provides a graphical overview of the research positioning.

Commensurate with traditional social sciences research, the following research steps were identified:

- Research Model
- Research Objectives

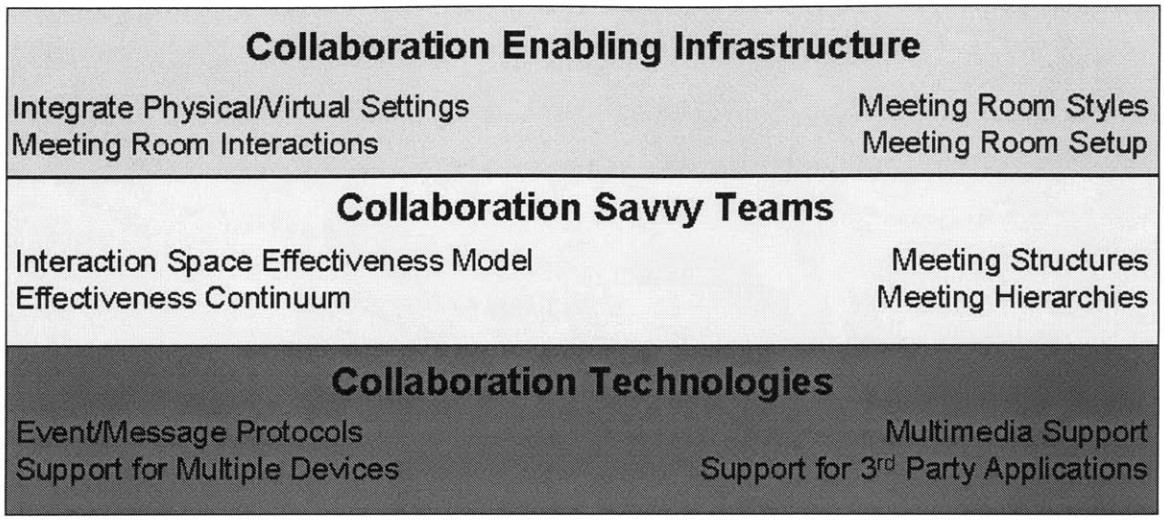



Figure 8-1: Research Positioning

- Hypotheses
- Data Collection
- Data Analysis
- Dissemination

Each of these steps is explained further in the next few sections.

## 8.1 Research Model

Traditional research models popular in physical sciences and engineering systems research include in some form the requirements-field/lab work-analysis-conclusion cycle. Such a model was found to be inadequate considering the fact that field/lab work would bias the research model. In addition, teams identified in Chapter 7 placed heavy emphasis on dissemination of key findings at all stages of the research process. Hence the model combined the traditional research model with a participatory action research model to allow the research team to reflect on some of the research questions and present preliminary findings to the teams being studied. Figure 8-2 shows the research model used in the current research effort.

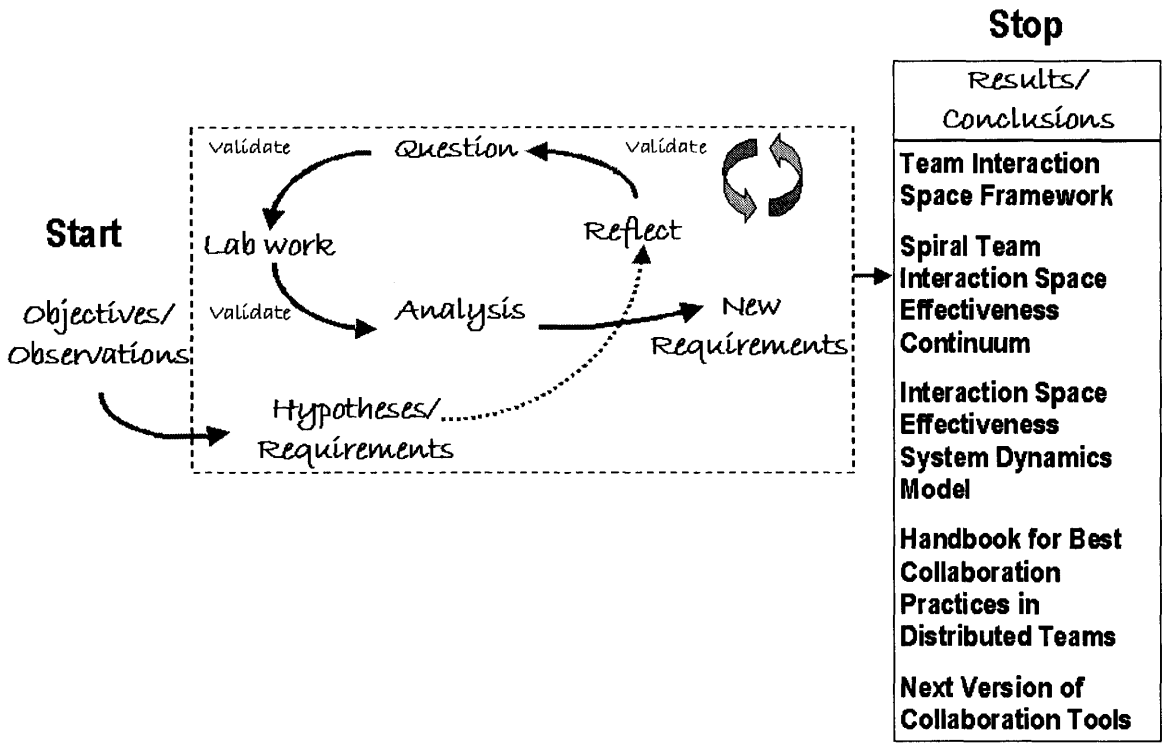



Figure 8-2: Research Model

The various stages of the research model are explained below:

- In seeking to understand the experiences of globally dispersed teams, personal experiences as members of global dispersed teams helped in creating the initial set of research objectives. Furthermore, the Objectives/Observations stage as included tracking synchronous interactions by observing video conferences of select globally dispersed teams identified in Chapter 7. Preliminary data on global team interactions was gathered during focus group meetings and discussion forums.

- In the Reflection stage, observations from the synchronous interactions was presented to the team members to elicit their feedback. Specific interaction patterns were presented to a wider audience in discussion forums to gather reflections on initial research hypotheses and questions.

- In the Question stage, surveys and interviews were carried out to collect both quantitative and qualitative data on team interaction space to either substantiate or refute the key hypotheses.

- As the model iterated between the above mentioned key stages, the final outcomes included:

    1. Team Interaction Space Framework
    2. Spiral Team Interaction Space Effectiveness Continuum
    3. Team Interaction Space Effectiveness Dynamics
    4. Handbook for Best Collaboration Practices in Distributed Teams (Sen 2001)
    5. Next Version of Collaboration Tools

## 8.2 Research Objectives

After multiple iterative rounds of Observations-Reflection-Question stages in the research model presented in Section 8.1, the following broad research objectives were

enumerated:

1. To gain a better understanding of collaboration between globally dispersed team members by observing the team interaction space.

2. To investigate potential roles of technology, organizational processes and spatial setup on facilitating interactions.

In addition, going a level deeper, based on these research objectives, the following research questions were identified:

- What is collaboration between geographically and temporally dispersed teams working on global projects?
- What are the major components of collaboration?
- How do team members separated across geographical, temporal, organizational and cultural boundaries interact?
- What are the common interaction patterns demonstrated by effective globally dispersed teams?
- What are the metrics by which interaction can be considered effective and/or efficient?
- Does the way team members interact affect their perception of how well their team is performing?
- What are the roles of information technology, organizational processes and spatial setup in supporting collaboration between globally dispersed team members?
- How does information technology affect the interaction space?
- Should information technology be considered as a uni-dimensional factor affecting the effectiveness of team interaction space?

- What are the key organizational processes affecting team interaction space? What is the relative impact of each?
- How does spatial setup affect team member interactions?
- What is the relative significance of physical space and digital space on making team interactions effective and/or efficient?
- What forms of dispersion affects effectiveness of the team interaction space?
- Does time dispersion affect the effectiveness of globally dispersed team than geographic separation?
- Are their differences in the way team members perceive the effectiveness of the team? What are the key patterns in such differences?

## 8.3 Research Hypotheses

Based on the above research questions, the following research hypotheses were decided to be tested:

1. Effectively managing the team interaction space helps perceived team performance
2. Communication Technologies, organizational processes and spatial setup positively affect the effectiveness of team interaction space
3. Technologies used by globally dispersed teams needs to be considered in multiple dimensions: ability, capability, reliability, accessibility and supportiveness.
4. Time, not geographical distance, is a major form of dispersion in global teams.
5. In global teams, there are more differences along the management hierarchy than across different geographical sites.

## 8.4 Data Collection

The data collection stage involved a multidisciplinary research team and employed a variety of techniques, including case studies, interviews, interaction observations, survey administration, and feedback sessions. The research team consists of 1 faculty member from MIT School of Engineering, 1 faculty member from the MIT Sloan School of Management, 1 Post-Doctoral Associate from MIT Sloan School of Management, 1 Doctoral Candidate from MIT School of Engineering and 1 Master of Science Candidate from MIT School of Engineering. The research team also worked with one or more research partners from each of the GlobalCo divisions in the study. This partner network was multidisciplinary, consisting of personnel in senior management, human resources, organizational development and team leaders from some of the teams.

Data was collected from multiple sources at several points in time, guided by a protocol developed according to recommendations of qualitative research and grounded theory (Eisenhardt 1989) and (Yin 1994). This protocol also provided a framework for within- and cross-case analyses during and after the data collection. Consistent with the research model from Section 8.1, the research team also incorporated mechanisms for gathering data on other aspects of global teams functioning to capture other important elements and to assess the validity of the research hypotheses identified in earlier sections. The research protocol incorporated examining the relationships among the various variables of the team interaction space framework and guided the data collection at several points in time. Although the protocol guided the data collection, the details were adapted as more data from the team interaction space was collected from the various teams. Qualitative data was collected through semi-structured and unstructured interviews, observations of video, audio and traditional face-to-face interactions, logs of members' computer-mediated interactions and website postings. Quantitative data was collected in the form of a survey administered to the members from various teams identified in Chapter 7.

Each method focused on adding richness and depth to a specific part of the frame-

work, with each hypotheses studied using multiple methods. The research team conducted semi-structured interviews with senior management, managers to whom the teams reported, and select team members to gain further details and perspective on the key elements of the team interaction space. The interviews also provided qualitative data allowing the research team to explore in-depth the relationship among various elements of the interaction space and the dynamics over time. A sample of semi-structured interview guides is shown in the Appendix B. Observations of face-to-face meetings and audio/video conference calls provided data concerning interaction patterns, organization protocols, technology use, group processes, spatial setup and the relationship among the elements and changes over time. A sample of the interaction observation templates is shown in the Appendix B. Unfortunately, GlobalCo teams would not permit recording any of the interviews, conference calls, or face-to-face meetings. 2 or 3 research team members were present for almost all interviews and interaction observations. In the interviews, one researcher focused on asking questions and guiding the interview, while other researchers took extensive notes on computer and paper, which were reviewed by the research team for completeness. While "observing" the interactions amongst the team members remotely, research team members took as many notes as possible using the observation templates shown in Appendix B. In addition, the research team compared notes and added comments for clarification and completeness after each interaction observation. These notes were also compared with the agenda and minutes often shared by the team leaders. Quantitative data from the questionnaire provided additional assessment of interaction space, technology use, organizational processes, spatial setup and some structural characteristics and group outcomes. The questionnaire consisted of 150 questions with a 7-point Likert scale ranging from strongly agree to strongly disagree. The questionnaire was sub-divided into the following sections:

| | | |
|---|---|---|
| INS | General Instructions | 8 questions |
| COM | Communication Technologies | 13 questions |
| INTER | Team Interactions | 21 questions |
| IND | Individual | 18 questions |
| STR | Team Structure and Processes | 28 questions |
| OUT | Team Outcomes | 23 questions |
| SUP | Team Support | 26 questions |
| DEM | Demographics | 13 questions |

Questionnaire characteristics are provided in Table 8.1 while the actual instrument manifestation is included in Appendix B. Note that negatively worded questions are marked with a "X" under the wording column in Table 8.1.

Table 8.1: Questionnaire

| VAR | W | Description |
|---|---|---|
| COM1 | | Overall, I am satisfied with the current set of technologies used in communicating with global team members |
| COM2 | X | Communication technologies used for communicating synchronously with remote team members are difficult to use |
| COM3 | | Communication technologies used for communicating with remote team members facilitate effective global team meetings |
| COM4 | | I receive sufficient training to use communication technologies most effectively on global teams |
| COM5 | X | I have no input in the selection of communication technologies that we use on the global team |
| COM6 | | Communication technologies allow me to convey my ideas very effectively to my global team members |
| COM7 | | I use very basic technologies such as phone, email and project web sites to meet my functional needs to collaborate with my global team members |
| | | *Continued on next page* |

Table 8.1 – continued from previous page

| VAR | W | Description |
|---|---|---|
| COM8 | | Asynchronous communication technologies (e.g., emails, team web sites) are more useful than synchronous technologies (e.g., real-time presentation sharing) |
| COM9 | | Communication technologies used by the global team are conveniently accessed from multiple locations (e.g., cubicles, office, meeting room, home, airport) |
| COM10 | X | New communication technologies that provide better functionalities do not have to be very reliable before they can be adopted by my global team members |
| COM11 | | For computer-based communication technologies (e.g., team web sites), I prefer functionality over user interface |
| COM12 | | The company provides excellent support (e.g., training staff, help desks) for using communication technologies |
| COM13 | | Communication technologies allow everyone in the team to have access to information needed to get the job done |
| INTER1 | | Face-to-face meetings are much more effective than remote conferencing meetings (e.g., audio or video teleconference meetings) |
| INTER2 | | Local team members appear more interested than remote team members in meeting discussions |
| INTER3 | | It is important to have a well-defined agenda circulated to all team members before a global team meeting |
| INTER4 | X | The agenda items for my global team meetings are poorly defined |
| INTER5 | | My team rotates the responsibility of chairing the meetings among all the sites represented on the global team |
| INTER6 | X | Remote team members appear less committed than local team members during most meetings |

*Continued on next page*

Table 8.1 – continued from previous page

| VAR | W | Description |
|---|---|---|
| INTER7 | | Team members have the training to run effective global team meetings |
| INTER8 | | All global team members express opinions and ideas freely in most meetings |
| INTER9 | X | The same team members appear to be making all the decisions in global team meetings |
| INTER10 | | The team leader regularly talks with team members outside global team meetings |
| INTER11 | | Team meetings are used by the team to agree on the responsibility for specific tasks |
| INTER12 | | The needs of the global team and local priorities are reconciled outside team meetings |
| INTER13 | | On a regular basis, global team members take the time during the meetings to share lessons learned at their local sites |
| INTER14 | X | The needs of the global team and local priorities are rarely reconciled during meetings |
| INTER15 | | Ambiguous tasks are clarified with all the global team members outside meetings |
| INTER16 | | When my global team meets, the team members whose input is needed to accomplish the task are always present |
| INTER17 | | Audio conferencing technologies for global team meetings are more effective than video conferencing technologies |
| INTER18 | | My global team has sufficient opportunities to conduct face-to-face meetings |
| INTER19 | X | Asynchronous interactions (e.g., using email or posting documents on a web site) are less important than synchronous interactions (e.g., audio/video teleconferences) |

*Continued on next page*

Table 8.1 – continued from previous page

| VAR | W | Description |
|---|---|---|
| INTER20 | | I regularly talk about work related issues with my remote team members outside global team meetings |
| INTER21 | X | I rarely talk about social issues with my remote team members outside global team meetings |
| INTER22 | | Lot more work is achieved during planned interactions (e.g., meetings) than during unplanned interactions |
| IND1 | | All members of my global team agree on the team's goals. |
| IND2 | X | It is hard to work with my global team members who are more than two time zones (hours) away |
| IND3 | X | I have yet to master the communication technologies needed to share knowledge with my global team members |
| IND4 | | My prior experience on global teams was an important reason why I was selected for this global team. |
| IND5 | | I completely understand the goals of my global team. |
| IND6 | X | My individual role in my global team is ambiguous |
| IND7 | | I have complete confidence and trust in local team members to get the job done. |
| IND8 | | I have complete confidence and trust in remote team members to get the job done. |
| IND9 | | I believe the work of my global team is important |
| IND10 | | Working on a global team has changed how I relate to coworkers at my local site. |
| IND11 | | I get official recognition for working on globally dispersed teams |
| IND12 | | I report to the top management at my site about my global team on a regular basis |
| IND13 | X | I never expected to learn as much as I do from other members of my global team. |

*Continued on next page*

Table 8.1 – continued from previous page

| VAR | W | Description |
|---|---|---|
| IND14 | X | Employees should not disagree with management decisions |
| IND15 | X | Managers should not delegate important tasks to employees |
| IND16 | | It is important to have job requirements and instructions spelled out in detail so that employees know what they are expected to do |
| IND17 | | Rules and regulations are important because they inform employees what the organization expects from them. |
| IND18 | | I believe training in my company prepares people to work on globally dispersed teams |
| STR1 | | All members of my global team agree on the team's goals |
| STR2 | | Team members participate in the decision making process |
| STR3 | | The combination of skills on my global team was carefully chosen to fit the task. |
| STR4 | | Our global team has complementary technical and social skills. |
| STR5 | | Functional skills are the most important factor for choosing global team members |
| STR6 | X | Language is not a barrier to success of global teams |
| STR7 | X | Team members of different countries do not work well together on the team |
| STR8 | X | Most team members in my global team have no experience working in locations with different culture |
| STR9 | | Diversity among people on the global team helps create better solutions. |
| STR10 | | Cultural differences hinder global team performance. |
| STR11 | X | Changes in the team membership negatively impact global team performance effectiveness. |
| STR12 | | Working together over time improves my team's performance |
| STR13 | | The team members trust our team leader to fairly represent our global team needs |

*Continued on next page*

Table 8.1 – continued from previous page

| VAR | W | Description |
|---|---|---|
| STR14 | X | The team has the autonomy to select options that the team leader does not endorse |
| STR15 | | The global team has a formal process to help transition new team members into their new role |
| STR16 | X | Transition for new members on the global team happens too quickly |
| STR17 | | The team has created norms of appropriate behavior among its members |
| STR18 | | The global team has a mentor who helps the global team in reaching its goals |
| STR19 | | Global team operating procedures and protocols support successful completion of the team's task |
| STR20 | | Success of the team is dependent on the shared contributions of all team members |
| STR21 | | Among the members of the global team, duties are divided equitably |
| STR22 | | Work details are often defined when team members talk with each other. |
| STR23 | | Over time the team is creating it's own unique 'history' of stories and ways of doing things |
| STR24 | | Sharing knowledge with my team members is an important part of my work with the team |
| STR25 | | My global team shares lessons learned from other teams |
| STR26 | | As the global team continues to work toward a shared goal, the relationships among all the team members are becoming more important |
| STR27 | X | It is hard to trust the other people on the global team because we do not have time to get to know each other. |
| STR28 | X | Remote team members are less productive than team members from local site |

*Continued on next page*

Table 8.1 – continued from previous page

| VAR | W | Description |
|---|---|---|
| OUT1 | | The success of my global team depends entirely on the team delivering results |
| OUT2 | | My global team makes fast decisions |
| OUT3 | | Decisions made in the global team are of high quality |
| OUT4 | X | My global team has not been very successful in achieving its objectives |
| OUT5 | | Working on global teams has been a good experience for me |
| OUT6 | | Working together my team creates solutions that I could not create working alone. . |
| OUT7 | | Working on global teams increases my technical expertise. |
| OUT8 | | An important information-sharing network has been created among members of my team. |
| OUT9 | | Working on the global team gives me access to useful knowledge I can get nowhere else. |
| OUT10 | | I derive great personal satisfaction from my work with the members of my team. |
| OUT11 | | I am satisfied with my individual performance on my global team |
| OUT12 | | I would enjoying work with my current team members on another global team |
| OUT13 | | Work on global teams helps my long-term career objectives. |
| OUT14 | | I enjoy working on global teams |
| OUT15 | X | My global team members have no input in my individual performance appraisal |
| OUT16 | | I know exactly how my performance is measured on this team. |
| OUT17 | X | I think my global team could have performed a lot better |
| OUT18 | | My global team leader provides formal input in my individual performance appraisal |

*Continued on next page*

Table 8.1 – continued from previous page

| VAR | W | Description |
|---|---|---|
| OUT19 | X | Concerns about individual promotion and career advancement have an impact on the performance of the global team members |
| OUT20 | X | I do not plan on networking with members of this global team for other projects |
| OUT21 | | My work on the global team helps my local site achieve its performance metrics |
| OUT22 | | I feel that I have increased my ability to work in a global community |
| OUT23 | | My performance in global teams enhances the reputation of my local site |
| SUP1 | | Considering the company as a whole, globally dispersed teams are successful |
| SUP2 | X | Company leadership does not understand the major concerns facing global teams in meeting discussions |
| SUP3 | | Company provided cross-cultural training classes to help its employees work effectively on global teams |
| SUP4 | X | The team is a global initiative, but the company has no global structure of policies and procedures to support it |
| SUP5 | | Local supervisors chose members of my global team. |
| SUP6 | | Functional department goals take priority over the goals of the global team |
| SUP7 | X | No matter how global the focus of some of my work is, it is what I do locally that gets rewarded. |
| SUP8 | | Any rewards I receive for my work with the team must come from my local supervisors |
| SUP9 | | Work on global teams is weighted equally with functional department work on performance evaluations. |
| SUP10 | | All global team members identify with a corporate culture. |

*Continued on next page*

Table 8.1 – continued from previous page

| VAR | W | Description |
|---|---|---|
| SUP11 | X | My local supervisor supports global teams as long as they don't disrupt local activities |
| SUP12 | | Local needs are taken into account in global team decisions outside global team meetings |
| SUP13 | | My local site readily implements the recommendations of the global team team meetings |
| SUP14 | X | Local management does not understand how to support its employees when they work on globally dispersed teams |
| SUP15 | | My local supervisor understands the goals of the globally dispersed team |
| SUP16 | X | Contributions of the local sites in global teams are not as appreciated as they should be |
| SUP17 | X | My local supervisor doesn't understand the importance of my work on the global team. |
| SUP18 | | Global teams have made a significant impact on the way the company does business |
| SUP19 | | Company provides the global team with all the material resources (e.g. money for equipment, computers) needed to make it successful |
| SUP20 | X | Travel funds are not always available for the global team to do its work |
| SUP21 | | The company is promoting cross-cultural working relationships among its workforce |
| SUP22 | | It is clear in this company that employees are valued equally for their contribution no matter what site they come from |
| SUP23 | X | The company does not understand what employees at remote sites need to be successful |
| SUP24 | | The company appreciates my contribution to global teams. |
| SUP25 | | The company effectively shares lessons learned across the organization. |
| SUP26 | | I depend on the local site budget to support my team activities. |

## 8.5 Data Analysis

Although data collection and analysis are presented in two sections here because they represent different conceptual stages of the research process, chronologically the two activities overlapped (Eisenhardt 1989). For example, early interviews, discussions and observations from the interaction space guided the design and development of the interaction observation template and questionnaire. The analysis on these guided what the research team looked for in later interactions between globally dispersed team members. An "onion-peel" approach to data analysis was used. At the first pass, reliability analysis was performed on the data collected from the various research instruments used in the research. Secondly for hypotheses analysis, the research team triangulated the qualitative and quantitative data using two types of data analysis: template coding (King 1998) and analysis of emergent higher level relationships (Eisenhardt 1989) and (Yin 1994).

As part of reliability analysis, the following steps were undertaken:

1. Instrument Reliability - measures the consistency of the research instruments used in the data collection step.

    - Interaction Observation coding sheets were finalized after multiple collaboration sessions between the research team members comprising of 2 faculty members, 1 post-doctoral associate, 1 doctoral student and 1 masters student.
    - Interview Guide was finalized after each round of interviews. Depending on the responses from the interviewees, the research team discussed which questions to add and which questions to de-emphasize during the next round of interviews. As for the observation coding sheets, this was formulated after multiple collaboration sessions between the research team members.
    - For the questionnaire, test/retest was difficult to implement considering the length of the questionnaire and the significant time commitment re-

quired from GlobalCo team members. Instead, Cronbach alpha for the entire instrument (150 questions) was calculated. Cronbach alpha (Cronbach 1951) for the instrument was 0.9315. Most organizational studies report Cronbach alpha in the neighborhood of 0.80, indicating that the questionnaire research instrument was statistically reliable.

2. Sample Reliability - ensures sample is diverse.

   Sample reliability was estimated based on the relatively high response rates obtained for the questionnaire:

| | | |
|---|---|---|
| Assembly and Test teams | 25% | 72 respondents |
| Intra-Organizational Logistics team | 40% | 12 respondents |
| Tools and Methodologies team | 40% | 12 respondents |

The research team conducted the analyses within each team separately, then compared the analyses across teams to substantiate or refute some of the research hypotheses and answer some of the research questions. analysis of the teams. Initial data analyses followed template analysis coding procedures (King 1998). In contrast to a pure grounded theory approach which begins with open coding (or, the coding of data without a priori idea of what the categories should be, template analysis begins with coding according to the research template. Themes in the data are first coded according to the highest level categories in the template, then they are coded according to lower level categories.

A critical step in template analysis is continually adjusting the template based on findings in the data. Categories may be added, deleted, or shifted in their hierarchical level. For example, we found that the uni-dimensional technology category suggested by Goodman & Sproull (1990) was not helpful to understand the impact of technology in the interaction space effectiveness. Instead, it was decided to break technology variable into a number of different dimensions and code the data for each dimension to substantiate the research claims regarding technology. Although template coding is designed for use on textual data, we also applied it to the results of the questionnaire. Rather than analyzing the questionnaire results as samples indicative

of a larger population, the data was considered as summarized information provided by individual team members about themselves and their own team. The research team therefore examined individual scores from the 7-point Likert scale and patterns of scores within the team, team means on the scale, and variance within each team. The information coded from the questionnaire was used alongside that of the graphical and textual data from the interviews and interaction space observation as input to the next stage of analysis.

Following template coding, the data was analyzed to uncover relationships among categories and sub-categories. Although the team interaction space framework was used as a background to search for patterns, any data or information that would disconfirm or add to the hypotheses was also included. For example, an analyses of interview data indicated that there were definite patterns along team hierarchy when asked to explain team effectiveness. Some evidence about relationships was evident in direct statements from team members. For example, a large number of interviews indicated that the effect of time zone differences was felt on the effectiveness. Other information about relationships came from identifying patterns of categories that seemed to co-occur, or to cause one another (Cook & Campbell 1979). Once the general relationships among concepts in the team interaction space were tested, the research team looked for larger patterns and patterns over time. The final analysis objective was to generate a well tested team interaction space framework, by identifying the categories and sub-categories of variables that affected the team interaction space of globally dispersed teams.

## 8.6 Dissemination

The final phase of the research consisted of a major feedback, dissemination, and interpretive effort. This effort is on-going and this dissertation, in some form, is one manifestation towards feedback. This dissertation is a first estimate at integrating the learnings from the in-depth qualitative data collection step and the hypothesis-testing quantitative analysis phase. The key research findings are being disseminated to the

research partners from GlobalCo. The objective of the research team is to begin an ongoing dialog between researchers and global team members and practitioners that will promote greater learning on the general topic of interactions in global teams.

## 8.7 Discussion on Research Methodology

In summary, stages of data collection and analysis included:

1. Putting the data from multiple teams into usable form without compromising their richness.

2. Allowing the unique patterns of each team to emerge before pushing to generalize across teams (Eisenhardt 1989).

3. Conducting a template coding data analysis of certain types of pattern in the data.

4. Creating and refining constructs and identifying other variables of interest from the team interaction space framework

5. Using data analysis of emergent higher level relationships by refining the definition of constructs and building evidence to measure or refute some of the research hypotheses and questions.

6. Integrating the constructs into a tentative model that builds on the team interaction space framework.

7. Reviewing all data from the teams for a third time in order to refute or refine the model.

# Chapter 9

# Hypotheses Analysis

*... We are all listening to the same radio station WIIFM... what's in it for me?...*

*GlobalCo Manager from United States*

This chapter discusses the quantitative and qualitative results in greater detail in light of the team interaction space framework discussed in Chapter 3. The chapter is composed of 4 sections, one for each of the hypotheses outlined below:

1. Effectively managing the team interaction space helps perceived team performance
2. Communication Technologies, organizational processes and spatial setup positively affect the effectiveness of team interaction space
3. Technologies used by globally dispersed teams needs to be considered in multiple dimensions: ability, capability, reliability, accessibility and supportiveness.
4. Time, not geographical distance, is a major form of dispersion in global teams.
5. In global teams, there are more differences along the management hierarchy than across different geographical sites.

Each of these sections is comprised of six subsections:

- hypothesis statement and analysis techniques,

- quantitative analysis,
- qualitative analysis,
- summary of key findings,
- potential research impact, and
- potential industry impact

The final section summarizes the study and provides suggestions for future research. It should be highlighted that the higher level hypotheses were triangulated with data from quantitative questionnaires and qualitative data from interviews and interaction space observations. In addition graphical analysis of spatial setups during interactions between globally dispersed team members is provided to build the case for the importance of physical setup in team interactions. The findings presented represent exploratory generalizations, from a relatively small sample, regarding very specific global teams. In addition, the intent of this study was to focus on interaction aspects from the global team members' experiences and perceptions of the effectiveness of their teams. The study, therefore, did not deal with specific team tasks or individual variables that may have significant effects on the team effectiveness. For these reasons, the findings should be taken with a pinch of salt. However, they can also provide valuable information for identifying team interaction space and using it effectively to overcome barriers to increase perceived team performance.

## 9.1 Team Interaction Space

Considering the team interaction space framework and its impact on team performance, it is hypothesized that:

1. Effectively managing the team interaction space helps team performance
2. Communication technologies, organizational protocols and spatial setup positively affect the effectiveness of team interaction space

The role of team interaction space as a mediating variable between communication technology, organization protocols and perceived team performance is hypothesized as shown in Figure 9-1.

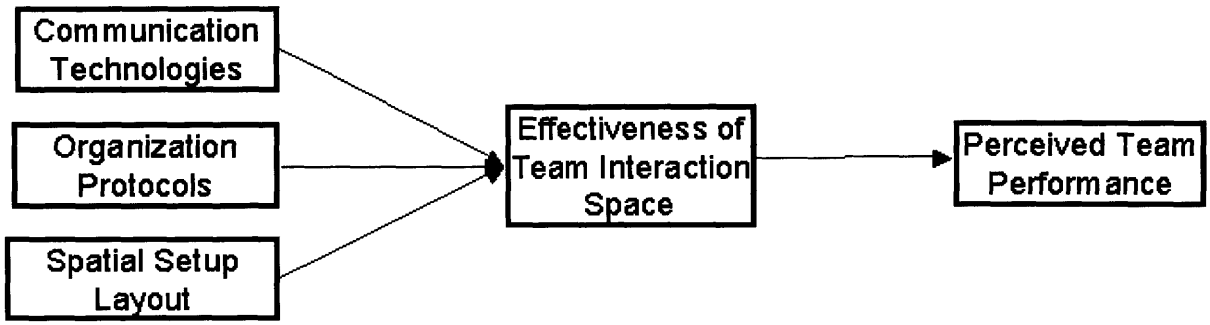



Figure 9-1: Team Interaction Space Enablers and Perceived Team Performance

The following analysis techniques and software tools were used to confirm or refute the above hypotheses:

- Factor Analysis for Creating Scales (using SPSS v10)
- Path Analysis for Modeling (using EQS v6)
- Correlations (using SPSS v10)
- Qualitative Analysis of Team Interactions

### 9.1.1 Quantitative Data

As a first step, Factor Analysis was carried out on the various items from the questionnaire described in Chapter 8. Detailed overview of Factor Analysis is presented in Appendix A. The steps followed are enumerated below:

- Create Scales for
    1. Communication Technology
    2. Organization Processes

3. Interaction Space Effectiveness

4. Perceived Team Performance

- Run Reliability Analysis for each Scale
- Find Correlations between Items

As a sample, detailed analysis results from the Factor Analysis for the Interaction Space Effectiveness Scale is shown in Figures 9-2 and 9-3. Kaiser-Meyer-Olkin Measure of Sampling Adequacy for the Team Interaction Space Effectiveness Scale is `0.739` while the Bartlett's Test of Spehericity shows Chi-Square of `125.819` and significance of `0.000`. KMO Measure should be greater than `0.5` and Bartlett's Test should have low significance values. Both these tests indicate that the Factor Analysis was fairly adequate and robust. In addition, it can be seen from Figure 9-2 that 3 Factors together explained a cumulative `35.112%` of variance. For factor analyses, the Extraction Method chosen was Principal Axis Factoring followed with Oblimin method with Kaiser Normalization for rotation since this allows for: a single primary factor (together with some residual variation accounted for by other lesser factors); and factors that are correlated (i.e., factor correlations are less than unity and therefore not orthogonal). The factor loadings reported below are derived from the "Pattern" matrices for a three factor solution as shown in Figure 9-3. After the individual items for each factor were identified, reliability analysis was carried out to determine if the items could be combined as a factor. In case the Cronbach alpha was less than `0.5`, then the items were dropped to make the factor reliable, as shown in Figure 9-4.

**KMO and Bartlett's Test**

| | | |
|---|---|---|
| Kaiser-Meyer-Olkin Measure of Sampling Adequacy. | | .739 |
| Bartlett's Test of Sphericity | Approx. Chi-Square | 125.819 |
| | df | 55 |
| | Sig. | .000 |

**Total Variance Explained**

| | Initial Eigenvalues | | Extraction Sums of Squared | |
|---|---|---|---|---|
| Factor | % of Variance | Cumulative % | % of Variance | Cumulative % |
| 1 | 26.774 | 26.774 | 21.180 | 21.180 |
| 2 | 13.389 | 40.164 | 7.951 | 29.131 |
| 3 | 11.153 | 51.317 | 5.980 | 35.112 |
| 4 | 8.883 | 60.200 | | |
| 5 | 7.580 | 67.780 | | |
| 6 | 6.961 | 74.741 | | |
| 7 | 5.941 | 80.681 | | |
| 8 | 5.814 | 86.495 | | |
| 9 | 4.728 | 91.223 | | |
| 10 | 4.570 | 95.794 | | |
| 11 | 4.206 | 100.000 | | |

Extraction Method: Principal Axis Factoring.

a. When factors are correlated, sums of squared loadings cannot be added to obtain a total variance.

Figure 9-2: Factor Analysis for Team Interaction Space Effectiveness Scale

**Pattern Matrix[a]**

| | Factor | | |
|---|---|---|---|
| | 1 | 2 | 3 |
| INTER20 | .624 | | |
| INTER13 | .553 | | -.110 |
| INTER22 | .546 | | |
| INTER16 | .405 | | -.151 |
| INTER8 | .194 | | -.167 |
| Recoded INTER6 | | -.688 | |
| INTER2 | .155 | .588 | .143 |
| Recoded INTER14 | .323 | -.388 | .162 |
| INTER12 | | -.116 | -.813 |
| INTER15 | | | -.458 |
| INTER11 | .370 | | -.401 |

Extraction Method: Principal Axis Factoring.
Rotation Method: Oblimin with Kaiser Normalization.

a. Rotation converged in 13 iterations.

Figure 9-3: 3 Factor Solution for Team Interaction Space Effectiveness Scale

| Factor/Scale | Std. Item Alpha* |
|---|---|
| INTER20, INTER13, INTER22, INTER16 | 0.6100 |
| INTER6, INTER2, INTER14 | 0.3336 |
| INTER6, INTER14 | 0.7470 |
| INTER12, INTER15, INTER11 | 0.6547 |

Figure 9-4: Reliability Analysis for Team Interaction Space Effectiveness Scale

The next steps in the analyses were:

- Identify strongly loading items for:
    1. Communication Technology Scale
    2. Organization Protocols Scale
    3. Interaction Space Effectiveness Scale
    4. Perceived Team Performance Scale
- Create Scales based on Mean of strongly loading items
- Run Path Analysis on combined Scales

The final outcome of the Factor Analyses is combined scales for Communications Technology, Organization Protocols, Interaction Space Effectiveness and Perceived Team Performance. The individual questionnaire items comprising the final scales is shown in Tables 9.1, 9.2, 9.3 and 9.4.

Table 9.1: Communication Technology Scale

| VAR | W | Description |
|---|---|---|
| COM1 | | Overall, I am satisfied with the current set of technologies in communicating with global team members |
| COM3 | | Communication technologies used for communicating with remote team members facilitate effective global team meetings |
| COM4 | | I receive sufficient training to use communication technologies most effectively on global teams |
| COM6 | | Communication technologies allow me to convey my ideas very effectively to my global team members |
| COM7 | | I use very basic technologies such as phone, email and project web sites to meet my functional needs to collaborate with my global team members |
| COM9 | | Communication technologies used by the global team are conveniently accessed from multiple locations (e.g., cubicles, office, meeting room, home, airport) |
| COM12 | | The company provides excellent support (e.g., training staff, help desks) for using communication technologies |
| COM13 | | Communication technologies allow everyone in the team to have access to information needed to get the job done |

Table 9.2: Organization Protocols Scale

| VAR | W | Description |
|---|---|---|
| INTER3 | | It is important to have a well-defined agenda circulated to all team members before a global team meeting |
| INTER4 | X | The agenda items for my global team meetings are poorly defined |
| INTER5 | | My team rotates the responsibility of chairing the meetings among all the sites represented on the global team |
| INTER7 | | Team members have the training to run effective global team meetings |
| INTER10 | | The team leader regularly talks with team members outside global team meetings |
| STR2 | | Team members participate in the decision making process |
| STR11 | X | Changes in the team membership negatively impact global team performance effectiveness. |
| STR13 | | The team members trust our team leader to fairly represent our global team needs |
| STR16 | X | Transition for new members on the global team happens too quickly |
| STR17 | | The team has created norms of appropriate behavior among its members |
| STR18 | | The global team has a mentor who helps the global team in reaching its goals |
| STR19 | | Global team operating procedures and protocols support successful completion of the team's task |
| SUP2 | X | Company leadership does not understand the major concerns facing global teams in meeting discussions |
| SUP3 | | Company provided cross-cultural training classes to help its employees work effectively on global teams |
| SUP4 | X | The team is a global initiative, but the company has no global structure of policies and procedures to support it |
| SUP12 | | Local needs are taken into account in global team decisions outside global team meetings |

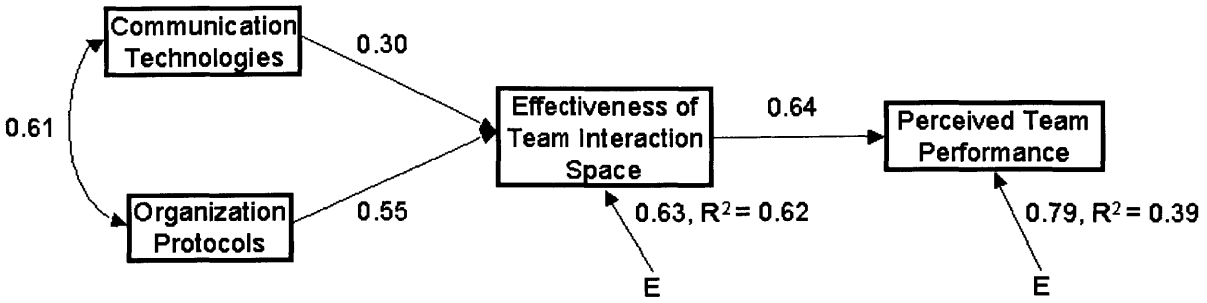
Table 9.3: Perceived Team Performance Scale

| VAR | W | Description |
|---|---|---|
| OUT2 | | My global team makes fast decisions |
| OUT3 | | Decisions made in the global team are of high quality |
| OUT4 | X | My global team has not been very successful in achieving its objectives |
| OUT5 | | Working on global teams has been a good experience for me |
| OUT7 | | Working on global teams increases my technical expertise. |
| OUT8 | | An important information-sharing network has been created among members of my team. |
| OUT9 | | Working on the global team gives me access to useful knowledge I can get nowhere else. |
| OUT10 | | I derive great personal satisfaction from my work with the members of my team. |
| OUT11 | | I am satisfied with my performance on my global team |
| OUT12 | | I would enjoying work with my current team members on another global team |
| OUT13 | | Work on global teams helps my long-term career objectives. |
| OUT14 | | I enjoy working on global teams |
| OUT17 | X | I think my global team could have performed a lot better |
| OUT20 | X | I do not plan on networking with members of this global team for other projects |
| OUT21 | | My work on the global team helps my local site achieve its performance metrics |
| OUT22 | | I feel that I have increased my ability to work in a global community |
| OUT23 | | My performance in global teams enhances the reputation of my local site |
| SUP1 | | Considering the company as a whole, globally dispersed teams are successful |

Table 9.4: Interaction Space Effectiveness Scale

| VAR | W | Description |
|---|---|---|
| INTER8 | | All global team members express opinions and ideas freely in most meetings |
| INTER9 | X | The same team members appear to be making all the decisions in global team meetings |
| INTER11 | | Team meetings are used by the team to agree on the responsibility for specific tasks |
| INTER12 | | The needs of the global team and local priorities are reconciled outside team meetings |
| INTER13 | | On a regular basis, global team members take the time during the meetings to share lessons learned at their local sites |
| INTER14 | X | The needs of the global team and local priorities are rarely reconciled during meetings |
| INTER15 | | Ambiguous tasks are clarified with all the global team members outside meetings |
| INTER16 | | When my global team meets, the team members whose input is needed to accomplish the task are always present |

The model data from the combined Scales was used as input for EQS 6 for Windows (Byrne 1994). To test our hypothesis on interaction space as mediating variable, Structural Equation Modeling was carried out on the various Scales. Commensurate with the interaction space framework, Communication Technology Scale and Organization Protocol Scales were chosen as "exogenous" variables. Exogenous variables are independents with no prior causal variable (though they may be correlated with other exogenous variables, usually depicted by a double-headed arrow in models). Team Interaction Space Effectiveness Scale and Perceived Team Performed Scale were "endogenous" variables. Endogenous variables are mediating variables (variables which are both effects of other exogenous or mediating variables, and are causes of other mediating and dependent variables), and pure dependent variables. The outcome of the SEM is shown in Figure 9-5.




$\chi^2$ = 7.64, P = 0.02, CFI = 0.95, LISREL GFI = 0.939, LISREL AGFI = 0.687, RMSEA = 0.23

$\chi^2$ < 10.00, P > 0.02, CFI > 0.9, LISREL GFI > 0.8, LISREL AGFI > 0.5, RMSEA < 0.1

Figure 9-5: Structural Equation Modeling of Team Interaction Space

The fit-indices (see Appendix A) from the model indicate that the model can not be rejected statistically and is a plausible representation of the causal structure. To confirm the hypothesis in one more dimension, the model was compared with competing models:

- Model B refers to the idea that communication technology and organization protocols affect perceived team performance directly with team interaction space playing no role
- Model C refers to the idea that communication technology and organization protocols both impact perceived team performance which in turn affects the effectiveness of the team interaction space.
- Model D refers to the idea that team interaction space is NOT a mediating variable. Instead team interaction space acts as an exogenous variable along with communication technology and organization protocols in affecting the perceived team performance.

The results from SEM on the various models is shown in Figure 9-6. As Figure 9-6 indicates, Model A CANNOT be rejected statistically and is a plausible representation of the causal structure underlying team interaction space and perceived team

performance. More importantly, Models B, C and D must be rejected statistically.

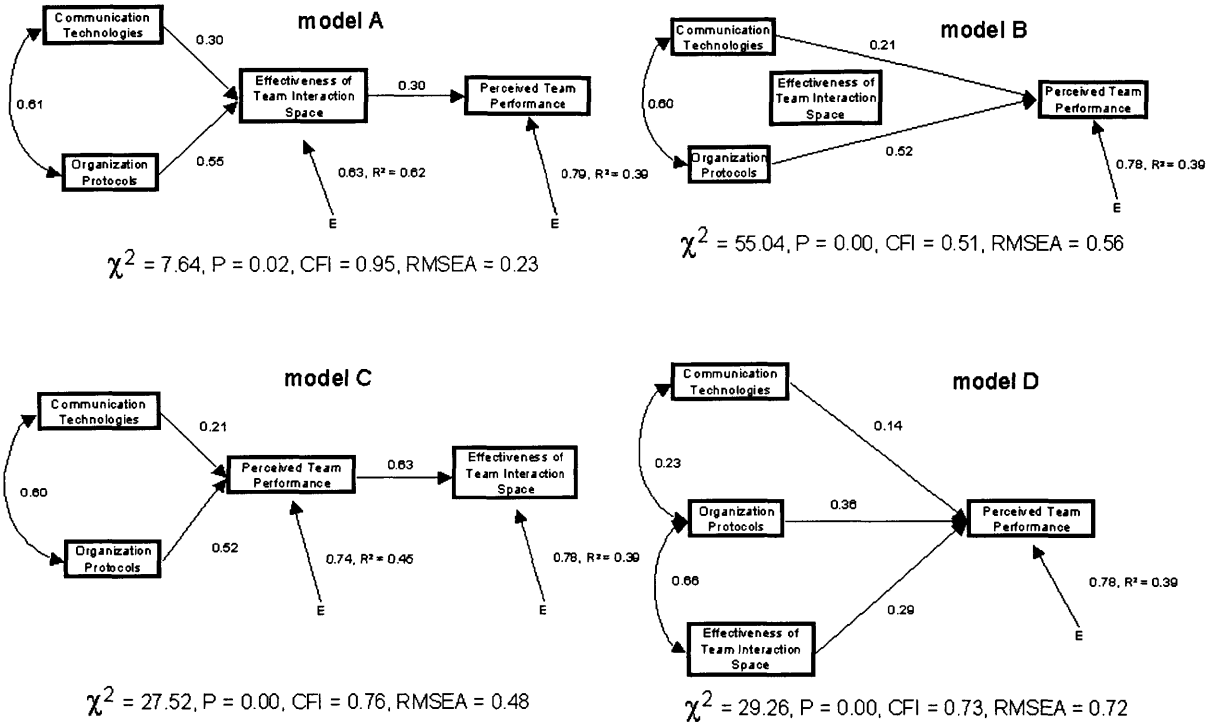



Figure 9-6: Structural Equation Modeling of Team Interaction Space

Correlations were computed to study the impact of following organization protocols on the effectiveness of team interaction space:

- Agenda Management
- Chairperson Rotation
- Training
- Member Transition

Scales were created for each of the organization protocol variables and their correlations measured with the Team Interaction Space Effectiveness Scale created earlier. Figure 9-7 shows the individual questionnaire items comprising the organization protocol scales.

Figure 9-8 shows the correlations between team interaction space effectiveness and the team outcomes. Agenda Management is strongly correlated to team interaction space effectiveness with a Pearson Correlation of 0.413 significant at the .01 level. This substantiates the hypothesis that well-defined agenda items circulated before the interaction session make the interaction session effective for globally dispersed teams. Chairperson Rotation is an organization protocol for ensuring that all sites share the responsibility of managing the team interaction space. Rotating the chairperson helps in ensuring that there is participation from all sites as well as all team members learn the intricacies of managing global team interactions. Chairperson Rotation was strongly correlated to team interaction space effectiveness with a Pearson Correlation of 0.445 significant at the 0.05 level. Training, which included: training to run effective global interactions, organization-wide training to work on globally dispersed teams, cross-cultural training classes and training to use communication technologies to interact with global team members. Training was strongly correlated to team interaction space effectiveness with a Pearson Correlation of 0.682 significant at the 0.05 level. Member Transition which deals with the process for managing new members into the teams was found to be less significantly correlated than other organization protocols. Member Transition was correlated to team interaction space effectiveness with a Pearson Correlation of 0.285 significant at the 0.01 level only.

## Agenda Management Scale

| ITEM | Description |
|---|---|
| INTER3 | It is important to have a well-defined agenda circulated to all team members before a global team meeting |
| INTER4 | The agenda items for my global team meetings are poorly defined |

## Chairperson Rotation

| ITEM | Description |
|---|---|
| INTER5 | My team rotates the responsibility of chairing the meetings among all the sites represented on the team |

## Training

| ITEM | Description |
|---|---|
| INTER7 | Team members have the training to run effective global team meetings |
| IND18 | I believe training in my company prepares people to work on globally dispersed teams |
| SUP3 | Company provided cross-cultural training classes to help its employees work effectively on global teams |
| COM4 | I receive sufficient training to use communication technologies most effectively on global teams |

## Member Transition

| ITEM | Description |
|---|---|
| STR15 | The global team has a formal process to help transition new team members into their new role |
| STR16 | Transition for new members on the global team happens too quickly |

Figure 9-7: Organization Protocol Scales

**Correlations**

| | | Interaction Space Effectiveness Scale |
|---|---|---|
| Agenda Management | Pearson Correlation | .413** |
| | Sig. (2-tailed) | .000 |
| | Sum of Squares and Cross-products | 17.176 |
| | Covariance | .215 |
| | N | 81 |
| Chairperson Rotation | Pearson Correlation | .445** |
| | Sig. (2-tailed) | .000 |
| | Sum of Squares and Cross-products | 39.887 |
| | Covariance | .499 |
| | N | 81 |
| Training | Pearson Correlation | .682** |
| | Sig. (2-tailed) | .000 |
| | Sum of Squares and Cross-products | 44.101 |
| | Covariance | .551 |
| | N | 81 |
| Member Transition | Pearson Correlation | .285* |
| | Sig. (2-tailed) | .012 |
| | Sum of Squares and Cross-products | 11.986 |
| | Covariance | .158 |
| | N | 77 |

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).

Figure 9-8: Organization Protocol and Team Interaction Space Effectiveness

### 9.1.2 Qualitative Data

To substantiate some of the quantitative analysis from the Although quantitative and qualitative data collection and analysis is presented sequentially in two separate sections here because they represent different conceptual methodologies for triangulating the hypotheses. However, chronologically the two activities overlapped. Qualitative data from interaction observations and interviews is presented here to substantiate the following claims:

- Interaction space involves significant local-global forms of communication at an individual and team level.
- Physical setup plays a significant role in controlling the interaction space. Furthermore, physical setup not conducive to computer-mediated interaction affects the perception of the usefulness of the interaction space
- Globally dispersed team members want to use the interaction space to get the perception that the team is not geographically distributed, but in the same room.
- Importance of organization protocols such as agenda management are important for effective management of the interaction space.

Figure 9-9 gives a graphical overview of the team interaction space. This GlobalCo team had 12 team members interacting from four different sites using video conferencing tools. The physical setup for each location as observed remotely by the research team is depicted for each site. In addition, total communication time and the sender-receiver pairs for each interaction were recorded. In the Figure 9-9, this interaction is depicted by line arrows with thickness indicating the time (thicker means longer) and the arrow pointing to the receiver. Looking at the internal site layout, it is evident that there were number of instances of local cross-talk and side-conversations during the global interaction.

Figure 9-10 shows the physical setup at a GlobalCo site during a video conference between team members separated across four countries. The numbered positions

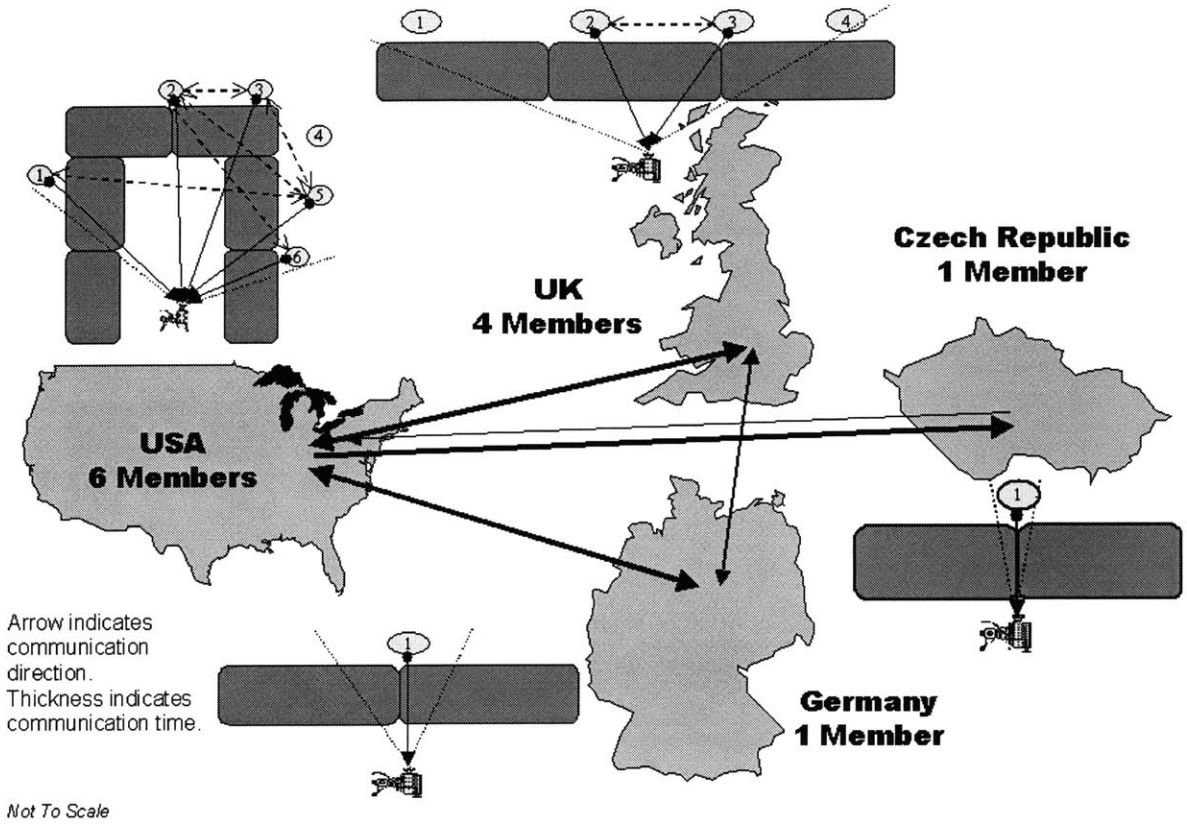



Figure 9-9: Qualitative Data for Team Interaction Space. *Note: Data is Masked*

indicate the chair locations that were occupied by team members during the interaction. The camera position and the lines of sight indicate the visual range from a remote perspective of the site. As before, total communication time and the sender-receiver pairs for each interaction were recorded by the research team members. In the Figure 9-10, this interaction is depicted by line arrows with thickness indicating the time (thicker means longer) and the arrow pointing to the receiver. Furthermore, line style was used to indicate if the interaction was a local discussion (indicated by dashed lines) or a global one (indicated by solid lines). It should be noted that the team member sitting in position number 4 in Figure 9-10 was the team leader and controlled most of the discussion during this interaction session. Physical setup for the interaction space is not very conducive to interacting as team members in positions 1 and 8 were barely visible in the visual range. Team members in position

9 was raining was strongly correlated to team interaction space effectiveness with a Pearson Correlation of 0.682 significant at the 0.05 level.never "seen" in the interaction, though his presence was felt by figuring out the directed local discussion. From a remote team members perspective, this hampered the overall interaction flow.

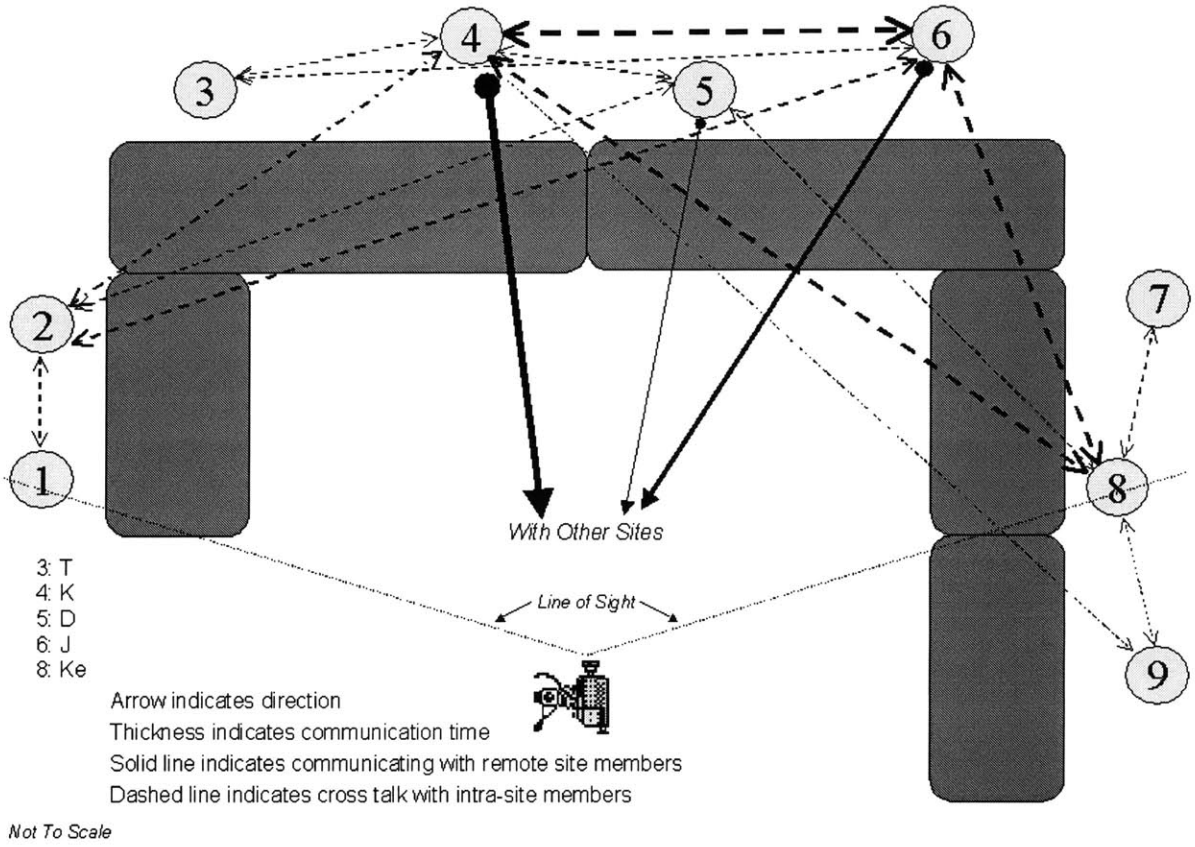



Figure 9-10: Qualitative Data for Spatial Setup Analysis. *Note: Data is Masked*

Figure 9-11 indicates another session of interaction space from one of GlobalCo's globally dispersed teams observed by the research team to collect qualitative data. Specifically, the various barriers to team interaction space effectiveness identified in Chapter 4.7 are highlighted on the interaction map.

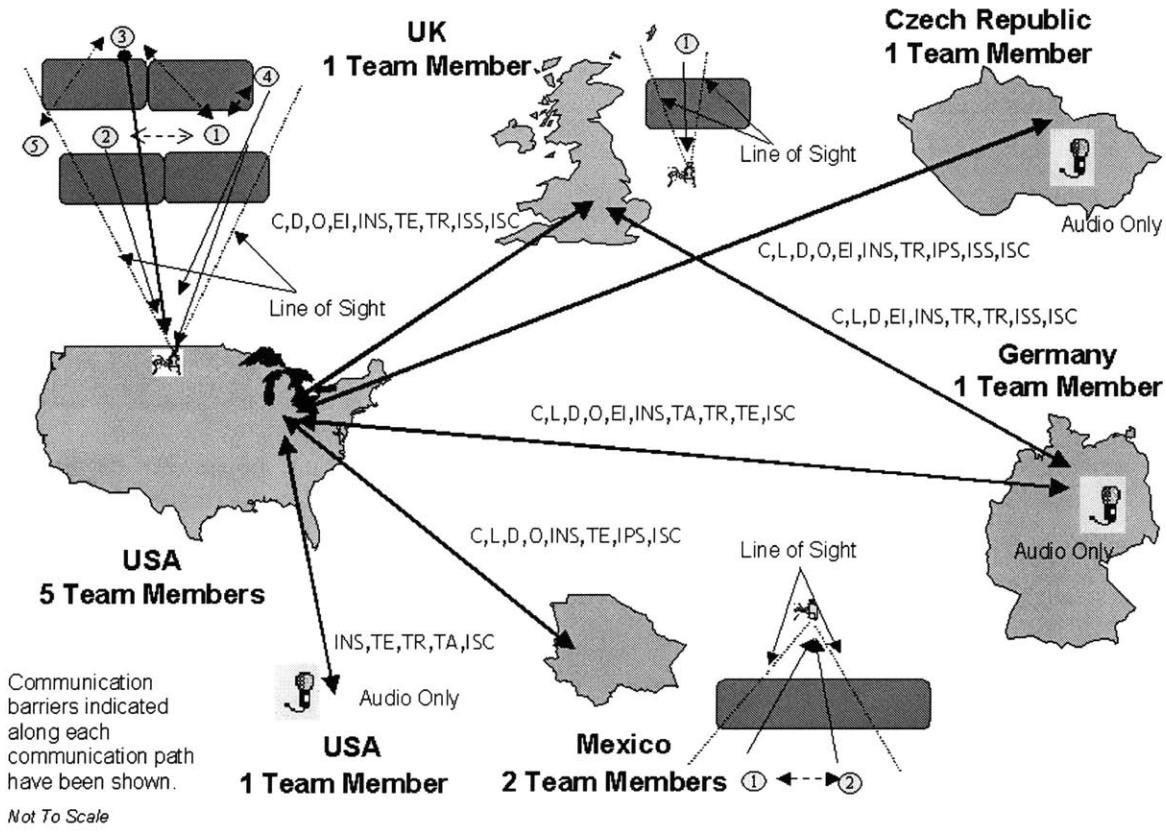



Figure 9-11: Qualitative Data for Identifying Barriers in the Team Interaction Space. *Note: Data is Masked*

The following qualitative data from interviews and interaction observation supports the importance of team interaction space for increasing perceived team performance.

*The key to global team is to be able to interact as (if) you are in the same room ... If you have clear communication, clear role and responsibilities, people accept their responsibility, the ability to resolve conflict as a group and not as individual...* . Middle Manager from United States

*... we need to update team to the open issues assigned in previous meetings. Every meeting will have an agenda for opens ... Issues get discussed based on agenda of the meeting set by the team chair...* Engineer from Asia

*... as the chair of the team you are accustomed to influencing the team.. The local site knows that I can remove roadblocks. If they have to deal with a person 14 hours away, the time zone (differences) does not help and the influence changes...* Middle Manager from South America

*... we have an agenda, weekly, most of them are on things that you need to update, safety, key learning ... Most of the items that we discuss in meetings. We also have open item to start the discussions ... the leader makes the agenda and every one contribute(s)...* Middle Manager from Asia

### 9.1.3 Key Findings

Summarizing the key findings:

- Significant correlation between the effectiveness of the team interaction space and perceived team performance
- Significant correlation between:
  - Organization Protocols
  - Communication Technologies
  - Team interaction space effectiveness

- Qualitative evidence on the impact of spatial setup on team interaction space effectiveness
- Following Organization Protocols:
  - Agenda management
  - Chairperson rotation
  - Training in the interaction space management

  are significantly correlated to the effectiveness of team interaction space
- Member transition is correlated to team interaction space effectiveness

### 9.1.4 Potential Research Impact

Based on the key findings from the above section, the potential research impact can be summarized as:

- Introduction of team interaction space to explain the potential impact of communication technologies and certain organizational processes on increasing the perceived team performance
- Well defined agenda circulated before meeting results in an increase in team interaction space effectiveness. Specifically, the analysis included the following two mechanisms for agenda management: agenda circulated before meeting, and the interaction agenda had well defined agenda items. Some key questions that need to be addressed in future research include:
  - Should agenda be managed proactively during meetings?
  - Who should be in charge of agenda management? Team leader only? This is especially important considering the importance of chairperson rotation to overall interaction space effectiveness.
  - How does the agenda structure impact the effectiveness of the interaction space?

- There is statistical evidence that providing training for team members increases effectiveness of team interaction space. Specifically, the following training mechanisms were tested:
  - Training to run global meetings
  - Training to work on global teams
  - Cross-cultural training
  - Training to use communication technologies

  Following the discussion with GlobalCo Human Resources personnel, and realizing the costs of training team members geographically separated, a valid question would be how much training should be provided to globally dispersed team members? Who gets the training and what should be the timing of the training?

### 9.1.5 Potential Industry Impact

Summarizing the key findings for globally dispersed organizations such as GlobalCo:

- Team interactions are strongly influencing the way team members perceive their teams are performing. When the interaction space is effective and efficient, team members perceive their teams are performing better.
- By managing the team interaction space, global team members can increase the perceived team performance
- Global team members need to use effective agenda management techniques to better manage interactions among global team members:
  - Agenda circulated before meeting
  - Well defined agenda items
  - Agenda managed proactively during meetings
  - Structured agenda

Towards that end, agenda templates provided in Chapter 3 can be used to maximize the use of the interaction space.

- Companies need to continue providing training for team members to increase the effectiveness of team interaction space. This is especially important considering that interview with Human Resources personnel indicated that budgetary constraints were forcing GlobalCo to curtail training activities of team members. It is important to point out that training is recommended for all employees working on global teams versus training for team members relocating to foreign countries only.

## 9.2 Technology Dimensions

When estimating the impact of communication technologies on the effectiveness of team interaction space, a uni-dimensional approach proposed in the literature is not sufficient to explain the barriers faced by global teams. Instead, Technologies used by globally dispersed teams need to be considered in multiple dimensions:

- Ability
- Capability
- Reliability
- Accessibility
- Supportiveness

The various technology dimensions proposed in this hypothesis are shown in Figure 9-12.

The following analysis techniques and software tools were used to confirm or refute the above hypotheses:

- Factor Analysis for Creating Scales (using SPSS v10)
- Correlations (using SPSS v10)

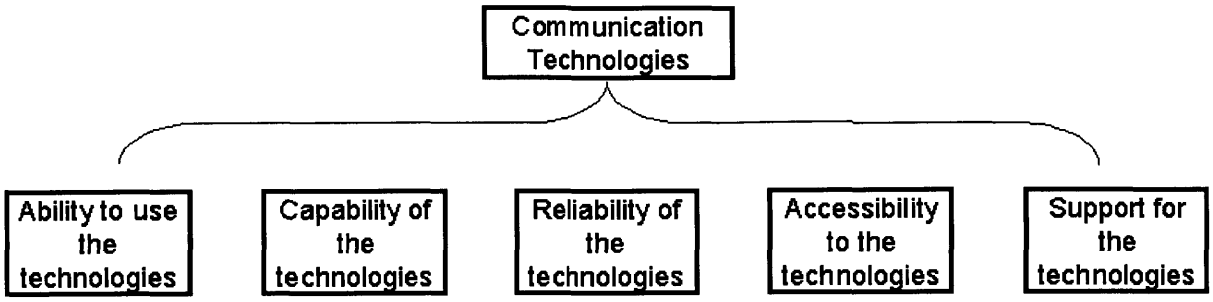



Figure 9-12: Technology Dimensions

### 9.2.1 Quantitative Data

As a first step, Factor Analysis was carried out on various items pertaining to communication technology from the questionnaire described in Chapter 8 (see Figure 9-13.

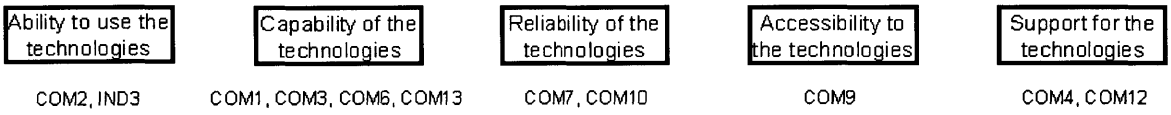



Figure 9-13: Questionnaire Items for the different Technology Dimensions

Detailed overview of Factor Analysis is presented in Appendix A. Communication Technology Scale created during the Factor Analysis step from the last hypothesis was used for this hypothesis. The Factor Analysis process for the Communication Technology Scale is shown in Figure 9-14. Kaiser-Meyer-Olkin Measure of Sampling Adequacy for the Team Interaction Space Effectiveness Scale is `0.788` while the Bartlett's Test of Spehericity shows Chi-Square of `177.425` and significance of `0.000`. KMO Measure and Bartlett's Test indicate that the Factor Analysis was fairly adequate and robust. In addition, it can be seen from Figure 9-14 that 3 Factors together explained a cumulative `51.735%` of variance. For factor analyses, the Extraction Method chosen was Principal Axis Factoring followed with Oblimin method with Kaiser Normalization for rotation, since this allows for: a single primary factor (together with some residual variation accounted for by other lesser factors); and factors that are correlated (i.e., factor correlations are less than unity and therefore not orthogonal). The

factor loadings reported below are derived from the "Pattern" matrices for a three factor solution as shown in Figure 9-14. After the individual items for each factor were identified, reliability analysis was carried out to determine if the items could be combined as a factor.

**KMO and Bartlett's Test**

| | | |
|---|---|---|
| Kaiser-Meyer-Olkin Measure of Sampling Adequacy. | | .788 |
| Bartlett's Test of Sphericity | Approx. Chi-Square | 177.425 |
| | df | 45 |
| | Sig. | .000 |

**Total Variance Explained**

| | Extraction Sums of Squared Loadings | | |
|---|---|---|---|
| Factor | Total | % of Variance | Cumulative % |
| 1 | 3.610 | 36.100 | 36.100 |
| 2 | .996 | 9.962 | 46.062 |
| 3 | .567 | 5.672 | 51.735 |

Extraction Method: Principal Axis Factoring.

**Pattern Matrix[a]**

| | Factor | | |
|---|---|---|---|
| | 1 | 2 | 3 |
| COM3 | .901 | | |
| COM6 | .800 | | -.193 |
| COM1 | .708 | .228 | |
| COM9 | .616 | | .212 |
| COM13 | .451 | .358 | .123 |
| COM4 | | 1.008 | -.197 |
| COM12 | .222 | .641 | |
| IND3 | | .293 | .172 |
| COM10 | -.158 | | .483 |
| COM7 | .123 | | .418 |

Extraction Method: Principal Axis Factoring.
Rotation Method: Oblimin with Kaiser Normalization.
a. Rotation converged in 7 iterations.

**Scree Plot**

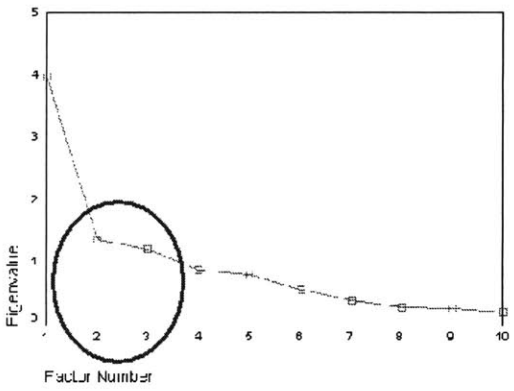



Figure 9-14: Factor Analysis for the Communication Technology Scale

From Figure 9-15, Factor Analysis recommended the following three factors for communication technologies:

1. Factor 1: COM3+COM6+COM1+COM9+COM13 which signifies capability of communication technology and accessibility to the technologies.

2. Factor 2: COM4+COM12 which pertains to supportiveness of the communication technologies.

3. Factor 3: COM10+COM7 which refers to the reliability of the technologies.


Figure 9-15: Communication Technology Factors from Factor Analysis

This substantiates the hypothesis that the impact of communication technologies on the effectiveness of team interaction space needs to be considered in multiple dimensions. Next step involved finding which of the technology dimensions correlated with team interaction space effectiveness.This will help analyze which technology dimensions are more important than others for increasing the effectiveness of the team interaction space. Figure 9-16 shows the questionnaire items corresponding to the different technology dimensions. Correlations were computed to study the impact of following technology dimensions on the effectiveness of team interaction space:

- Technology Ability
- Technology Capability
- Technology Accessibility
- Technology Supportiveness
- Technology Reliability

Figure 9-17 shows the correlations between team interaction space effectiveness and the technology dimensions. As the figure indicates, technology capability, accessibility and supportiveness were strongly correlated to team interaction space effectiveness with Pearson Correlations of 0.413, 0.406 and 0.637 respectively, significant at the 0.01 level. Surprisingly enough, technology ability (ability of team members to use the communication technologies to interact with global team members) was found to be not correlated with team interaction space effectiveness. Technology reliability was correlated with team interaction space effectiveness with a Pearson Correlation of 0.238 significant at the 0.01 level only. This indicates that reliability of technology does not impact team interaction space effectiveness. One possible explanation of this effect could be that team members use basic technologies such as phone, e-mail and project web-sites with very high inherent reliability. Since the technologies have high reliability, the effect of unreliable technologies is not experienced as frequently.

## Technology Ability

| ITEM | Description |
|---|---|
| COM2 | Communication technologies used for communicating synchronously with remote team members are difficult to use |
| IND3 | I have yet to master the communication technologies needed to share knowledge with my global team members |

## Technology Capability

| ITEM | Description |
|---|---|
| COM3 | Communication technologies used for communicating with remote team members facilitate effective team meetings |
| COM6 | technologies allow me to convey my ideas very effectively to my global team members |
| COM1 | Overall, I am satisfied with the current set of technologies used in communicating with global team members |
| COM13 | Communication technologies allow everyone in the team to have access to information needed to get the job done |

## Technology Accessibility

| | |
|---|---|
| COM9 | Communication technologies used by the global team are conveniently accessed from multiple locations (e.g., cubicle, office, meeting room, home, airport) |

## Technology Supportiveness

| ITEM | Description |
|---|---|
| COM4 | I receive sufficient training to use communication technologies most effectively on global teams |
| COM12 | The company provides excellent support (e.g., training staff, help desks) for using communication technologies |

Figure 9-16: Technology Dimensions

**Correlations**

| | | Interaction Space Effectiveness Scale |
|---|---|---|
| Technology Ability | Pearson Correlation | .204 |
| | Sig. (2-tailed) | .069 |
| | Covariance | .103 |
| | N | 80 |
| Technology Capability | Pearson Correlation | .588** |
| | Sig. (2-tailed) | .000 |
| | Covariance | .389 |
| | N | 80 |
| Technology Accessibility | Pearson Correlation | .406** |
| | Sig. (2-tailed) | .000 |
| | Covariance | .432 |
| | N | 80 |
| Technology Supportiveness | Pearson Correlation | .637** |
| | Sig. (2-tailed) | .000 |
| | Covariance | .583 |
| | N | 80 |
| Technology Reliability | Pearson Correlation | .238* |
| | Sig. (2-tailed) | .033 |
| | Covariance | .147 |
| | N | 80 |

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

Figure 9-17: Technology Dimensions and Team Interaction Space Effectiveness

### 9.2.2 Key Findings

Summarizing the key findings:

- Technologies used by globally dispersed teams need to be considered in multiple dimensions:
  - Ability to use the technology to interact
  - Capability of the technology to support the interaction space
  - Reliability of the technology used for interaction
  - Accessibility to the technology from multiple locations (for example, office, cubicles, meeting rooms, homes, airports)
  - Support provided to use the technology to interact
- Significant correlation between the support provided to use the technologies and effectiveness of the team interaction space
- Less correlation found between the ability to use the communication technologies and effectiveness of the team interaction space

### 9.2.3 Potential Research Impact

Based on the key findings from the above section, the potential research impact can be summarized as:

- Instead of traditional uni-dimensional scale, five statistically significant dimensions of communication technology identified Introduction of team interaction space to explain the potential impact of communication technologies and certain organizational processes on increasing the perceived team performance
- Contrary to conventional wisdom, ability to use the technology seems to have less impact on the interaction space effectiveness
  - Over 80% of the questionnaire respondents disagreed with the question that they found it difficult to use the communication technologies.

- Over 74% of the questionnaire respondents agreed that they had not mastered the technologies to share knowledge with globally dispersed team members.

- New variable identified, support provided by the company to use the technology, significantly affecting the effectiveness of team interaction space. One plausible explanation for this phenomenon could be that Technology supportiveness helps acceptance of technology use within the interaction space.

- Accessibility to communication technologies:
  - is a strongly desired feature amongst global team members (76% of questionnaire respondents agree)
  - was strongly correlated with the effectiveness of team interaction space. Accessibility leads to the follow-on questions on which team members get access to the technology and what technologies should have maximum access?

### 9.2.4 Potential Industry Impact

Summarizing the key findings for globally dispersed organizations such as GlobalCo:

- When introducing new communication technologies for global team members, companies need to look at the following factors:
  - Ability to use the technologies
  - Capability of the technologies to support interactions
  - Reliability of the technologies
  - Accessibility to the technologies
  - Support that can be provided to use the technologies

- Companies need to continue providing proactive support for communication technologies making the interaction space more effective. This support could be in the form of help desks or skilled technical assistants/meeting facilitators in the interaction space

- Companies need to make communication technologies more accessible to global team members to increase the effectiveness of team interaction space. For example:
  - Project web sites accessible through corporate firewalls
  - Secure access to global voice conferences using cellular phones
  - Provide two phone lines at homes for team members to use voice conferencing systems and access the Intranet

## 9.3 Time Dispersion

Using Ancona & Caldwell's (1992) definition, globally dispersed teams are designed with deliberate differences in demographic diversity and technical specialization. There are a number of dimensions of diversity including differences in geographical sites, time zones, team member age, education, organizational tenure and functional backgrounds. Consider the different forms of dispersion, it is hypothesized that differences in time zones, not geographical dispersion, is a major form of dispersion in global teams. Furthermore, this time dispersion negatively impacts the effectiveness of team interaction space and perceived team performance (see Figure 9-18).


Figure 9-18: Time Dispersion impact on Team Interaction Space Effectiveness

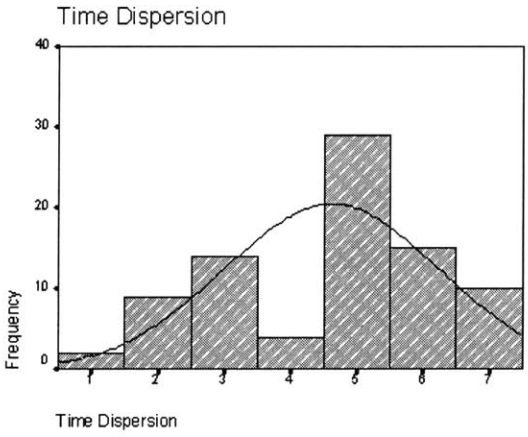
The following analysis techniques and software tools were used to confirm or refute the above hypotheses:

- Frequency Analysis (using SPSS v10)
- Factor Analysis for Creating Scales (using SPSS v10)
- Correlations (using SPSS v10)

- Path Analysis (using EQS v6)

### 9.3.1 Quantitative Data

As a first step, Frequency Analysis was carried out on `IND2` item from the questionnaire described in Chapter 8. The research team decided to study the effect of time dispersion after analyzing data from the interviews with globally dispersed team members. Team members reported that they found it difficult to interact with team members working in other GlobalCo sites because of differences in time zones. The window of opportunity to interact was barely 1-2 hours daily considering the differences in work hours between the sites. Since the questionnaire had in excess of 150 questions, it was decided by the research team to limit the study of this phenomenon with only one questionnaire item: `It is hard to work with my global team members who are more than two time zones (hours) away`. The frequency analysis provides quantitative support to the notion that time dispersion was indeed an important variable affecting the performance of global teams (see Figure 9-19. From the frequency chart in Figure 9-20, `54 (29 + 15 + 10)` of the `83` respondents (`65%`) agreed with the hypothesis that it was hard to work with global team members that were more than two time zones away.




**Statistics**

Time Dispersion

| | | |
|---|---|---|
| N | Valid | 83 |
| | Missing | 12 |
| Mean | | 4.61 |
| Median | | 5.00 |
| Mode | | 5 |
| Std. Deviation | | 1.62 |
| Variance | | 2.63 |

Figure 9-19: Histogram and Descriptive Statistics for Time Dispersion

**Time Dispersion**

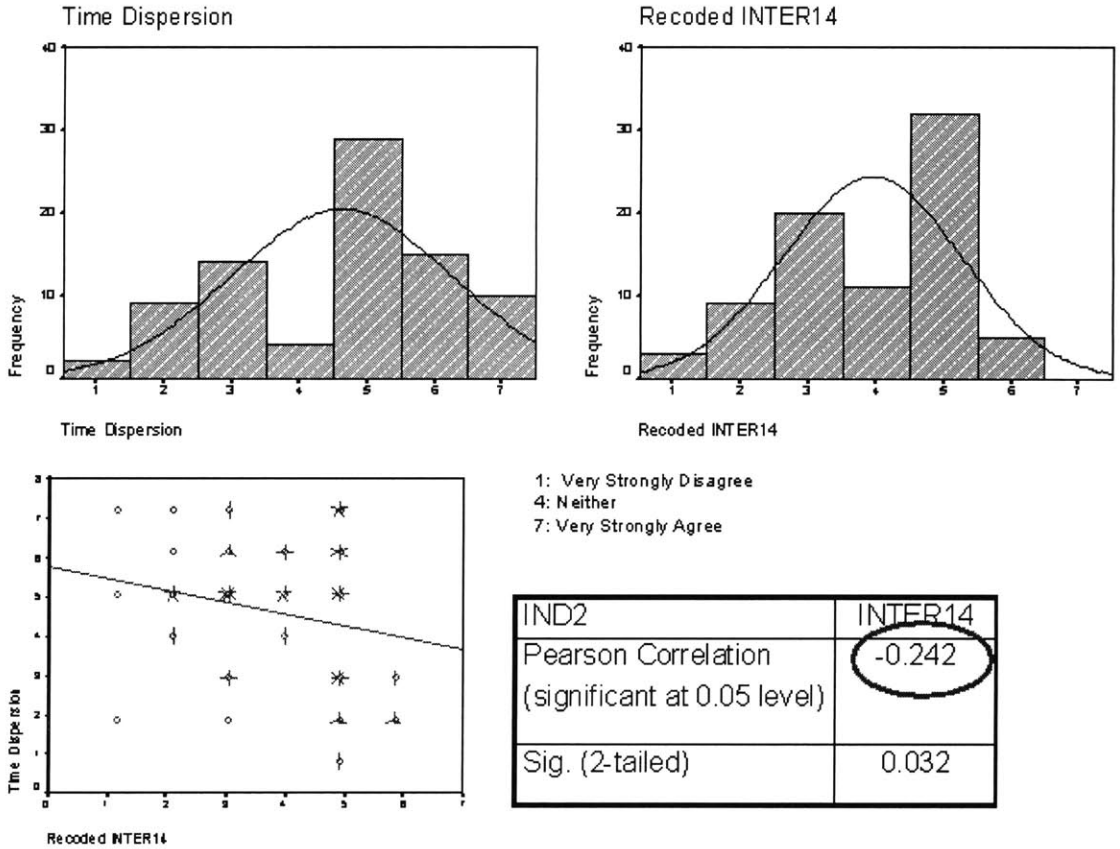
| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | Very Strongly Disagree | 2 | 2.1 | 2.4 | 2.4 |
| | Strongly Disagree | 9 | 9.5 | 10.8 | 13.3 |
| | Disagree | 14 | 14.7 | 16.9 | 30.1 |
| | Neither | 4 | 4.2 | 4.8 | 34.9 |
| | Agree | 29 | 30.5 | 34.9 | 69.9 |
| | Strongly Agree | 15 | 15.8 | 18.1 | 88.0 |
| | Very Strongly Agree | 10 | 10.5 | 12.0 | 100.0 |
| | Total | 83 | 87.4 | 100.0 | |
| Missing | No Data/Missing Data | 12 | 12.6 | | |
| Total | | 95 | 100.0 | | |

Figure 9-20: Frequency Table for Time Dispersion

To study the impact of time dispersion further, correlations were computed for certain key questionnaire items on interaction space. Figures 9-21 and 9-22 show the frequency analysis and correlations between time dispersion and whether needs of global teams and local priorities are reconciled during scheduled meetings. The frequency chart and correlations indicate that if global team and local priorities are not reconciled during meetings, team members would need to interact outside scheduled meetings which would be difficult when team members are separated more than two time zones.

| VAR | W | Description | N | Mean | Std. Dev. | Variance |
|---|---|---|---|---|---|---|
| IND2 | | It is hard to work with my global team members who are more than two time zones (hours) away | 95 | 4.61 | 1.62 | 2.63 |
| INTER14 | X | The needs of the global team and local priorities are rarely reconciled during meetings | 95 | 3.94 | 1.31 | 1.70 |

Figure 9-21: Effect of Time Dispersion on the Needs of Global Teams



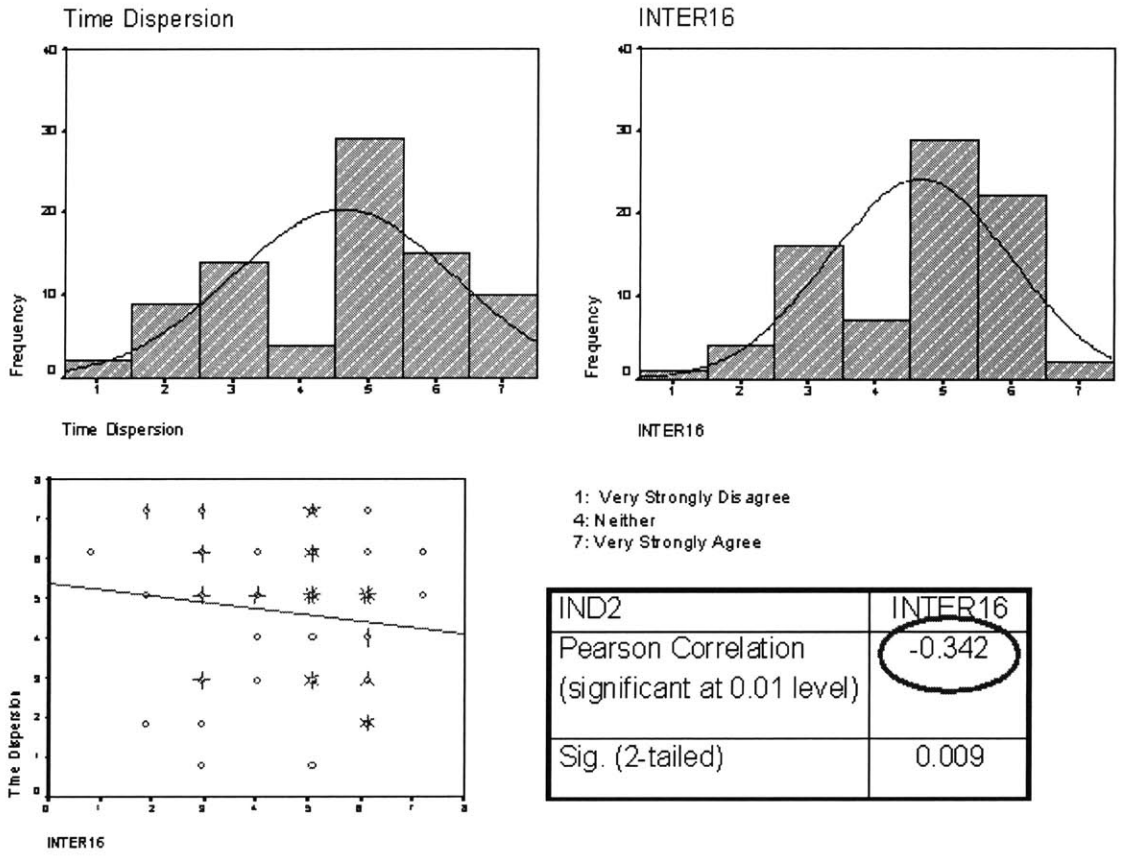

| IND2 | INTER14 |
|---|---|
| Pearson Correlation (significant at 0.05 level) | -0.242 |
| Sig. (2-tailed) | 0.032 |

Figure 9-22: Analysis for Time Dispersion and Needs of Global Teams

Figures 9-23 and 9-24 show the frequency analysis and correlations between time dispersion and whether team member needed for the interaction space are present. The frequency chart and correlations indicate that if team member needed to accomplish the task were always present at meetings, then there would be a less need to interact outside meetings and the effect of time dispersion would not be felt. This can be evinced from the negative correlations between the two items.

| VAR | W | Description | N | Mean | Std. Dev. | Variance |
|---|---|---|---|---|---|---|
| IND2 | | It is hard to work with my global team members who are more than two time zones (hours) away | 95 | 4.61 | 1.62 | 2.63 |
| INTER16 | | When my global team meets, the team members whose input is needed to accomplish the task are always present | 95 | 4.64 | 1.34 | 1.78 |

Figure 9-23: Presence of Key Team Members and Time Dispersion



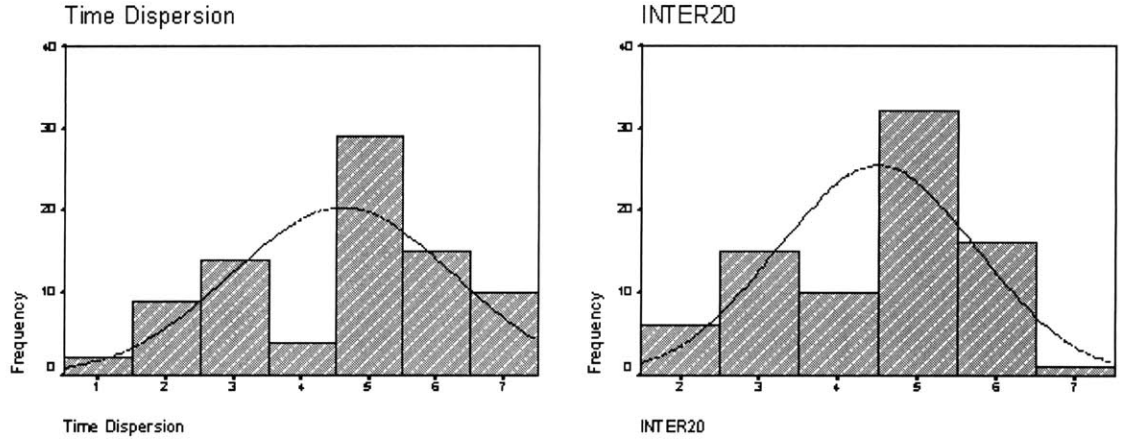

| IND2 | INTER16 |
|---|---|
| Pearson Correlation (significant at 0.01 level) | -0.342 |
| Sig. (2-tailed) | 0.009 |

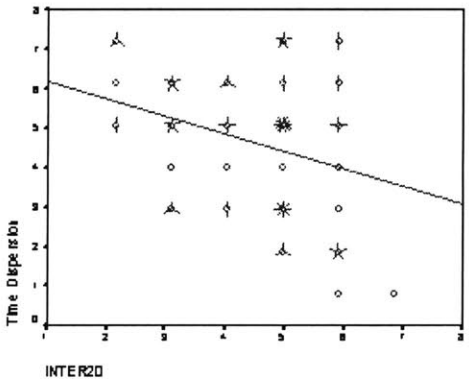
Figure 9-24: Analysis for Time Dispersion and Presence of Key Team Members

Figures 9-25 and 9-26 show the frequency analysis and correlations between time dispersion and whether team members regularly interact on work issues outside scheduled meetings. The frequency chart and correlations indicate that if the team member regularly talked about work issues with remote team members outside meetings, then the impact of time dispersion would be felt. This can be evinced from the negative correlations between the two items.

| VAR | W | Description | N | Mean | Std. Dev. | Variance |
|---|---|---|---|---|---|---|
| IND2 | | It is hard to work with my global team members who are more than two time zones (hours) away | 95 | 4.61 | 1.62 | 2.63 |
| INTER20 | | I regularly talk about work related issues with my remote team members outside global team meetings | 95 | 4.50 | 1.25 | 1.57 |

Figure 9-25: Effect of Time Dispersion and Work Related Interactions




1: Very Strongly Disagree
4: Neither
7: Very Strongly Agree

| IND2 | INTER20 |
|---|---|
| Pearson Correlation (significant at 0.01 level) | -0.341 |
| Sig. (2-tailed) | 0.002 |

Figure 9-26: Analysis for Time Dispersion and Work Related Interactions

### 9.3.2 Qualitative Data

The following qualitative data from interviews and interaction observation supports the claim that time dispersion is negatively affecting team interaction space.

*Unfortunately he is not in this meeting, but I can communicate with him about this matter offline... No chance of getting him right now then?... How about early tomorrow?...* Interactions between Senior Manager from Asia and team members

*... is a headache with coordination in different time zones and there are a series of meetings to hold in a crunched time frame...* Senior Manager from US

*... as the chair of the team you are accustomed to influencing the team.. The local site knows that I can remove roadblocks. If they have to deal with a person 14 hours away, the time zone (differences) does not help and the influence changes...* Middle Manager from South America

*... more than the distance is the time differential. It is hard to work with them when you are working and they are sleeping or vice versa. Because of the wait we separate ourselves on two sides. That way (it) is a lot easier, because we are in close time zones...* Engineer from South America

### 9.3.3 Key Findings

Summarizing the key findings:

- The impact of dispersion on team interaction space effectiveness needs to be considered in multiple dimensions:
  - Time
  - Geographical
  - Educational background
  - Experience with other cultures (living/working)
  - Function
  - Corporate culture

  - Technology
  - Organization
  - Industry

- Statistically significant evidence that time dispersion negatively affects team interaction space and team performance
- Data from other dispersion dimensions warrants further research

### 9.3.4 Potential Research Impact

Summarizing the key findings, the key research areas are:

- For effectiveness of team interaction space, time dispersion needs to be considered separately from geographic dispersion
- Different dispersion dimensions identified, though relative significance of each on the effectiveness of team interaction space not addressed in this research
- Time dispersion has significant negative impact on the interaction space and perceived team performance
  - Hard to work with team members in different time zones
  - Impact of time dispersion on trust
  - Impact of time dispersion on expanding interaction space
  - Time dispersion forcing team members to create smaller groups based on geography ("East versus West" phenomenon)

### 9.3.5 Potential Industry Impact

Summarizing the key findings for globally dispersed organizations such as GlobalCo, to reduce impact of time dispersion, team members need to ensure team members needed to accomplish the task are always present at meetings. In addition, Focusing

on work related issues during scheduled interactions will ensure a less need to interact outside work hours thereby reducing impact of time dispersion.

## 9.4 Management Differences

There are a number of dimensions of diversity in global teams including differences in geographical sites, time zones, team member age, education, organizational tenure and functional backgrounds. Consider the different forms of dispersion, it is hypothesized that there are more differences in management hierarchies than across different geographical sites. Furthermore, it is hypothesized that junior management and senior management report lower team interaction space effectiveness than middle managers.

The following analysis techniques and software tools were used to confirm or refute the above hypotheses:

- Frequency Analysis (using SPSS v10)
- One way ANOVA (using SPSS v10)

### 9.4.1 Quantitative Data

As a first step, Frequency Analysis was carried out on all the items from the questionnaire described in Chapter 8. The frequency analysis provided the first hints that middle managers reported higher levels of agreement with questionnaire items than team members from the senior and junior management levels. To substantiate the data from Frequency Analysis, ANOVA (see Appendix A) was carried out using Team Interaction Space Effectiveness Scale and Perceived Team Performance Scale with the Demographic item on position in the company. Questionnaire respondents were given the following choices for:

1. Executive
2. Senior Level Management (Project/Program/Factory Manager)

3. Middle Level Management

4. First Level Management

5. Non-supervisory Position

For ANOVA analysis, the variable `position in the company` was recoded in the following manner: `Executive` and `Senior Level Management` positions were merged to create a new management level called `Senior Management`. The remaining three management levels were kept the same.

Figures 9-27 and 9-28 show the results of the ANOVA analysis. As is evident from the graphs, junior management and senior management report lower team interaction space effectiveness than middle managers. Furthermore, middle managers have a higher perception of team performance than team members from the senior and junior management levels. It should be noted that the differences between the levels is `0.5` for the Team Interaction Space Effectiveness Scale and `0.3` for the Perceived Team Performance Scale. Looking at the significance levels in the ANOVA table in Figure 9-27, the differences are NOT significant. From the ANOVA analysis, we can conclude that there is some evidence

**ANOVA**

Interaction Space Effectiveness Scale

| | | | df | F | Sig. |
|---|---|---|---|---|---|
| Between Groups | (Combined) | | 3 | 2.924 | .040 |
| | Linear Term | Unweighted | 1 | 5.531 | .021 |
| | | Weighted | 1 | 5.918 | .017 |
| | | Deviation | 2 | 1.426 | .247 |
| | Quadratic Term | Unweighted | 1 | .233 | .630 |
| | | Weighted | 1 | .034 | .854 |
| | | Deviation | 1 | 2.819 | .097 |
| Within Groups | | | 73 | | |
| Total | | | 76 | | |

**ANOVA**

Percieved Team Performance

| | | | df | F | Sig. |
|---|---|---|---|---|---|
| Between Groups | (Combined) | | 3 | 1.032 | .383 |
| | Linear Term | Unweighted | 1 | 1.057 | .307 |
| | | Weighted | 1 | 1.439 | .234 |
| | | Deviation | 2 | .829 | .441 |
| | Quadratic Term | Unweighted | 1 | .766 | .384 |
| | | Weighted | 1 | .478 | .492 |
| | | Deviation | 1 | 1.180 | .281 |
| Within Groups | | | 73 | | |
| Total | | | 76 | | |

Figure 9-27: ANOVA Table for Management Levels

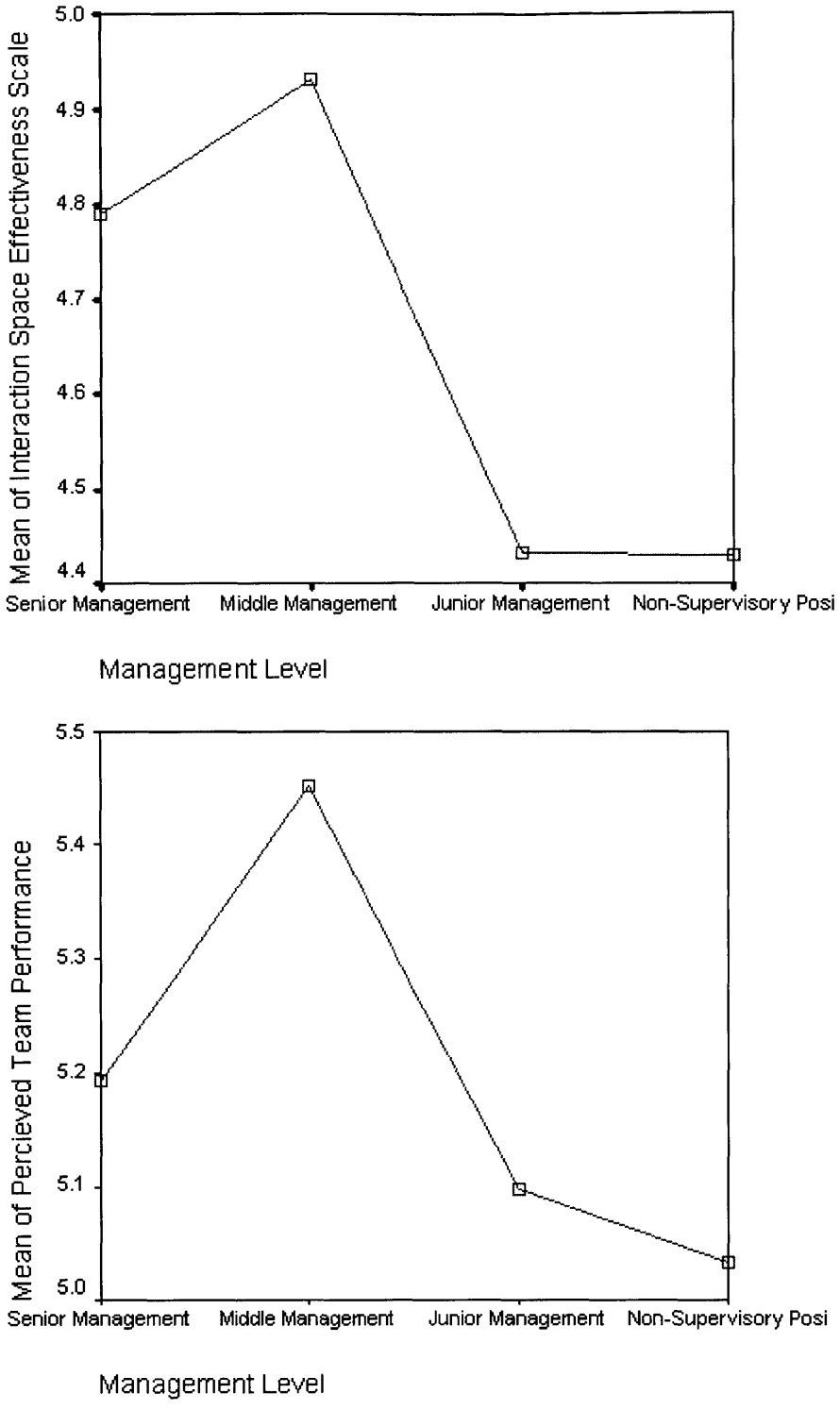



Figure 9-28: ANOVA Graphs for Management Levels

### 9.4.2 Key Findings

Summarizing the key findings:

- Some evidence that middle managers respond differently than senior management and junior management on interaction space effectiveness and perceived team performance.
- Hierarchy differences are NOT statistically significant in our sample ANOVA analysis on hierarchy differences warrants further research in this phenomenon using a larger sample with more members at different hierarchies.

### 9.4.3 Potential Research Impact

Based on the key findings from the above section, the potential research impact can be summarized as:

- Earlier studies in team performance indicated differences between management and non-management. Contrary to prior research on organizational tenure, present research hints at differences between middle management and senior/junior management.
- There is some evidence of management differences on:
  - Effectiveness of team interaction space
  - Perceived team performance
  - Importance of Agenda Management
  - Technology Accessibility
  - Technology Supportiveness
- Perceived team performance by middle managers more in line with hard result oriented corporate culture.

### 9.4.4 Potential Industry Impact

Differences in perception of effective team interaction space can lead to bottlenecks between different management levels. Middle managers are focusing on "hard numbers", while Senior/Junior management are including "soft targets" such as member satisfaction, team learning, individual growth when perceiving how well a global team is performing. One of the recommendations for organizations with global teams is to consider cross-hierarchical face-to-face meetings at regular intervals. Most global teams include semi-annual or annual face-to-face meetings to get members from different sites together. The suggestion would be to use these face-to-face meetings to get team members from different management levels together and focus on assumptions and views of effectiveness at different management levels. In absence of quantitative measures, perception of team performance is driving rewards and benefits for employees.

## 9.5 Summary

To summarize the four top level research hypotheses introduced in this chapter:

- Introduced team interaction space as a mediating variable to explain the role of technology, organizational processes and spatial setup on perceived team performance.
- Impact of communication technology needs to be considered in five dimensions.
- For increasing the effectiveness of team interaction space:
  - Technology accessibility is significant
  - Technology support is significant
  - Technology ability is less significant
- Significance of training and organizational support in increasing perceived team performance highlighted with quantitative data

- Agenda management is very important for effective interactions between globally dispersed team members
- Time dispersion seems to be a major form of dispersion in globally dispersed teams
- Differences across management hierarchy recorded in globally dispersed team members

# Chapter 10

# Diffusing the Learning from Team Interaction Space

*Teamwork means never having to take all the blame yourself.*

*GlobalCo Engineer from Asia*

## 10.1 Research Summary

The overarching goal for this research endeavor was to study teams that are distributed across geographical and organizational boundaries and identify patterns that make them more effective and efficient. Towards this goal the following broad research objectives were identified:

- To gain a better understanding of collaboration between globally dispersed team members by observing the team interaction space.
- To investigate the potential roles of technology, organizational processes and spatial setup on facilitating team interactions.
- To obtain a set of basic criteria defining what are effective and efficient collaboration practices for globally dispersed teams.

In particular, the research focused on teams that are unable/unwilling to hold face-to-face meetings creating a limitation on the development of effective team interaction

space. Prior research work in this area (Hussein 1998), (Vadhavkar & Peña-Mora 2000) and (Sen 2001) identified the significance of interaction space for fostering effective collaboration between globally dispersed team members. These research efforts have concentrated on the individual roles of technology, physical space and organizational issues on the performance of dispersed teams. Thus, to break new grounds, it was the intent of this research effort to focus on the convergence of these three areas shown in Figure 10-1.

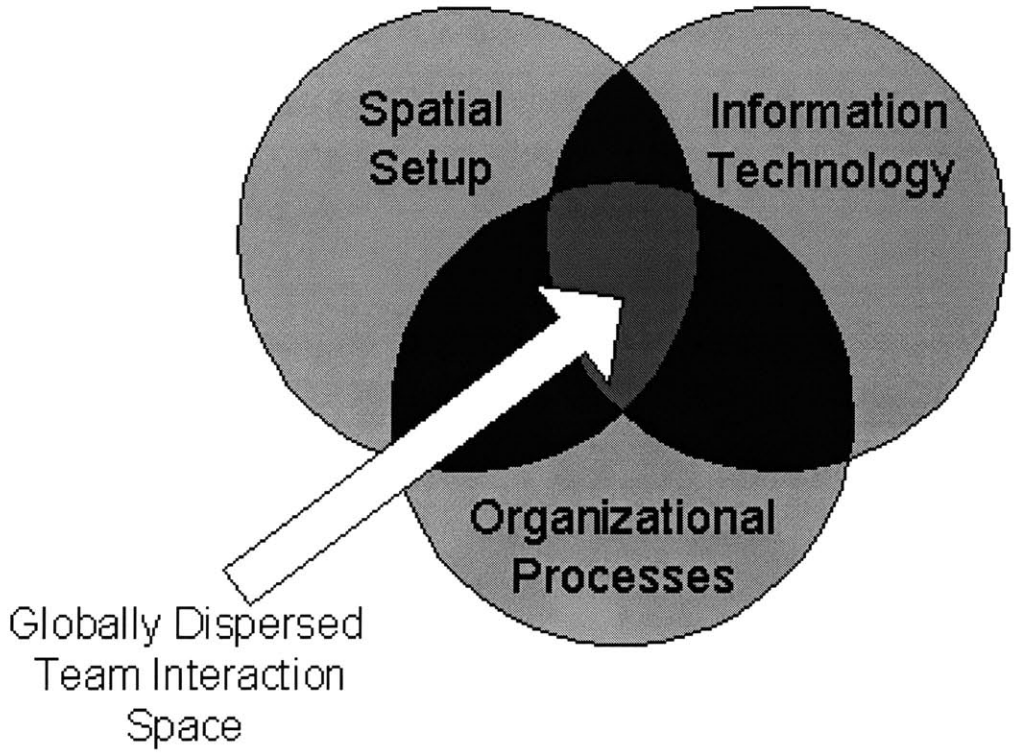



Figure 10-1: Globally Dispersed Team Interaction Space

In this multi-company research effort, teams from Global 500 companies were researched and a case study was presented considering the teams belonging to a fictional global organization called "GlobalCo." The research team comprised of 2 MIT faculty members, 1 MIT Post-Doctoral associate, 1 Doctoral candidate and 1 Master of Science student. The research effort involved qualitative and quantitative approaches to collecting data from the above mentioned globally dispersed teams. For

qualitative data, the research team observed remotely and analyzed 35 Audio/Video Conferences (2 hours each) and 9 face-to-face team interactions (2+ days each). In addition, the research team conducted 82 interviews (1hour each) with members from globally dispersed teams in 3 continents. To collect quantitative data, the research team used Microsoft Excel-based and web-based surveys to solicit feedback on select questions on team interaction space and team performance. Overall, there were 96 respondents from an estimated population of 300 team members. Survey data was statistically analyzed using Frequency Analysis, Factor Analysis, Correlations and Path Analysis to test some of the key hypothesis on team interaction space.

The problem of building and sustaining effective global teams is a multi-dimensional one. The research outlined in this dissertation presents a holistic view for a comprehensive understanding of the problem. Qualitative and quantitative data collected as part of this research has shown that the identification and optimum use of the global team interaction space is essential for the success of global teams. In particular, the research has introduced team interaction space as a mediating variable to explain the effect of organization protocols, communication technology and spatial setup on the effectiveness of team interaction space. Globally dispersed team members can reduce the possibilities of misunderstanding and conflict by managing the three drivers of team interaction space: organization protocols, communication technology and the spatial setup. Based on these three drivers, the research also outlined a team interaction space framework to understand the scope of the problem and provide measures to prevent the disintegration of the interaction process. The framework can be summarized as follows:

- Identify the components of the virtual team interaction process.
- Identify the barriers to effective interaction by frequent observations and analysis of the team interaction process.
- Improve the interaction process by taking some actions to eliminate the barriers.
- Evaluate the effectiveness of the team interaction process.

- Provide suggested actions to improve the team effectiveness.

## 10.2 Potential Research Impact

The key research contribution is the introduction of the team interaction space variable as a mediating factor to explain the role of organization protocols, communication technology and spatial setup on perceived team interaction space. Effectiveness of team interaction space was found to be strongly correlated with the perceived team performance. Organization protocols and communication technology were found to be strongly correlated to the effectiveness of the team interaction space. Qualitative data from interaction observations provide strong evidence that spatial setup influences the effectiveness of the team interaction space. Qualitative data not only enriches and complements the quantitative data, but also highlights dynamics that might have been altogether missed without such a multi-faceted approach.

This dissertation presents findings gained from studying globally dispersed teams from large multi-national companies, using a multi-faceted research approach. One of the research goals was to illustrate the ways in which such a research approach provides new insights into globally dispersed team processes. The research has generated a number of useful insights that can be explored in future research, particularly in the area of technology appropriation, path dependencies in media use, and the importance of interaction efficiency with respect to team performance. The research also found evidence of a relationship between the team interaction patterns and the degree to which team members trusted each other.

In summary, the multi-faceted research approach involved a team of researchers, explored multiple virtual teams over time and used multiple methods across a range of qualitative and quantitative sources of data. In combination, the approach is able to acknowledge the complexity of researching interaction patters of globally dispersed teams. It is envisioned that by exploring multiple global teams under the same research umbrella increases the external validity of the research findings. The ability to compare across teams helps differentiate idiosyncratic behavior from patterns that

are likely to be found again.

## 10.3 Potential Industry Impact

Pending empirical testing, leaders and members of globally dispersed teams still may wonder what implications for practice follow from this research work. This work suggests that team interactions are strongly influencing and biasing the way team members and leaders perceive the performance of a global team. The key findings and potential industry impact are enumerated below:

- By managing the team interaction space, global team members can increase the perceived team performance.
- Global team members need to use effective agenda management techniques to better manage interactions among global team members. The research identified the need for:
  - Agenda circulated before meeting.
  - Well-defined agenda items.
  - Agenda managed proactively during meetings
  - Structured agenda
- Companies need to continue providing training for team members to increase the effectiveness of team interaction space
- Training for employees working on global teams versus training for team members relocating to foreign countries
- When introducing new communication technologies for global team members, companies need to look at the following factors:
  - Ability to use the technologies
  - Capability of the technologies to support interactions

  - Reliability of the technologies
  - Accessibility to the technologies
  - Support that can be provided to use the technologies

- Companies need to continue providing support for communication technologies for making the interaction space more effective in the form of: help desks and skilled technical assistants managing the interaction space.

- Companies need to make communication technologies more accessible to global team members to increase the effectiveness of team interaction space

- For effectiveness of team interaction space, time dispersion needs to be considered separately from geographic dispersion. In addition:

  - To reduce impact of time dispersion, team members need to ensure team members needed to accomplish the task are always present at meetings
  - Focusing on work related issues during scheduled interactions would ensure a less need to interact outside work hours thereby reducing impact of time dispersion

- Differences in perception of effective team interaction space can lead to frequent bottlenecks between different management levels. In particular, Middle managers focusing on "hard numbers", Senior/Junior management including "soft targets" for team performance.

## 10.4 Research Outcomes

In summarizing the research outcomes, following contributions can be identified:

- Developed Team Interaction Space Framework for impacting perceived team performance through monitoring the team interactions

- Created Spiral Team Interaction Space Effectiveness Continuum to help position team based on team interactions

- Team Interaction Space Effectiveness System Dynamics Model for identifying the various elements of team interaction space
- Creating a web-based Handbook for Best Collaboration Practices in Distributed Teams
- Requirements for next version of Collaboration Tools identified

## 10.5 Future Research

The significant new concepts introduced in this research are the team interaction space effectiveness framework, the team interaction space effectiveness continuum and the team interaction space effectiveness model. The System Dynamics based team interaction space effectiveness model is at a conceptual stage with additional variables being added to the model based on some of the quantitative analysis that is being carried out at this time. The data gathered from numerous research instruments like questionnaires and interaction observation templates needs to be translated into numerical data that will be the input to the team interaction space effectiveness model. This translation to numerical data will need to be backed up by further experimentation to validate the model. For automating the model, numerical relationships between the different variables of the model need to be identified in mathematical terms. While the Structural Equation Modeling highlighted in this research identified some of the data, further simulations are required for establishing the numerical relationships.

There is also a need to related the team interaction space effectiveness model to the team interaction space effectiveness continuum. The team interaction space effectiveness model will be a translation from a conceptual and real-life "as is" view of the team through the measurements of different aspects of the team interaction space to a "how good is the process" view in the team interaction space effectiveness continuum. The two outcomes of this research represent different dimensions of the same problem. Relating the results from the team interaction space effectiveness

model to a related position on the continuum spiral will require a significant amount of calibration backed by data to prove that the translation is indeed representative of the actual case.

This research presented qualitative and quantitative data to support Hussein (1998) theory that the interaction process is continuous, not discrete. The continuous quality of the interaction process in global teams lends itself to automation. A thorough understanding of the interaction processes would definitely lead to the development of a comprehensive information technology framework capable of:

- Imitating the global team interaction space
- Providing formal methods to evaluate team interaction effectiveness through the means of questionnaires/communication patterns and feedback on the interaction space
- Providing a comprehensive model to evaluate the team interaction effectiveness
- Proactively making suggestions to the team on required action for improvement of the interaction process.

The development of the team interaction space effectiveness continuum is an ongoing research effort. Specifically, additional work is being carried out to identify effectiveness targets as representations of the team performance at various stage in the spiral. In addition, there is a need to validate the proposed team interaction space framework in real-life global teams. This will involve studying and comparing global teams before and after the introduction of the team interaction space framework.

# Appendix A

# Discussion on Statistical Measures in Social Sciences

## A.1 Reliability

Reliability is the consistency of the measurement, or the degree to which an instrument measures the variable the same way each time it is used under the same condition with the same respondents. A measure is considered reliable if a respondent's score on the same test given twice is similar. It is important to remember that reliability is not measured but estimated. There are two ways that reliability is usually estimated: test/retest and internal consistency.

### A.1.1 Test/Retest

Test/retest is a conservative method to estimate reliability where the core idea is that the respondent should get the same score on test 1 as s/he does on test 2. The three main steps in the Test/Retest method:

1. Implement the measurement instrument at two separate times for each respondent.

2. Compute the correlation between the two separate measurements.

3. Assume there is no change in the underlying concept or trait that is being measured between test 1 and test 2.

### A.1.2 Internal Consistency

Internal consistency estimates reliability by grouping questions in a survey that measure the same concept. For example, the survey can include two sets of three questions that measure the same concept or trait and after collecting the responses, run a correlation between those two groups of three questions to determine if the survey instrument is reliably measuring that concept.

One common way of computing correlation values among the questions on the survey instruments is by using Cronbach's alpha (Cronbach 1951). Cronbach's alpha splits all the questions on the survey every possible way and computes correlation values for them all. The closer the calculated Cronbach's alpha value is to one, the higher the reliability estimate of the research instrument. Cronbach's alpha is a less conservative estimate of reliability than test/retest.

The primary difference between test/retest and internal consistency estimates of reliability is that test/retest involves two administrations of the measurement instrument, whereas the internal consistency method involves only one administration of that instrument.

## A.2 Validity

Validity is the strength of the conclusions, inferences or propositions drawn from the data collected from the research instruments. (Cook & Campbell 1979) define validity as the "best available approximation to the truth or falsity of a given inference, proposition or conclusion." Validity is the extent to which a measure reflects only the desired construct without contamination from other systematically varying constructs (Judd, Smith & Kidder 1991). Note that validity requires reliability as a pre-requisite. Even if a measure is highly reliable, showing little effect of randomly varying measurement error, it may not be high in validity because it measures the

wrong constructs.

Most social sciences research includes research hypotheses where research variables are outlined and the causality between the variables is indicated. The variable used to measure the causal construct is called the independent variable. The variable used to measure the affected construct is called the dependent variable. Within the norms of the hypotheses and variables, there are three main types of validity commonly examined in social sciences research.

Construct validity pertains to the degree to which both the independent and dependent variables accurately reflect or measure the constructs of interest. If a study has high construct validity, all the constructs in the hypothesis that motivates the research have been successfully measured by the data collected on the specific variables through the research instruments.

Internal validity concerns the extent to which conclusions can be drawn about the causal effects of one variable on another. In research with high internal validity, we are relatively more able to argue that relationships are causal ones.

External validity refers to our ability to generalize the results of the research study to populations and settings of interest in the hypothesis

## A.3 Threats to Construct Validity

- Poor definition of the research concepts results in threats from *Inadequate Pre-operational Explication of Constructs.*
- *Mono-operation bias* results from a study of a single version of the independent variable.
- *Mono-method bias* results from using only one measure or observation of an important concept.
- *Interaction of Testing and Treatment* occurs when the testing in combination with the treatment produces an effect.

- Unanticipated effects from the research program can result in *Restricted Generalizability Across Constructs.*

- Threats from *Confounding Constructs* occur when the researcher is unable to detect an effect from the program because you may have mislabeled your constructs or because the level of your treatment wasn't enough to cause an effect.

- When participants base their behavior on what they think the research study is about they induce threats from *Hypothesis Guessing.* The research outcome is really not due solely to the program - but also to the participants' reaction to the researcher and the study.

- When participants are fearful of the researcher study to the point that it influences the treatment effect you detect the threats are due to *Evaluator Apprehension.*

- When researcher reactions shape the participant's responses threats due to *Experimenter Expectancies* are introduced

## A.4 Threats To Internal Validity

- A *Maturation Threat* to internal validity occurs when standard events over the course of time cause the outcome.

- A *Testing Threat* to internal validity is simply when the act of taking a pre-test affects how that group does on the post-test.

- An *Instrumentation Threat* to internal validity could occur if the effect of increased participation could be due to the way in which that pretest was implemented.

- A *Mortality Threat* to internal validity occurs when study respondents drop out of the research study leading to an inflated measure of the effect.

- A *Regression Threat* to internal validity occurs when there is a tendency for the research sample to score close to the mean of a larger population from the pretest or post-test.

- A *Selection-History* threat occurs when an event occurring between the pre and post-test affects the two groups differently.

- A *Selection-Maturation* threat occurs when there are different rates of growth or maturation between the two groups between the pre and post-test.

- A *Selection-Testing* threat is the result of the different effect from taking tests between the two groups.

- A *Selection-Instrumentation* threat occurs when the test implementation affects the groups differently between the pre and post-test.

- A *Selection-Mortality* threat occurs when there are different rates of dropout between the groups leading the researcher to an effect that may not actually occur.

- A *Selection-Regression* threat occurs when the two groups regress towards the mean at different rates.

## A.5 Scales

Research variables – independent and dependent may have different types of scales or levels or measurement. Four types of scales are commonly distinguished:

- *Nominal scales* contain qualitatively different categories to which we attach names rather than numerical meaning. The simplest are dichotomies, with only two values, such as male or female.

- An *ordinal scale* contains categories that can be ordered by rank on a continuum. The categories have a rudimentary arithmetic meaning such as more or less of the quantity being measured.

- When numbers attached to a variable imply not only that 4 is more than 3 and 3 is more than 2, but also that the size of interval between 4 and 3 is the same as the interval between 3 and 2, they form an *interval scale.* The numbers on an interval scale can be added or subtracted because the properties of the scale are such that the difference in the scale is the same. But numbers on an interval scale cannot be multiplied or divided because the scale does not have a true zero.

- *Ratio scales* on the other hand have a true zero.

The above-mentioned four types of scales from social sciences research: nominal, ordinal, interval, and ratio scales can be categorized into two groups: categorical and continuous scale data. Nominal and ordinal scales are categorical data; interval and ratio scales are continuous data.

## A.6 Statistical Significance (p-value)

The statistical significance of a result is the probability that the observed relationship between variables or a difference between means in a sample occurred by pure chance, and that in the population from which the sample was drawn, no such relationship or differences exist. The statistical significance of a result tells us something about the degree to which the result is a true representative of the population. More technically, the value of the p-value represents a decreasing index of the reliability of a result. The higher the p-value, the less we can believe that the observed relation between variables in the sample is a reliable indicator of the relation between the respective variables in the population. Specifically, the p-value represents the probability of error that is involved in accepting our observed result as valid, that is, as "representative of the population." For example, a p-value of .05 indicates that there is a 5% probability that the relation between the variables found in our sample is a random event, not a relation. In other words, assuming that in the population there was no relation between those variables whatsoever, and we were repeating experiments like ours

one after another, we could expect that approximately in every 20 repetitions of the experiment there would be one in which the relation between the variables in question would be equal or stronger than in ours. In many areas of research, the p-value of .05 is customarily treated as a "border-line acceptable" error level.

## A.7 Correlations

Correlation is a measure of the relation between two or more variables. The measurement scales used should be at least interval scales, but other correlation coefficients are available to handle other types of data. Correlation coefficients can range from -1.00 to +1.00. The value of -1.00 represents a perfect *negative* correlation while a value of +1.00 represents a perfect *positive* correlation. A value of 0.00 represents a lack of correlation.

The most widely-used type of correlation coefficient is *Pearson r*, also called *linear* or *product-moment* correlation. Pearson correlation assumes that the two variables are measured on at least interval scales, and it determines the extent to which values of the two variables are "proportional" to each other. The value of correlation, also called the correlation coefficient, does not depend on the specific measurement units used. The correlation between two variables is high if the relationship can be "summarized" by a straight line (sloped upwards or downwards). This line is called the *regression line* or *least squares line*, because it is determined such that the sum of the *squared* distances of all the data points from the line is the lowest possible. If the correlation coefficient is squared, then the resulting value ($r^2$, the coefficient of determination) will represent the proportion of common variation in the two variables (i.e., the "strength" or "magnitude" of the relationship). In order to evaluate the correlation between variables, it is important to know this "strength" or "magnitude" as well as the *significance* of the correlation. The significance level calculated for each correlation is a primary source of information about the reliability of the correlation.

## A.8 Data Analyses

It should be noted that the data analysis method is different depending on the scale of measurement. Categorical scale data use non-parametric measures such as logistic regression models and loglinear models. Continuous scale data use parametric measures such as t-test, ANOVA, regression described briefly in the next paragraph.

Regression methods describe the relationship between the dependent variable and one or more independent variables. Usually, it is said that regression methods are used with continuous response (dependent, or Y) and explanatory (independent, or X) variables. While most statistical depend on continuous data, some social sciences measurements generate dichotomous responses such as 'yes or no', 'male or female', or 'success or failure'. When the responses are measured with binary data, it should be treated as categorical data and the number of responses should be counted. When explanatory variables are not continuous, i.e, dichotomous, the dummy variables are applied to distinguish the differences among dichotomous groups. On the other hand, when response variables are discrete, taking on two (binary) or more dichotomous values, the logistic regression model is considered.

Depending on the characteristics of the data (continuous/categorical) and the role of the data (explanatory/response) in the research, the appropriate statistical data analysis method should be chosen as shown in Table A.1.

Table A.1: Statistical Data Analysis Choices

| | *Dependent Variable* | |
|---|---|---|
| *Independent Variable* | Continuous Data | Categorical Data |
| Continuous Data | Regression | Logistic Regression |
| Categorical Data | ANOVA | Loglinear Model |
| Mixed Data | ANCOVA | Logistic Regression |

## A.9 t-tests

The $t$-test is the most commonly used method to evaluate the differences in means between two groups. For example, the $t$-test can be used to test for a difference in test scores between a group of patients who were given a drug and a control group who received a placebo. Theoretically, the t-test can be used even if the sample sizes are very small, as long as the variables are normally distributed within each group and the variation of scores in the two groups is not reliably different. The normality assumption can be evaluated by looking at the distribution of the data (via histograms) or by performing a normality test such as Kolmogorov-Smirnov test.

The $p$-level reported with a $t$-test represents the probability of error involved in accepting the research hypothesis about the existence of a difference. Technically, this is the probability of error associated with rejecting the hypothesis of no difference between the two categories of observations (corresponding to the groups) in the population when, in fact, the hypothesis is true.

In the $t$-test analysis, comparisons of means and measures of variation in the two groups are usually visualized in box and whisker plots which help to quickly evaluate and "intuitively visualize" the strength of the relation between the grouping and the dependent variable. There are two main types of t-test analyses: t-test for independent samples and t-test for dependent samples. In order to perform the $t$-test for independent samples, one independent variable and at least one dependent variable are required. The means of the dependent variable are compared between selected groups based on the specified values of the independent variable.

The t-test for dependent samples helps the researcher to take advantage of one specific type of design in which an important source of within-group variation (or so-called, error) can be easily identified and excluded from the analysis. Specifically, if two groups of observations that are to be compared are based on the same sample of subjects who were tested twice (for example, *before* and *after* a treatment), then a considerable part of the within-group variation in both groups of scores can be attributed to the initial individual differences between subjects. Instead of treating

each group separately, and analyzing raw scores, we can look only at the differences between the two measures in each subject. By subtracting the first score from the second for each subject and then analyzing only those "pure (paired) differences," the researcher can exclude the entire part of the variation in the data set that results from unequal base levels of individual subjects.

Technically, we can apply the *t*-test for dependent samples to any two variables in our data set. However, applying this test will make very little sense if the values of the two variables in the data set are not logically and methodologically comparable. *t*-tests for dependent samples can be calculated for long lists of variables, and reviewed in the form of matrices produced with case-wise or pairwise deletion of missing data.

## A.10 Logistic Regression

Logistic regression is a form of regression that is used when the dependent variable is a dichotomy and the independent variables are continuous variables, categorical variables, or both. Logistic regression applies maximum likelihood estimation after transforming the dependent into a logit variable (the natural log of the odds of the dependent variable occurring or not). Logistic regression estimates the probability of a certain event occurring by calculating changes in the log odds of the dependent, not changes in the dependent itself. Note that logistic regression does not assume linearity of relationship between the independent variables and the dependent, does not require normally distributed variables, and in general has less stringent requirements.

The outputs of running logistic regression models are called logit coefficients, also called unstandardized logistic regression coefficients or effect coefficients. Let p be the probability that dependent event y=1 is a function of the logit coefficients. For instance, let y=0 and let $x_1$, $x_2$, and $x_3$ be continuous independent variables for the logistic model $y = b_0 + b_1x_1 + b_2x_2 + b_3x_3$. The estimate of p (y=1) is the natural logarithm e to the power of a term that is the logistic regression equation.

Maximum likelihood estimation, MLE, is the method used to calculate the logit coefficients. MLE seeks to maximize the log likelihood, LL, which reflects how likely

it is (the odds) that the observed values of the dependent may be predicted from the observed values of the independents. MLE is an iterative algorithm, which starts with an initial arbitrary "guesstimate" of what the logit coefficients should be. The MLE algorithm determines the direction and size change in the logit coefficients that will increase LL. After this initial function is estimated, the residuals are tested and a re-estimate is made with an improved function, and the process is repeated (usually about a half-dozen times) until convergence is reached. The Wald statistic is commonly used to test the null hypothesis in logistic regression that a particular logit (effect) coefficient is zero. It is the ratio of the unstandardized logit coefficient to its standard error. The Wald statistic tests the significance of the logit coefficient associated with a given independent. Classification tables are the 2 x 2 tables in the logistic regression output for dichotomous dependent variables, or the 2 x n tables for ordinal logistic regression, which tally correct and incorrect estimates. The columns are the two predicted values of the dependent, while the rows are the two observed (actual) values of the dependent.

Looking at the classification table, showing correct and incorrect classifications of the dichotomous or ordinal dependent variables, one can assess the success of the logistic regression. Also, the Wald statistic is used to test the model's significance.

## A.11 ANOVA / ANCOVA / MANOVA / MANCOVA

Analysis of variance (ANOVA) is used to uncover the main and interaction effects of categorical independent variables (called "factors") on an interval dependent variable. A "main effect" is the direct effect of an independent variable on the dependent variable. An "interaction effect" is the joint effect of two or more independent variables on the dependent variable. Whereas regression models cannot handle interaction unless explicit cross-product interaction terms are added, ANOVA uncovers interaction effects on a built-in basis. There is also a variant for using interval-level control vari-

ables (analysis of co-variance (ANCOVA), and for the case of multiple dependents, multiple analysis of variance (MANOVA), and there is a combination of MANOVA and ANCOVA called MANCOVA).

The key statistic in ANOVA is the F-test of difference of group means, testing if the means of the groups formed by values of the independent variable (or combinations of values for multiple independent variables) are different enough not to have occurred by chance. If the group means do not differ significantly then it is inferred that the independent variable(s) did not have an effect on the dependent variable. If the F test shows that overall the independent variable(s) is/are related to the dependent variable, then multiple comparison tests of significance are used to explore just which value groups of the independent(s) have the most to do with the relationship. The F-test is an overall test of the null hypothesis that group means on the dependent variable do not differ. It is used to test the significance of each main and interaction effect (the residual effect is not tested directly). For most ANOVA designs, F is between-groups mean square variance divided by within-groups mean square variance. (Between-groups variance is the variance of the set of group means from the overall mean of all observations. Within-groups variance is a function of the variances of the observations in each group weighted for group size.) If the computed F value is around 1.0, differences in-group means are only random variations. If the computed F score is significantly greater than 1, then there is more variation between groups than within groups, from which we infer that the grouping variable does make a difference. Note that the significant difference may be very small for large samples. The researcher should report not only significance, but also strength of association, discussed below.

Unlike regression tests, ANOVA does not assume linear relationships and handles interaction effects automatically. Some of the key assumptions are that the groups formed by the independent variable(s) be relatively equal in size and have similar variances on the dependent variable ("homogeneity of variances"). Like regression, ANOVA is a parametric procedure, which assumes multivariate normality (the dependent has a normal distribution for each value category of the independent(s)).

If the data involve repeated measures of the same variable, as in before-after or matched pairs tests, the F-test is computed differently from the usual between-groups design, but the inference logic is the same. There are also a large variety of other ANOVA designs for special purposes, all with the same logic. The formulas for the t-test (a special case of one-way ANOVA), and for the F-test used in ANOVA, thus reflect three things: the difference in means, group sample sizes, and the group variances. That is, the ANOVA F-test is a function of the variance of the set of group means, the overall mean of all observations, and the variances of the observations in each group weighted for group sample size.

ANOVA and ANCOVA have a number of different experimental designs. The alternative designs affect how the F-ratio is computed in generating the ANOVA table. However, regardless of design, the ANOVA table is interpreted similarly – the significance of the F-ratio indicates the significance of each main and interaction effect (and each covariate effect in ANCOVA). One-way ANOVA tests differences in a single interval dependent variable among two, three, or more groups formed by the categories of a single categorical independent variable. This design deals with one independent variable and one dependent variable. It tests whether the groups formed by the categories of the independent variable seem similar (specifically that they have the same pattern of dispersion as measured by comparing estimates of group variances). If the groups seem different, then it is concluded that the independent variable has an effect on the dependent. One may note also that the significance level of a correlation coefficient for the correlation of an interval variable with a dichotomy will be the same as for a one-way ANOVA on the interval variable using the dichotomy as the only factor. This similarity does not extend to categorical variables with greater than two values. Two-way ANOVA analyzes one interval dependent in terms of the categories (groups) formed by two independents, one of which may be conceived as a control variable. Two-way ANOVA tests whether the groups formed by the categories of the independent variables have similar centroids. Two-way ANOVA is less sensitive than one-way ANOVA to moderate violations of the assumption of homogeneity of variances across the groups.

## A.12 Factor Analysis

Factor analysis is a generic term that is used to describe a number of methods designed to analyze interrelationships within a set of variables or objects resulting in the construction of a few hypothetical variables or objects, called factors. These factors are supposed to contain the essential information in a larger set of observed variables or objects. By taking advantage of inherent interdependencies, a small number of factors will usually account for approximately the same amount of information as do the much larger set of original observations (Daniel 1989).

Factor analysis includes a variety of correlational analyses designed to examine the interrelationships among variables (Carr 1992). Two major dichotomies exist regarding factor analysis: exploratory and confirmatory. The determination as to which form to use in an analysis is made based on the purpose of the data analysis. Exploratory factor analysis is used to explore data to determine the number or the nature of factors that account for the co variation between variables when the researcher does not have, a priori, sufficient evidence to form a hypothesis about the number of factors underlying the data. Therefore, exploratory factor analysis is generally thought of as more of a theory-generating procedure as opposed to a theory-testing procedure (Stevens 1996).

When used appropriately, exploratory factor analysis can be helpful to researchers in assessing the nature of relationships among variables and in establishing the construct validity of test scores. Several criticisms have been aimed at exploratory factor analysis. The first, according to (Mulaik 1987), pertains to the perception that exploratory factor analysis may "find optimal knowledge." "*... there is no rationally optimal ways to extract knowledge from experience without making certain prior assumptions...*"((Mulaik 1987), page 265).

Also, exploratory assumptions may not always honor the relationships among the variables in a given data set. Linear model, the common factor analysis model is appropriate for only certain kinds of data. Many causal relationships are nonlinear. Superimposing a linear relationship will yield results, but these results may be

misleading.

Confirmatory factor analysis is a theory-testing model as opposed to a theory-generating method like exploratory factor analysis. In confirmatory factor analysis, the researcher begins with a hypothesis prior to the analysis. This model, or hypothesis, specifies which variables will be correlated with which factors and which factors are correlated. The hypothesis is based on a strong theoretical and/or empirical foundation (Stevens 1996). In addition, confirmatory factor analysis offers the researcher a more viable method for evaluating construct validity. The researcher is able to explicitly test hypotheses concerning the factor structure of the data due to having the predetermined model specifying the number and composition of the factors.

Confirmatory methods, after specifying the *a priori factors*, seek to optimally match the observed and theoretical factor structures for a given data set in order to determine the "goodness of fit" of the predetermined factor model. The first step in a confirmatory factor analysis requires beginning with either a correlation matrix or a variance/covariance matrix. The researcher proposes competing models, based on theory or existing data that are hypothesized to fit the data. The models specify things such as pre-determination of the degree of correlation, if any, between each pair of common factors, pre-determination of the degree of correlation between individual variables and one or more factors, and specification as to which particular pairs of unique factors are correlated. The actual confirmatory factor analysis can be conducted using one of several computer programs such as LISREL VII (Joreskog & Sorbom 1989) or EQS 6 for Windows (Byrne 1994).

## A.13 Structural Equation Modeling

Structural equation modeling (SEM) grows out of and serves purposes similar to multiple regression. However SEM takes into account the modeling of interactions, nonlinearities, correlated independents, measurement error, correlated error terms, multiple latent independents each measured by multiple indicators, and one or more latent dependents also each with multiple indicators. SEM may be used as a more

powerful alternative to multiple regression, path analysis, factor analysis, time series analysis, and analysis of covariance. That is, these procedures may be seen as special cases of SEM.

Advantages of SEM compared to multiple regression include more flexible assumptions (particularly allowing interpretation even in the face of multicollinearity), use of confirmatory factor analysis to reduce measurement error by having multiple indicators per latent variable, the attraction of SEM's graphical modeling interface, the desirability of testing models overall rather than coefficients individually, the ability to test models with multiple dependents, the ability to model mediating variables, the ability to model error terms, the ability to test coefficients across multiple between-subjects groups, and ability to handle difficult data (time series with autocorrelated error, non-normal data, incomplete data).

SEM is usually viewed as a confirmatory rather than exploratory procedure. In practice, much SEM research combines confirmatory and exploratory purposes: a model is tested using SEM procedures, found to be deficient, and an alternative model is then tested based on changes suggested by SEM modification indexes. Ultimately, however, SEM cannot itself draw causal arrows in models or resolve causal ambiguities.

The competing models are then tested against one another via the computer program. The completed analysis yields several different statistics for determining how well the competing models fit the data or explain the covariation among the variables. These statistics are collectively referred to as "fit statistics". The fit statistics test all of the parameters simultaneously (Stevens 1996). These fit statistics are evaluated to determine which predetermined model(s) best explain the relationships between the observed and latent variables. If the model does not fit the data, the proposed model is rejected as a possible candidate for the causal structure underlying the observed variables. If the model cannot be rejected statistically, it is a plausible representation of the causal structure (Bentler 1980).

Examples of fit statistics include the chi square/degrees of freedom ratio, the Bentler comparative fit index (CFI) (Bentler 1990) and the Goodness-of-fit Index

(GFI) (Joreskog & Sorbom 1989). The chi-square tests the hypothesis that the model is consistent with the pattern of co-variation among the observed variables. In the case of the chi-square statistic, smaller rather than larger values indicate a good fit. Another way to describe the chi square goodness of fit statistic is to say that it tests the null hypothesis that there is no statistically significant difference in the observed and theoretical covariance structure matrices. The good of fit index (GFI) is a measure of the relative amount of variances and covariances jointly accounted for by the model (Joreskog & Sorbom 1989) (S. Mulaik, Bennett & Lind 1989). The closer the GFI is to 1.00, the better is the fit of the model to the data. The adjusted goodness of fit statistic (AGFI) is based on a correction for the number of degrees of freedom in a less restricted model obtained by freeing more parameters. Both the GFI and the AGFI are less sensitive to sample size than the chi square statistic and generally preferred over chi-square tests.

It is important to remember when interpreting the findings from a confirmatory factor analysis that more than one model can be determined that will adequately fit the data. Therefore, finding a model with good fit does not mean that the model is the only, or optimal model for that data. In addition, because there are a number of fit indices with which to make comparisons, fit should be simultaneously evaluated from the perspective of multiple fit statistics (Campbell, Gillaspy & Thompson 1995).

When a confirmatory analysis fails to fit the observed factor structure with the theoretical structure, the researcher can evaluate ways to improve the model by exploring which parameters might be freed that had been fixed and which might be fixed that had been freed. The computer packages can be utilized to change parameters one at a time in order to determine what changes offer the greatest amount of improvement in the fit of the model.

# Appendix B

# Research Instruments

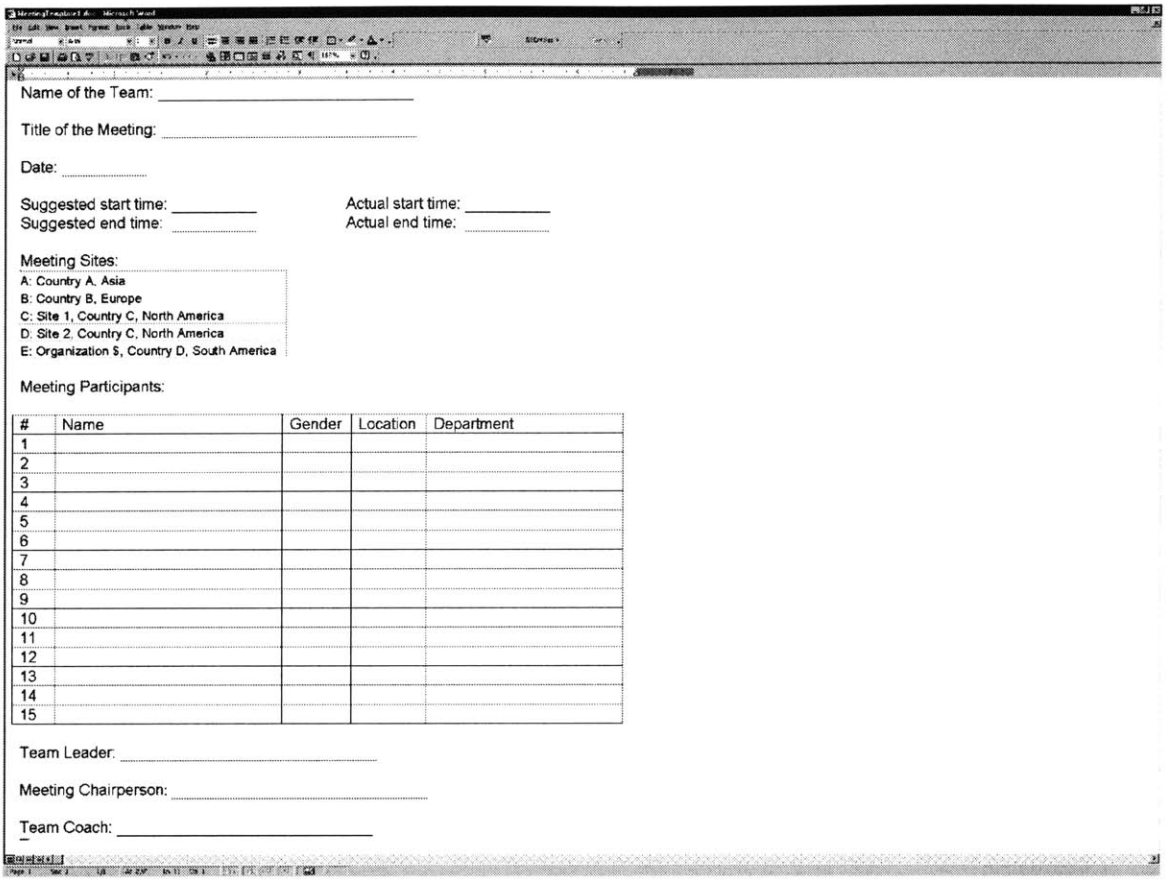
This appendix provides examples of the types of research instruments used with the methods described earlier in the dissertation. These are not intended to serve as prototypes for researchers, but to give the research community a more concrete idea of what the research instruments look like.

Table B.1 highlights the various research instruments used in this study.

Table B.1: Research Instruments

| *Research Instrument* | *Output* | *Figures* |
|---|---|---|
| Interaction Observation Template | `Microsoft Word` Document | B-1 - B-4 |
| Interaction Observation Template | `Microsoft Excel` Spreadsheet | B-5 - B-8 |
| Interview Guide | `Microsoft Word` Document | B-9 - B-12 |
| Interaction Space Survey | `Microsoft Excel` Spreadsheet | B-13 |
| Survey | `Microsoft Excel` Spreadsheet | B-14 - B-21 |
| Survey | Web Pages | B-22 |

# B.1 Interaction Observation Template



Name of the Team: _____

Title of the Meeting: _____

Date: _____

Suggested start time: _____ Actual start time: _____
Suggested end time: _____ Actual end time: _____

Meeting Sites:

A: Country A, Asia
B: Country B, Europe
C: Site 1, Country C, North America
D: Site 2, Country C, North America
E: Organization $, Country D, South America

Meeting Participants:

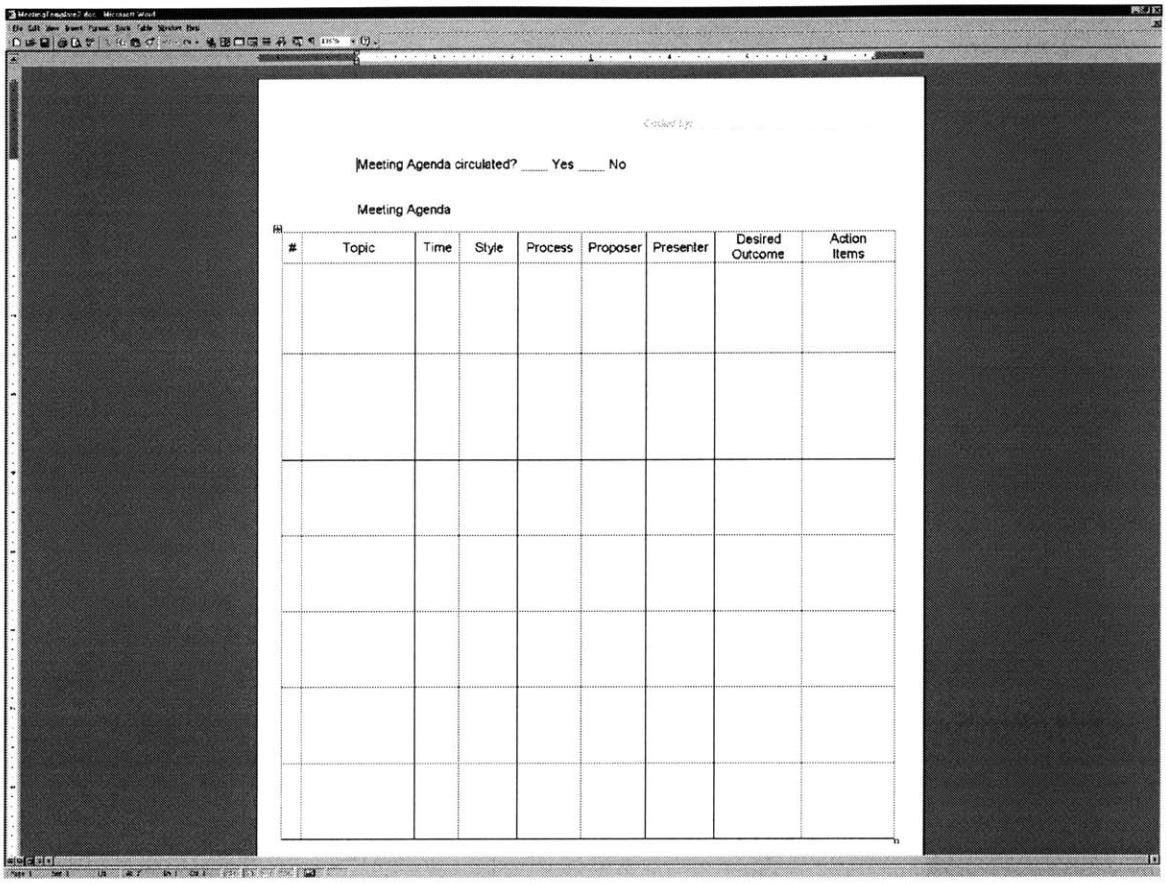
| # | Name | Gender | Location | Department |
|---|---|---|---|---|
| 1 | | | | |
| 2 | | | | |
| 3 | | | | |
| 4 | | | | |
| 5 | | | | |
| 6 | | | | |
| 7 | | | | |
| 8 | | | | |
| 9 | | | | |
| 10 | | | | |
| 11 | | | | |
| 12 | | | | |
| 13 | | | | |
| 14 | | | | |
| 15 | | | | |

Team Leader: _____

Meeting Chairperson: _____

Team Coach: _____

Figure B-1: Observation Template for Video Conferences (Participant Details)



Meeting Agenda circulated? _____ Yes _____ No

Meeting Agenda

| # | Topic | Time | Style | Process | Proposer | Presenter | Desired Outcome | Action Items |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |

Figure B-2: Observation Template for Video Conferences (Agenda Details)

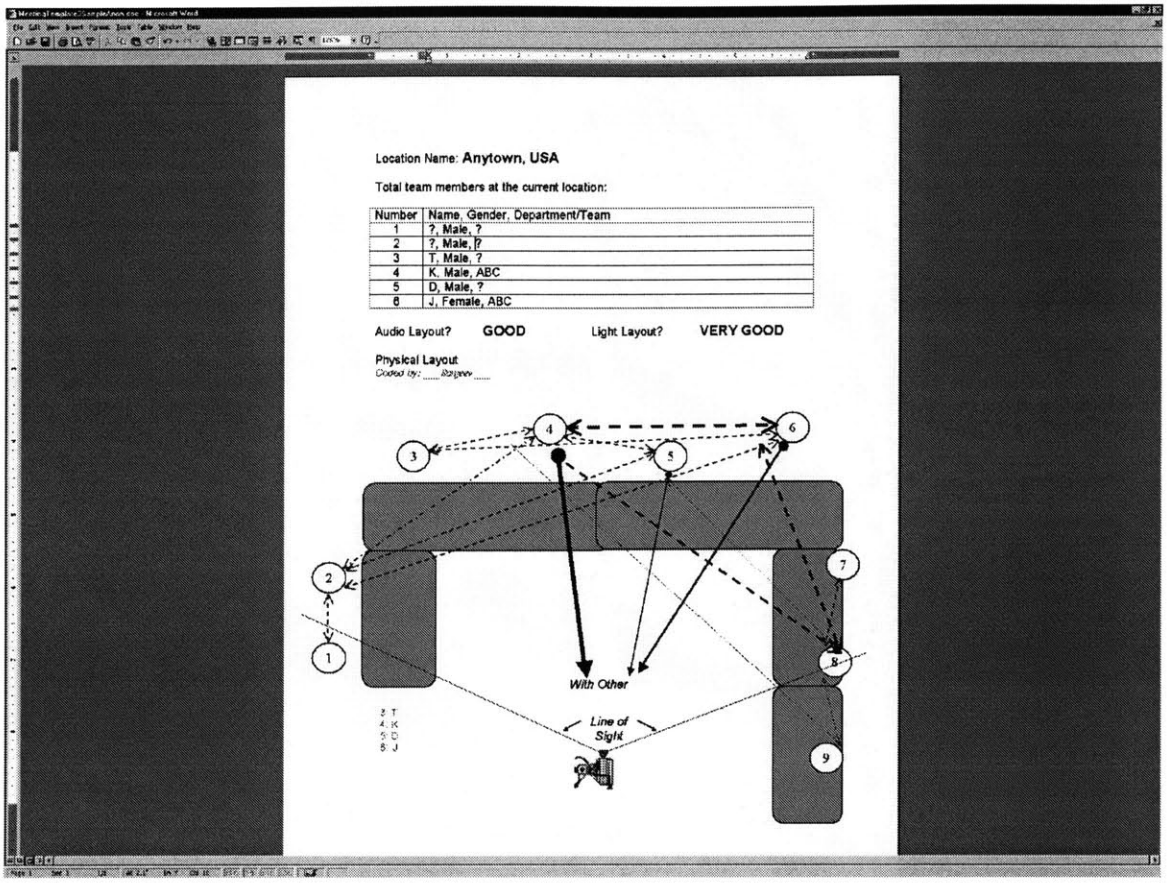
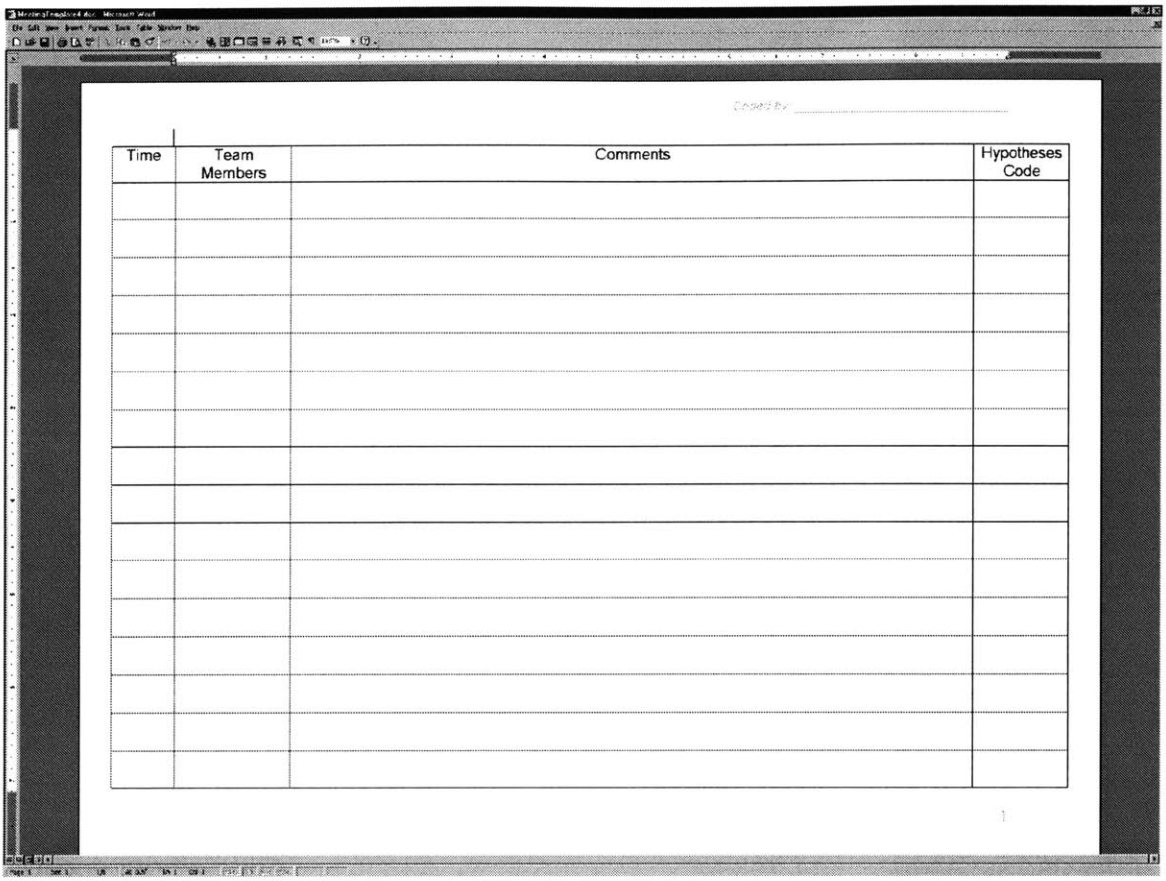
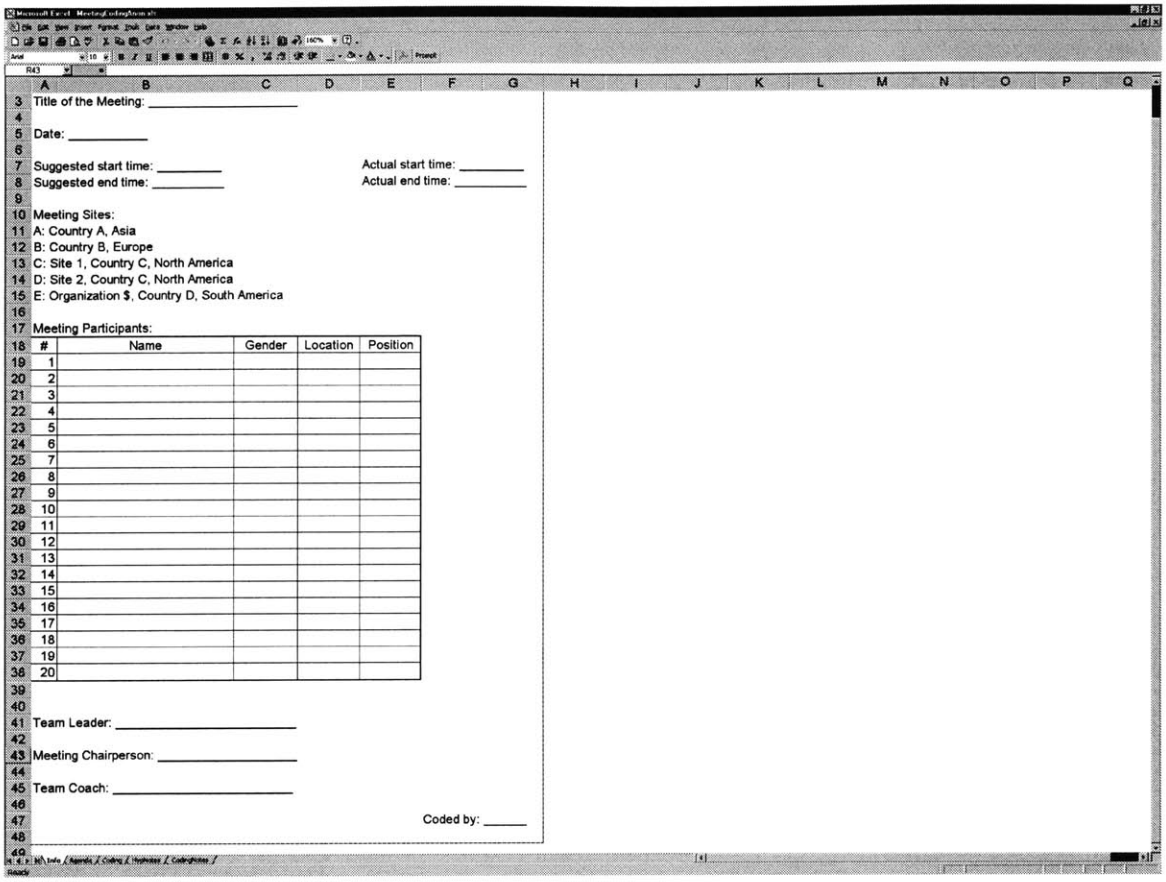



Figure B-3: Sample Data from the Observations *Note: Identities are Masked*



| Time | Team Members | Comments | Hypotheses Code |
|---|---|---|---|
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |

Figure B-4: Observation Template for Video Conferences (Interaction Details)



Title of the Meeting: _____

Date: _____

Suggested start time: _____ Actual start time: _____
Suggested end time: _____ Actual end time: _____

Meeting Sites:
A: Country A, Asia
B: Country B, Europe
C: Site 1, Country C, North America
D: Site 2, Country C, North America
E: Organization $, Country D, South America

Meeting Participants:

| # | Name | Gender | Location | Position |
|---|---|---|---|---|
| 1 | | | | |
| 2 | | | | |
| 3 | | | | |
| 4 | | | | |
| 5 | | | | |
| 6 | | | | |
| 7 | | | | |
| 8 | | | | |
| 9 | | | | |
| 10 | | | | |
| 11 | | | | |
| 12 | | | | |
| 13 | | | | |
| 14 | | | | |
| 15 | | | | |
| 16 | | | | |
| 17 | | | | |
| 18 | | | | |
| 19 | | | | |
| 20 | | | | |

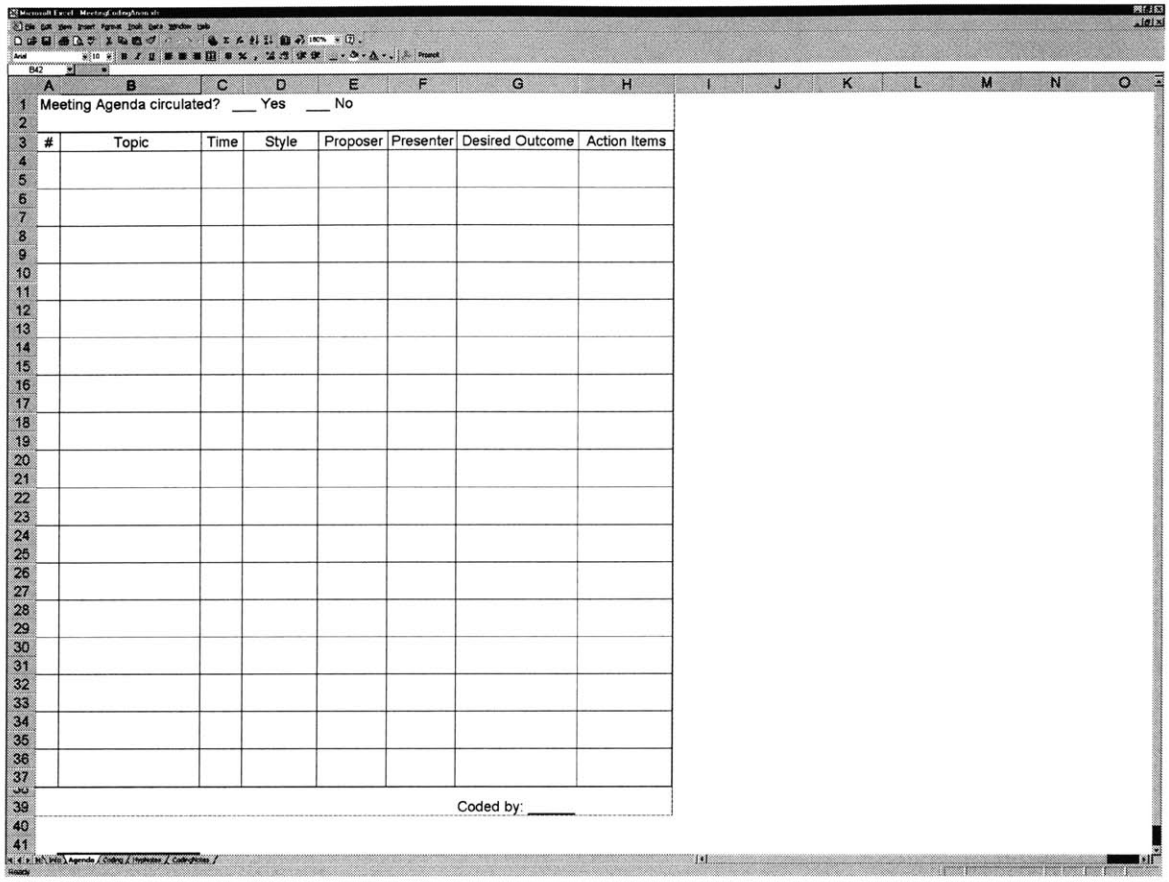
Team Leader: _____

Meeting Chairperson: _____

Team Coach: _____

Coded by: _____

Figure B-5: Observation Template for Audio Conferences (Interaction Details)

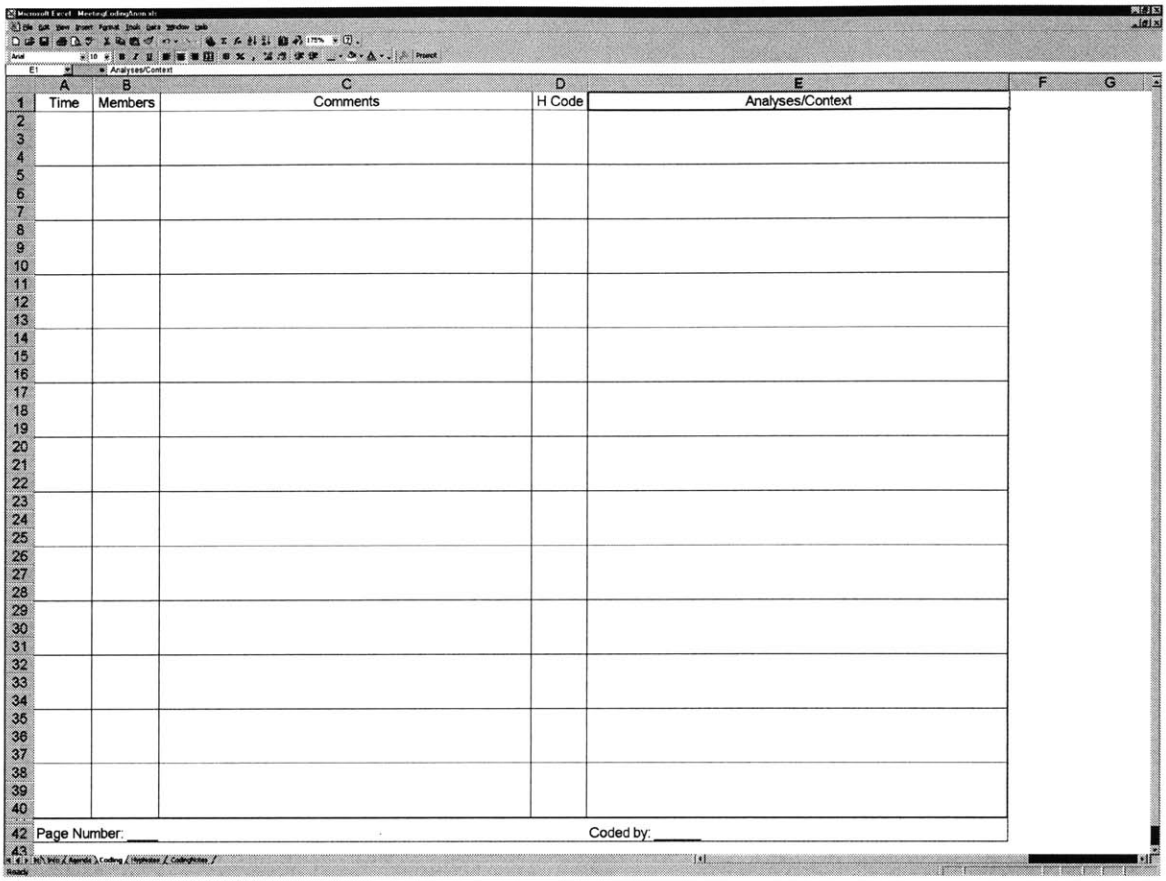


Meeting Agenda circulated? ___ Yes ___ No

| # | Topic | Time | Style | Proposer | Presenter | Desired Outcome | Action Items |
|---|---|---|---|---|---|---|---|
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |

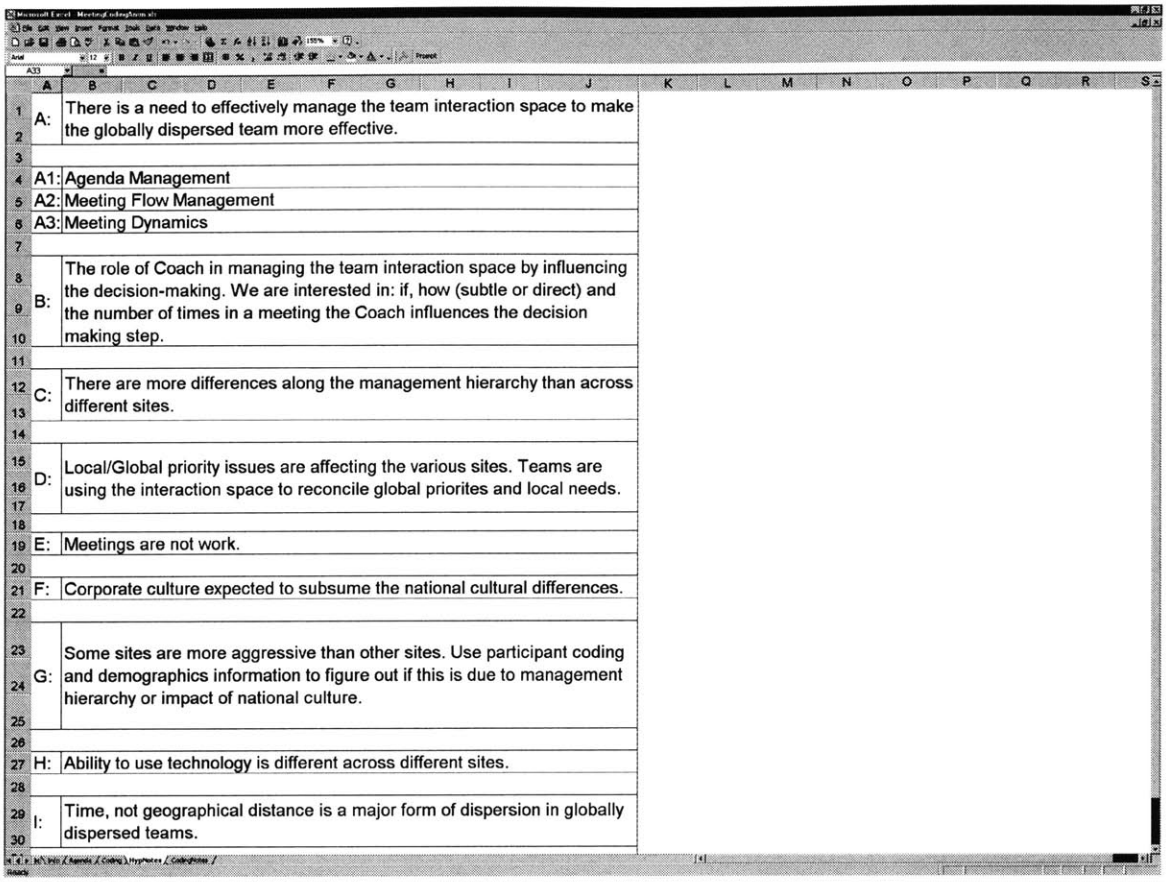
Coded by: _____

Figure B-6: Observation Template for Audio Conferences (Agenda Details)



| | A | B | C | D | E | F | G |
|---|---|---|---|---|---|---|---|
| 1 | Time | Members | Comments | H Code | Analyses/Context | | |
| 2 | | | | | | | |
| 3 | | | | | | | |
| 4 | | | | | | | |
| 5 | | | | | | | |
| 6 | | | | | | | |
| 7 | | | | | | | |
| 8 | | | | | | | |
| 9 | | | | | | | |
| 10 | | | | | | | |
| 11 | | | | | | | |
| 12 | | | | | | | |
| 13 | | | | | | | |
| 14 | | | | | | | |
| 15 | | | | | | | |
| 16 | | | | | | | |
| 17 | | | | | | | |
| 18 | | | | | | | |
| 19 | | | | | | | |
| 20 | | | | | | | |
| 21 | | | | | | | |
| 22 | | | | | | | |
| 23 | | | | | | | |
| 24 | | | | | | | |
| 25 | | | | | | | |
| 26 | | | | | | | |
| 27 | | | | | | | |
| 28 | | | | | | | |
| 29 | | | | | | | |
| 30 | | | | | | | |
| 31 | | | | | | | |
| 32 | | | | | | | |
| 33 | | | | | | | |
| 34 | | | | | | | |
| 35 | | | | | | | |
| 36 | | | | | | | |
| 37 | | | | | | | |
| 38 | | | | | | | |
| 39 | | | | | | | |
| 40 | | | | | | | |
| 42 | Page Number: ____ | | | | Coded by: _____ | | |
| 43 | | | | | | | |

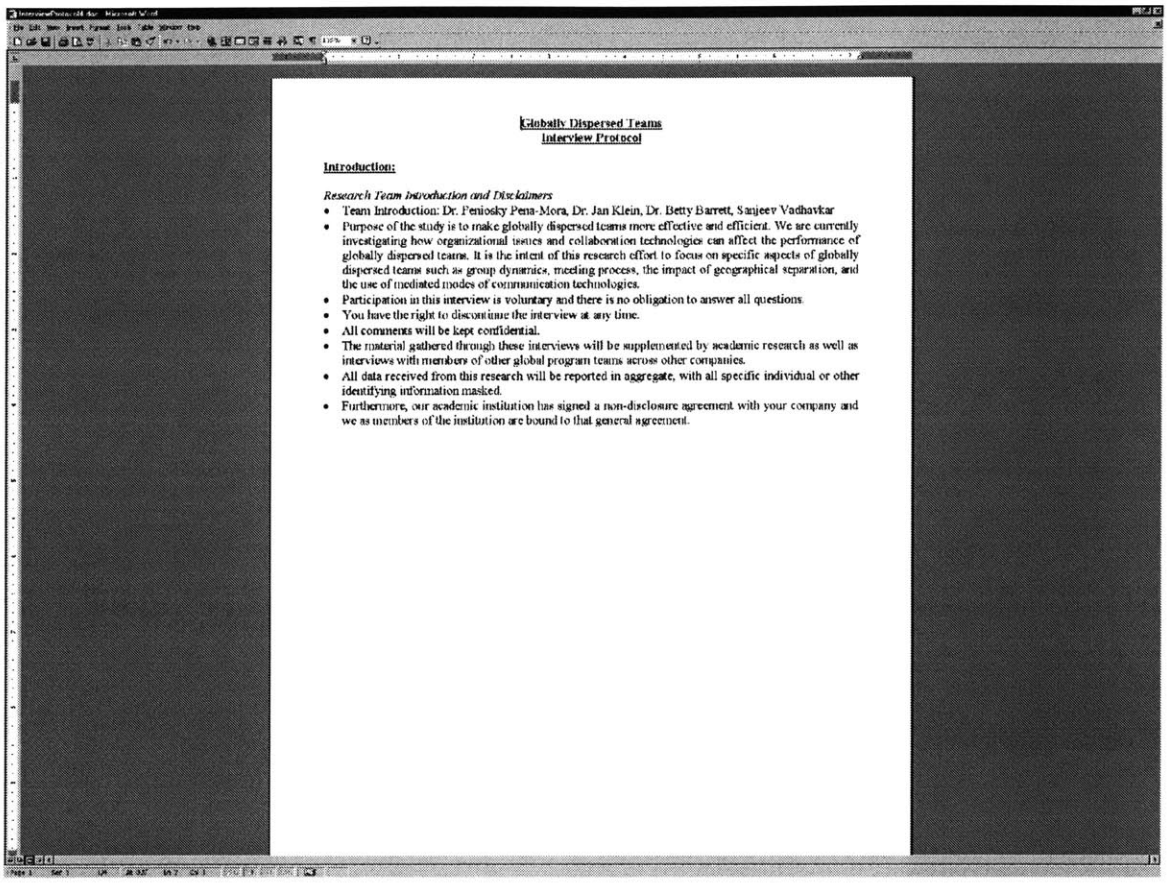
Figure B-7: Observation Template for Audio Conferences (Interaction Details)



| | |
|---|---|
| A: | There is a need to effectively manage the team interaction space to make the globally dispersed team more effective. |
| A1: | Agenda Management |
| A2: | Meeting Flow Management |
| A3: | Meeting Dynamics |
| B: | The role of Coach in managing the team interaction space by influencing the decision-making. We are interested in: if, how (subtle or direct) and the number of times in a meeting the Coach influences the decision making step. |
| C: | There are more differences along the management hierarchy than across different sites. |
| D: | Local/Global priority issues are affecting the various sites. Teams are using the interaction space to reconcile global priorites and local needs. |
| E: | Meetings are not work. |
| F: | Corporate culture expected to subsume the national cultural differences. |
| G: | Some sites are more aggressive than other sites. Use participant coding and demographics information to figure out if this is due to management hierarchy or impact of national culture. |
| H: | Ability to use technology is different across different sites. |
| I: | Time, not geographical distance is a major form of dispersion in globally dispersed teams. |

Figure B-8: Observation Template for Audio Conferences (Hypotheses Codes)

## B.2 Interview Guide



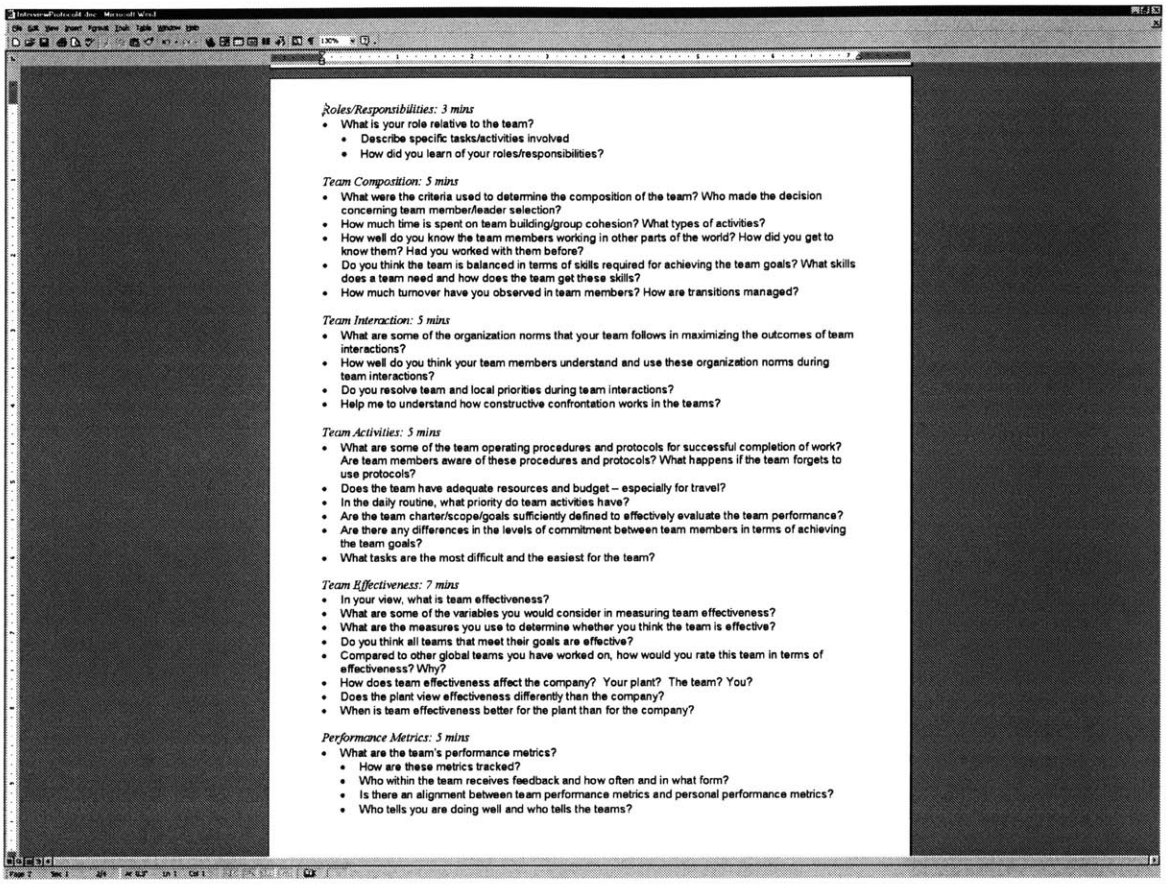
**Globally Dispersed Teams**
**Interview Protocol**

**Introduction:**

*Research Team Introduction and Disclaimers*

- Team Introduction: Dr. Peniosky Pena-Mora, Dr. Jan Klein, Dr. Betty Barrett, Sanjeev Vadhavkar
- Purpose of the study is to make globally dispersed teams more effective and efficient. We are currently investigating how organizational issues and collaboration technologies can affect the performance of globally dispersed teams. It is the intent of this research effort to focus on specific aspects of globally dispersed teams such as group dynamics, meeting process, the impact of geographical separation, and the use of mediated modes of communication technologies.
- Participation in this interview is voluntary and there is no obligation to answer all questions.
- You have the right to discontinue the interview at any time.
- All comments will be kept confidential.
- The material gathered through these interviews will be supplemented by academic research as well as interviews with members of other global program teams across other companies.
- All data received from this research will be reported in aggregate, with all specific individual or other identifying information masked.
- Furthermore, our academic institution has signed a non-disclosure agreement with your company and we as members of the institution are bound to that general agreement.

Figure B-9: Interview Guide (Introduction)



*Roles/Responsibilities: 3 mins*

- What is your role relative to the team?
  - Describe specific tasks/activities involved
  - How did you learn of your roles/responsibilities?

*Team Composition: 5 mins*

- What were the criteria used to determine the composition of the team? Who made the decision concerning team member/leader selection?
- How much time is spent on team building/group cohesion? What types of activities?
- How well do you know the team members working in other parts of the world? How did you get to know them? Had you worked with them before?
- Do you think the team is balanced in terms of skills required for achieving the team goals? What skills does a team need and how does the team get these skills?
- How much turnover have you observed in team members? How are transitions managed?

*Team Interaction: 5 mins*

- What are some of the organization norms that your team follows in maximizing the outcomes of team interactions?
- How well do you think your team members understand and use these organization norms during team interactions?
- Do you resolve team and local priorities during team interactions?
- Help me to understand how constructive confrontation works in the teams?

*Team Activities: 5 mins*

- What are some of the team operating procedures and protocols for successful completion of work? Are team members aware of these procedures and protocols? What happens if the team forgets to use protocols?
- Does the team have adequate resources and budget – especially for travel?
- In the daily routine, what priority do team activities have?
- Are the team charter/scope/goals sufficiently defined to effectively evaluate the team performance?
- Are there any differences in the levels of commitment between team members in terms of achieving the team goals?
- What tasks are the most difficult and the easiest for the team?

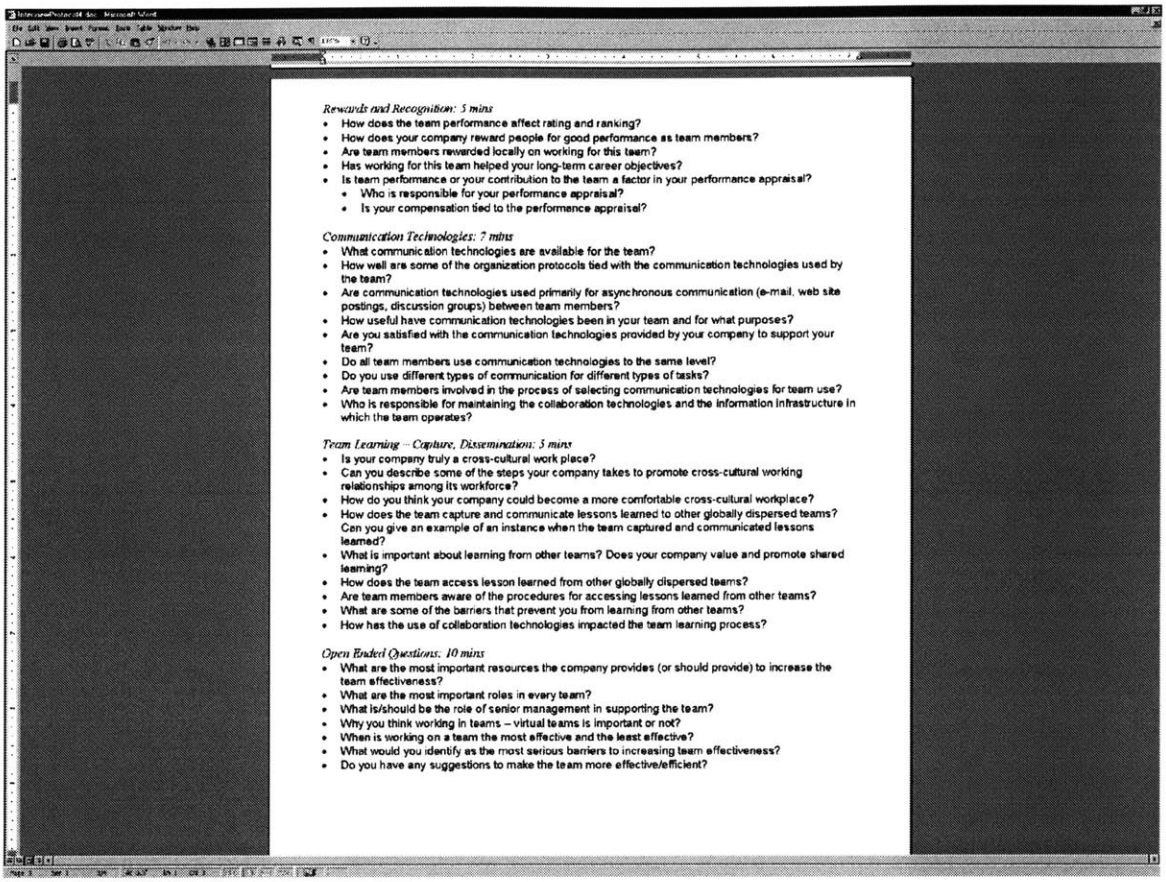
*Team Effectiveness: 7 mins*

- In your view, what is team effectiveness?
- What are some of the variables you would consider in measuring team effectiveness?
- What are the measures you use to determine whether you think the team is effective?
- Do you think all teams that meet their goals are effective?
- Compared to other global teams you have worked on, how would you rate this team in terms of effectiveness? Why?
- How does team effectiveness affect the company? Your plant? The team? You?
- Does the plant view effectiveness differently than the company?
- When is team effectiveness better for the plant than for the company?

*Performance Metrics: 5 mins*

- What are the team's performance metrics?
  - How are these metrics tracked?
  - Who within the team receives feedback and how often and in what form?
  - Is there an alignment between team performance metrics and personal performance metrics?
  - Who tells you are doing well and who tells the teams?

Figure B-10: Interview Guide (Page 2)



*Rewards and Recognition: 5 mins*

- How does the team performance affect rating and ranking?
- How does your company reward people for good performance as team members?
- Are team members rewarded locally on working for this team?
- Has working for this team helped your long-term career objectives?
- Is team performance or your contribution to the team a factor in your performance appraisal?
  - Who is responsible for your performance appraisal?
  - Is your compensation tied to the performance appraisal?

*Communication Technologies: 7 mins*

- What communication technologies are available for the team?
- How well are some of the organization protocols tied with the communication technologies used by the team?
- Are communication technologies used primarily for asynchronous communication (e-mail, web site postings, discussion groups) between team members?
- How useful have communication technologies been in your team and for what purposes?
- Are you satisfied with the communication technologies provided by your company to support your team?
- Do all team members use communication technologies to the same level?
- Do you use different types of communication for different types of tasks?
- Are team members involved in the process of selecting communication technologies for team use?
- Who is responsible for maintaining the collaboration technologies and the information infrastructure in which the team operates?

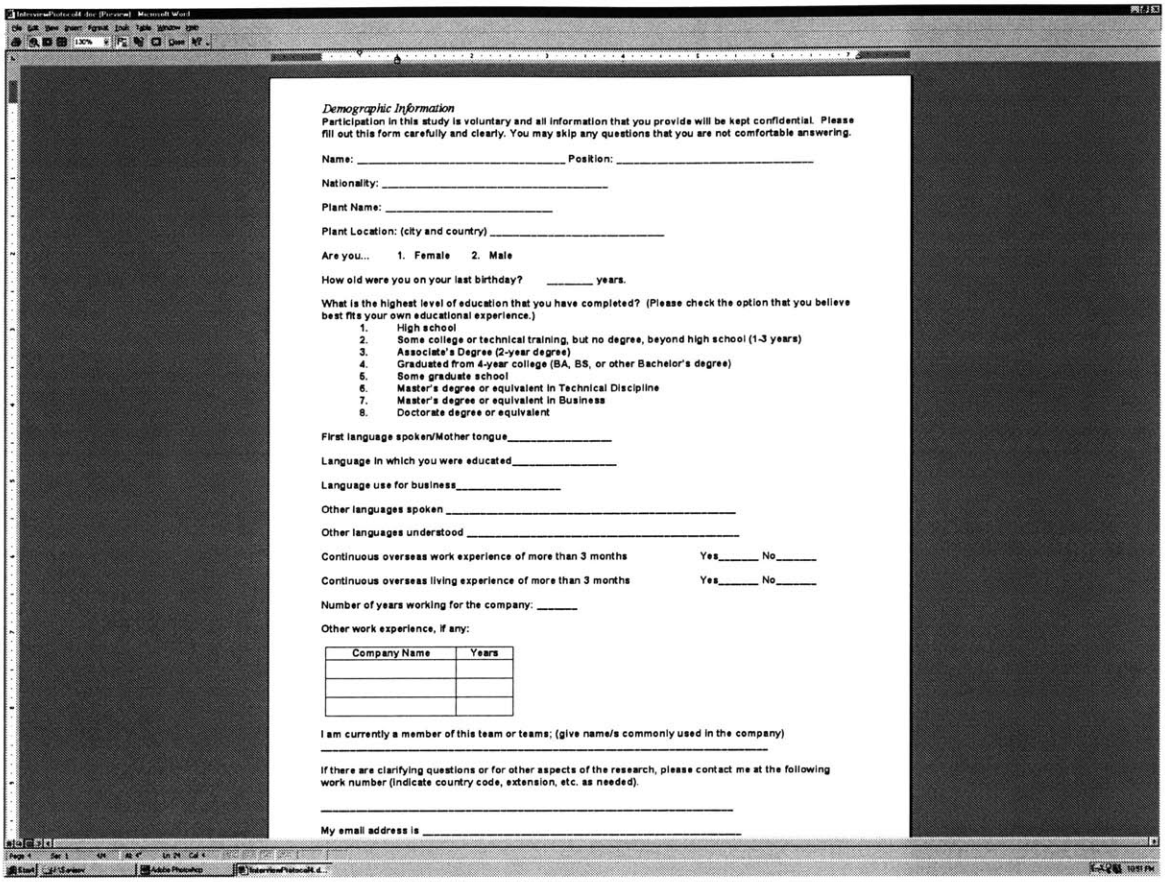
*Team Learning – Capture, Dissemination: 5 mins*

- Is your company truly a cross-cultural work place?
- Can you describe some of the steps your company takes to promote cross-cultural working relationships among its workforce?
- How do you think your company could become a more comfortable cross-cultural workplace?
- How does the team capture and communicate lessons learned to other globally dispersed teams? Can you give an example of an instance when the team captured and communicated lessons learned?
- What is important about learning from other teams? Does your company value and promote shared learning?
- How does the team access lesson learned from other globally dispersed teams?
- Are team members aware of the procedures for accessing lessons learned from other teams?
- What are some of the barriers that prevent you from learning from other teams?
- How has the use of collaboration technologies impacted the team learning process?

*Open Ended Questions: 10 mins*

- What are the most important resources the company provides (or should provide) to increase the team effectiveness?
- What are the most important roles in every team?
- What is/should be the role of senior management in supporting the team?
- Why you think working in teams – virtual teams is important or not?
- When is working on a team the most effective and the least effective?
- What would you identify as the most serious barriers to increasing team effectiveness?
- Do you have any suggestions to make the team more effective/efficient?

Figure B-11: Interview Guide (Page 3)



*Demographic Information*

**Participation in this study is voluntary and all information that you provide will be kept confidential. Please fill out this form carefully and clearly. You may skip any questions that you are not comfortable answering.**

**Name:** _____ **Position:** _____

**Nationality:** _____

**Plant Name:** _____

**Plant Location: (city and country)** _____

**Are you...** 1. Female 2. Male

**How old were you on your last birthday?** _____ **years.**

**What is the highest level of education that you have completed? (Please check the option that you believe best fits your own educational experience.)**

1. High school
2. Some college or technical training, but no degree, beyond high school (1-3 years)
3. Associate's Degree (2-year degree)
4. Graduated from 4-year college (BA, BS, or other Bachelor's degree)
5. Some graduate school
6. Master's degree or equivalent in Technical Discipline
7. Master's degree or equivalent in Business
8. Doctorate degree or equivalent

**First language spoken/Mother tongue**_____

**Language in which you were educated**_____

**Language use for business**_____

**Other languages spoken** _____

**Other languages understood** _____

**Continuous overseas work experience of more than 3 months** Yes_____ No_____

**Continuous overseas living experience of more than 3 months** Yes_____ No_____

**Number of years working for the company:** _____

**Other work experience, if any:**

| Company Name | Years |
|---|---|
| | |
| | |
| | |

**I am currently a member of this team or teams; (give name/s commonly used in the company)**

_____

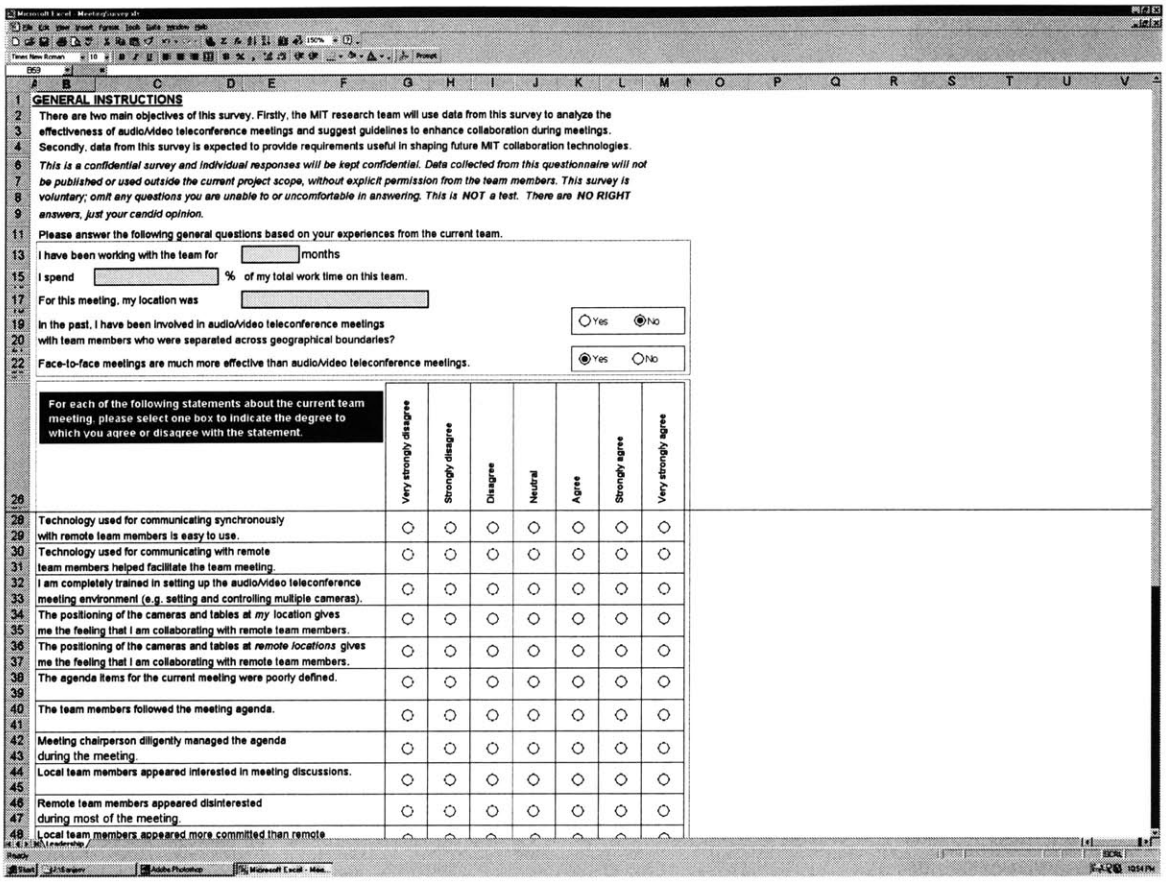
**If there are clarifying questions or for other aspects of the research, please contact me at the following work number (indicate country code, extension, etc. as needed).**

_____

**My email address is** _____

Figure B-12: Interview Guide (Page 4)

## B.3 Survey



**GENERAL INSTRUCTIONS**

There are two main objectives of this survey. Firstly, the MIT research team will use data from this survey to analyze the effectiveness of audio/video teleconference meetings and suggest guidelines to enhance collaboration during meetings. Secondly, data from this survey is expected to provide requirements useful in shaping future MIT collaboration technologies.

*This is a confidential survey and individual responses will be kept confidential. Data collected from this questionnaire will not be published or used outside the current project scope, without explicit permission from the team members. This survey is voluntary; omit any questions you are unable to or uncomfortable in answering. This is NOT a test. There are NO RIGHT answers, just your candid opinion.*

Please answer the following general questions based on your experiences from the current team.

I have been working with the team for [ ] months

I spend [ ] % of my total work time on this team.

For this meeting, my location was [ ]

In the past, I have been involved in audio/video teleconference meetings with team members who were separated across geographical boundaries? ○ Yes ◉ No

Face-to-face meetings are much more effective than audio/video teleconference meetings. ◉ Yes ○ No

| For each of the following statements about the current team meeting, please select one box to indicate the degree to which you agree or disagree with the statement. | Very strongly disagree | Strongly disagree | Disagree | Neutral | Agree | Strongly agree | Very strongly agree |
|---|---|---|---|---|---|---|---|
| Technology used for communicating synchronously with remote team members is easy to use. | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| Technology used for communicating with remote team members helped facilitate the team meeting. | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| I am completely trained in setting up the audio/video teleconference meeting environment (e.g. setting and controlling multiple cameras). | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| The positioning of the cameras and tables at *my* location gives me the feeling that I am collaborating with remote team members. | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| The positioning of the cameras and tables at *remote locations* gives me the feeling that I am collaborating with remote team members. | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| The agenda items for the current meeting were poorly defined. | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| The team members followed the meeting agenda. | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| Meeting chairperson diligently managed the agenda during the meeting. | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| Local team members appeared interested in meeting discussions. | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| Remote team members appeared disinterested during most of the meeting. | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| Local team members appeared more committed than remote | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

Figure B-13: Interaction Space Survey in `Microsoft Excel` format

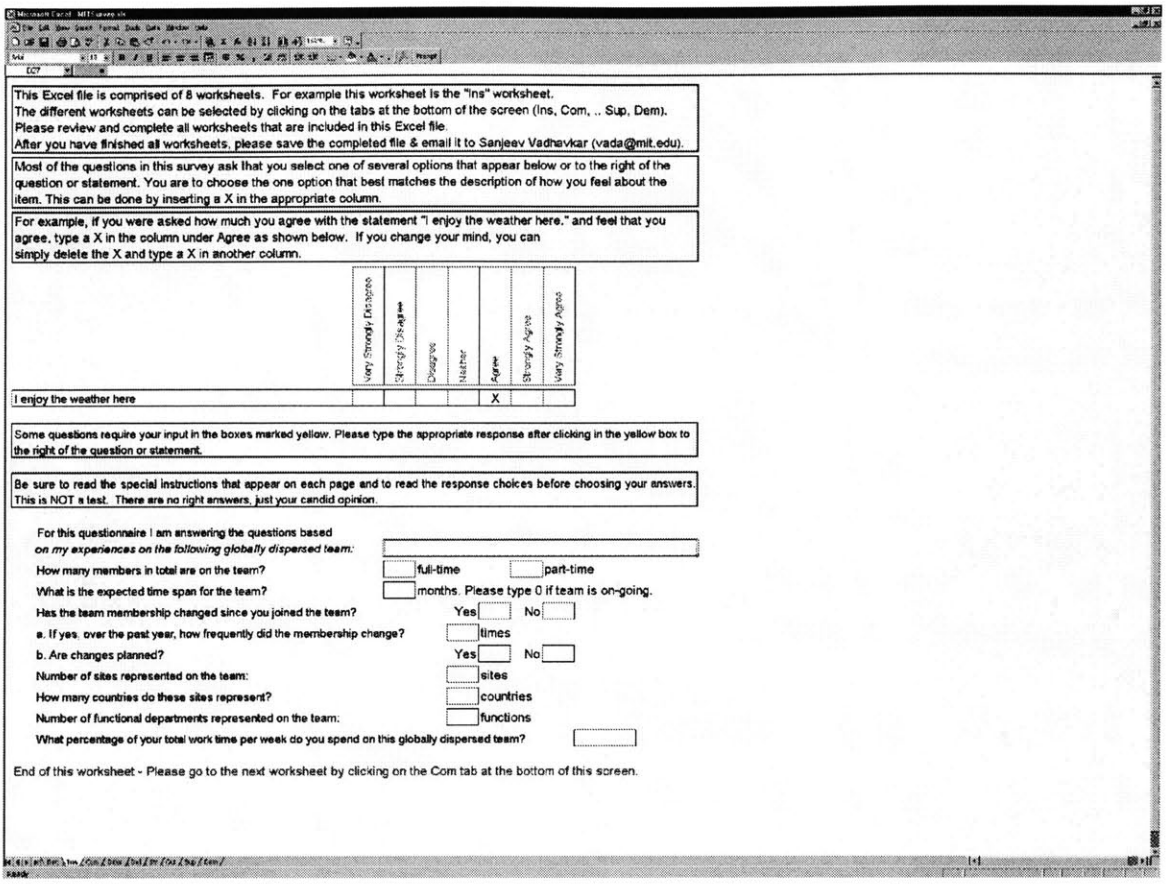



Figure B-14: Survey in `Microsoft Excel` format (Instructions)

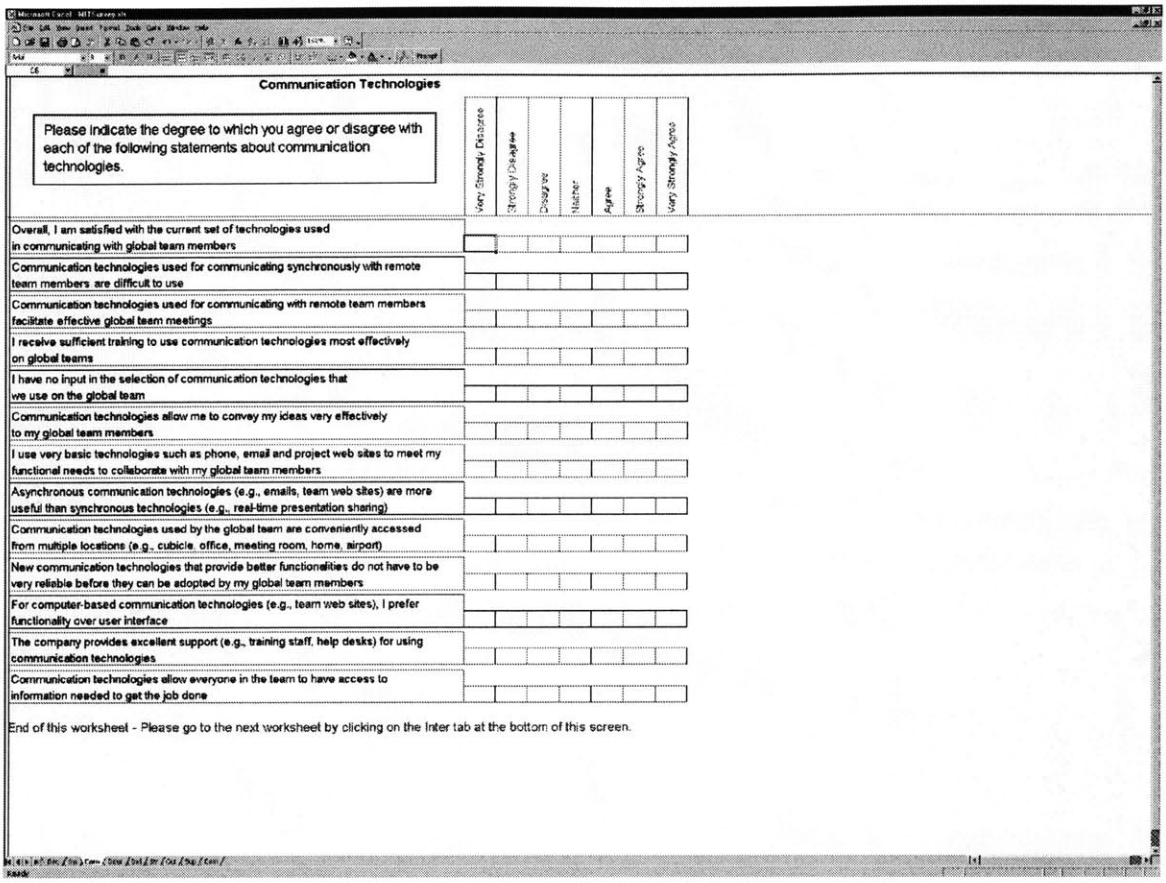
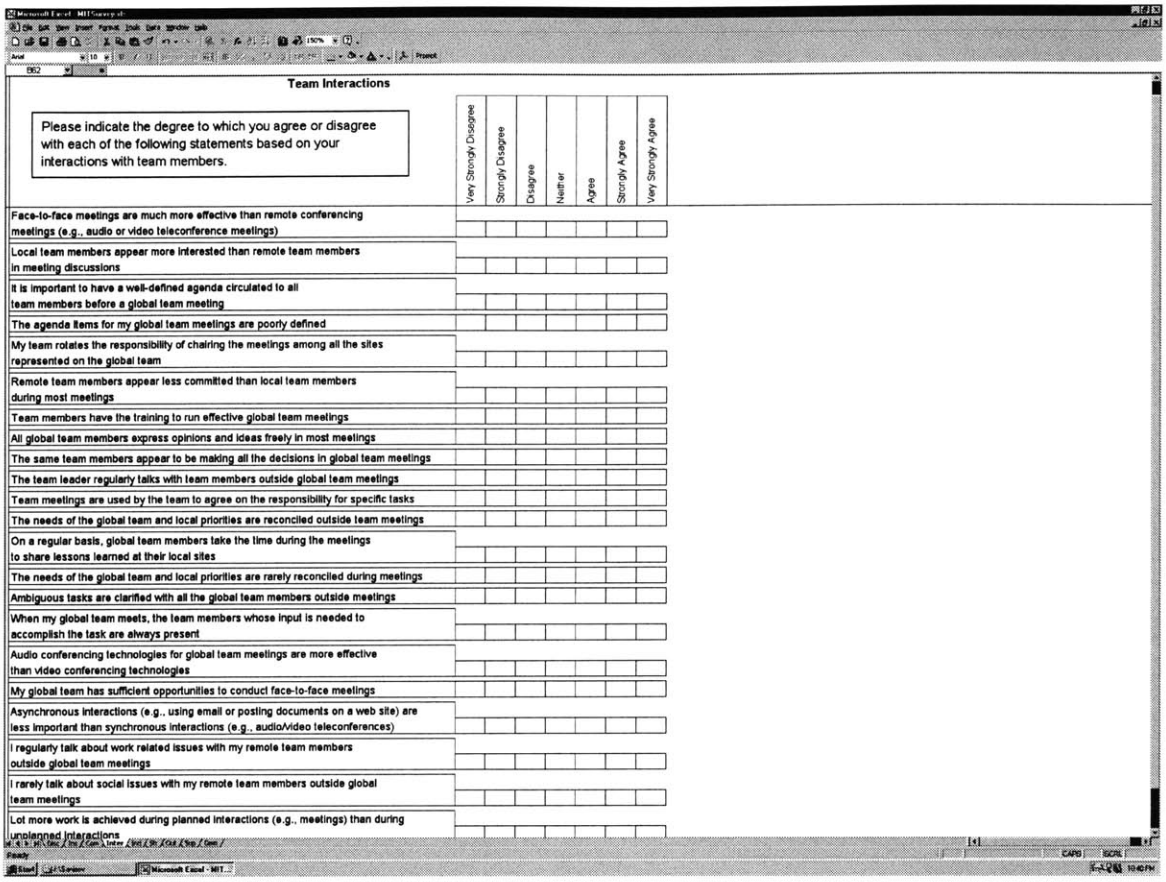



Figure B-15: Survey in `Microsoft Excel` format (Communication Technology)

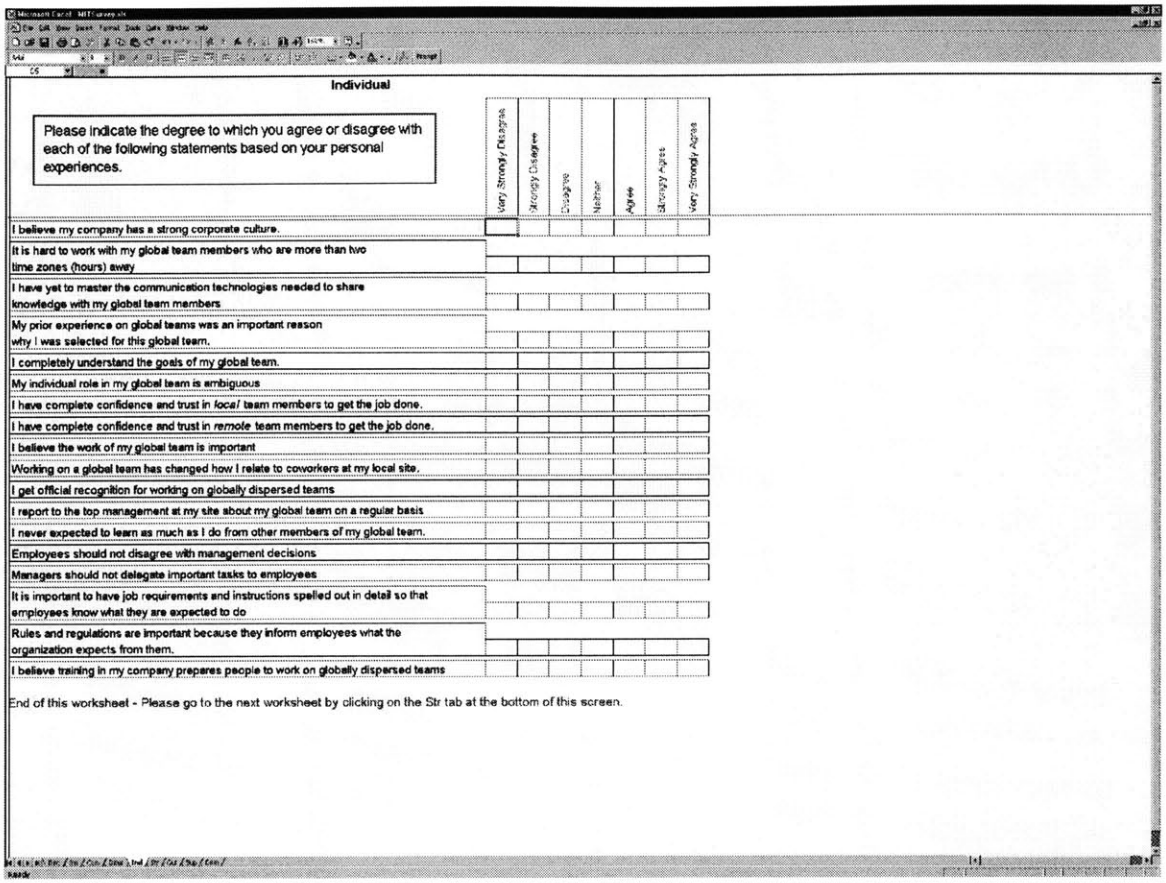


**Team Interactions**

Please indicate the degree to which you agree or disagree with each of the following statements based on your interactions with team members.

| | Very Strongly Disagree | Strongly Disagree | Disagree | Neither | Agree | Strongly Agree | Very Strongly Agree |
|---|---|---|---|---|---|---|---|
| Face-to-face meetings are much more effective than remote conferencing meetings (e.g., audio or video teleconference meetings) | | | | | | | |
| Local team members appear more interested than remote team members in meeting discussions | | | | | | | |
| It is important to have a well-defined agenda circulated to all team members before a global team meeting | | | | | | | |
| The agenda items for my global team meetings are poorly defined | | | | | | | |
| My team rotates the responsibility of chairing the meetings among all the sites represented on the global team | | | | | | | |
| Remote team members appear less committed than local team members during most meetings | | | | | | | |
| Team members have the training to run effective global team meetings | | | | | | | |
| All global team members express opinions and ideas freely in most meetings | | | | | | | |
| The same team members appear to be making all the decisions in global team meetings | | | | | | | |
| The team leader regularly talks with team members outside global team meetings | | | | | | | |
| Team meetings are used by the team to agree on the responsibility for specific tasks | | | | | | | |
| The needs of the global team and local priorities are reconciled outside team meetings | | | | | | | |
| On a regular basis, global team members take the time during the meetings to share lessons learned at their local sites | | | | | | | |
| The needs of the global team and local priorities are rarely reconciled during meetings | | | | | | | |
| Ambiguous tasks are clarified with all the global team members outside meetings | | | | | | | |
| When my global team meets, the team members whose input is needed to accomplish the task are always present | | | | | | | |
| Audio conferencing technologies for global team meetings are more effective than video conferencing technologies | | | | | | | |
| My global team has sufficient opportunities to conduct face-to-face meetings | | | | | | | |
| Asynchronous interactions (e.g., using email or posting documents on a web site) are less important than synchronous interactions (e.g., audio/video teleconferences) | | | | | | | |
| I regularly talk about work related issues with my remote team members outside global team meetings | | | | | | | |
| I rarely talk about social issues with my remote team members outside global team meetings | | | | | | | |
| Lot more work is achieved during planned interactions (e.g., meetings) than during unplanned interactions | | | | | | | |

Figure B-16: Survey in `Microsoft Excel` format (Interaction Space)



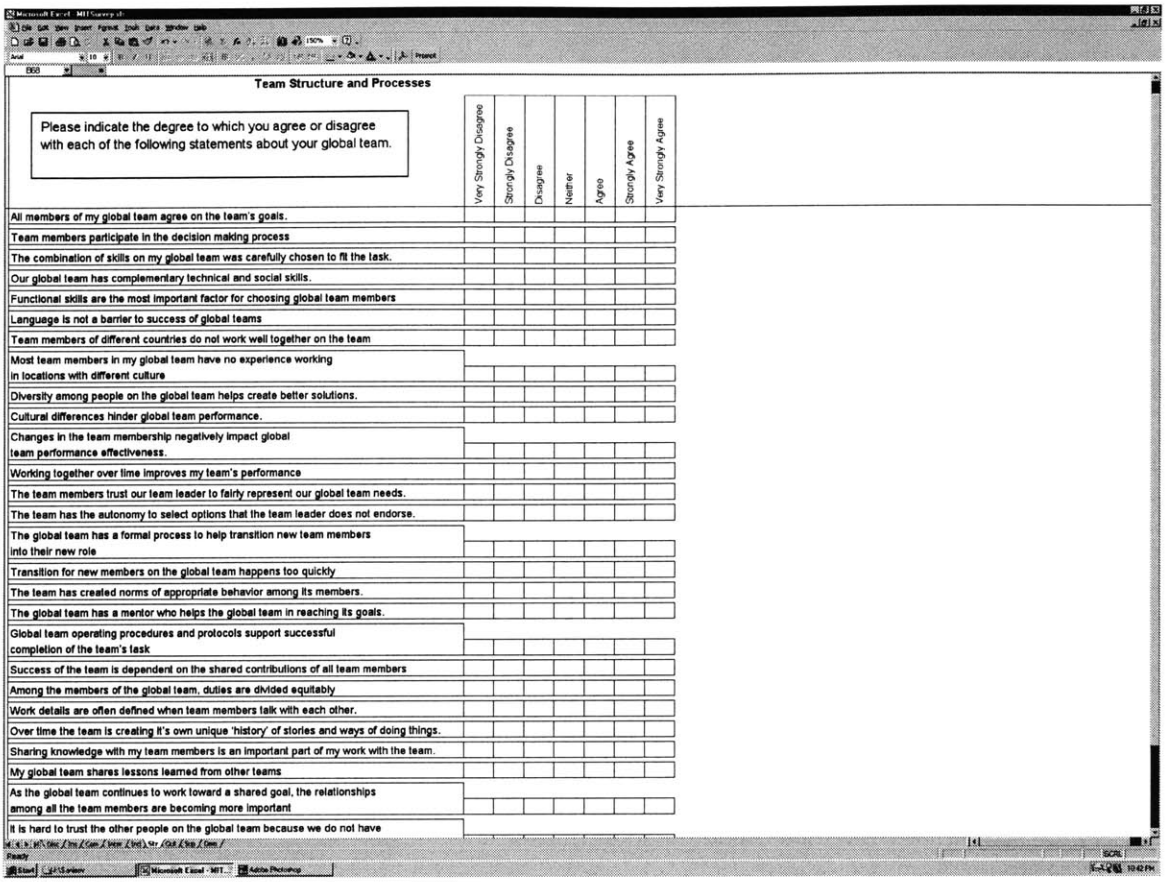
Individual

Please indicate the degree to which you agree or disagree with each of the following statements based on your personal experiences.

| | Very Strongly Disagree | Strongly Disagree | Disagree | Neither | Agree | Strongly Agree | Very Strongly Agree |
|---|---|---|---|---|---|---|---|
| I believe my company has a strong corporate culture. | | | | | | | |
| It is hard to work with my global team members who are more than two time zones (hours) away | | | | | | | |
| I have yet to master the communication technologies needed to share knowledge with my global team members | | | | | | | |
| My prior experience on global teams was an important reason why I was selected for this global team. | | | | | | | |
| I completely understand the goals of my global team. | | | | | | | |
| My individual role in my global team is ambiguous | | | | | | | |
| I have complete confidence and trust in *local* team members to get the job done. | | | | | | | |
| I have complete confidence and trust in *remote* team members to get the job done. | | | | | | | |
| I believe the work of my global team is important | | | | | | | |
| Working on a global team has changed how I relate to coworkers at my local site. | | | | | | | |
| I get official recognition for working on globally dispersed teams | | | | | | | |
| I report to the top management at my site about my global team on a regular basis | | | | | | | |
| I never expected to learn as much as I do from other members of my global team. | | | | | | | |
| Employees should not disagree with management decisions | | | | | | | |
| Managers should not delegate important tasks to employees | | | | | | | |
| It is important to have job requirements and instructions spelled out in detail so that employees know what they are expected to do | | | | | | | |
| Rules and regulations are important because they inform employees what the organization expects from them. | | | | | | | |
| I believe training in my company prepares people to work on globally dispersed teams | | | | | | | |

End of this worksheet - Please go to the next worksheet by clicking on the Str tab at the bottom of this screen.

Figure B-17: Survey in `Microsoft Excel` format (Individual)

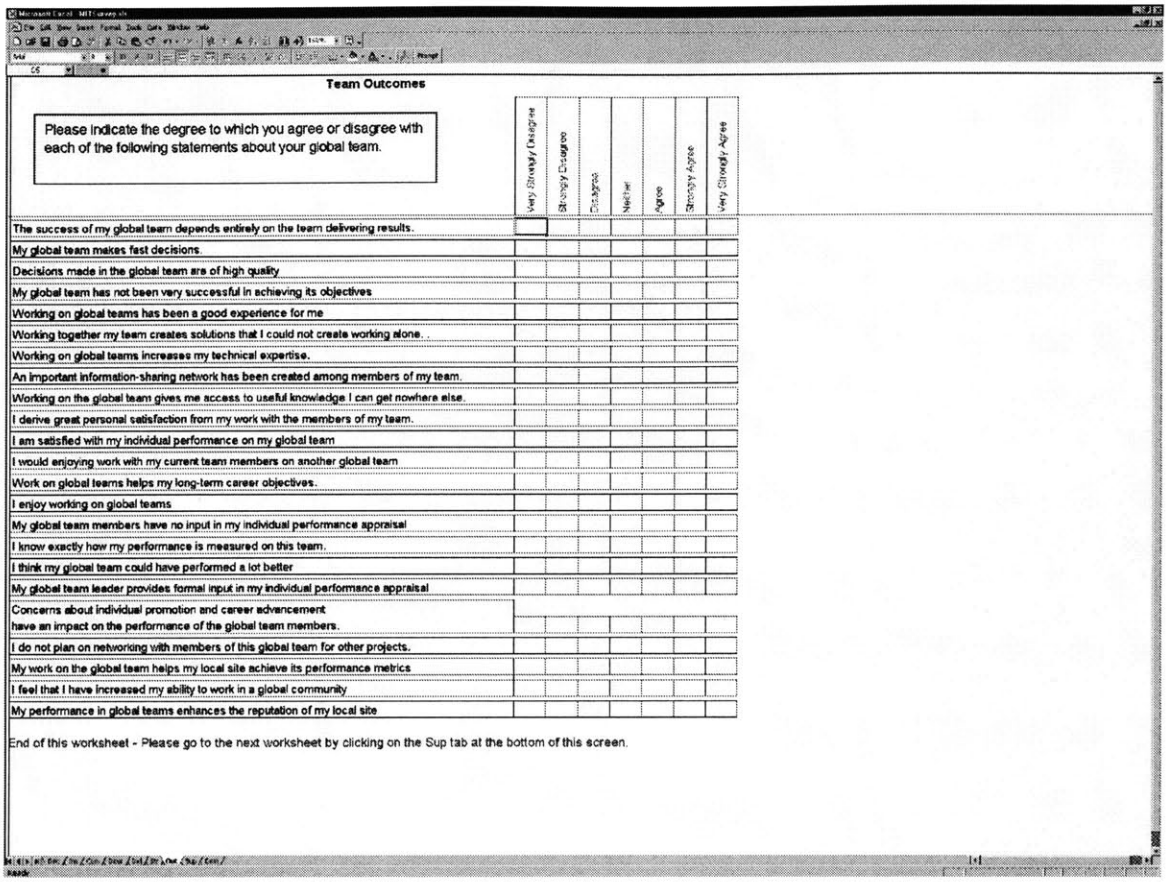


**Team Structure and Processes**

Please indicate the degree to which you agree or disagree with each of the following statements about your global team.

| | Very Strongly Disagree | Strongly Disagree | Disagree | Neither | Agree | Strongly Agree | Very Strongly Agree |
|---|---|---|---|---|---|---|---|
| All members of my global team agree on the team's goals. | | | | | | | |
| Team members participate in the decision making process | | | | | | | |
| The combination of skills on my global team was carefully chosen to fit the task. | | | | | | | |
| Our global team has complementary technical and social skills. | | | | | | | |
| Functional skills are the most important factor for choosing global team members | | | | | | | |
| Language is not a barrier to success of global teams | | | | | | | |
| Team members of different countries do not work well together on the team | | | | | | | |
| Most team members in my global team have no experience working in locations with different culture | | | | | | | |
| Diversity among people on the global team helps create better solutions. | | | | | | | |
| Cultural differences hinder global team performance. | | | | | | | |
| Changes in the team membership negatively impact global team performance effectiveness. | | | | | | | |
| Working together over time improves my team's performance | | | | | | | |
| The team members trust our team leader to fairly represent our global team needs. | | | | | | | |
| The team has the autonomy to select options that the team leader does not endorse. | | | | | | | |
| The global team has a formal process to help transition new team members into their new role | | | | | | | |
| Transition for new members on the global team happens too quickly | | | | | | | |
| The team has created norms of appropriate behavior among its members. | | | | | | | |
| The global team has a mentor who helps the global team in reaching its goals. | | | | | | | |
| Global team operating procedures and protocols support successful completion of the team's task | | | | | | | |
| Success of the team is dependent on the shared contributions of all team members | | | | | | | |
| Among the members of the global team, duties are divided equitably | | | | | | | |
| Work details are often defined when team members talk with each other. | | | | | | | |
| Over time the team is creating it's own unique 'history' of stories and ways of doing things. | | | | | | | |
| Sharing knowledge with my team members is an important part of my work with the team. | | | | | | | |
| My global team shares lessons learned from other teams | | | | | | | |
| As the global team continues to work toward a shared goal, the relationships among all the team members are becoming more important | | | | | | | |
| It is hard to trust the other people on the global team because we do not have | | | | | | | |

Figure B-18: Survey in `Microsoft Excel` format (Team Structure)



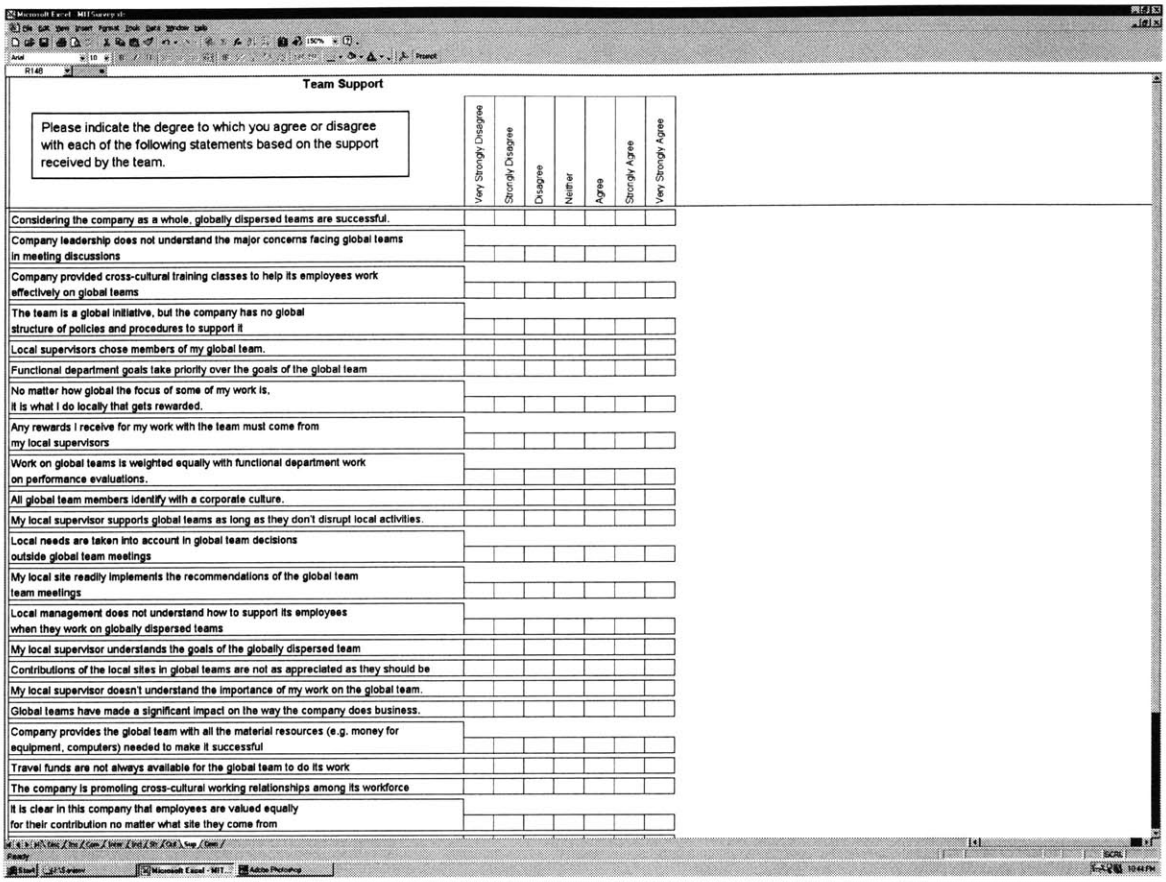
**Team Outcomes**

Please indicate the degree to which you agree or disagree with each of the following statements about your global team.

| | Very Strongly Disagree | Strongly Disagree | Disagree | Neither | Agree | Strongly Agree | Very Strongly Agree |
|---|---|---|---|---|---|---|---|
| The success of my global team depends entirely on the team delivering results. | | | | | | | |
| My global team makes fast decisions. | | | | | | | |
| Decisions made in the global team are of high quality. | | | | | | | |
| My global team has not been very successful in achieving its objectives | | | | | | | |
| Working on global teams has been a good experience for me | | | | | | | |
| Working together my team creates solutions that I could not create working alone. | | | | | | | |
| Working on global teams increases my technical expertise. | | | | | | | |
| An important information-sharing network has been created among members of my team. | | | | | | | |
| Working on the global team gives me access to useful knowledge I can get nowhere else. | | | | | | | |
| I derive great personal satisfaction from my work with the members of my team. | | | | | | | |
| I am satisfied with my individual performance on my global team | | | | | | | |
| I would enjoying work with my current team members on another global team | | | | | | | |
| Work on global teams helps my long-term career objectives. | | | | | | | |
| I enjoy working on global teams | | | | | | | |
| My global team members have no input in my individual performance appraisal | | | | | | | |
| I know exactly how my performance is measured on this team. | | | | | | | |
| I think my global team could have performed a lot better | | | | | | | |
| My global team leader provides formal input in my individual performance appraisal | | | | | | | |
| Concerns about individual promotion and career advancement have an impact on the performance of the global team members. | | | | | | | |
| I do not plan on networking with members of this global team for other projects. | | | | | | | |
| My work on the global team helps my local site achieve its performance metrics | | | | | | | |
| I feel that I have increased my ability to work in a global community | | | | | | | |
| My performance in global teams enhances the reputation of my local site | | | | | | | |

End of this worksheet - Please go to the next worksheet by clicking on the Sup tab at the bottom of this screen.

Figure B-19: Survey in `Microsoft Excel` format (Team Outcomes)

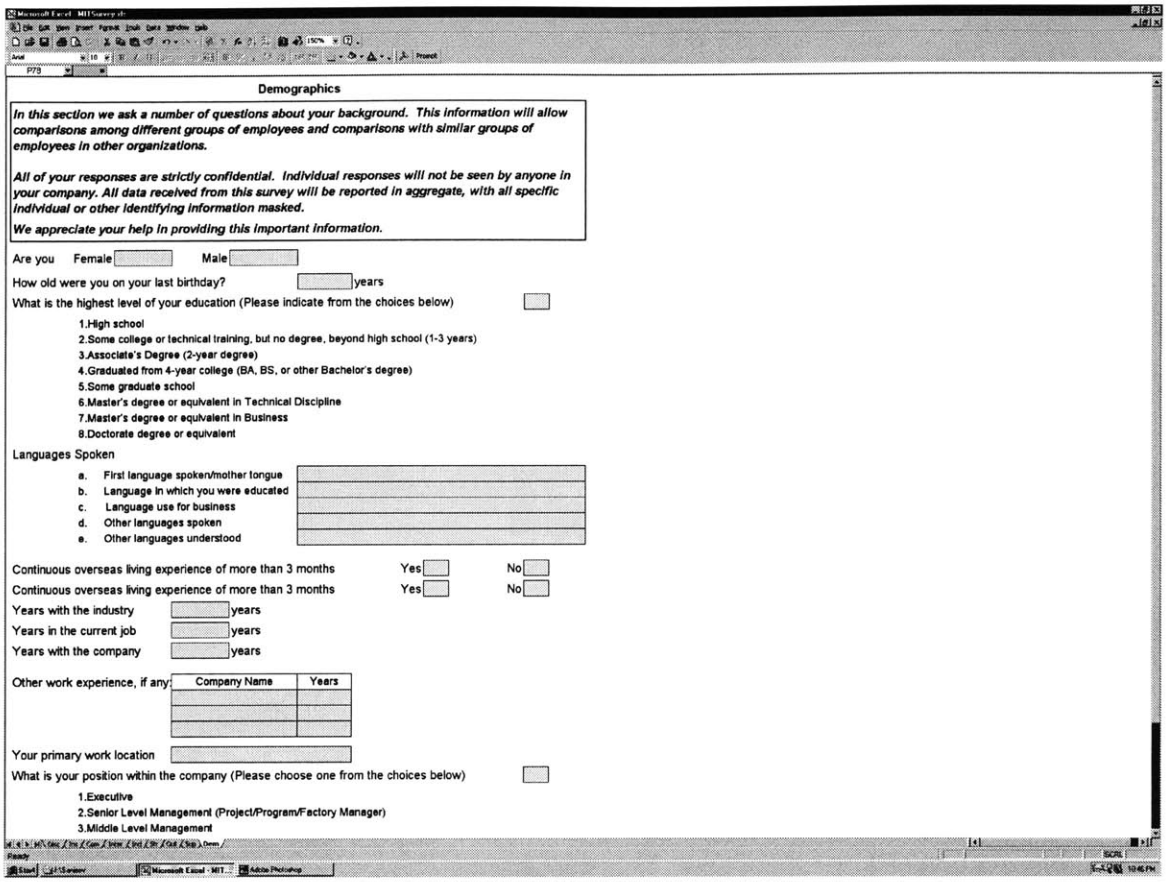


**Team Support**

Please indicate the degree to which you agree or disagree with each of the following statements based on the support received by the team.

| | Very Strongly Disagree | Strongly Disagree | Disagree | Neither | Agree | Strongly Agree | Very Strongly Agree |
|---|---|---|---|---|---|---|---|
| Considering the company as a whole, globally dispersed teams are successful. | | | | | | | |
| Company leadership does not understand the major concerns facing global teams in meeting discussions | | | | | | | |
| Company provided cross-cultural training classes to help its employees work effectively on global teams | | | | | | | |
| The team is a global initiative, but the company has no global structure of policies and procedures to support it | | | | | | | |
| Local supervisors chose members of my global team. | | | | | | | |
| Functional department goals take priority over the goals of the global team | | | | | | | |
| No matter how global the focus of some of my work is, it is what I do locally that gets rewarded. | | | | | | | |
| Any rewards I receive for my work with the team must come from my local supervisors | | | | | | | |
| Work on global teams is weighted equally with functional department work on performance evaluations. | | | | | | | |
| All global team members identify with a corporate culture. | | | | | | | |
| My local supervisor supports global teams as long as they don't disrupt local activities. | | | | | | | |
| Local needs are taken into account in global team decisions outside global team meetings | | | | | | | |
| My local site readily implements the recommendations of the global team team meetings | | | | | | | |
| Local management does not understand how to support its employees when they work on globally dispersed teams | | | | | | | |
| My local supervisor understands the goals of the globally dispersed team | | | | | | | |
| Contributions of the local sites in global teams are not as appreciated as they should be | | | | | | | |
| My local supervisor doesn't understand the importance of my work on the global team. | | | | | | | |
| Global teams have made a significant impact on the way the company does business. | | | | | | | |
| Company provides the global team with all the material resources (e.g. money for equipment, computers) needed to make it successful | | | | | | | |
| Travel funds are not always available for the global team to do its work | | | | | | | |
| The company is promoting cross-cultural working relationships among its workforce | | | | | | | |
| It is clear in this company that employees are valued equally for their contribution no matter what site they come from | | | | | | | |

Figure B-20: Survey in `Microsoft Excel` format (Team Support)



**Demographics**

***In this section we ask a number of questions about your background. This information will allow comparisons among different groups of employees and comparisons with similar groups of employees in other organizations.***

***All of your responses are strictly confidential. Individual responses will not be seen by anyone in your company. All data received from this survey will be reported in aggregate, with all specific individual or other identifying information masked.***

***We appreciate your help in providing this important information.***

Are you Female Male

How old were you on your last birthday? years

What is the highest level of your education (Please indicate from the choices below)

1.High school
2.Some college or technical training, but no degree, beyond high school (1-3 years)
3.Associate's Degree (2-year degree)
4.Graduated from 4-year college (BA, BS, or other Bachelor's degree)
5.Some graduate school
6.Master's degree or equivalent in Technical Discipline
7.Master's degree or equivalent in Business
8.Doctorate degree or equivalent

Languages Spoken

a. First language spoken/mother tongue
b. Language in which you were educated
c. Language use for business
d. Other languages spoken
e. Other languages understood

Continuous overseas living experience of more than 3 months Yes No

Continuous overseas living experience of more than 3 months Yes No

Years with the industry years

Years in the current job years

Years with the company years

Other work experience, if any:

| Company Name | Years |
|---|---|
| | |
| | |
| | |

Your primary work location

What is your position within the company (Please choose one from the choices below)

1.Executive
2.Senior Level Management (Project/Program/Factory Manager)
3.Middle Level Management

Figure B-21: Survey in `Microsoft Excel` format (Demographics)

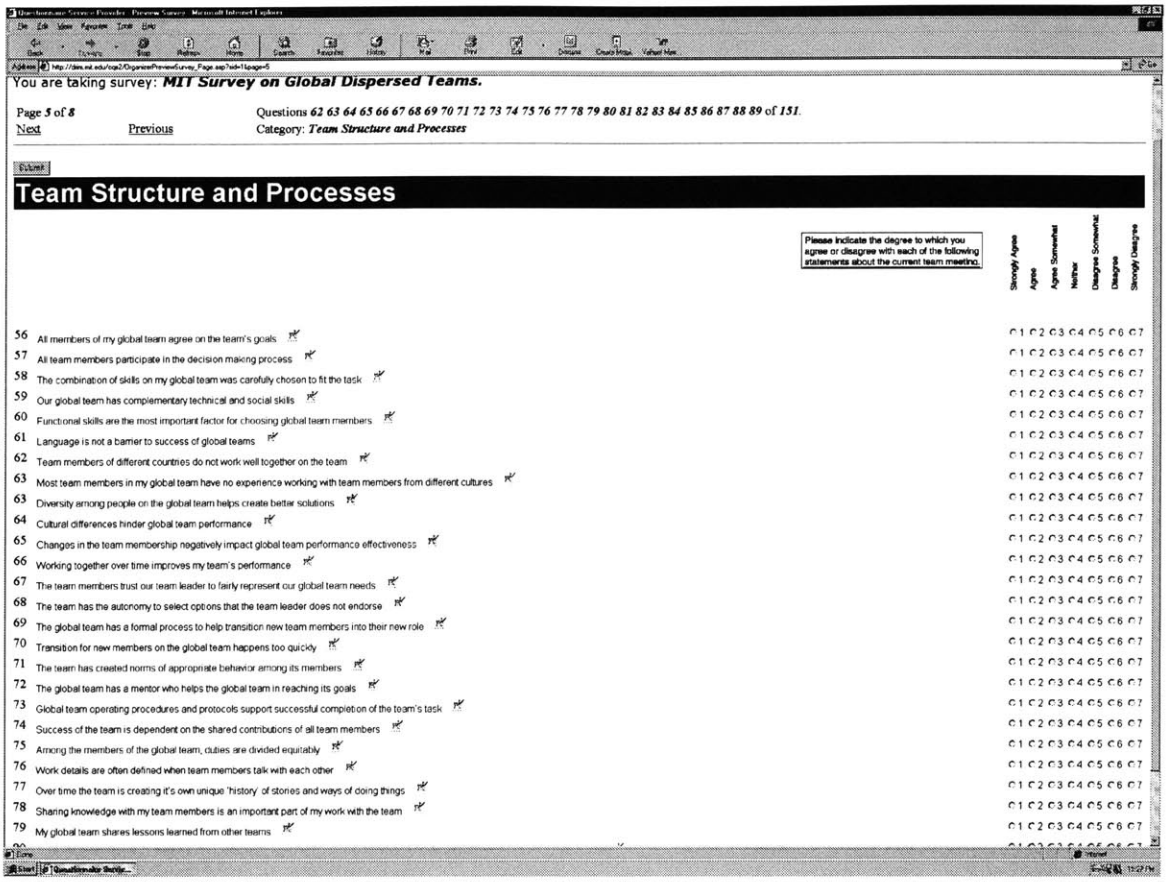



Figure B-22: Survey offered over the Web

# Appendix C

# Discussion on Surveys

This appendix provides in a nutshell the steps to be undertaken for creating a survey instrument used for quantitative social science research. By no means are the steps exhaustive and are highlighted to give a first-time reader a brief introduction to the survey creation process.

Surveys are a common data collection technique. The term "survey" generally refers to collecting data in a standardized form from a specific group of subjects. Today the word "survey" is used most often to describe a method of gathering information from a sample of individuals. This "sample" is usually just a fraction of the population being studied. In a bona fide survey, the sample is not selected haphazardly or only from persons who volunteer to participate. It is scientifically chosen so that each person in the population will have a measurable chance of selection. This way, the results can be reliably projected from the sample to the larger population.

Information is collected by means of standardized procedures so that every individual is asked the same questions in more or less the same way. The survey's intent is not to describe the particular individuals who, by chance, are part of the sample but to obtain a composite profile of the population. The industry standard for all reputable social sciences research is that individual respondents should never be identified in reporting survey findings. All of the survey's results should be presented in completely anonymous summaries, such as statistical tables and charts.

Surveys can be classified in many ways. One dimension is by size and type of

sample. Surveys can be classified by their method of data collection. Mail, telephone interview, and in-person interview surveys are the most common. One can further classify surveys by their content. Some surveys focus on opinions and attitudes (such as a pre-election survey of team members), while others are concerned with factual characteristics or behaviors (such as team member's education, work experience).

Many surveys combine questions of both types. Respondents may be asked if they have heard or read about an issue ... what they know about it ... their opinion ... how strongly they feel and why... their interest in the issue ... past experience with it ... and certain factual information that will help the survey analyst classify their responses (such as age, gender, work experience, and place of residence). Questions may be open-ended ("Why do you feel that way?") or closed ("Do you approve or disapprove?").

The confidentiality of the data supplied by respondents is of prime concern to all reputable survey organizations. Several research and professional organizations dealing with survey methods have codes of ethics (for example, Federal mandate (45 CFR 46) and long-standing M.I.T. policy requires that the Committee on the Use of Humans as Experimental Subjects (COUHES) review and approve all research involving human subjects. COUHES approval must be obtained before any human studies are begun). These codes of ethics prescribe rules for keeping survey responses confidential. The recommended policy for survey organizations to safeguard such confidentiality includes

- Including a standardized disclaimer on the front of the research instrument.
- Clarifying the confidentiality disclaimer up-front before starting the survey process.
- Using only number codes to link the respondent to a questionnaire and storing the name-to-code linkage information separately from the questionnaires.
- Refusing to give the names and addresses of survey respondents to anyone outside the survey organization, including clients and research sponsors.

- Destroying questionnaires and identifying information about respondents after the responses have been entered into the computer.
- Omitting the names and addresses of survey respondents from computer files used for analysis.
- Presenting statistical tabulations by broad enough categories so that individual respondents cannot be singled out.

It should be noted that surveys can be both deductive and inductive in approach. A deductive approach is often taken when a survey is being used to assess causal relationships. In this case the reliability of data collection and the statistical manipulation of the variables are the major strengths of the method. Surveys can, however, be used for exploratory research, in which case the questions tend to be open-ended and the approach inductive. Whether the approach is deductive or inductive, there are certain stages to bear in mind during the design of the survey.

1. Selecting the survey population. This might be (unusually) a complete population or, more commonly, a sample.
2. Design the interview/questionnaire:
    - Preparatory work - prepare preliminary questions.
    - Format and layout - create an appealing instrument.
    - More detailed question content - checking question format.
    - Pre-testing - ensure the questions give consistent answers.
3. Prepare information systems to collect questionnaire data
4. Training interviewers (in the case of interviews).
5. Code the data.
6. Analyze the data.

# Bibliography

Adelman, L., Christian, M., Gualtieri, J. & Bresmick, T. (1998). Examining the effects of communication training and team composition on the decision making of patriot air defense teams, *IEEE Transactions on Systems, Man, and Cybernetics - Part A: Systems and Humans* **28**(6): 729–741.

Ahuja, M. & Carley, K. (1998). Network structure in virtual organizations, *Journal of Computer-Mediated Communications* **3**(4).

Alavi, M., Wheeler, B. & Valacich, J. (1996). Using it to re-engineer business education: An exploratory investigation of collaborative telelearning, *MIS Quarterly* **19**: 293–312.

Alavi, M. & Yoo, Y. (1997a). Is learning in virtual teams real?, *Working Paper 97-095*, Harvard Business School, Harvard Business School, Allston, Massachusetts.

Alavi, M. & Yoo, Y. (1997b). Leadership emergence in virtual team environments, *Working Paper 97-097*, Harvard Business School, Harvard Business School, Allston, Massachusetts.

Allee, V. (1997). *The Knowledge Evolution: Expanding Organizational Intelligence*, Butterworth-Heineman, Woburn, Massachusetts.

Allen, T. & Hauptman, O. (1990). The substitution of communication technologies for organizational structure in research and development, *in* J. Fulk & C. Steinfeld (eds), *Organizations and Communication Technology*, Sage Publications, Newbury Park, California, pp. 275–294.

Ancona, D. & Caldwell, D. (1992). Bridging the boundary: External activity and performance in organizational teams, *Administrative Science Quarterly* **37**: 634–665.

Andriessen, J. (1995). The why, how and what to evaluate of interaction technology: A review and proposed integration, *in* P. Thomas (ed.), *(CSCW) Requirements and Evaluation*, Springer, New York, pp. 107–124.

Armstrong, D. & Cole, P. (1995). Managing distances and differences in geographically distributed work groups, *in* S. Jackson & M. Ruderman (eds), *Diversity in Work Teams*, American Psychological Association, Washington, DC, pp. 187–215.

Ash, J. (1997). State of the art among early adopters of knowledge management. White Paper published by Knowledge Incorporated.

Athanasiou, R. & Yoshioka, G. (1973). The spatial character of friendship formation, *Environment and Behavior* **5**: 43–65.

Bantel, K. (1993). Top team, environment, and performance effects on strategic planning formality, *Group and Organization Management* **18**(4): 436–458.

Bantel, K. & Jackson, S. (1989). Top management and innovations in banking: Does the composition of the top team make a difference?, *Strategic Management Journal* **10**: 107–124.

Bass, B. (1990). *Bass and Stogdill's Handbook of Leadership: Theory, Research, and Management Application*, third edn, The Free Press, New York.

Becker, F. & Steel, F. (1995). *Workplace by Design: Mapping the High-Performance Workspace*, Jossey-Bass Management Series, San Francisco, California.

Bentler, P. (1980). Multivariate analysis with latent variables: Causal modeling, *Annual Review of Psychology* **31**: 11–21.

Bentler, P. (1990). Comparative fit indices in structural models, *Psychological Bulletin* **107**: 238–246.

Boland, R., Tenkasi, R. & Te'eni, D. (1994). Designing information technology to support distributed cognition, *Organization Science* **5**(3): 456–475.

Bowers, J. (1994). The work to make a network work: Studying (cscw) in action, *Proceedings of the ACM*, Conference on CSCW'94, pp. 287–297.

Brand, S. (1995). *How Buildings Learn: What Happens After They are Built*, Penguin, New York.

Brooking, A. & Motta, E. (1996). A taxonomy of intellectual capital and a methodology for auditing it. Paper presented at the 17th Annual National Business Conference, McMaster University, Ontario, Canada (24-26 Jan).

Byrne, B. (1994). *Structural Equation Modeling with EQS and EQS/Windows*, Sage Publications, Newbury Park, California.

Byrne, J. (1993). The virtual corporation, *Business Week* **3304**: 98–102.

Campbell, T., Gillaspy, J. & Thompson, B. (1995). The factor structure of the bem sex-role inventory (bsri): A confirmatory factor analysis. Paper presented at the annual meeting of the Southwest Educational research Association, Dallas. (ERIC Document Reproduction Service No. ED 380 491).

Campion, M., Medsker, G. & Higgs, A. (1993). Relations between work group c characteristics and effectiveness: Implications for designing effective work groups, *Personnel Psychology* **46**: 823–850.

Carr, S. (1992). A primer on the use of q sort technique factor analysis, *Measurement and Evaluation in Counseling and Development* **25**: 133–138.

Chernier, D. & Picasso, M. (2000). *Enabling globally distributed teams*, Master's thesis, Sloan Fellows Thesis Massachusetts Institute of Technology.

Chidambaram, L. & Jones, B. (1993). Impact of communication medium and computer support on group perceptions and performance: A comparison of face-to-face and dispersed meetings, *MIS Quarterly* **17**(4): 465–491.

Cohen, S., Ledford, G. & Spreitzer, G. (1996). A predictive model of self-managing work team effectiveness, *Human Relations* **49**(5): 643–675.

Cook, T. & Campbell, D. (1979). *Quasi-experimentation: Design and analysis issues for field settings*, Rand-McNally, Chicago, Illinois, chapter 3.

Coutu, D. (1998). Organization: Trust in virtual teams, *Harvard Business Review* **76**: 20–21.

Cox, T. (1993). *Cultural Diversity in Organizations: Theory, Research and Practice*, Berrett-Koehler, San Francisco, California.

Cramton, C. (1997). Information problems in dispersed team, *in* L. Dosier & J. Keys (eds), *Academy of Management Best Papers Proceedings*, Georgia, Southern University, pp. 298–302.

Cronbach, L. (1951). Coefficient alpha and the internal structure of tests, *Psychometrika* **16**(3): 297–333.

Curtis, B., Hefley, W. & Miller, S. (1995). People capability maturity model ™, *Working Paper CMU/SEI-95-MM-002 ADA 200822*, Software Engineering Institute, Carnegie Mellon University, Pittsburgh, Pennsylvania.

Daniel, L. (1989). Comparisons of exploratory and confirmatory factor analysis. Paper presented at the annual meeting of the Southwest Educational Research Association, Little Rock. (ERIC Document Reproduction Service No. ED 314 447).

Davenport, T. (1997). *Information Ecology*, Oxford University Press, New York, New York.

Davidow, W. & Malone, M. (1993). *The Virtual Corporation: Structuring and Revitalizing the Corporation of the 21st Century*, Harper Collins, New York, New York.

Davison, S. (1994). Creating a high performing international team, *Journal of Management Development* **13**: 81–90.

Davison, S., Hambrick, D., Snell, S. & Snow, C. (1996). Use transnational teams to globalize your company - part i, *Organizational Dynamics* pp. 50–67.

Davison, S. & Ward, K. (1999). *Leading International Teams*, McGraw Hill, United Kingdom.

DeMuese, K. & Liebowitz, S. (1981). An empirical analysis of the team building research, *Group and Organization Studies* **6**(4): 357–378.

DeSanctis, G. & Monge, P. (1998). Collaboration processes for virtual organizations, *Journal of Computer-Mediated Communications* **3**(4).

Duarte, D. & Snyder, N. (1999). *Mastering Virtual Teams: Strategies, Tools, and Techniques That Succeed*, first edn, Jossey-Bass, San Francisco, California.

Eisenhardt, K. (1989). Building theories from case study research, *Academy of Management Review* **14**(4): 532–550.

Eunice, A. & Kimball, L. (1997). Zen and the art of facilitating virtual teams, *Proceedings of the Organization Development Network Annual Conference, October 4-8.*

Finley, M. (1995). Toward a definition of groupware, *Managing Office Technology* **4**(10).

Frederickson, J. & Iaquinto, A. (1989). Inertia and creeping rationality in strategic decision processes, *Academy of Management Journal* **32**: 516–542.

Fulk, J. & DeSanctis, G. (1995). Electronic communication and changing organizational forms, *Organization Science* **6**: 337–349.

Gerber, B. (1995). Virtual teams, *Training* pp. 36–40.

Gladstein, D. (1984). Groups in context: A model of task group effectiveness, *Administrative Science Quarterly* **29**: 499–517.

Goddard, J. (1992). New technology and the geography of the uk information economy, *in* K. Robbins (ed.), *Understanding information business technology and geography*, Belhaven Press, London, United Kingdom, pp. 178–201.

Goodman, P. & Sproull, L. (1990). *Technology and Organizations*, Jossey-Bass, San Francisco, California.

Gorton, I. & Motwani, S. (1996). Issues in co-operative software engineering using globally distributed teams, *Information and Software Technology* **38**: 647–655.

Grenier, R. & Metes, G. (1995). *Going Virtual: Moving Your Organization into the 21st Century*, Prentice Hall, Englewood Cliffs, New Jersey.

Hackman, J. (1987). The design of work teams, *in* J. Lorsch (ed.), *Handbook of Organizational Behavior*, Prentice Hall, Englewood Cliffs, New Jersey, pp. 315–342.

Hackman, J. (1990). Introduction, *in* J. Hackman (ed.), *Groups that Work (and Some that Don't): Creating Conditions for Effective Teamwork*, Jossey-Bass, San Francisco, California, pp. 1–17.

Hambrick, D., Cho, T. & Chen, M. (1996). The influence of top management heterogeneity on firms' competitive moves, *Administrative Science Quarterly* **41**: 659–684.

Hamlin, C. (1994). Team building a global team at apple computer, *Employee Relations Today* **21**(1): 55–62.

Handy, C. (1995). Trust and the virtual organization, *Harvard Business Review* **73**: 40–50.

Hartman, F. & Ashrafi, R. (1996). Virtual organizations - an opportunity for learning, *Proceedings of the 1996 International Conference on Engineering and Technology (IEMC '96) Vancouver, Canada*, pp. 201–205.

Hartman, F. & Guss, C. (1996). Virtual teams: Constrained by technology or culture?, *Proceedings of the 1996 International Conference on Engineering and Technology (IEMC '96) Vancouver, Canada*, pp. 185–190.

Haywood, M. (1998). *Managing Virtual Teams: Practical Techniques for High-Technology Project Managers*, Artech House Publishers, Boston, Massachusetts.

Heller, R. (1994). Survival of the globally adapted, *Management Today* .

Henry, J. & Hartzler, M. (1998). *Tools for Virtual Teams: A Team Fitness Model*, McGraw-Hill, New York, chapter 2-5.

Hequet, M., Lee, C., Picard, M. & Stamps, D. (1996). Teams get global, *Training* .

Hightower, R. & Sayeed, L. (1996). Effects of communication mode and prediscussion information distribution characteristics on information exchange in groups, *Information Systems Research* **7**(4): 451–465.

Hirsh, S. & Kusnserow, J. (1990). *Introduction to Type in Organizations-Individual Interpretive Guide*, first edn, Consulting Psychologists Press, Palo Alto, California.

Hofstede, G. (1980). *Culture's consequences: International differences in work-related values*, Sage Publications, Newbury Park, California.

Hofstede, G. (1991). *Cultures and organizations: Software of the mind*, McGraw-Hill, London, United Kingdom.

Horgen, T., Schon, D., Porter, W. & Joroff, M. (1998). *Excellence by Design: Transforming Workplace and Work Practice*, first edn, John Wiley & Sons, New York.

Howell, J., Bowden, D., Dorfman, P., Kerr, S. & Podsakoff, P. (1990). Substitutes for leadership: Effective alternatives to ineffective leadership, *Organizational Dynamics* **19**: 20–38.

Humphrey, W. (1997). *Managing Technical People: Innovation, Teamwork, and the Software Process*, Addison Wesley, Reading, Massachusetts.

Hussein, K. (1998). *Computer Supported Interactions in Distributed Design Teams*, PhD thesis, Massachusetts Institute of Technology.

III, C. O., Snyder, R. & Boothe, J. (1993). Effects of executive team demography on organizational change, *in* G. Huber & W. Glick (eds), *Organizational change and redesign: Ideas and insights for improving performance*, Oxford, New York, pp. 147–175.

Ives, B. & Jarvenpaa, S. (1996). Will the internet revolutionize business education and research?, *Sloan Management Review* **37**(3): 33–41.

Jarvenpaa, M., Knoll, K. & Leidner, D. (1998a). Communication and trust in global virtual teams, *Journal of Computer-Mediated Communications* **3**(4).

Jarvenpaa, M., Knoll, K. & Leidner, D. (1998b). Is anybody out there? antecedents of trust in global virtual teams, *Journal of MIS* **14**(4): 29–64.

Jarvenpaa, S. & Ives, B. (1994). The global network organization of the future: Information management opportunities and challenges, *Journal of MIS* **10**(4): 25–57.

Joreskog, K. & Sorbom, D. (1989). *LISREL 7: A guide to the program and applications*, second edn, SPSS, Chicago, Illinois.

Judd, C., Smith, E. & Kidder, L. (1991). *Research Methods in Social Relations*, sixth edn, Holt Rinehart & Winston, Orlando, Florida.

Jude-York, D., Davis, L. & Wise, S. (2000). *Virtual Teaming*, Crisp Publications, Menlo Park, California.

Katzenbach, J. & Smith, D. (1993). The discipline of teams, *Harvard Business Review* pp. 111–120.

Katzenbach, J. & Smith, D. (1994). *The Wisdom of Teams: Creating the High-Performance Organization*, Harvard Business School Press, Boston, Massachusetts.

Keck, S. (1997). Top management team structure: Differential effects by environmental context, *Organization Science* **8**(2): 143–156.

Keen, P. (1987). Telecommunications and organizational choice, *Communication Research* **14**(5): 588–606.

Keirsey, D. & Bates, M. (1984). *Please Understand Me : Character and Temperament Types*, fifth edn, Prometheus Nemesis Book Company, Del Mar, California.

Kielser, S., Siegel, J. & McGuire, T. (1984). Social psychological aspects of computer-mediated communication, *American Psychologist* **39**(10): 1123–1134.

King, N. (1998). Template analysis, *in* G. Symon & C. Cassell (eds), *Qualitative Methods and Analysis in Organizational Research: A Practical Guide*, second edn, Sage Publications, Newbury Park, California, pp. 118–134.

Klein, J. & Barrett, B. (2000). One foot in a global team, one foot at the local site: Making sense out of living in two worlds simultaneously. Paper presented at the 2000 Individual, Team, and Organizational Effectiveness Symposium at University of North Texas.

Kostner, J. (1996). *Virtual Leadership: Secrets from the Round Table*, Warner, New York.

Krauss, R. & Fussell, S. (1990). Mutual knowledge and communicative effectiveness, *in* R. K. J. Galegher & C. Egido (eds), *Intellectual Teamwork: The Social and Technological Bases of Cooperative Work*, Erlbaum, Hillsdale, New Jersey, pp. 111–144.

Kurland, N. & Bailey, D. (1999). The advantages and challenges of working here, there, anywhere and anytime, *Organizational Dynamics* **8**(2): 193–206.

Kurland, N. & Egan, T. (1999). Telecommuting: Justice and control in the virtual organization, *Organization Science* **10**(4): 500–513.

Kydd, C. & Ferry, D. (1991). A behavioral view of computer supported cooperative work tools, *Journal of Management Systems* **3**(1): 55–67.

Lacoursiere, R. (1980). *The Life Cycle of Groups: Group Development Stage Theory*, Human Service Press, New York.

Larson, C. & LaFasto, F. (1989). *Teamwork: What Must Go Right, What Can Go Wrong*, Sage Publications, Newbury Park, California.

Latane, B., Liu, J., Nowak, A., Bonevento, M. & Zheng, L. (1995). Distance matters: Physical space and social impact, *Personality and Social Psychology Bulletin* **21**(8): 795–805.

Li, F. (1995). *he Geography of Business Information*, John Wiley and Sons, New York.

Li, F. & Williams, H. (1999). Organizational innovations through information systems: Some lessons from geography, *in* L. Brooks & C. Kimble (eds), *Information Systems - The Next Generation. Proceedings of the Fourth UKAIS Conference*, McGraw-Hill, London, United Kingdom, pp. 471–485.

Lindstaedt, S. & Schneider, K. (1997). Bridging the gap between face-to-face communication and long-term communication, *Proceedings of the International ACM SIGGROUP*, Conference on Supporting Group Work: the Integration Challenge, pp. 331–340.

Lipnack, J. & Stamps, J. (2000). *Virtual Teams: Reaching across Space, Time and Organizations with Technology*, second edn, John Wiley & Sons, New York.

Manz, C. & Sims, H. (1993). *Business Without Bosses: How Self-Managing Teams are Building High-Performing Companies*, second edn, John Wiley & Sons, New York.

Maruca, R. (1994). The right way to go global: An interview with whirlpool ceo david whitwam, *Harvard Business Review* pp. 111–120.

Mattessich, P. & Monsey, B. (1992). *Collaboration: What makes it work. A review of research literature on factors influencing successful collaboration*, Amherst Wilder Foundation, St. Paul, Minesotta.

McGarry, D. (1994). Playing on both the home and away teams, *Business Quarterly* **59**(2).

McGrath, J. (1964). Toward a theory of method for research on organizations, *in* W. Cooper, L. Leavitt & M. Shelly (eds), *New perspectives in organizational research*, John Wiley, Summerset, New Jersey, pp. 533–547.

McGrath, J. & Hollingshead, A. (1994). *Groups Interacting with Technology*, first edn, Sage Publications, Thousand Oaks, California.

McGrath, M. & Hoole, R. (1992). Manufacturing's new economies of scale, *Harvard Business Review* .

McShane, S. & Gilnow, M. V. (2000). *Organizational Behavior*, McGraw Hill, Boston, Massachusetts.

Meglino, B., Ravlin, E. & Adkins, C. (1989). A work values approach to corporate culture: A field test of the value congruence process and its relationship to individual outcomes, *Journal of Applied Psychology* **74**: 424–432.

Melymuka, K. (1997). Virtual realities: Need for teamwork across geographical boundaries, *Computerworld* **31**(17).

Miller, P., Pans, J. & Naude, P. (1996). Global teams, *Financial Times* **33009**.

Monk, A. & Watts, L. (1998). Peripheral participants in mediated communication, *Human Factors in Computing Systems Conference Proceedings, CHI'98*, pp. 285–286.

Mulaik, S. (1987). A brief history of the philosophical foundations of exploratory factor analysis, *Multivariate Behavioral Research* **22**: 267–305.

Myers, J. & McLean, J. (1997). Knowledge management for citizens' advice in the 21st century; an innovative is strategy, *Proceedings of the IRIS 20 Conference, Norway, August 9-12.*

Nash, S. (1999). *Turning Team Performance Inside Out : Team Types and Temperament for High-Impact Results*, Davies-Black Publications.

Nohria, N. & Eccles, R. (1992). Face-to-face: Making network organizations work, *in* N. Nohria & R. Eccles (eds), *Networks and Organizations: Structure, Form and Action*, Harvard Business School Press, Boston, Massachusetts, pp. 288–301.

O'Hara-Devereaux, M. & Johansen, R. (1994). *Globalwork: Briding Distance, Culture and Time*, Jossey-Bass Management Series, San Francisco, California.

Pearce, J. & Ravlin, E. (1987). The design and activation of self regulating work groups, *Human Relations* **11**: 751–782.

Pelled, L., Eisenhardt, K. & Xin, K. (1999). Exploring the black box: An analysis of work group diversity, conflict, and performance, *Administrative Science Quarterly* **44**: 1–28.

Peña-Mora, F. (1999). The disel handbook 1999-2000. MIT Intelligent Engineering Systems Laboratory Technical Report.

Rayner, S. (1996). *Team Traps*, first edn, John Wiley & Sons, New York.

Rice, R. & Gattiker, U. (1999). New media and organizational structuring of meanings and relations, *in* F. Jablin & L. Putnam (eds), *New Handbook of Organizational Communication*, Sage Publications, Newbury Park, California, pp. 554–581.

S. Mulaik, L. James, J. v. A., Bennett, N. & Lind, S. (1989). Evaluation of goodness-of-fit indices for structural equation models, *Psychological Bulletin* **105**: 430–455.

Sarker, S., Lau, F. & Sahay, S. (1999). Building an inductive theory of collaboration in virtual teams: an adapted grounded theory approach. Paper presented at the Hawaii International Conference in Systems Science, 1999.

Scharlott, B. & Christ, W. (1995). Overcoming relationship initiation barriers: The impact of a computer-dating system on sex role, shyness, and appearance inhibitions, *Computers in Human Behavior* **11**(2): 191–204.

Schrage, M. (1995). *No More Teams! : Mastering the Dynamics of Creative Collaboration*, reprint edn, Currency/Doubleday Random House, New York.

Sen, S. (2001). *Globally dispersed project teams: Interaction space management*, Master's thesis, Master of Science Thesis Massachusetts Institute of Technology.

Shea, G. & Guzzo, R. (1987). Groups and human resources, *in* K. Rowland & G. Ferris (eds), *Research in human resources and personnel management (Vol. 5)*, JAI Press, Greenwich, Connecticut, pp. 323–356.

Simons, T., Pelled, L. & Smith, K. (1999). Making use of difference: Diversity, debate, and decision comprehensiveness in top management teams, *Academy of Management Journal* **42**(6): 662–673.

Smith, P. & Kearny, L. (1994). *Creating Workplaces Where People Can Think*, Jossey-Bass Management Series, San Francisco, California.

Snow, C., Snell, S., Davison, S. & Hambrick, D. (1996). Using transnational teams to globalize your company, *Organizational Dynamics* **24**(4): 50–67.

Sproull, L. & Kiesler, S. (1991). *Connections: New Ways of Working in the Networked Organization*, first edn, MIT Press, Cambridge, MA.

Steiner, I. (1972). *Group process and productivity*, Academic Press, New York.

Stevens, J. (1996). *Applied multivariate statistics for the social sciences*, third edn, Lawrence Erlbaum Associates, Mahwah, New Jersey.

Straus, S. & McGrath, J. (1994). Does the medium matter? the interaction of task type and technology on group performance and member reactions, *Journal of Applied Psychology* **79**(1): 87–97.

Streitz, N., Geibler, J. & Holmer, T. (1998). Roomware for cooperative buildings: Integrated design of architectural spaces and information spaces, *in* N. Streitz, S. Konomi & H. Burkhardt (eds), *Cooperative Buildings - Integrating Information, Organization, and Architecture. Proceedings of CoBuild '98, Darmstadt, Germany, LNCS Vol. 1370*, Springer, Heidelberg, Germany, pp. 4–21.

Sundstorm, E., Meuse, K. D. & Futrell, D. (1990). Work teams: Application and effectiveness, *American Psychologist* **45**: 120–133.

Townsend, A., DeMarie, S. & Hendrickson, A. (1998). Virtual teams: Technology and the workplace of the future, *Academy of Management Executive* **12**(3): 17–29.

Tuckman, B. (1965). Developmental sequence in small groups, *Psychological Bulletin* **63**: 384–399.

Tuckman, B. & Jensen, M. (1977). Stages of small-group development revisited, *Group and Organization Studies* **2**: 419–442.

Vadhavkar, S. & Peña-Mora, F. (2000). Geographically distributed team interaction space, *in* R. Fruchter, F. Peña-Mora & W. Roddis (eds), *Computing in Civil and Building Engineering, Proceedings of the Eighth International Conference (ICCCBE - VIII), Stanford University*, pp. 373–379.

Warkentin, M., Sayeed, L. & Hightower, R. (1998). Virtual teams versus face-to-face teams: An exploratory study of web-based conference system, *Decision Sciences* **28**(4): 975–995.

Whitmore, J. (1996). *Coaching for Performance (People Skills for Professionals*, second edn, Nicholas Brealey Publishing, London, United Kingdom.

Yin, R. (1994). *Case Study Research: Design and Methods*, revised edn, Sage Publications, Newbury Park, California.

Zelinsky, M. (1998). *New Workplaces for New Workstyles*, McGraw-Hill, New York.