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## **Virtual Teams: an Investigation of the Determinants of Team Effectiveness and the Contribution of Managerial Behavior Control.**

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**VIRTUAL TEAMS: AN INVESTIGATION OF  
THE DETERMINANTS OF TEAM  
EFFECTIVENESS AND THE CONTRIBUTION  
OF MANAGERIAL BEHAVIOR CONTROL**

**A Dissertation**

**Submitted to the Graduate Faculty of the  
Louisiana State University and  
Agricultural and Mechanical College  
in partial fulfillment of the  
requirements for the degree of  
Doctor of Philosophy**

**in**

**The Interdepartmental Program in  
Business Administration  
(Information Systems and Decision Sciences)**

**by**

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**Laurea, Universita' di Pavia, 1995**

**M.B.A., Louisiana State University, 1998**

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*A Margaret,*

*Senza la cui comprensione e  
l'incessante aiuto questo lavoro  
sarebbe stato impossibile.*

*A Mamma e Papa',*

*Il cui esempio ed i cui insegnamenti  
mi hanno permesso di arrivare a  
questo punto.*

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## **ABSTRACT**

Information Technology is providing the backbone for development of new organizational forms. Virtual teams represent one such organizational form that has the potential to change the workplace and provide organizations with increased levels of flexibility and responsiveness. Many organizations are recognizing these potential benefits and are implementing virtual teams.

A gap exists in the current Information Systems literature. No previous study has looked at the role of managerial control mechanisms in fostering virtual team effectiveness. This study contributes a model of virtual team effectiveness based on an extension of research in traditional environments. The contribution of managerial behavior control practices to virtual team effectiveness is evaluated through a field experiment juxtaposing self-directed teams with virtual teams where managerial behavior control is enforced. Two hundred and one graduate and undergraduate students enrolled in six geographically dispersed universities participated in the experiment. Fifty-one teams of three and four students worked together over an eight weeks period and completed two team projects. During completion of the main project, lasting five weeks, half of the teams were required to comply with a weekly reporting schedule while the others were allowed to self-direct.

Team effectiveness was measured in terms of team performance, individual psychosocial outcomes and team member viability. The results indicate that the managerial behavior control mechanism used had no effect on team performance and team member viability. Moreover, the findings indicate that behavior control had a negative effect on individual psychosocial outcomes. Post hoc qualitative research

based on the case study method suggests that the exclusive reliance on computer mediated communication, and the challenges to effective team coordination and communication posed by the virtual environment, made it difficult for the managed teams to faithfully appropriate the required reporting structure. Furthermore, the weekly progress reports created an environment where trust was easily breached.

These results suggest that simply adopting traditional control mechanisms in virtual teams may prove unsuccessful and even detrimental. They also indicate that managerial behavior control mechanisms may not be suited to the virtual environment. Based on the research findings, implications for research and practice are drawn.

# **INTRODUCTION**

**This chapter introduces the problem area and presents the new organizational forms that have been fostered by the changing competitive landscape that companies will face in the 21<sup>st</sup> century. Attention is primarily devoted to the Virtual Team, the focus of this research, and the promises that it holds according to its proponents. An important research void in current information systems research, namely the lack of attention to the managerial function in virtual teams, is addressed. Following is a discussion of research objectives for the study and the organization of this document.**

## **The Challenge**

**The extraordinary development of Information Technologies (IT) in the last two decades is supporting the development of new organizational forms (Fulk and DeSanctis, 1995; Jarvenpaa and Ives, 1994). These new organizational forms fall under a number of labels. For example, network organizations (Miles and Snow, 1992, 1986), virtual corporations (Davidow and Malone, 1992), and virtual organizations (Grenier and Metes, 1995).**

**While different names appear in the literature, researchers agree on the defining characteristics of these new organizational forms and the environmental factors that have made the need for such new organizational forms apparent (Grenier and Metes, 1995; Davidow and Malone, 1992; Miles and Snow, 1992, 1986). The new successful organizations are the ones that are organized in a dynamic network form that allows them to adapt to ever-changing competitive landscapes and customer requirements (Jarvenpaa and Ives, 1994). Increasing global competition, shortened product life cycles, the need for mass customization and higher levels of responsiveness to customer demands are among the new**

environmental circumstances driving organizational change (Grenier and Metes, 1995; Miles and Snow, 1992, 1986).

The exponential growth of IT and the virtual ubiquity of new communication tools that enable “anytime-anyplace” connectivity offer the backbone to support these dynamic networks. Technical issues, though, represent a minimal fraction of the challenges to successful migration to the new organizational form. The development of individual competencies, the ability of the work force to adjust to the new environment, the ability to coordinate the individual skills of strangers to produce interdependent work, the ability of organizations to modify their cultures to take advantage of the possibilities offered by the new environment, are just a few of the unknowns and challenges faced by organizations as they enter the 21<sup>st</sup> century.

## **The Promise**

One novel organizational form that has the potential to deliver unique strategic flexibility, and the building block of the virtual organization, is the Virtual Team (Duarte and Snyder, 1999; Townsend, et. al., 1998, Lipnack and Stamps, 1997).

Virtual teams are groups of geographically and organizationally dispersed knowledge workers that are brought together across time and space through information and telecommunication technologies on an "as needed basis" to cooperate on specific tasks, or to fulfill specific customer needs (Jarvenpaa and Leidner, 1998; DeSanctis and Poole, 1997; Lipnack and Stamps, 1997).

Jarvenpaa and Ives (1994) present an intriguing futuristic scenario in which organizations, in order to achieve and maintain positions of competitive advantage, "couple to, and decouple from, the networks of knowledge nodes" (p. 25). The backbone of such successful organizations of the future (or is it the present?), is the virtual team. It is composed of empowered employees who join forces with external consultants, clients, and suppliers to solve specific problems or to provide unique service as contingent situations may require (Jarvenpaa and Ives, 1994).

Information and telecommunication technologies serve as the enabler of the above process. Technological support for virtual teams is only recently becoming viable and cost effective. As a consequence, a growing number of organizations are implementing them or plan to implement them soon (Townsend et al. 1998; Lipnack and Stamps, 1997; Townsend, et al., 1996).

Virtual teams are touted as the key to organizational survival and prosperity in the 21<sup>st</sup> century, both in the academic and popular press (Lipnack and Stamps, 1997; Jarvenpaa and Ives, 1994). Proponents of this new organizational structure suggest that virtual teams will help companies face a number of challenges ranging from the continued shift from production to service environments (Townsend, et al., 1998), the shift toward cross-organizational strategic cooperation (Townsend, et al., 1998; Jarvenpaa and Ives, 1994), the need to cross geographical, temporal and organizational boundaries, and bring together dispersed talent (Jarvenpaa and Leidner, 1998; Lipnack and Stamps, 1997).

While the potential payoffs are great, new organizational forms may have a "dark side" that to date has gone unrecognized (Victor and Stephens, 1994).

Virtual teams, due to their limited ability to interact in a face-to-face environment, operate in a context that is dramatically different from that of their traditional counterparts. Authors have suggested that the dispersion of team members may engender low levels of trust and cooperation (Handy, 1995; Nohria and Eccles, 1992), a reduction in employees' well-being and satisfaction, (Victor and Stephens, 1994) and may ultimately reduce the overall ability of the team to perform adequately.

Organizations that implement virtual teams must be able to effectively use IT to rapidly mesh the individual skills of strangers into interdependent work products (Iacono and Weisband, 1997; Lipnack and Stamps, 1997). Further, more than technological problems, these new organizational forms may engender coordination and communication problems that lead to confusion and process losses (DeSanctis and Poole, 1997). Inability to identify and overcome the technical, structural, and social barriers posed by the virtual context will likely lead to failure rather than the promised benefits (Duarte and Snyder, 1999).

We have very limited knowledge of the organizational context and internal processes that lead to the successful implementations of virtual teams. The gap in the literature is described next, followed by a list of possible research questions and a discussion of the organization of this document.

## **Research Gap**

There is a growing interest in virtual teams because of their potential and their newly attained viability. Nevertheless, we have very limited knowledge of how

they will change group interaction and impact team effectiveness (Furst, et al., 1999; DeSanctis and Poole, 1997). In particular, we have almost no knowledge of the circumstances under which managerial control mechanisms might be beneficial.

Issues of team effectiveness and managerial behavior have received considerable attention in traditional collocated environments (see Guzzo and Dickson, 1996 for a review). Virtual teams, perhaps due to their novelty, have not yet attracted extensive research attention. The current considerable growth of virtual team adoption and their foreseeable ubiquity in organizations in the near future, though, call for immediate research attention (Furst, et al., 1999). As we are entering the "new organizational era" (Rousseau, 1997) a thorough understanding of such issues is crucial to ensure that virtual teams do indeed deliver on their promise.

Some theorists argue that the transition to teams in new organizational forms "may result in decreased use of formalized rules and procedures as control mechanisms." (DeSanctis and Poole, 1997 p. 168). They propose that "teams will rely less on formalized procedures and more on information retrieval and sharing systems to accomplish their work." (DeSanctis and Poole, 1997 p. 168). This foreseen trend seems very realistic. Thus, it is important to determine through rigorous research whether the increased flexibility and discretion will benefit the team and the organization at large. Conversely, it is arguable that greater levels of team self-control may engender increased confusion, decreasing individual responsibility, and may introduce a lack of accountability that could have drastic



repercussions at the team, organizational, and societal levels (Handy, 1995; Victor and Stephens, 1994).

Recently, information systems researchers have begun to investigate virtual teams. The focus of this early research though has been mainly on self-directed virtual teams – teams that can self-regulate their behavior on relatively whole tasks (Cohen and Ledford, 1994). For example, Alavi and Yoo (1997) studied learning in self-directed virtual teams of executives. Galegher and Kraut (1994) compared virtual teams using different communication media and collocated teams performing a collaborative writing exercise. All teams in the experiment were allowed to organize their work as they preferred. Jarvenpaa and colleagues (Jarvenpaa and Leidner, 1998; Jarvenpaa et al., 1998) studied global virtual teams over time focusing their research on trust within the team. The teams were provided with a schedule of deliverables but were able to self organize to complete their work. Yoo and Alavi (1998) studied leadership emergence in virtual project teams by investigating self-directed executive teams over a ten-week period.

No empirical study has explicitly investigated the impact of managerial control on virtual teams' effectiveness. While some descriptive and normative literature aimed to practitioners has been published on the subject (Duarte and Snyder, 1999; Haywood, 1998; Wardell, 1998; Lipnack and Stamps, 1997; Grenier and Metes, 1995; Kostner, 1994), no empirical research has focused on the impact of managerial controls on virtual team effectiveness.

A rich research tradition focuses on the impact of managerial involvement and control in collocated teams. Extending this research to the emerging virtual

environment is very important as the research findings may be strongly influenced by contextual variables (Janz, et al., 1997; McGrath, 1986). Consequently, the dynamics that emerge in virtual teams may differ substantially from those that develop in collocated ones. As Janz and his colleagues observe, "what constitutes 'effective team processes' or 'positive team context' may be different for teams of knowledge workers" (p. 878). Similarly, it should not be uncritically assumed that the findings emerging from the collocated team literature would hold true in the virtual environment (Furst, et al., 1999). Other researchers have called for empirical testing of the assumption that "previous theory and practice on traditional group processes and outcomes easily generalize to the virtual environment. (Furst, et al., 1999). In line with these calls for research attention, this study begins to fill the gap in the virtual team literature by testing the applicability of the findings that have emerged from the collocated research to the virtual context.

## **Research Question**

As virtual teams enjoy growing adoption rates in organizations, it becomes compelling to study all facets and implications of this new form of work structure. The need for extensive research is crucial because virtual teams are not an organizational panacea, and the degree to which they will deliver on their much publicized promises is a function of organizational characteristics, effective change management, employee training and development, and technological

infrastructure and expertise (Townsend, et al., 1998). Some of the unexplored questions that merit attention can be grouped in four major categories:

- **Internal Issues:** Can effective virtual team processes be identified? How do they emerge? Are there consistent traits of successful virtual teams? What are they?
- **External Issues:** Is there a need for team boundaries in the virtual context? What is the role of gatekeepers and team sponsors? How can effective external communication be fostered?
- **Technological Issues:** What technologies are most effective in supporting virtual teams? What are the limitations of information technologies in enabling virtual teams?
- **Societal Issues:** What are the implications for society? What is the sociology of the virtual workplace?

The following is a collection of critical questions concerning the various facets of virtual teams and phenomena entailed by their adoption. Can a "sense of group" (cohesiveness) be achieved in virtual teams? How can contribution to product development be measured? Does perception of individual contribution differ across members? In other words, does the self-involvement that seems to characterize computer-mediated communication translate into unfair peer evaluation? As a corollary of the previous point, are collocated members more favorably evaluated than remote members? How do the above issues affect overall team effectiveness?

One of the major advantages of virtual teams is the ability to overcome geographic distance and span organizational boundaries. Under these circumstances, what are effective ways of coordinating effort and different organizational goals in the new environment? What implications does the ability to work any time anywhere and be constantly "connected" have for employee privacy and work / private life balance?

The present work focuses on team effectiveness as it represents the most important measure of team success. In the final analysis, the viability and importance of the virtual team as an emergent organizational form is predicated on its ability to promote and foster achievement of the organization's goals. Surprisingly, however, the limited research that has focused on virtual teams has not concentrated on team effectiveness.

The present work builds on previous research on project teams in collocated environments to gain insight on the role of managerial behavior control in enhancing the effectiveness of project virtual teams. At the moment there is no empirical support for the proposition that project virtual teams that are invested with greater autonomy will be more effective. This lack of evidence is troublesome in light of the focus of much contemporary information systems research that seems to implicitly assume that project virtual teams will be self-directed, and that they will be granted control over internal organization of teamwork.

A cogent theory of the determinants of virtual team effectiveness has yet to be developed. But established theories of group effectiveness (Hackman, 1987),

product development (Brown and Eisenhardt, 1995), managerial control (Kirsch, 1997; Henderson and Lee, 1992), project team effectiveness (Pinto et al., 1993; Guinan et al., 1998) in traditional, collocated, environments can provide guidance for addressing research questions in the new environment. Based on a review and extension of this literature the following research questions will be addressed:

- What internal team processes account for virtual team effectiveness? In other words, what are the immediate determinants of virtual team effectiveness?
- Are virtual teams more effective when managerial behavior control is enforced rather than allowing the team to self-direct?
- How does managerial behavior control affect internal virtual team processes to promote or hinder increased virtual team effectiveness?

The first question examines the "black box" of virtual teams and seeks to discern what internal processes are distinctive of successful virtual teams. The second research question seeks to demonstrate the benefit of managerial behavior control, as opposed to team's self-direction, in virtual teams. The third question combines knowledge from the previous two in order to determine the role of managerial behavior control practices in fostering virtual team success.

## **Organization of This Document**

The next chapter of this document provides a number of useful definitions and it establishes the theoretical framework for the study. The chapter contributes a review of the relevant research literature. The third chapter presents the research model guiding the investigation. From the model, the research proposition and

testable hypothesis are drawn. Next the chapter outlines the research methodology, data collection procedures and analysis techniques. The fourth chapter reports the study results. The fifth chapter provides a discussion of the research findings. The next chapter reports and discusses the results of a follow-up qualitative analysis. The seventh chapter presents conclusions, a discussion of the contributions and limitations of this work and it offers suggestions for future research.

# **LITERATURE REVIEW**

This chapter establishes the theoretical framework for the investigation. Three major theoretical traditions pertinent to the management of virtual teams are identified: product development theories, control theory and the computer mediated communication literature. Literature related to each is reviewed after essential concepts are introduced and definitional issues are addressed.

## **Definitions**

Concepts relevant to the study of virtual teams are introduced and briefly discussed. Definitional issues are also addressed.

### **Teams**

Small collections of people performing shared work have been the focus of research attention since the classic Hawthorne studies in the 1930s. A number of labels have been coined to describe variations of this phenomenon. Among the terms employed are: work groups, empowered teams, autonomous work groups, semi-autonomous work groups, self-managing teams, self-determining teams, self-design teams, crews, cross-functional teams, quality circles, project teams, task forces, emergency response teams and committees (Guzzo and Dickson, 1996). Various terms have been used to identify entities that differ with respect to goals, tasks to be completed, life span, degrees of decisional freedom, membership, and the like. The major issue in this definitional debate is whether the term "team" substantially differs from the term "group" or if the two terms should be used interchangeably (Fisher, et al., 1997).

While historically the word "group" has enjoyed widespread use, the management literature has recently preferred the term "team" instead (Guzzo and Dickson, 1996). Many scholars use the two words interchangeably (Langfred, 1998; Cohen and Bailey, 1997; Mullen and Copper, 1994; Sundstrom et al., 1990). But this duality in terminology has recently come under scrutiny because some authors believe teams to be a special subset of groups. More specifically, some authors believe that groups differ on the level of "groupness" that they exhibit (Fisher, et al., 1997; Katzenbach and Smith, 1993). Consequently, they propose that the term "team" should be reserved for those groups that display high levels of interdependency and integration among members. The issue, far from being settled, has been recently investigated through an empirical analysis of managers' own perceptions (Fisher, et al., 1997). It appears that managers perceive teams as being more creative, innovative and well-rounded than work groups (Fisher, et al., 1997).

For the purpose of this research study, a widely accepted definition is adopted. A team is defined as: "a collection of individuals who are interdependent in their tasks, who share responsibility for outcomes, who see themselves and who are seen by others as an intact social entity embedded in one or more larger social systems and who manage their relationship across organizational boundaries." (Cohen and Bailey, 1997 p. 241). The key concepts that emerge from the above definitions are the high degree of interdependence among team members, their joint responsibility for the team's output, and the relative independence of the team.



Teams can be further grouped on a number of dimensions such as membership, purpose, and duration. Four broad categories are normally identified in the literature (Cohen and Bailey, 1997; Mohrman, et al., 1995; Katzenbach and Smith, 1993; Sundstorm, et al., 1990). While labels and terminology vary, the underlying grouping attributes are fairly consistent.

- a. Advice and involvement teams are primarily focused on examining and debating issues to reach a decision, make recommendations and suggest courses of action. Such teams are assembled for problem solving and improvement oriented activities (Cohen and Bailey, 1997). Examples of advice and involvement teams are decision-making committees and quality control circles (Cohen and Bailey, 1997; Sundstorm, et al., 1990).
- b. Action and negotiation teams are comprised of highly skilled individuals that convene for specific, normally brief, events. Individual roles in action and negotiation teams are normally very specialized and the circumstances in which they operate are often unpredictable and require a high degree of improvisation. Examples of action and negotiation teams are sports teams, military combat units, and surgery teams (Cohen and Bailey, 1997).

Management teams represent an example of action and negotiation teams in business organizations (Cohen and Bailey, 1997). Management teams are responsible for directing and integrating the work of independent sub-units across business processes (Mohrman, et al., 1995)

- c. Production and service teams are primarily concerned with fabricating goods or delivering specific services. Production and service teams are

normally encountered in manufacturing and service industries and are comprised of first line employees who are assigned full time to the team for an extensive period of time. Examples of such teams are shop floor assembly teams (Wall, et al., 1986) and audit teams (Gupta, et al., 1994).

- d. Project and development teams are groups of knowledge workers who cooperate on unique, one-time outputs. Project and development teams are time-limited, often cross-functional, and normally disband and reassemble upon completion of the assigned activity (Cohen and Bailey, 1997).

Examples of project teams are Information Systems (IS) design and software development teams (Guinan, et al., 1998; Henderson and Lee, 1992) and new product development teams (Ancona and Caldwell, 1992).

This study concentrates on project teams. Thus, the next section provides a more detailed description of such teams, and it discusses some of their distinctive characteristics.

### **Project and Development Teams**

As briefly discussed above, the literature seems to agree on one definition of project and development team. Such teams are time-limited, non-repetitive, and involve substantial application of knowledge, expertise and judgment (Cohen and Bailey, 1997). Project and development teams are comprised of white-collar professionals who produce a complex and unique output (Mankin, et al., 1996; Sundstorm, et al., 1990), and they are often cross-functional (Brown and Heisenhardt, 1995; Pinto, et al., 1993), drawing members from different business areas of the organization.

Project and development teams have been of central interest to IS researchers for a number of years (Guinan, et al., 1998). This trend is due to the extensive reliance on project and development teams in IS development projects and the persistent high failure rate of such projects. Research in this area has focused on the determinants of team performance (Guinan, et al., 1998; Kraut and Streeter, 1995; Henderson and Lee, 1992) and product quality. Attention has been directed to teams' external processes and relationship with users (Guinan, et al., 1998; Ancona and Caldwell, 1992), internal processes and effective communication (Guinan, et al., 1998), team coordination (Kraut and Streeter, 1995) and project manager and team members' control relationship (Kirsch, 1997; Henderson and Lee, 1992).

### **Self-directed Teams**

The concept of self-directed teams was originally developed for production and service teams in manufacturing and service businesses. Historically production and service teams have been directed by a supervisor in charge of making all decisions regarding all aspects of work such as planning, scheduling, dividing work, assigning tasks, and so on. While self-directed teams have a long history both in practice and in the academic literature, there has been little momentum for widespread implementation until the past decade (Guzzo and Dickson, 1996). Lately, as organizations felt the need to de-layer and downsize, increase flexibility and reduce costs while improving employees' satisfaction and motivation, the implementation of self-directed teams has received a new stimulus (Cohen, et al., 1996; Cohen and Ledford, 1994; Cordery, et al., 1991)

The literature has adopted a number of different labels such as “empowered teams,” autonomous work groups, semi-autonomous work groups, self-managing teams, self-determining teams, self-design teams to refer to what is typically the same type of entity. As these labels are mostly equivalent (Guzzo and Dickson, 1996; Sundstorm, et al., 1990), throughout this document the term “self-directed team” will be employed. Self-directed teams are defined as “groups of interdependent individuals that can self-regulate their behavior on relatively whole tasks.” (Cohen and Ledford, 1994; Goodman, et al., 1988). Thus, the principal attributes of self-directed teams are task interdependence and joint responsibility and members' discretion over determinations of work assignment, work methods, and scheduling of activities (Cohen, et al., 1996; Goodman, et al., 1988).

### **Virtual Teams**

The transition from individualized work to teamwork has been described as a revolution in the workplace (Sundstorm, et al., 1990). Advent of widespread IT and communication technologies has started a further revolution within teamwork, that of the virtual team (Townsend, et al., 1998).

While virtual teams are a relatively new phenomenon, the literature seems to agree on a specific definition. They have been defined as “a temporary group of individuals who have little or no face-time during the team task performance.” (Alavi and Yoo, 1997 p. 4). Their members “are located in otherwise independent organizational units or even separate firms but work together to accomplish a common goal. Like their organizational counterparts, the structure of virtual teams exists only in electronic space, since members share no common physical work

place and may have little or no face-to-face contact with one another” (DeSanctis and Poole, 1997 p. 165-166). In general, virtual teams are defined as groups of geographically and organizationally dispersed knowledge workers who are brought together across time and space through information and telecommunication technologies on an "as needed basis" to cooperate on specific tasks (Jarvenpaa and Leidner, 1998; Lipnack and Stamps, 1997; Jarvenpaa and Ives, 1994). Thus, the distinctive features of virtual teams are their composition, mainly knowledge workers and professionals, their preponderant, and at times exclusive, reliance on information and communication technologies rather than face-to-face interaction, their flexible composition and short life, and their ability to traverse traditional organizational boundaries and traditional time constraints.

In this study, project virtual teams are defined as groups of interdependent knowledge workers who share responsibility for completion of a project and are geographically dispersed, thus interacting exclusively through information and communication technologies.

### **Team Effectiveness**

As the literature is inconsistent as to what constitutes a team, so too is there little agreement on how to measure team effectiveness (Langfred, 1998; Guzzo and Dickson, 1996). Part of the problem at the root of the proliferation of inconsistent definitions is that team effectiveness can be measured at different levels of analysis (Cohen and Bailey, 1997). A team produces outcomes at the individual level (i.e., individual member's satisfaction), at the group level (i.e.,

product teams' time to market and adherence to schedules), at the unit or divisional level, and at the broader organizational level (i.e., contribution to financial results).

For the purpose of this research, the attention will be restricted to the individual and group levels of analysis. Thus, team effectiveness is defined in terms of group-produced outputs, the consequences a group has for its members and the enhancement of individuals' ability to perform effectively in future virtual teams (Cohen and Bailey, 1997; Guzzo and Dickson, 1996; Sundstorm, et al., 1990; Hackman, 1987). Effective teams should be able to produce high quality output (i.e., products and services), reward team members in terms of gratification and satisfaction with the working experience, and contribute to individuals' learning and ability to engage in future projects (Jarvenpaa and Ives, 1994).

## **Theoretical Framework**

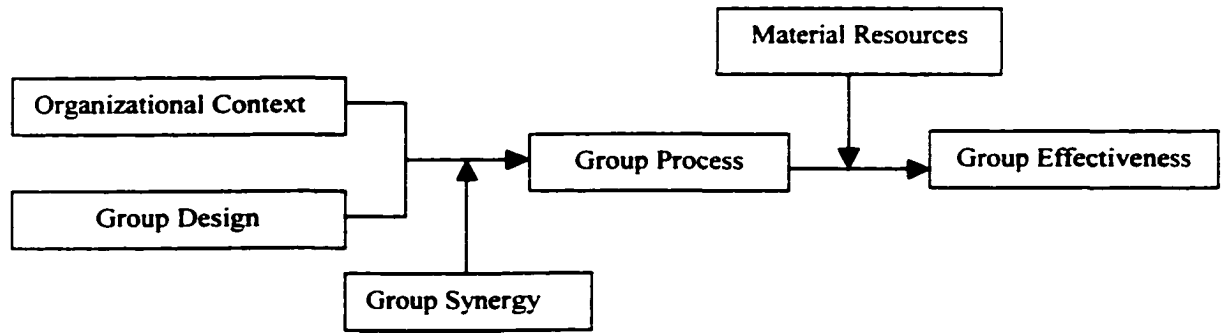
The state of the art in our discipline provides very limited knowledge regarding the possible impact of managerial control on team effectiveness and the process by which such contributions take place. On the other hand, theoretical models of group effectiveness (Hackman, 1987), product development (Brown and Eisenhardt, 1995), managerial control (Kirsch, 1997; Henderson and Lee, 1992), and the determinants of project team effectiveness (Guinan, et al., 1998; Pinto, et al., 1993) have been developed in traditional environments. These models provide a starting point for the investigation of virtual team effectiveness (Furst, et al., 1999) and are used in the present study to formulate the research propositions and to derive testable hypotheses.

## **Team Effectiveness**

Research has long recognized the multiplicity of antecedents of teams' productivity. Stainer (1972) suggests that productivity is a function of task characteristics, available resources and group processes. He states: "task demands specify the resources that are needed [...]. The adequacy of resources available to an individual or group determines its potential productivity; the appropriateness of its processes determines how well its actual productivity approximates its potential productivity" (p. 9).

Managerial involvement, defined as "a social process in which the project manager demonstrates a higher level of influence" (Guinan, et al., 1998, p. 107), strongly contributes to enhance team performance (McGrath, 1984). Adopting Steiner's framework, it appears that managerial behavior can improve internal group processes thereby reducing the gap between potential and actual performance. Hackman (1987) has developed a more comprehensive model of group effectiveness in collocated environments that is adopted here as the general frame of reference. While this research finds its reason d'être in the recognition that virtual teams dynamics may differ substantially from those emerging in collocated teams (Furst, et al., 1999), it is beneficial to extend existing research and test the viability of existing models in new environments.

Hackman's (1987) model of team effectiveness (Figure 1) identifies five general categories of determinants of team effectiveness: organizational context, group design, group synergy, group process and material resources.



**Figure 1: Hackman's model of collocated team effectiveness.**

### **Organizational Context**

The organizational context in which the team is embedded, along with its design characteristics, ultimately determines team effectiveness. Particularly, the following environmental attributes must be structured in a way that supports and reinforces competent task work:

- **Reward system.** The evaluation and compensation system must encourage and promote effective task and team behaviors.
- **Education system.** Training programs must emphasize appropriate task and teamwork skills.
- **Information system.** The organization's information systems must support the team and provide accurate and timely information.

### **Group Design**

Group design must promote and facilitate competent teamwork. Particularly important design characteristics are:



- **Task structure.** The team's task should be appropriate for teamwork, team members should be jointly accountable for the outcome, receive extensive feedback on their performance and be motivated to achieve their goals.
- **Group composition.** Team members should complement each other in terms of knowledge, skills and abilities. All team members should be indispensable to the team.
- **Core norms regulating group behavior.** Behavioral norms, the information rules for how to accomplish team goals, and organize the work are instrumental in fostering team effectiveness (Furst, et al., 1999). Thus, developing and enforcing a team structure and norms that best suit the team task and environment will have a positive impact on team effectiveness.

### **Group Process**

The immediate determinants of effectiveness are group processes. Group processes mediate the impact of contextual and design variables on team effectiveness. Hackman identifies the following:

- **Team effort.** The level of effort exerted by team members is sufficient to accomplish the task satisfactorily.
- **Knowledge and skills.** The amount of knowledge and skill applied to the task is sufficient to ensure achievement of goals.
- **Task performance strategies.** The team is able to identify and employ performance strategies that are appropriate to the work to be performed and the setting in which team interaction occurs.

### **Group Synergy**

Group synergy moderates the relationship between external determinants of effectiveness, organizational context and group design, and effective group processes. Synergies consist in support activities that promote synergistic process gains and limit process losses.

### **Material Resources**

The availability of sufficient material resources required to timely and satisfactorily complete the task moderate the relationship between group processes and actual manifestations of team effectiveness.

### **Team Effectiveness**

Team effectiveness is conceptualized as a multidimensional construct with the following three facets:

- Output acceptability for the customer. This is a measure of team performance. Effective teams are able to deliver timely, high-quality products.
- Individual psychosocial outcomes. This facet represents an outcome measure at the individual levels. Effective teams are able to satisfy individual team members' needs, rather than frustrate them, as a byproduct of team interaction.
- Team viability. This is a measure of the team's ability to perform well in the future. Effective teams are able to maintain or strengthen the ability of team members to work well together.

The objective of this study is not to provide a comprehensive test of the validity and applicability of Hackman's model in the virtual environment. Rather, the focus is on group design variables and internal processes only. This research has the objective of evaluating suitability of control mechanisms to affect key process variables and ultimately promote high levels of team effectiveness in virtual teams.

Hackman's model of group effectiveness provides the theoretical context guiding this research. Within its scope fall a number of more narrowly defined models. The remainder of this section discusses more focused theoretical models that are instrumental in the development of the research proposition. More specifically, product development theories, control theory and the computer mediated communication literature are reviewed.

### **Product Development Theories**

The ability to develop and deliver timely products that meet the target markets' requirements is of crucial importance in the modern competitive landscape. As a consequence of such heightened sensitivity to product development effectiveness, academic research has focused on understanding how effective product development can emerge and be maintained. The relevance of this research tradition to the present study lies in the fact that the product development team is the central entity in product development projects, and a large body of knowledge on the determinants of team effectiveness has been accumulated. Further, much attention has been devoted to cross-functional teams. This focus is particularly valuable to the study of virtual teams because they are, by definition, comprised of

functionally or even organizationally dispersed knowledge workers (Lipnack and Stamps, 1997).

Three main product development research streams have emerged: 1) product development as a rational plan, 2) product development as communication web and 3) product development as disciplined problem solving. Each one approaches the problem from a separate tradition and contributes to our understanding of the complex development process. A review of these streams and their relevant findings follows.

The rational plan perspective identifies careful planning, plan execution and senior management support as key determinants of product development success (Brown and Eisenhardt, 1995). While this tradition focuses on a number of contributions to product success, such as product advantage (i.e., intrinsic value of the product to the customer) (Cooper and Kleinschmidt, 1987, 1993; Cooper, 1979), market conditions (Cooper and Kleinschmidt, 1987), and top management commitment (Gupta and Wilemon, 1990; Zieger and Maidique, 1990), of interest to this study are the findings regarding internal team organization and plan execution. The rational plan literature indicates that the internal organization of the product development team is crucial to product success. A project plan must be developed and executed smoothly through high levels of coordination among cross functional groups (Zieger and Maidique, 1990). Research in this stream has been mostly exploratory and has taken a broad view of the determinants of product development success rather than focusing on team processes and managerial contribution. However, there is evidence suggesting that the project team

dynamics that underlie plan execution, such as coordination and communication, contribute to development success.

The product development as a communication web perspective has taken a diametrically opposite approach. Instead of investigating product development projects at the macro-level, this tradition has focused on internal and external team communication processes. While such a narrow focus may not account for a number of important variables, it provides researchers with a thorough understanding of communication processes and their role in successful product development (Brown and Eisenhardt, 1995). This research tradition offers consistent support for the proposition that internal communication has a significant impact on project and development team effectiveness (Brown and Eisenhardt, 1995; Ancona and Caldwell, 1992; Dougherty, 1992; Ebadi and Utterback, 1984; Allen, 1977). In a review of the literature on group communication processes and performance, Ancona and Caldwell (1992) conclude that "the amount and patterns of communication (particularly technical communication) within the team and between the team and outside groups are related to performance" (p. 324). Brown and Eisenhardt (1995) suggest that "high internal communication increases the amount and variety of internal information flow and, so, improves development-process performance" (p. 358).

The third perspective, product development as disciplined problem solving, also attests to the importance of internal communication (Brown and Eisenhardt, 1995). Research involving cross-functional teams showed that internal communication increased the information flow among team members, thereby

creating shared knowledge and allowing team members from different organizational functions to understand and coordinate each others' contributions (Imai, et al., 1985). Research in this tradition also points to the crucial role of team leaders who are able to provide internal support and coordination while working with senior management to secure resources and support for the project development effort (Clark and Wheelwright, 1992).

Brown and Eisenhardt (1995) propose an integrated model of product development that builds upon the findings of the three streams discussed above. While the model primarily takes a macroscopic perspective, it emphasizes a number of project team characteristics and leader behaviors that can potentially influence project team performance. In this model, the project team is at the heart of the product development process because its members are responsible for turning concepts and specifications into a tangible deliverable. In particular, they indicate that team composition, group processes and work organization will each ultimately influence performance.

Regarding group processes, Brown and Eisenhardt (1995) state: "Results from all three research streams indicate that effective group processes, particularly those related to communication, increase information and so are essential for high-performing development processes" (p. 368). Internal communication increases information both directly and indirectly. Task related communication, defined as an exchange that deals primarily with the project under development, directly magnifies the team's internal flow of information. Frequent communication also has an indirect link to increased information sharing. Keller (1986) suggests that

more cohesive groups were the best performers among all research and development teams he studied. As group cohesiveness stimulates communication, it indirectly increases information (Keller, 1986) and ultimately improves effectiveness (Keller, 1986; Ebadi and Utterback, 1984). Moreover, higher levels of communication, particularly when effectively structured, increase the amount of information exchanged and reduce misunderstandings thereby increasing process performance (Dougherty, 1992).

The important role of communication and coordination processes in project and development teams clearly emerges from the literature. Project leaders and managerial behaviors are instrumental in promoting and fostering communication and coordination (Brown and Eisenhardt, 1995). But, surprisingly, little research attention has been paid to this issue by the above three research streams (Brown and Eisenhardt, 1995).

Control theory provides a basis to develop propositions regarding the effect of managerial control mechanisms on internal team processes and ultimately on team effectiveness.

### **Control Theory**

Modern control theories are based on the work of organizational theorists, particularly Thompson (1967) and Ouchi (1979). Ouchi (1979) approached the problem of internal control from a macroscopic organizational perspective and studied the discrepancy of organizational goals and organization members' goal alignment. Ouchi's work was mainly concerned with "the mechanisms through which an organization can be managed so that it moves toward its objectives"

(Ouchi, 1979 p. 833). He introduced three types of control mechanisms both formal and informal, and proposed a prescriptive framework for their implementation (Ouchi, 1979). Formal control methods are output measurement and behavior measurement while "clan" control is a form of informal control (Kirsch, 1997; Ouchi, 1979).

- Output measurement stems from the ability to accurately quantify output (Kirsch, 1997). In other words, the organization can rely on "objective" output measures.
- Behavior measurement derives from knowledge of and the ability to observe behaviors that leads to the desired outcome (Kirsch, 1997). In other words, behavior control mechanisms are applicable when the organization has identified the behaviors that lead to achievement of objectives and is able to scrutinize their execution.
- Clan control refers to highly ritualized and ceremonial forms of control that are used when no "objective" forms of control can be implemented. Clan control is most appropriate when neither behaviors nor outcomes are observable and measurable (Kirsch, 1997). In such context, the controller attempts to create an environment where individuals internalize the values of the organization and behave according to such values.

Ouchi's framework suggests that output measurement should be employed when output is easily measured and the transformation process yielding the product is not perfectly known. An example of output control is the use of financial controls to evaluate the performance of strategic business units.



Behavior measurement should be adopted when the transformation process yielding the product is known but output cannot be easily measured. For example, behavior control methods are extensively used in IS development teams because the complexity and uncertainty surrounding the development effort limits the ability to use output controls. On the other hand, procedures and methodologies that likely lead to successful implementations are often codified.

Finally, clan control measures should be implemented when both outcome and behavior measurements are not feasible (Eisenhardt, 1985; Ouchi, 1979).

Ouchi's original formulation was concerned with the organization as the unit of analysis and focused on broad base organizational control structures. Later work has adopted control theories in a more limited environment such as small retail outlets (Eisenhardt, 1985) and IS design and development teams (Guinan, et al., 1998; Henderson and Lee, 1992).

Clan control, as well as other informal control methods, is based on selection and socialization of members (Kirsch, 1997; Ouchi, 1979). Virtual teams, as defined in this research, are short lived groups of professionals assembled across geographical and organizational boundaries in response to unique organizational needs. Under such circumstances the extensive socialization process that is the prerequisite of informal modes of control does not appear to be a viable alternative (Furst, et al., 1999). It is conceivable that in the future, organizations that extensively rely on virtual teams will be able to socialize team members so that they internalize cross-organizational virtual team member values. In such a scenario, clan control would be a viable and powerful control mechanism. Virtual

teams represent a new form of organization that is just now starting to be extensively implemented. Therefore it seems implausible that this form of "distributed clan control" can be implemented at present.

Formal control methods (i.e., behavior and output) appear more viable in the virtual context, at least in the short term. Thus, this study will focus on formal control and the potential benefits of their implementation in project virtual teams.

The most valuable feature offered by virtual teams is their flexibility. Organizations that employ virtual teams have the ability to group the most appropriate set of individuals required to complete a specific task (Jarvenpaa and Leidner, 1998; Townsend et al., 1996). For this reason, virtual teams may often be assembled to complete atypical and ad hoc projects (Jarvenpaa and Ives, 1994), involving unique information and changing customer requirements (Lipnack and Stamps, 1997). Output control is predicated on the ability to accurately measure output (i.e., quantity and quality), and it presupposes knowledge of ordinary production outcomes. Arguably, because of the highly specialized nature of most virtual team projects, it would be difficult to devise precise and generally applicable output control mechanisms. Outcome control may represent a viable alternative when virtual teams are assembled in response to unique customer requests or when team objectives are clearly defined and their achievement is easily measurable. Applicability of output control mechanisms may be contingent on project characteristics and research is needed to understand their range of applicability in virtual teams.

Managerial behavior control appears to be best suited to the unique characteristics of the virtual environment. Moreover, this control method can be easily and broadly implemented across a wide range of virtual teams and projects. The major challenges to virtual team effectiveness stem from the lack of face-to-face interaction and the ensuing communication and coordination difficulties. Therefore, if behaviors that mitigate these problems and contribute to minimize process losses can be identified and enforced, effectiveness of a wide range of virtual teams should be ensured. Townsend and his colleagues (1998), for example, clearly endorse behavior control as a method of managerial control in virtual teams. They state: "the virtual team's rich communicative environment, along with the system's capacity for archiving data and communications, actually empowers considerably more managerial monitoring than it is possible in traditional environments" (p. 25). Further, they state that for virtual teams "clear schedules must be established of when the team will provide reports, interim deliverables and final product" (p. 25).

No prior work has examined the effect of managerial control mechanisms on virtual team effectiveness. Most research has concentrated on self-directed teams, but there is evidence of positive effects of managerial behavioral control on team performance in collocated project and development teams (Henderson and Lee, 1992). Specifically Henderson and Lee (1992) in their analysis of 41 IS design teams found that managerial behavior control was significantly correlated to all three measures of performance used. They also found managerial outcome control to be unrelated to team performance. Kirsch (1997), in multiple case studies in

four organizations, found that during IS project development both behavior and outcome controls are used extensively.

The IS literature has operationalized managerial behavior control in a number of ways. The most common are:

- role clarification (Henderson and Lee, 1992);
- work assignment (Henderson and Lee, 1992);
- rules and procedures specification (Ouchi, 1979; Orlikowski, 1991);
- development methodology (Alavi, 1984; Necco et al., 1987);
- project plans and project reports (Kirsch, 1997).

What is the process through which managerial behavior control contributes to team effectiveness? It appears that managers who engage in behavior control benefit the team by reducing uncertainty, clarifying roles and providing guidance (Henderson and Lee, 1992). In complex development projects the high degree of uncertainty, lack of structure in problem solving, and the considerable role ambiguity experienced by team members, all contribute to internal and external process losses (Guinan, et al., 1998). Arguably, in this context, behavior control mechanisms contribute to limit these process losses leading to increased team effectiveness. In support of this view, previous research findings identified a direct relationship between behavior control mechanisms such as superordinate goal setting and project team rules with task outcomes and psychosocial outcomes (Pinto, et al., 1993).

As discussed in the next section, the lack of face-to-face interaction in virtual teams may magnify these problems thus increasing the potential contribution of

behavior control mechanisms. In global virtual teams, for example, high trusting and effective teams engage in behaviors that contribute to improve communication and reduce uncertainty (e.g., predictable communication, substantive and timely response) (Jarvenpaa and Leidner, 1998).

The above findings are congruent with other theoretical traditions. Reduction of uncertainty and clarity of team's objectives, for example, have been consistently found to be related to team effectiveness in organizational behavior literature (O'Leary-Kelly, et al., 1994; Locke, and Latham, 1990; Locke, et al., 1981).

### **Computer Mediated Communication and Virtual Teams**

One defining characteristic that differentiates virtual teams from collocated teams is the reduced, and often non-existent, possibility of face-to-face interaction. Because of the very design of their work unit, members of virtual teams have to rely extensively, if not exclusively, on computer and communication technologies.

The Computer Mediated Communication (CMC) literature has been concerned with the effect that interaction through communication devices has on the communication process. Information and communication technologies have been evolving at a rapid pace, particularly in the last decade. The pace of technological innovation makes it difficult to generalize the research findings to any particular situation (Walther, 1992). Nonetheless, a review of the CMC literature offers a number of potential contributions to our understanding of virtual teams and their internal processes, particularly in light of the importance of communication and coordination discussed above.

A number of theories and models have been introduced to explain media effects on the communication process (Fulk and Boyd, 1991). They can be organized into two main streams, whether they focus on intrinsic media characteristics and their effect on the communication process, the "cues filtered out" approach (Culnan and Markus, 1987), or they take a social interactionist perspective (i.e., they acknowledge and model the social process inherent in interpersonal communication).

This section briefly introduces relevant theories and findings and discusses their implications for virtual teams research.

### **Cues Filtered Out Approaches**

The underlying assumption of these approaches, also known as rational choice models of media selection, is that communication media have inherent properties that are independent of the users but perfectly salient to them. Moreover, individuals are hypothesized to make independent choices and to not be influenced by the social environment in which they are immersed

The above assumptions are somewhat restrictive and provide a limited view of organizational communication (Fulk and Boyd, 1991). Nevertheless, rational choice models are very appealing from a researcher standpoint (Ngwenyama and Lee, 1997) and have been widely employed, generating a wealth of findings and interpretations.

### **Social Presence Theory**

The main focus of Social Presence Theory (SPT) (Short, et al., 1976) is not electronic communication, still in its infancy when the theory was introduced, but

various other forms of telecommunication such as telephone, and audio and video technologies with particular emphasis on cross-media comparison. The primary goal of SPT is the study of

the way in which new technologies might affect individuals and groups, and the ways in which those individuals and groups will react to and use the new technology (Short, et. al., 1976 p. 9)

Communication is defined as: "the physical signals whereby one individual can influence the behavior of another" (Cherry, 1957). This definition is particularly attentive to the multiplicity of non-verbal cues offered in face to face interaction. "Social presence," is defined as the degree of salience, or "realness" (George and Carlson, 1999) of the interaction and of the other person involved in the communication (Short, et al., 1976). Social presence is postulated to be an inherent quality of the medium and depends on the medium's capability to convey visual and non-verbal cues. Not to be mistaken, the authors recognize the role of individual differences and perceptions. Social presence is defined as a subjective characteristic of the communication medium as perceived by the person involved in the communication.

According to SPT, different communication media can be ordered on a continuum of social presence, with business letters and face-to-face communication as the two opposite extremes (Short, et al., 1976).

The original version of SPT did not consider CMC, but later research extended it to the emerging electronic communication media, specifically electronic mail

(Rice and Williams, 1984). Electronic mail's position on the social presence continuum is somewhere between telephone and written messages (George and Carlson, 1999). Therefore, electronic mail is deemed more appropriate for tasks requiring less interaction (e.g., exchanging information) versus more interaction (e.g., negotiating). Rice and Case (1983) also found that experienced users would rate electronic communication as appropriate for many tasks calling for high interaction, providing early evidence for the experience effect, a phenomenon that is now recognized in the literature.

### **Media Richness Theory**

Media Richness Theory (MRT) (Daft and Lengel, 1986, 1984), in its original formulation, proposes a prescriptive model for managers to choose the most appropriate communication medium to convey a particular message.

Information richness is defined as the ability of information to change understanding within a time interval. Communication transactions that can overcome different frames of reference or clarify ambiguous issues to change understanding in a timely manner are considered rich. (Daft and Lengel, 1986 p. 560)

A communication medium is deemed rich when it enables immediate feedback, transmission of multiple cues, multiplicity of channels (e.g., audio, video), personalization of the message, and language variety (Daft and Lengel, 1986). Media positioned low in the richness continuum are labeled lean.

According to MRT, richer media are better suited to convey equivocal messages while leaner media are more appropriate for unequivocal messages.



Using a lean medium for equivocal messages would be inadequate because the limited number of cues and lack of immediate feedback would impede successful resolution of complex messages. Conversely, using a rich medium for unequivocal messages would be inefficient and potentially cause confusion because of the excess number of cues conveyed (Trevino, et al., 1990). According to MRT the media, from richer to leaner are: face to face interaction, telephone conversations, personal written documents, impersonal written documents and numeric documents. Electronic mail is richer than written documents, but leaner than telephone interaction (Trevino, et al., 1990; Trevino, et al., 1987).

While MRT has been used extensively, almost exclusively, to understand and predict managerial media choice, in its original formulation it was intended to be a theory of media use, not media choice (Dennis and Kinney, 1998). The theory argues that performance improves when managers effectively match the degree of message equivocality and uncertainty with media offering adequate levels of information richness (Dennis and Kinney, 1998; Daft, et al., 1987). While a definition of performance was not offered in the original theory formulation, later research has proposed decision quality, establishment of shared systems of meaning, better use of participants' time and satisfaction as measures of performance (Dennis and Kinney, 1998; Trevino, et al. 1990; Lengel and Daft, 1988). For the purposes of this study, this elucidation is particularly noteworthy because virtual teams, whose members only have access to relatively lean media, may suffer performance losses due to misunderstanding, slower agreement, and reduced satisfaction with the communication process.

MRT has been widely used to interpret managerial media selection. Its appeal lies in its intuitive simplicity. In the context of computer mediated communication, though, the theory has been extensively criticized. Critics have raised doubts as to the accurateness of the proposed media ranking on the richness continuum (Markus, 1994). Specifically, the quickness of feedback from face-to-face interaction or telephone conversation is dependent on availability of the parties involved. Secondly, electronic mail offers features and capabilities that are not available in traditional media, such as multiple addressing of the same message to a number of people, ability to store, retrieve and search past communication transcripts (Sproull and Kiesler, 1991).

Even if the richness continuum were to be revised to incorporate the above criticism, information richness theory would remain an individual-level, rational choice explanation of behavior. Such theory fails to recognize and account for the fact that communication in organizations is a social behavior that takes place in an established social context which exerts its influences on individuals' media selection (Markus, 1994; Fulk and Boyd, 1991).

#### **Lack of Social Context Clues Hypothesis**

The lack of social context cues hypothesis (Sproull and Kiesler, 1986) shares a number of characteristics with information richness theory and social presence theory. Like them, it claims that the electronic medium has static attributes. The model was introduced as an early attempt to investigate the impact that CMC, particularly electronic mail, has on the communication process.

The social context cues hypothesis suggests that different communication media induce a reduction in the number of social context cues that are available in face-to-face conversation (i.e., electronic communication media are lean). Social context cues include aspects of physical environment and non-verbal behaviors that define the nature of the social situation and actors' roles and relative status (Dubrovsky, et al., 1991).

Sproull and Kiesler (1986) suggest that communicators perceive the social context from static and dynamic cues. Static cues originate from physical artifacts and communicators' appearance and are unrelated to the communication process per se (e.g., private office, job title). Dynamic cues originate from the communicator's non-verbal behavior (e.g., voice inflection, demeanor). Perception of the social context, through both static and dynamic cues, influences communication behavior. Sproull and Kiesler (1986) state "Typically, when social context cues are strong, behavior tends to be relatively other-focused, differentiated, and controlled. When social context cues are weak, people's feeling of anonymity tend to produce relatively self-centered and unregulated behavior" (p. 1495).

Electronic communication media such as electronic mail can only provide cues as to the sender name and address, and maybe job title and position and organizational affiliation. Therefore, the static cues are drastically reduced while dynamic cues are eliminated. The use of emoticons, special combinations of characters on screen that are used to represent feelings and emotion, can help to

introduce dynamic cues. On the other hand, they only represent a very primitive surrogate for dynamic cues.

### **Social Definition Theories of Media Selection**

Social definition theories of media selection suggest that social units develop shared attitudes regarding appropriate uses of a new technology (Barley, 1986). Social definition theories of computer mediated communication are rooted in the conviction that communication is a social behavior that cannot be interpreted without explicit recognition of the influence that social interaction of users exerts on the individual.

### **Social Influence Model**

The Social Influence Model of Media Use (Fulk, 1993; Fulk, et. al., 1990; Fulk, et. al., 1987) purports that perception of communication media is "subjectively rational" and it therefore varies across individuals. Drawing upon Social Information Processing Theory (Salancik and Pfeffer, 1978) and Social Learning Theory (Bandura, 1986), the proponents of the model assert that perceptions of communication media, such as richness and social presence, are in part socially constructed. Social information processing theory (Salancik and Pfeffer, 1978) argues that co-workers directly influence each other's attitudes and behaviors. Such influence occurs through overt statements, interpretation of events, and communication and creation of norms for judging appropriate use of communication media (Fulk, 1993). A second source of social influence on media perception is vicarious learning (Bandura, 1986). By witnessing communication technology use by co-workers, individuals form attitudes regarding the outcome of

such behavior, and if evaluation of such outcome is favorable, behavior modeling may occur (Fulk, et. al., 1990). For example, if a user of electronic mail, who believes that the medium is very lean and would not be suited for use in highly equivocal tasks, witnesses a co-worker rapidly and successfully resolve disagreement using the system, this may change his own evaluation of the medium.

On these premises, proponents of the social influence model of media use predict that media use by co-workers and work groups will influence individuals' perception and media choice. As a result, a high degree of intra-group homogeneity and inter-group variation in media use are expected. Such variation could not be explained in terms of media characteristics (i.e., richness) and task ambiguity (Fulk, 1993). Also, results from field studies that show patterns of sponsorship behavior, socialization of new members and social control of deviants do not fit with traditional models of rational media choice but can be interpreted in terms of social definition theories (Markus, 1994).

The social influence model was developed with the specific objective of explaining individuals' media choice without specific reference to performance or communication outcomes. Nonetheless, the model suggests that leaner media (i.e., electronic mail, computer based synchronous conferences, and the like) can be successfully employed for equivocal communication by members of a group that have established communication norms and have achieved shared cognition (Fulk, 1993) with respect to the capabilities of the communication technology and the topic of discussion.

## **Social Information Processing Theory**

**Social Information Processing Theory (Walther, 1992, 1995, 1996, 1997)** focuses on relational and socioemotional aspects of communication. The theory was developed in the context of self-directed advice and involvement teams (i.e., small teams in charge of debating an issue, reaching a decision, and suggesting a solution). It explicitly acknowledges inherent media characteristics that affect the communication process and recognizes that some media convey more cues (i.e., are richer) than others. The theory though takes such a basic proposition one step further by explicitly accounting for the effect of time and experience with the medium. It claims that computer supported teams need more time than face-to-face teams to develop close relations. Walther (1992) states:

**Given sufficient time and message exchanges for interpersonal impression formation and relational development to accrue, and all other things being equal, relational communication in later periods of CMC and face to face communication will be the same (p. 69).**

This hypothesis stems from the almost exclusive use of typed messages by members of computer-mediated groups. The time necessary to exchange the same amount of information is much greater for these groups than it is for groups meeting face-to-face. Studies that compare face-to-face to computer-mediated interaction have almost always imposed equal time constraints for task completion to groups in the two conditions. As a consequence, computer-mediated interaction seems unduly task oriented and impersonal when, if allowed enough time, groups

in computer-mediated environments will indeed be able to carry out rich socioemotional exchanges.

The principal goal of social information processing theory was to reconcile conflicting findings between many empirical studies, mainly laboratory studies, of CMC and collaboration. Laboratory experiments comparing groups in face-to-face interaction and groups collaborating in computer-mediated environments have too often employed zero history teams under time constraint, thus ignoring important factors that shape group interaction in real world situations (George and Jessup, 1997; Hollingshead, et. al., 1993; Walther, 1992). Findings from this research tradition are in antithesis with results obtained in many field studies and experiments over time, which suggest that socioemotional exchange and participation are often developed in groups constrained to electronic interaction (Jarvenpaa and Leidner, 1998; Chidambaram, 1996; Steinfield, 1986). Social information processing theory suggests a possible explanation of such incongruent results.

### **Relevant findings**

Research in the tradition of the above theories points to a number of interesting implications of telecommunication technology use in organizational communication. These findings can provide insights in the effect that virtual teams' extensive reliance on information and communication technologies may have on team dynamics and ultimately on team effectiveness. This section discusses some of the evidence accumulated and how it relates to virtual teams.

Aside from earlier work investigating cost benefit tradeoffs and measures of productivity change brought about by the new technology (see Rice and Bair, 1984, for a review), research has focused on the social implications of CMC at the individual and organizational levels.

CMC imposes a number of restrictions on the communication process. Electronic media, such as email, asynchronous discussion conferences, synchronous chat rooms, and video conferencing are intrinsically leaner and constrain social presence with respect to face-to-face communication. This substantial difference, coupled with the limited CMC experience and skills that most individuals have developed to date, has surfaced in the research findings in various forms. Early work in this area found subjects using CMC devices to be more self-absorbed (Sproull and Kiesler, 1986), less attentive to status differences and contextual cues (Sproull and Kiesler, 1986; Kiesler et al., 1984) and consequently noted an increase in uninhibited behavior and flaming - insulting or sarcastic messages in electronic communication. (Weisband, 1992). Interaction in CMC groups has also appeared more impersonal, task-oriented, less friendly, and more business-like (Connolly, et al., 1990; Rice and Love, 1987; Sproull and Kiesler, 1986). DeMeyer (1991) found that, in global research and development teams, use of communication technologies was limited to coordination tasks (i.e., scheduling, results and publications sharing), while periodical face-to-face meetings were deemed necessary to share knowledge and solve problems.

More recent work has challenged some of the above results. When given enough time, CMC teams can achieve high levels of communication quality and



socio-emotional exchange and overcome the restrictions imposed by leaner media (Chidambaram, 1996; Walther, 1995, 1992). In other words, while electronic groups may be slower (e.g., due to typing, slower feedback), the electronic medium does not appear to constrain communication.

The basic tenet of media richness theory has also been recently questioned. Dennis and Kinney (1998) found that while leaner media lead to slower performance overall, matching media with task equivocality did not lead to better group performance. These findings suggest that communication in virtual environments, albeit slower, may not be qualitatively inferior to face-to-face communication, particularly when interaction takes place over an extended period of time (Chidambaram, 1996).

While considerable research attention has been devoted to various forms of electronic groups, there is a dramatic lack of research focusing on "sustained project oriented teamwork of the sort that is important in most real-world organizations" (Galegher and Kraut, 1994 p. 111; Warkentin, et al., 1997). The findings from research that has focused on long-term project oriented teamwork indicate that exclusive reliance on information and communication technologies precludes secondary communication and may hamper orderly and effective information exchange (Hightower et al., 1997).

Virtual teams may face particularly strong challenges to their ability to be highly cohesive and engender members' satisfaction with the group's interaction process (Warkentin, et al., 1997).

## **Research Propositions**

Drawing on the above literature review, this section presents the background for development of the research propositions. The first proposition is based on a review and extension of the product development and traditional team literature. The second and third propositions draw on control theories and the CMC literature.

Product development theories have been generated to provide an understanding of how effective product development processes can emerge and be sustained (Brown and Eisenhardt, 1995) in collocated environments. The product development team is at the heart of the product development process and it has therefore been the focus of much research in this tradition. With respect to internal group processes, Brown and Eisenhardt (1995) state that the findings from the extensive product development research indicate that "effective group processes, particularly those related to communication, increase information and so are essential for high-performing development processes." (p. 368). These findings are echoed by others and clearly point to the central role of frequent and effective internal communication for team success (Ancona and Caldwell, 1992; Dougherty, 1992; Ebadi and Utterback, 1984; Allen, 1977).

A high level of coordination among team members is also a mark of highly effective teams (Kraut and Streeter, 1995; Pinto, et al., 1993; Ancona and Caldwell, 1992). Particularly, communication and coordination breakdowns are seen as a major hurdle faced by project teams (Curtis, et al., 1988). Coordination

problems arise in teams from the dependencies between members, and they are often engendered by the structure of the problem, particularly in complex projects (Crowston and Kammerer, 1998). Rules and procedures (i.e., behavior controls) are often introduced to mitigate such coordination problems (Pinto, et al., 1993).

In the virtual context, due to the lack of face-to-face interaction, it appears that obstacles to effective coordination and communication are more salient and may further impair team effectiveness (Jarvenpaa and Leidner, 1998; Jarvenpaa, et al., 1998). Interaction in CMC groups has also appeared to be impersonal, task-oriented, less friendly, and more business like (see Bordia, 1997 for a review). Some authors indicate that these findings are a function of slow communication interaction brought about by the need for extensive typing and the need to adjust to the CMC environment (Hollingshead, et al., 1993; Walther, 1992; 1995). But there is compelling evidence indicating that the virtual context dramatically increases communication needs and task uncertainty (Jarvenpaa and Leidner, 1998; Jarvenpaa, et al., 1998). It appears that successful virtual teams are the ones that engage in extensive and predictable communication patterns, display high task goal clarity, superior time management skills and alertness to deadlines (Jarvenpaa and Leidner, 1998; Jarvenpaa, et al., 1998). The findings discussed provide evidence indicating that in virtual teams, internal coordination and communication assume paramount importance. Thus,

**Proposition 1: Virtual teams that achieve higher levels of coordination, greater internal communication and higher communication effectiveness are more effective.**

As discussed earlier in this chapter, modern control theories (Thompson, 1967; Ouchi, 1979) are concerned with "the mechanisms through which an organization can be managed so that it moves toward its objectives" (Ouchi, 1979 p. 833). To this end, a number of control mechanisms, both formal and informal, have been introduced. The present work empirically evaluates virtual team effectiveness and its determinants and compares self-directed and managed virtual teams. The focus is on managerial behavior control which is contrasted to team self-direction and autonomy as a form of control to ensure effective team processes and outcomes.

Previous research indicates that there is a positive correlation between autonomy and effectiveness for traditional work teams in both manufacturing (Seers, et al., 1995; Cordery, et al., 1991) and service settings (Cohen, et al., 1996; Cohen and Ledford, 1994). Conversely, the benefits of autonomy seem to elude collocated project teams of knowledge workers. Autonomous teams have consistently failed to be best performers, and autonomy has generally been found to negatively impact team effectiveness in this context (Cohen and Bailey, 1997; Levi and Salem, 1995). It has been suggested that the dynamics that emerge in project and development teams may not be conducive to autonomy (Janz, et al., 1997). According to Janz and his associates, knowledge workers executing interdependent team tasks do not welcome ample team autonomy, particularly over organization, planning and product decisions. Greater levels of autonomy for teams of knowledge workers often translate into escalating decision-making requirements that increase complexity and unduly tax team interaction. Finally, there is evidence attesting to the benefits of behavior control in collocated teams

(Guinan, et al., 1998; Henderson and Lee, 1992) and the benefits of formal structure and organization of work in virtual teams (Lurey, 1998).

No empirical research has attempted to extend this knowledge to the virtual environment. More specifically, there is very little information regarding the role of managerial direction and control in this novel environment. Virtual teams, due to their short life and cross-functional or cross-organizational membership, may be unable to quickly reach the critical mass of communication and information sharing that is fundamental to project teams' success (Brown and Eisenhardt, 1995; Keller, 1986). Indeed some scholars explicitly advocate periodic face to face meetings for teams involved in intensive communication tasks (e.g., project planning) to build and maintain relationships (Gelegher and Kraut, 1994; DeMeyer, 1991).

It is plausible that virtual teams experience reduced effectiveness due to lack of social context cues, difficulty in enforcing group norms and generally increased ambiguity in the communication process. Enforcement of behavior controls designed to stimulate internal communication and enhance internal coordination may help mitigate these problems.

Organizations with international research and development activities, for example, have stimulated communication and coordination among geographically dispersed professionals by way of behavior control (Hakanson and Zander, 1988). And there is evidence indicating that managers who engage in behavioral control contribute substantially to improve project teams effectiveness (Kirsch, 1997; Henderson and Lee, 1992). It is proposed:

**Proposition 2: Virtual teams where managerial behavior control is enforced are more effective than self-directed virtual teams.**

Longitudinal research that has examined self-directed virtual teams has found great variation in their ability to successfully manage teamwork, develop trust and ultimately perform (Jarvenpaa and Leidner, 1998; Jarvenpaa, et al., 1998). The successful teams appear to be able to quickly focus on the task at hand, manage time well and develop effective patterns of communication (Jarvenpaa and Leidner, 1998; Jarvenpaa, et al., 1998).

It is hypothesized that in project virtual teams, managerial behavior control benefits the team by encouraging and stimulating communication while increasing internal coordination. By compelling the team to be constantly cognizant of deadlines and monitor its own progress, to develop specific work assignments that make team members individually responsible and clarify their role, and by nurturing effective communication, it is expected that managerial behavior control will foster high levels of communication and coordination. The improved internal team processes will then lead to team effectiveness improvements.

**Proposition 3: Behavior control in virtual teams will stimulate higher levels of communication and coordination that contribute to increase team effectiveness.**

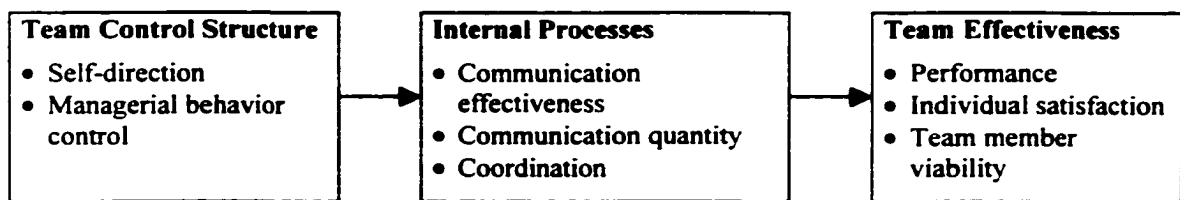
# RESEARCH METHODOLOGY

This chapter presents the research model and eleven testable hypotheses drawn from the research propositions. It then introduces the research design, including a description of subjects, procedures, measurement, and level of analysis issues. The chapter concludes with a discussion of the data analysis methodology.

## Research Model and Hypothesis Development

Chapter two reviewed previous research relevant to the study of virtual teams and the potential contribution of managerial control mechanisms. Three research propositions were developed. The literature review and research propositions led to the development of the research model depicted in figure 2.

According to Hackman's (1987) conceptualization, a mediated relation between group design characteristics (i.e., team control structure) and team effectiveness is modeled. Group processes, in particular internal communication and coordination, are expected to mediate the relationship between team control structure and team effectiveness.



**Figure 2: Research Model**

This section presents a discussion of the variables included in the model followed by the development of thirteen testable hypotheses drawn from the research propositions.

## **Dependent Variables**

Virtual project teams are collections of workers that come together across geographical, temporal and organizational boundaries to pool their skills and expertise in order to complete a project. This study examines the internal processes of such teams. The ultimate objective of the study is to inform research and practice on how to enhance virtual team effectiveness.

Three facets of team effectiveness in the traditional, collocated, environment have attracted considerable research attention. They are: Group-produced outputs, the consequences a group has for its members, and the enhancement of a team's capability to perform effectively in the future (Cohen and Bailey, 1997; Guzzo and Dickson, 1996; Sundstorm, et al., 1990; Hackman, 1987). Keeping with this tradition the following three aspects of team effectiveness are investigated:

- **Team performance.** Team performance is measured in terms of the quality of the group-produced output. Team performance is traditionally regarded as a primary measure of team effectiveness (Hackman, 1989). Virtual teams enable the pooling of the most appropriate resources to complete any given project (Iacono and Weisband, 1997). They are touted as a flexible organizational form that has the potential to produce quality outputs (Lipnack and Stamps, 1997). While the greater flexibility and efficiency they provide could justify the implementation of virtual teams, the team's ability to produce high quality outputs likely remains the most important measure of their effectiveness.



- **Individual psychosocial outcomes.** Individual psychosocial outcomes represent the extent to which group processes and the joint working experience are considered worthwhile, satisfying and productive by team members (Pinto, et al., 1993). Individual psychosocial outcomes (e.g., satisfaction with the teamwork experience, growth and well being of team members) are reflected in the perception that the teamwork experience has been gratifying and rewarding (Pinto, et al., 1993; Hackman, 1989). Virtual teams are new organizational forms that change, at times radically, the meaning and characteristics of teamwork. If this new organizational form is to succeed it must be acceptable to team members. Moreover, there is a general carry over effect from previous experiences that influence individuals' willingness to collaborate and contribute to future team projects (Hackman, 1989). Employees who are frustrated by the experience may be more likely to withdraw, refuse to participate and in general not perform well in the new environment (Hackman, 1992). Thus, individual psychosocial outcomes represent an important measure of team effectiveness.
- **Virtual team member viability.** While team viability has traditionally been an important dimension of effectiveness for collocated teams, it does not seem to fit the virtual environment well. Virtual teams are often short lived and are generally disbanded upon project completion. Team members depart and reassemble in other, newly formed, virtual teams. Because of this dynamic membership (Townsend, et al., 1996) and the teams' limited

life span, it is crucial that dispersed knowledge workers develop the unique knowledge, skills and ability (KSA) to immediately and efficiently contribute to their team's success. The set of KSAs necessary to contribute to virtual teams is, at least partially, different from the ones that most employees have developed over time working in traditional teams (Furst, 1999; Townsend et al., 1998). Further, not everyone may feel at ease or quickly adapt to the "free-floating demands of the hyperflexible workplace." (Victor and Stephens, 1994, p.481).

Effective virtual team members "must be trained and acclimated to the virtual team environment" (Townsend et al., 1998 p. 26). In organizations that adopt a team model, the teams themselves often become the "training grounds for the acquisition of new skills and knowledge areas." (Cianni and Wnuck, 1997 p. 106). While virtual team members will be equipped with a minimum set of technical skills before being assigned to a project, the bulk of learning will likely take place "in action," particularly during early adoption of this new organizational form. "Teams can be used to leverage growth and development for both the team as a whole and the team members as individuals." (Cianni and Wnuck, 1997 p. 106). Thus, effective teams are those that can tangibly contribute to the ongoing on-the-job training and acclimatization process of their members. The concept of virtual team member viability, defined as the individual's KSA development and ability to perform effectively in virtual teams in the future, is introduced and included as a measure of team effectiveness.

## **Mediator Variables**

Team coordination and internal communication are hypothesized to be proximal determinants of project virtual team effectiveness. They are hypothesized to mediate the relationship between behavior control and team effectiveness. In the remainder of this section, each mediator variable is defined in turn.

### **Coordination**

Coordination has been defined as a "means of integrating or linking together different parts of an organization to accomplish a collective set of tasks" (Van De Ven, et al., 1976 p. 322). In general, coordination should be regarded as the degree of functional articulation and unity of effort between different organizational parts (Georgopoulos and Mann, 1962) and "the extent to which the work activities of organizational members are logically consistent and coherent." (Cheng, 1983 p. 156). Thus, in a well-coordinated organization, work activities are complementary and are directed toward a common goal without duplication of effort or fragmentation (Cheng, 1984). In a team environment, internal coordination can be thought of as the management of dependencies (Crowston and Kammerer, 1998) and it refers to how organized the team is in carrying out its mission (Janz, et al., 1997).

The nature of the relationship between coordination needs and team effectiveness is dependent on team task (Straus and McGrath, 1994). According to Galbraith (1977), who focuses on the organizational level rather than the team

level of analysis, as task uncertainty increases, the amount of information required to perform a specific task increases accordingly. In order to maintain constant performance standards, internal organization structure and coordination mechanisms must change to accommodate the higher need for information. Thus, internal coordination becomes much more important as task uncertainty increases.

McGrath (1984) identifies four types of tasks that teams typically are confronted with: generating ideas or plans, choosing among alternatives, negotiating conflicts and executing activities. When teams interact substantially over time, they are likely to engage in most, if not all, of the above. Nonetheless, depending on the objectives and purpose of the team, their interaction may be skewed toward one type of recurrent task. For example, customer service team may predominantly execute activities, while quality circles may tend to focus more on idea generation.

The four different tasks proposed by McGrath (1984) vary with respect to the level of interdependence among team members. The tasks characterized by the highest level of interdependence are those that require team members to discuss different alternatives and reach a consensus on a preferred, rather than univocally correct, alternative (Straus and McGrath, 1994).

Early research indicates that virtual team are best suited to work on projects focusing on idea generation, planning and reporting (Furst, 1999; Lipnack and Stamps, 1997). These projects require a great deal of interaction. One of the greatest potential advantages offered by virtual teams, and arguably the primary reason for their implementation, is their ability to pool dispersed talent of cross-

functional or cross-organizational workers and produce highly interdependent and creative outputs that incorporate input from a plurality of stakeholders. Thus, in project virtual teams, where team members are heavily interdependent due to the nature of their task, coordination appears to be of paramount importance. It is hypothesized here that high levels of team coordination represent a necessary condition for virtual teams to be highly effective.

### **Internal Communication**

Internal communication effectiveness denotes the extent to which information exchanged by team members is timely, useful and reliable. Internal communication quantity represents the amount of interaction that occurs between team members. Strong evidence attesting to the positive relationship between communication effectiveness and quantity and team effectiveness is found in the literature (Brown and Eisenhrdt, 1995; Ancona and Caldwell, 1992; Dougherty, 1992; Keller, 1986; Allen, 1977). It is suggested that teams that experience extensive and highly effective communication are more effective.

### **Testable Hypotheses**

Drawing on the literature reviewed in the previous chapter and the propositions outlined there, a set of eleven testable hypotheses is developed using the construct definitions presented above.

Proposition 1: Virtual teams that achieve higher levels of coordination, greater internal communication and higher communication effectiveness are more effective.

**Hypothesis 1a: Without regard for the control mechanism (self-direction vs. behavior control), the higher the levels of coordination and communication (quantity and effectiveness) achieved by the team, the higher the quality of the team's project deliverable.**

**Hypothesis 1b: Without regard for the control mechanism (self-direction vs. behavior control), the higher the levels of coordination and communication (quantity and effectiveness) achieved by the team, the higher the psychosocial outcomes reported by the team members.**

**Hypothesis 1c: Without regard for the control mechanism (self-direction vs. behavior control), the higher the levels of coordination and communication (quantity and effectiveness) achieved by the team, the higher the individual team member's viability.**

**Proposition 2: Virtual teams where managerial behavior control is enforced are more effective than self-directed virtual teams.**

**Hypothesis 2a: The project deliverable produced by project virtual teams where managerial behavior control is enforced is of higher quality than that of self-directed teams.**

**Hypothesis 2b: Members of project virtual teams where managerial behavior control is enforced report higher psychosocial outcomes than members of self-directed teams.**

**Hypothesis 2c: Team member viability is higher for members of project virtual teams where managerial behavior control is enforced than for members of self-directed teams.**

**Proposition 3: Behavior control in virtual teams will stimulate higher levels of communication and coordination that contribute to increased team effectiveness.**

**Hypothesis 3a: Project virtual teams where behavior control is enforced display higher levels of coordination than self-directed teams.**

**Hypothesis 3b: Project virtual teams where behavior control is enforced display higher levels of communication effectiveness than self-directed teams.**

**Hypothesis 3c: Project virtual teams where behavior control is enforced communicate more extensively than self-directed teams.**

**Hypothesis 3d: When the effects of internal coordination and communication (quantity and effectiveness) are controlled, self-directed teams perform as well as teams where managerial behavior control is enforced.**

**Hypothesis 3e: When the effects of internal coordination and communication (quantity and effectiveness) are controlled, the members of self-directed teams and those of teams where managerial behavior control is**

enforced report the same levels of psychosocial outcomes.

Hypothesis 3f: When the effects of internal coordination and communication (quantity and effectiveness) are controlled, the members of self-directed teams and those of teams where managerial behavior control is enforced achieve the same levels of team member viability.

## **Research Design**

This study employed a two-group longitudinal design, varying team control structure (self-direction vs. behavior control). Half the subjects were assigned to self-directed teams while the remaining subjects worked in teams that comply with a set of externally established requirements. The members of self-directed teams could structure the work processes as they see fit and retained full control over the organization of the project. By contrast, the members of teams in the “managerial behavior control” condition were required to comply with a set of behaviors externally enforced and their degree of discretion over the manner of project completion was limited.

Most studies of project teams have generally employed survey research techniques, and they have analyzed a cross-section of teams at a specific moment in time. This approach is certainly valuable and it allows for maximum generalizability over the population of interest (McGrath, 1982). However, the



researcher cannot follow teams over time and manipulate any of the constructs of interest.

A longitudinal experimental design offers a number of advantages. First and foremost, internal validity of the findings is improved (Cook and Campbell, 1979). The ability to manipulate the independent variable (i.e., team control structure), and observe its effects, provides the strongest basis for inferring causality. Second, an experimental design allows the researcher to collect observational data and triangulate the results obtained through self-reported questionnaires. In this research study, the heavy use of text based communication tools, coupled with the researcher's access to communication logs provides a rich source of data.

## **Subjects**

Fifty-one teams were assembled, drawing from a population of two hundred and one MBA, M.S. and undergraduate students enrolled in electronic commerce courses in six different universities. Undergraduate students, twenty-four seniors and one junior, comprised 11% of the total subject population.

The teams were initially comprised of four subjects (three teams had only three subjects). Participation in the study was secured from schools in the US, Europe and New Zealand. The following schools participated in the experiment:

- California State Polytechnic University, USA
- University of Colorado at Denver, USA
- DePaul University, USA
- Louisiana State University, USA,
- Massey University, New Zeland
- University College Dublin, Ireland

## **Procedure**

All subjects participating in the experiment were surveyed prior to the beginning of the experiment. Information was collected on a number of demographic variables, work experience, experience working in teams, self-reported experience using the available communication and collaboration technologies, attitudes toward information technology and computer self-efficacy (i.e., individual's perception of their own ability to successfully use computers).

Following the preliminary data collection, subjects were randomly assigned to teams. No two subjects from the same institution were assigned to the same team.

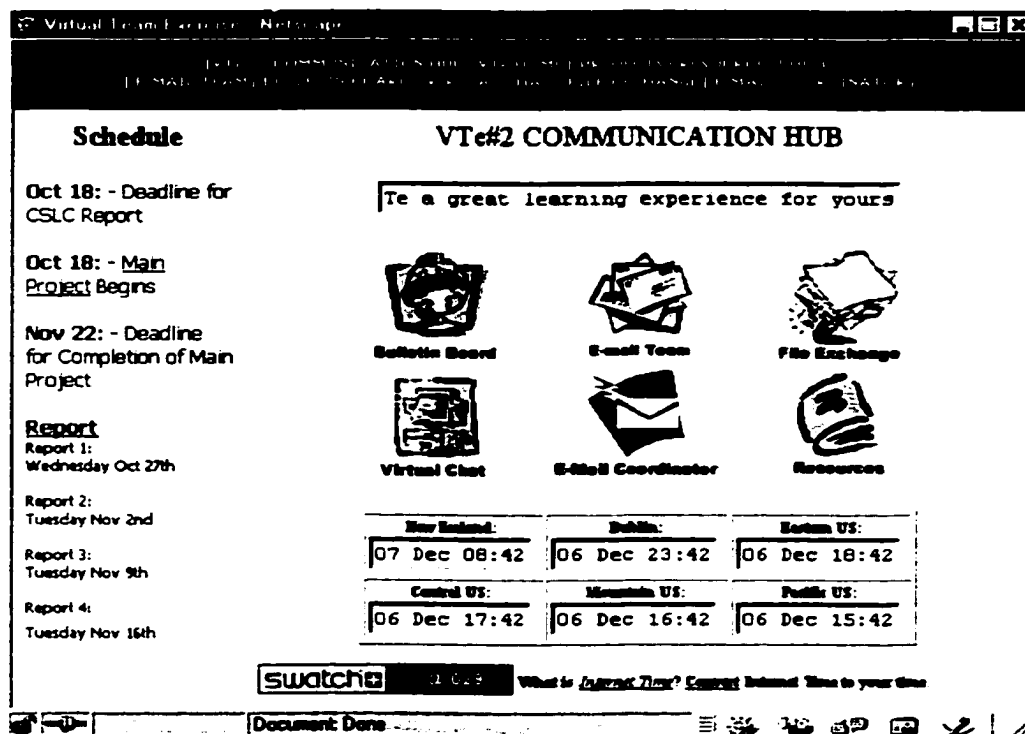
A substantial percentage of students' final grade (20 – 25%) was assigned to the exercise to increase students' motivation. A financial incentive, seven hundred and fifty US dollars for the two best teams, was also pledged to increase motivation.

### **Communication technology**

Each team was equipped with a web-based application called the "communication hub." The communication hub, a custom developed communication center available through the world wide web, provided access to a set of communication media and team resources. Figure 3 depicts the communication hub interface.

Each team had password-protected access to its own personalized communication hub. Capabilities the student could draw upon from the hub included:

- A non-moderated, private distribution list that allowed each team members to send electronic mail messages to the other members of his or her team.
- An online conferencing system that offered both asynchronous threaded discussion and synchronous discussion capabilities (i.e., private chat rooms).
- A web based shared File Transfer Protocol (FTP) area where team members could upload and retrieve shared files.
- An array of resources for completion of the projects.



**Figure 3: The interface of the communication hub provided to each team**

Each team member also had a private electronic mail account. Messages sent through personal mail, unless directed through the team distribution list, were not

included in the communication logs. The teams had discretion over what communication medium (or portfolio of communication media) available in the communication hub, to use to accomplish team tasks.

The communication technologies were developed and centrally maintained by the host institution: Louisiana State University. At the start of the project each team member was provided with a user-id and password that gave them access to their team's communication hub. The communication hub was developed with the objective of collecting comprehensive logs of all communication in each team, with the exception of personal electronic mail. The communication hub provided an easy to reach and easy to use location for team interaction. By providing each team with a private communication hub it was hoped that the team members would not resort to alternative communication media. The next chapter reports evidence that most of the team communication indeed took place through the media provided and was therefore recorded.

### **Team building exercise**

The experiment lasted eight weeks. During the first week all students were engaged in a team building exercise. The subjects were asked to contact their team members and introduce themselves, provide some background information such as their work experience, educational background and interests. The purpose of this initial exercise was twofold. It was intended to stimulate early communication and the development of cohesive teams. It was intended to help subjects become acquainted with the available communication and collaboration technologies.

### **Customer Service Life Cycle discussion and analysis exercise**

The CSLC discussion and analysis exercise represented the first of two projects that each participating team had to complete. The CSLC discussion and analysis exercise was a short preliminary exercise that lasted two weeks. It began with a learning activity. Subjects, either individually, or during class time, took a set of Web-based learning modules describing the Customer Service Life Cycle (Ives, 1999; Ives and Learmonth, 1984).

The CSLC is a framework describing the various stages a customer follows to research, obtain, own and dispose of a product or service. Primarily, the CSLC is a support tool to help managers think creatively about how their organization could harness the Internet and World Wide Web to improve customer service and gain a sustainable competitive advantage. As Ives (1999) states,

Most of all, [the customer service life cycle] is a powerful way to think about your Internet strategy and a means to obtain a sustainable competitive advantage over your competitors. In simple terms the Customer Service Life Cycle (CSLC) is intended to help you differentiate the various stages your customer goes through in acquiring a product/service from your firm. The basis for the differentiation is improved customer service.

The CSLC web-based learning modules introduce the conceptual framework and, through the extensive use of examples, provide a rich environment to understand the dynamics of the CSLC. The learning modules also contain a case study. The case study focuses on the publishing industry and it is designed to stimulate analysis and discussion of the CSLC as well as its practical application.

Upon completion of the learning task, and after reading the case study, the subjects were required to discuss solutions and opportunities that emerge from the case study within their team. Subsequently, each team wrote a report detailing the team's analysis of the case study and proposed solutions. A standard template was developed and provided to the teams to ensure consistency and comparability of team reports.

The discussion and analysis exercise was also designed to follow right after the team building exercise and, on the momentum generated by it, continue the development of team cohesiveness and members' proficiency in using the available technologies. More importantly, the discussion and analysis exercise was intended to develop a preliminary understand of the opportunities and challenges offered by virtual teams and their environment, develop a team working style and start thinking creatively about the possibilities that Internet technologies offer to businesses around the globe.

### **Business plan project**

The second project spanned the remaining five weeks. Each team was required to prepare a business plan for a newly formed company that specializes in developing and marketing a specific business innovation, or prepare a business proposal for an existing company introducing a new product or service. The teams selected the product or new business they intended to pursue with the only restriction that the product/service they choose was enabled by the Internet and related technologies. During the allotted five weeks the teams carried out the necessary research and studied the viability and market potential of the selected

innovation. The deliverable of this project was a traditional business plan detailing the specifics of the product/service, market analysis, analysis of viability of the innovation, the proposed market strategy, selected financial figures and the forecasted return on investment. The project coordinator, to ensure comparability of the deliverables, provided the teams with a general template to be followed when developing the business plan.

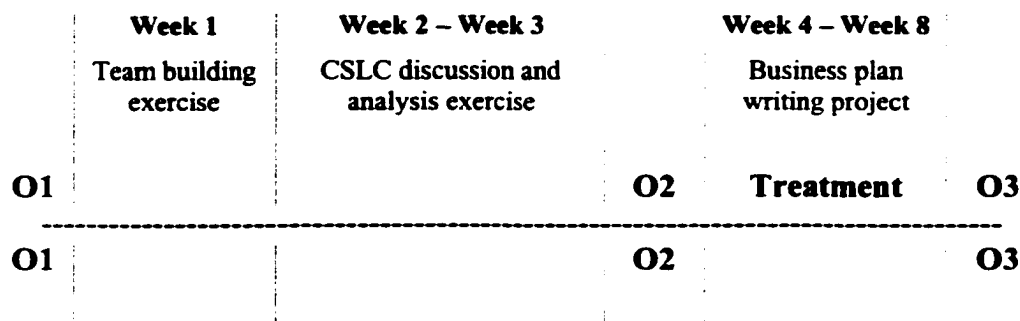
This project is particularly well suited for the investigation of the research questions in this study because the task requires a lot of team interaction and could not be easily accomplished by one or two group members. Specifically, the project has components of decision making, information exchange and requires extensive communication and coordination of effort. Virtual teams are likely to focus on such projects as planning, reporting, developing ideas and the like, rather than actual execution of activities (Furst, et al., 1999). Thus, the project chosen for this study is a realistic one and is not unlike the kinds of projects that virtual teams may be confronted with in “real world” situations.

## **Experimental Manipulation**

Team control structure (self-direction vs. managerial behavior control) represents the manipulated variable in this study. Twenty-six teams, the treatment group, were exposed to managerial behavior control. These teams had a restricted amount of control over the organization of work during the experiment as they were required to comply with external managerial guidelines that partly regulated their behavior (see below). The remaining twenty-five teams, the control group,

were allowed to self-directed. They retained complete control over their behavior and the organization of work, work assignment, work methods, and scheduling of activities. Figure 4 depicts the data collection timeline for the experiment.

As shown in the figure, no experimental manipulation was applied during either the team building exercise or the discussion and analysis exercise. The experimental manipulation was operational only during the main project spanning the last five weeks.



**Figure 4: Projects and data collection timeline**

During the manipulation, the treatment group was required to comply with a set of requirements based on the operational definition of managerial behavior control. A literature review of common managerial behavior control mechanisms enforced in traditional teams provided the basis for the development of the requirement (Kirsch, 1997; Henderson and Lee, 1992; Orlikowski, 1991; Ouchi, 1979). Chapter two provides a review of behavior control mechanisms traditionally used in collocated team. A subset of such mechanism was used in



this study. Specifically, the following weekly documentation was required of the teams in the treatment group:

- **Project plan.** On a weekly basis, the teams in the treatment group had to engage in long range and short term planning. More specifically they were asked to document the major activities needed to successfully complete the project, and what activities had to be completed by the following week.
- **Work assignments.** Along with the project plan, each team in the treatment group was required to file a work assignment sheet. For each task due for completion by the following week, specific team members had to be identified as responsible for completion.
- **Progress report.** Each week the teams in the treatment group also were responsible for reporting on the progress made toward project completion. In the progress report they were asked to discuss the short-term goals identified in the previous week's project plan and the advancement toward their achievement.

Note that composing the documentation and forwarding it to the exercise coordinator is not the primary objective of the requirements. Instead, the objective is to indirectly enforce the behaviors that are expected to contribute to enhance team effectiveness. Namely, increase coordination and communication among the teammates.

In order to achieve a balanced experimental design, and to avoid providing the treatment group with an unfair advantage over the control group, a resource page was made available to all teams (i.e., treatment and control groups). Among other valuable resources, a tutorial describing the role and benefits of project plans, work assignments and progress reports, was posted to the resource page for their

benefit. At the beginning of the exercise, all teams involved were encouraged to read and utilize the available resources. At the start of the experiment, three weeks into the exercise, the requirement to comply with the reporting regime was enforced for the teams in the treatment group.

Weekly Report - Netscape

HOME DISSEMINATION GUIDE VTe GUIDE PROJECTS RESOURCES HELP  
MAIL TEAM PROJECTS FAQ VTe FAQ CONTACT CHANGE MAIL COORDINATOR

# Weekly Report

[Help](#) VTe

To: VTe Coordinator  
From: VTe#2  
Date: 12/6/99

**Project Plan:**  
In this section you will provide the short-term and long-term planning that you have for completion of the project. You will document the major activities that are needed to successfully complete the project. In many cases these activities would fall under your long-term planning. Be sure to include a detail schedule for the completion of these long term activities. You will also list the tasks that you will be completing by the following week. These would be your short-term activities.

**Long-Term Planning:**

Document Done

**Figure 5: Web-based application used by the treatment group for weekly reporting**

In order to ensure consistency of reports filed by the teams in the treatment group, and to simplify the report filing process, a web-based reporting application was developed. This consisted in an online reporting application employing an HTML form that could be filled by each team and was automatically delivered to the exercise coordinator upon submission. Each team in the treatment group was

required to submit one set of weekly reports. Figure 5 provides a representation of the web-based reporting application.

To even the workload the subjects in the control group were required to complete an individual two-page report at the end of the project. This individual reporting requirement had the only objective to balance external requirements across all teams and to reduce the perception by the treatment group that they were treated unfairly. The individual reports to be filed by the subjects in the control group did not interfere with the internal organization of their teams. These teams were informed that they should self-direct during completion of the project. A template for individual reporting would be released at the end of the exercise and they would be asked to complete it. This final report queried the individuals regarding their evaluation of the experience working in virtual teams and their suggestions for the improvement of future similar projects.

## **Threats to Validity**

Randomized assignment of subjects to teams and teams to treatments provides control over many internal validity threats. On the other hand, not all threats to internal validity are automatically eliminated by randomization (Cook and Campbell, 1979). Threats of imitation of treatment, compensatory rivalry and resentful demoralization are particularly notable (Cook and Campbell, 1979). In the context of this study, imitation of treatment represents the possibility that self-directed teams, once made aware of the procedures being used by the treatment group, imitate them, thus confounding the results. Compensatory rivalry may

occur in self-directed teams. If they become aware of the procedures being used by the teams in the treatment group, and perceive them to be unfairly benefiting the managed teams, they may exert extra effort to overcome their perceived disadvantaged situation. Conversely, resentful demoralization could manifest itself if subjects in the control group "give up" once they perceive themselves to be at a disadvantage. In all three cases the research findings would be confounded by conditions that are an artifact of the experimental situation.

In order to limit the potential for internal validity threats in the context of this experiment, it is crucial to limit the amount of information exchange between teams assigned to different experimental conditions.

Upon beginning the exercise the communication hub for each team in the treatment and control group were the same in every aspect except for the reporting feature.

One source of concern is that the proposed manipulation may engender different workloads. While the treatment group had to report weekly to the coordinator, the members of the teams in the control group had to file an individual report at the end of the project. Therefore, all projects were comparable in terms of workload. Nonetheless, it is plausible that the subjects in the treatment condition may perceive the reporting requirements to represent added work that the teams in the control condition do not have to do. This perceived unfairness of the workload may lead to resentful demoralization or to a negative reaction and failure to comply. The solution lies in the ability to control and minimize the

information exchange between teams in different conditions and to make the reports very simple and straightforward to submit.

To legitimize the different participation rules and reporting requirements, each team was assigned to a business plan (bizPlan) liaison and was instructed that a portion of the team's final score (20%) was allocated by the bizPlan liaison. Such evaluation, the subjects were told, was based on the team's compliance with the participation rules communicated by the liaison.

While only one coordinator existed in reality, two fictitious identities were created and presented to the subjects. One of the two liaisons was assigned to the treatment group while the other oversaw the control group. To minimize the likelihood that they would discover that different procedures were required of different teams, the subjects were not told how many liaisons were there or who was assigned to what liaison. Upon the beginning of the experimental manipulation the exercise coordinator introduced the bizPlan liaison. Immediately after the introduction, the liaison introduced themselves to the teams and indicated what procedures they should follow during the completion of the main project.

To further reduce the possibility of inter-team communication and increase subjects' motivation, a competition for the best business plan was instituted. The participants were informed that the two winning teams would receive a cash prize (\$750 per team) and that their work could be forwarded to a venture capital firm for examination and possible funding of their idea. They were therefore instructed to treat all information about the projects (content and process) with maximum confidentiality.

A further control measure that was considered was to require the teams in the control group to follow a reporting schedule similar to that of the teams in the treatment group. Such reporting schedule would be designed to limit the perception of uneven workload and it would not lead to any behavior modification. In other words, it was thought to request that teams in the control group report to the coordinator at the same times and at similar intervals as the teams in the treatment group. Unlike the teams in the treatment group though, they would report on events unrelated to the team's internal organization of work and the team's progress toward completion of the project.

This parallel reporting solution engenders two problems. It is very difficult to identify reporting requirements that would be considered reasonable by the team members while at the same time not overlapping those required of the treatment group. More importantly, it is not the act of reporting that is being studied. Rather, it is the fact that filing weekly reports requires the team members to perform behaviors believed to improve team effectiveness. For example, negotiate responsibility for specific tasks, focus on team goals early, develop a strategy to achieve such goals, revise and modify such strategy if needed, communicate extensively within the team. Therefore, requiring self-directed teams to report on a regular basis, independently of the content of the reports, would indirectly stimulate them to perform some of the above behaviors and consequently confound the research findings.

## **Measurement Issues and Scales**

This section focuses on the measurement of the research variables. Team control structure, the independent variable, is experimentally controlled. The remainder of this section discusses the measurement of the dependent variables, the measurement of the proposed mediators, the survey instrument pre-test, and issues of aggregation of individual responses at the team level of analysis.

### **Dependent Variables**

Team performance was based on the quality of the final document produced by the teams. Two independent raters, blind to the research hypotheses and team assignment to the treatment or control group, were asked to evaluate each team's business plan. They rated the originality of the product or service proposed, its feasibility, the thoroughness of the market research and the professionalism of the document presented. These dimensions were averaged to obtain an overall quality index.

Individual psychosocial outcomes were measured through self-report questionnaire. The measure was slightly adapted from a validated scale (Pinto, et al., 1993) used in collocated cross-functional teams research. The modifications reflect the focus of this study on virtual teams rather than traditional ones. Seven items scored on a seven point agree/disagree Likert scale were used.

Team member viability represents the prospective ability of each team member to be an effective virtual team member. This construct was measured using a peer evaluation system. Each member evaluated each teammate on a number of skills

and abilities that are deemed fundamental in the virtual environment. Evaluations were then aggregated across evaluators (i.e., teammates) to compute an individual team member viability score.

A ten-item team member viability scale was developed for this study. The measure is based on a review of knowledge, skills and ability (KSA) requirements for teamwork in collocated teams (Stevens and Campion, 1994) and its extension to the virtual environment (Furst, et al., 1999). The measure was refined through interview and discussions with both practicing virtual team members and academic experts. Nonetheless, the measure should be considered exploratory and subject to validation.

### **Mediator Variables**

A measure of coordination was developed by modifying validated scales (Janz, et al., 1997; Cheng, 1984). The developed scale consists of nine items scored on a seven point Likert scale.

Internal communication was assessed using both self-reported and objective measures. A scale measuring internal communication effectiveness was developed by slightly modifying a validated instrument (Frone and Major, 1988). The scale consists of three items (i.e., to what extent was the information that you received from your teammates usually timely / accurate / useful) scored on a seven point Likert scale with anchors ranging from “to a very little extent” to “to a very great extent.”

The communication logs provided measures of communication quantity. The team's distribution list, asynchronous conference and synchronous discussion were



monitored. The number of messages sent through the distribution list and the number of messages posted to the asynchronous conference were counted to establish the quantity of interaction through them. The size of the team's chat room log (in kilobytes) provided the measure of synchronous communication quantity. Self-reported assessments of communication quantity through the above media and a number of alternative media (e.g., telephone, fax) were also collected. The purpose of such data collection was to triangulate the results of log analyses and to determine the extent to which the logs contained reliable and exhaustive data.

### **Survey Instrument Pre-Test**

The survey questionnaire was pre-tested by several individuals. Twenty-one graduate students were asked to evaluate the questionnaire in terms of readability, ease of understanding and clarity of presentation. The questionnaire was delivered and completed online and, during pre-test, the subjects were observed interacting with the interface. They were asked to voice any concern they might have or difficulty they might encounter while completing the survey.

After refinement of the questionnaire, two individuals who had previously participated as subjects in similar studies and three researchers with extensive survey research experience were also asked to review the instrument. They were invited to provide comments and suggest items deemed important that had not been included.

The pre-test proved to be a good source of comments and allowed for refinement and streamlining of the survey instrument. During pre-test it was also

possible to gauge the approximate time requirements for completion of the questionnaire.

### **Level of Analysis and Group Level Aggregation**

This study is grounded in a "meso" research perspective. Meso theory is defined as research concerning "the simultaneous study of at least two levels of analysis" (House, et al., 1995 p. 73). In organizational research, phenomena that occur at different levels of analysis are connected and influence one another (House, et al., 1995). For example, individuals contribute to shape and change the organizational context and social structures to which they belong (Boeker, 1989; Miner, 1987). Conversely organizational context variables influence individual behavior (Hackman, 1989; Daft and Weick, 1984).

Thus in this study a cross-level analysis approach was followed. Team performance, communication, coordination and managerial behavior control are treated as group level variables. Individual psychosocial outcomes and team member viability instead pertain to the individual level of analysis.

All variables, with the exception of team performance and communication quantity were measured at the individual level. However, for communication effectiveness, and coordination, the theoretical unit of reference is the team, not the individual. In other words, individuals reported perceptions of communication and coordination, but such measures were used to represent the level of coordination and communication achieved by their team. Thus, all questions in the coordination and communication scales were worded using the team as the referent object.

In order to use data gathered at the individual level to represent group level constructs without committing a fallacy of the wrong level (Rousseau, 1985), the appropriateness of aggregating the scores was evaluated (James, et al., 1984; James, 1982). It would be erroneous, for example, to treat the members' mean response to the team coordination scale as an indicator of "team coordination" when widely different perceptions exist between members.

Perceptual agreement was established before aggregation by way of the  $r_{wg(j)}$  index (James, et al., 1984). To determine the  $r_{wg(j)}$  index, the following assumptions had to be met:

- Scale items should be worded using the higher level unit of analysis as the referent object
- The scale has acceptable psychometric characteristics
- Alternatives on each items scale are equally spaced
- The items in a scale have the same range (i.e., 1-7)

A scale is deemed appropriate for aggregation at the higher level of analysis (e.g., the team level), when a median  $r_{wg(j)}$  greater than 0.70 is found (Janz, et al., 1997; George, 1990). Aggregation at the team level was obtained by averaging the scores among team members.

## **Data Analysis Methodology**

This section describes the procedures for data analysis and the rationale for the choices made. The procedure for validating the survey instrument and the statistical techniques chosen for the analysis are discussed in turn.

## **Instrument Validation**

The instruments are validated using both exploratory and confirmatory factor analyses. The first step consists in performing exploratory factor to ensure unidimensionality of all scales used. Scales are considered unidimensional when all scale items have acceptable loadings on the hypothesized construct and do not cross-load on a second factor. Following standard practice the items with factor loading greater than  $\pm .30$  are considered to meet the minimal levels of acceptability and are evaluated further.

Next, confirmatory factor analysis, using LISREL 8.14 (Joreskog and Sorbom, 1996), is performed in order to assess convergent and discriminant validity of the proposed scales.

Convergent validity is assessed through evaluation of the overall fit of the measurement model structure to the available data. This technique allows the researcher to specify what items should load on each latent variable on the basis of theoretical considerations. Thus, providing an explicitly test of the appropriateness of the selected theory driven model (Anderson and Gerbing, 1988).

LISREL provides an array of goodness-of-fit indices. Traditionally, the following indices have been reported in the literature:  $\chi^2$ , the Root Mean Square Error of Approximation (RMSEA) and the Goodness of Fit Index (GFI).

The  $\chi^2$  test provides a test of the null hypothesis that the variance/covariance matrix reproduced by the measurement model is not significantly different from

the original matrix constructed using the original data (Pedhazur and Schmelkin, 1991). The researcher's objective is thus not to reject the null hypothesis. The  $\chi^2$  test is very sensitive and even when the null hypothesis can not be rejected the measurement model may be appropriate. The analyst should then examine the  $\chi^2/df$  measure. A reasonable fit is indicated by  $\chi^2/df$  values as low as 2 and as high as 5 (Raghunathan, et al., 1999). Values below 0.08 are deemed acceptable for the RMSEA index and values exceeding 0.90 are normally considered acceptable for GFI (Hoyle and Panter, 1995).

A second set of goodness-of-fit indices, labeled incremental fit indices, is particularly valuable in assessing the quality of the measurement model used in the present study. These measures provide an estimation of the quality of the model fit with respect to the fit of the null model (Hu and Bentler, 1995). The null model normally being a single-construct model with all indicator variables perfectly measuring the construct (Hair et al., 1995). Traditional incremental fit measures are the Tucker-Lewis Index (also known as the Non-Normed Fit Index - NNFI), the Normed Fit Index (NFI) and the Comparative Fit Index (CFI). Traditionally, model fit is deemed acceptable when these indices exceed 0.90 (Hoyle and Panter, 1995).

Recent work by (Hu and Bentler, 1995) indicates that absolute fit indices, such as GFI, tend to reject appropriate models too frequently when small samples of less than 250 observations are used. With small samples, as in the case of this research, incremental fit indexes tend to be more accurate (Hu and Bentler, 1995).

Confirmatory factor analysis also provides measures of discriminant validity, the extent to which the constructs in the measurement model are unique and distinctively different from one another. A rigorous test of discriminant validity for two latent constructs consists in measuring the average variance extracted (AVE) for each construct and the squared correlation between the two. If the average AVE of the two constructs exceeds the squared correlation between them strong evidence of discrimination is provided. A second accepted test of discriminant validity, albeit less restrictive, consists in measuring the confidence interval ( $\pm$  two standard errors) around the correlation estimate between the two constructs ( $\phi$ ). If this confidence interval does not contain a value of 1.0, discrimination can be claimed (Anderson and Gerbing, 1988).

It should be noted here that the procedures outlined above provide evidence of convergent and discriminant validity, but do not replace explicit and more thorough validity tests (Campbell and Fiske, 1959).

The last step in instrument validation consists in the assessment of the reliability of the scales. Coefficient alpha (Chronbach's alpha) is employed. Acceptable reliability is traditionally denoted by coefficient alpha greater than 0.70 (Hair et al., 1995; Nunnally, 1978).

### **Data Analysis Strategy**

Multiple Ordinary Least Square (OLS) regression analyses, Analysis of Variance (ANOVA) and Hierarchical Linear Models (HLM) are used to evaluate

the research propositions. The rationale and justification for using each technique are presented in this section.

Organizations are hierarchical entities comprised of conceptually nested units. For example, individuals are nested (i.e., aggregated) in work groups, groups are nested in departments, departments are nested in divisions, and so on. Thus, in order to study organizations and comprehend their dynamics, we often need to carry out cross-level analyses. The units of analysis are often defined at different levels (i.e., individuals vs. teams).

This work is not exceptional in this regard. Team coordination, communication effectiveness and quantity, team performance and team managerial structure are variables conceptually defined at the team level of analysis. Conversely, individual psychosocial outcomes and team member viability are defined at the individual level of analysis. Individuals are nested within teams. Conceptually therefore it is possible that the characteristics of the higher level units (i.e., teams) and the processes that develop in such units influence the lower level units (i.e., individuals). In this study this kind of cross-level relationship is hypothesized and differences at the team level are expected to influence individuals.

Historically, cross-level analysis such as the one presented here has relied on Ordinary Least Squares (OLS) regression either at the individual level or at the group level (Hofmann and Gavin, 1998).

In the first case the researcher would develop a model adopting a regression equation designed to investigate the relationship between a dependent variable

( $Y_{ij}$ ), an individual level independent variable ( $X_{ij}$ ) and a group level independent variable ( $G_j$ ). This model would have the following form:

$$Y_{ij} = b_0 + b_1 X_{ij} + b_2 G_j + e_{ij} \quad [1]$$

Where  $i$  represents a specific individual and  $j$  represents the group the subject belongs to. The same value for  $G_j$  is thus assigned to each individual  $i$  in the  $j$  group. This approach is problematic on two grounds. OLS regression is based on the assumptions of normally distributed independent random errors with constant variance. When group scores are assigned to individuals though, the assumption of independence of the error terms is violated because error terms will now contain a systematic component due to group level random effect, and a random component. Observations within groups will thus likely be dependent (Bryk and Raudenbush, 1992). Moreover, if random group level errors vary across groups, the assumption of homoscedasticity is also violated.

Secondly, if the analysis is carried out at the individual level using OLS regression and assigning a group score to each unit in the group, the standard errors are underestimated and the chance of Type I error is inflated (Kidwell, et al., 1997; Bryk and Raudenbush, 1992).

A second approach consists in aggregating individual level data to the group level, typically using the means of individuals' responses. This procedure is not optimal either because it makes it difficult to model the cross-level nature of the



data and to study the effects of individual level variables (Bryk and Raudenbush, 1992).

Hierarchical Linear Models (HLM) provide the tools to more correctly and efficiently study cross-level phenomena. HLM separate individual level variables and group level variables by specifying level-1 and level-2 models.

$$\text{Level-1:} \quad Y_{ij} = \beta_{0j} + \beta_{1j} X_{ij} + r_{ij} \quad [2]$$

$$\text{Level-2:} \quad \beta_{0j} = \gamma_{00} + \gamma_{01} G_j + u_{0j} \quad [3]$$

$$\beta_{1j} = \gamma_{10} + \gamma_{11} G_j + u_{1j} \quad [4]$$

The level-1 equation [2] models the relationship between the dependent variable (defined at the individual level) and the individual level independent variables. The above model presents the case of one individual level independent variable ( $X_{ij}$ ). The level-1 equation is very similar in both computation and interpretation to a traditional OLS regression. A different level-1 equation though is estimated for each group in the analysis and the regression coefficients (i.e., the  $\beta$ s) are allowed to vary across groups. Thus,  $\beta_{0j}$  represents the intercept of the level-1 regression for team  $j$ . In other words, for team  $j$ , when  $X_{ij} = 0$ , then  $Y_{ij} = \beta_{0j}$ .  $\beta_{1j}$  represents the slope of the level-1 regression for team  $j$ . Thus, in team  $j$ , a unitary variation of  $X_{ij}$  will result in a change of  $Y_{ij} = \beta_{1j}$ .

HLM then estimates the two level-2 equations (equation 3 and equation 4 above). The dependent variables of these two equations are represented by the

intercept and slope coefficients estimated by the level-1 equation. While a comprehensive treatment of HLM is beyond the scope of this discussion (see Kidwell, et al., 1997 and Bryk and Raudenbush, 1992), it is important to discuss the interpretation of the level-2 equations.

Equations 3 and 4 allow the researcher to model the variability in the intercept and slope coefficients and thereby model the effect of group level variables (i.e.,  $G_j$ ). More specifically, equation 3 represents the main effect associated with the group level variable  $G_j$ . It allows the researcher to address the question: "What team characteristics (in this study the coordination and communication processes of the teams) are good predictors of differences in mean levels of the dependent variable (in this case psychosocial outcomes and team member viability) between teams?" In other words, equation 3 allows the researcher to study what group level variables account for between-group differences in the individual level dependent variable.

Equation 4 represents the interaction between  $G_j$  and  $X_{ij}$ . It allows the researcher to ask the question: "What group level variables are good predictors of differences among the effects of individual level variables (i.e.,  $X_{ij}$ ) on the individual level dependent variable?" Equation 4 allows us to study how group level variables change the relationship between individual level dependent and independent variable (a cross-level interaction effect).

The first step in estimating a Hierarchical Linear Model consists in running a fully unconditional model (Bryk and Raudenbush, 1992).

$$\text{Level-1:} \quad Y_{ij} = \beta_{0j} + r_{ij} \quad [5]$$

$$\text{Level-2:} \quad \beta_{0j} = \gamma_{00} + u_{0j} \quad [6]$$

This fully unconditional model represents a null model where no independent variables are specified. It provides information on how the variance in the dependent variable is partitioned between the two levels of analysis. This information is important because it allows the researcher to gauge at the onset of the analysis how the variability in individual responses is accounted for by independent variables at each level.

The fully unconditional model provides an estimate of the within-group variability,  $\text{Var}(r_{ij}) = \sigma_2$ , and the between-group variability,  $\text{Var}(u_{0j}) = \tau_{00}$  (Bryk and Raudenbush, 1992). HLM provides also a statistical test of the hypothesis that the between-group variance equals zero. This is a test of the null hypothesis  $H_0: \tau_{00} = 0$ . If the null hypothesis is not rejected it can not be concluded that there are differences among level-2 units (i.e., teams) and the analysis should focus exclusively on the individual level. Conversely if the null hypothesis of equal group means is rejected, there is substantial variability between teams and the analysis should proceed to uncover what level-2 variables are responsible for such differences.

The researcher must specify the level-1 equations and estimate the variance in the level-1 parameters of interest (i.e.,  $\beta_{0j}$ ,  $\beta_{1j}$ , etc.). If enough between-group variance in these parameters is found, the researcher can proceed with the

specification of level-2 equations and evaluate the significance of the estimated parameters (i.e.,  $\gamma_{00}$ ,  $\gamma_{01}$ ). HLM provides t-tests of significance of the level-2 parameters. Interpretation of the parameters' magnitude and significance levels is similar to that of traditional OLS regression.

Once a model with level-2 predictors is tested, the hypothesis of equal between-group variance provides useful to determine the value of further analysis. If the null hypothesis of significant between-group variance conditional on the significant predictors in the model,  $H_0: (\tau_{00} | G) = 0$ , is rejected, then substantial unexplained between-group variance remains, and the search for relevant predictors must continue. Conversely, if the null hypothesis is not rejected the researcher can confidently assert that the variables included in the analysis account for the between-group variability in the dependent variable.

One final step in HLM analysis consists in testing the parsimony of the model in order to evaluate competing simpler models that may provide equivalent explanatory power. HLM provides a statistic, the deviance statistic, to support the researcher's decision. The deviance statistic can be viewed as a measure of model fit (Bryk and Raudenbush, 1992). The lower the deviance the stronger the model fit.

Normally, introducing more predictors reduces the model deviance. The researcher should therefore evaluate whether this reduction is statistically significant. A comparative test of model fit, to evaluate if a simpler model is superior to a more complex one, can be developed by testing the null hypothesis:  $H_0: D_0 - D_1$ . Where  $D_0$  represents the deviance of the simpler model and  $D_1$

represents the deviance of the more complex model. This statistic has a  $\chi^2$  distribution with  $m$  degrees of freedom. Where  $m$  represents the number of unique variance and covariance components that the more complex model estimates in excess of the simpler one. A test of statistical significance can thus be performed to ensure that the adoption of a more complex model is warranted (Bryk and Raudenbush, 1992).

When variables, both at level-1 and level-2, are introduced in the model, the researcher must specify how the variables should be scaled, or centered (Hofmann and Gavin, 1998). While a thorough discussion of centering decisions is beyond the scope of this work (see Hofmann and Gavin, 1998 for a review), it is important to recognize that different centering strategies may change the interpretation of the results. Particularly sensitive is the centering of level-1 variables. Level-2 centering decisions are less of a concern (Hofmann and Gavin, 1998). Throughout the ensuing discussion of results, the centering decisions made will be justified with respect to the goals of the analysis.

### **Test of Mediation**

The third proposition in this study posits a mediated relationship between the team control structure and team effectiveness. The technique for testing models of mediation has been discussed by Baron and Kenny (1986). They treat a case when all variables (i.e., independent variable, mediator and dependent variable) are continuous. They suggest that the researcher should run a set of regression analyses to test for the significance of the independent-dependent variable path and the

independent variable-mediator path. Once the significance of the above relations has been established, the investigator should simultaneously regress the dependent variable on both the independent variable and the mediator. Partial moderation can be claimed when the variance explained by the independent variable decreases in the simultaneous regression. Complete mediation can be claimed if the independent variable has no effect on the dependent variable when the mediator is controlled for (Baron and Kenny, 1986).

While Baron and Kenny (1986) focus on the case of three continuous variables, the same logic can be applied in the context of the present study where the independent variable is a categorical dichotomy and the mediator and the dependent variables are metric. In this context the independent variable is coded as an indicator (dummy) variable and the analysis can proceed as recommended.

The next chapter presents the results of the analysis.

## **RESULTS**

The chapter reports on the results of the data analysis. After reporting the results of the manipulation check, the psychometric characteristics of the scales used are evaluated. Then, the data is aggregated to the appropriate level of analysis and the research hypotheses are evaluated using ordinary least square regression, analysis of variance and hierarchical linear models.

### **Manipulation Check**

Manipulation checks were carried out to verify that the proposed manipulation worked as expected. The results, presented in tables 1 through 3, indicate that it did.

The objective of this study is to test the fundamental proposition that managerial control contributes to team effectiveness in the virtual environment. This central thesis can be summarized as follows: “virtual teams under managerial control, achieved through the enforcement of behavior control mechanisms, are more effective than self-directed virtual teams, that are allowed to pursue their goal without external direction or control.”

Testing this proposition, and the hypotheses derived from it, requires the successful implementation of different team control structures (i.e., behavior control vs. self-direction).

In order to enforce managerial behavior control the treatment group was required to comply with a reporting scheme. This scheme was designed based on a literature review of commonly employed behavior control methods in traditional environments. The first and foremost

objective of the manipulation check is to ensure that individuals in the treatment group (i.e., individuals in teams that had to comply with the reporting scheme) recognize the requirement imposed on them. Then, because the reporting scheme was designed to stimulate a specific set of behaviors thought to increase team effectiveness, the manipulation checks should verify that the treatment group did indeed engage substantially more in such behaviors.

Table 1 reports the descriptive statistics and results of an independent samples t-test for the first manipulation check. The participants were asked to respond with a yes/no answer to the following questions: “My team was required to submit weekly reports to the bizPlan liaison.” A response of “no” is coded as 1 and a response of “yes” is coded as 2.

**Table 1: Recognition of reporting requirement: Manipulation checks**

	<b>N</b>	<b>Mean</b>	<b>Std. Dev.</b>	<b>t</b>	<b>df</b>	<b>Sig.</b>	<b>Mean Difference</b>
Behavior control	93	1.99	.10	52.440	185	.000	.97
Self-directed	94	1.02	.15				

The results provide a strong indication that the manipulation did work and that individuals recognized the control structure they were assigned to. Subjects in self-directed teams had no reporting requirements to comply with during the final project, while the others recognized their weekly reporting duty. Except for two teams, all the teams in the treatment group submitted all weekly reports. Each missed one report.



Once it was established that subjects in the treatment condition recognized and complied with their reporting requirement, it can be verified if the behavior control mechanisms did indeed stimulate the anticipated behaviors; namely planing, progress revision and formal task assignment. Subjects were asked to agree or disagree with the following three statements: “My virtual team planned its future tasks on a regular basis,” “My virtual team reviewed its progress toward attainment of team goals on a regular basis” and “My virtual team formally assigned specific tasks to individual team members on a regular basis.” A likert scale was used. A response of 1 indicates strong agreement and a response of 5 indicates strong disagreement with the statement.

Multivariate analysis of variance is used to identify group differences on these three dimensions. Results are reported in table 2 and 3.

**Table 2: Manipulation checks: Immediate behaviors, descriptive statistics**

		N	Mean	Std. Dev.
Planning	Behavior control	97	2.14	1.12
	Self-directed	95	2.64	1.21
Task assignment	Behavior control	97	1.87	.93
	Self-directed	95	2.25	1.17
Progress revision	Behavior control	97	2.39	1.22
	Self-directed	95	2.74	1.19

The results indicate that the reporting requirements did indeed stimulate the expected behaviors. Treatment and control groups were, in aggregate, significantly different on the three dimensions of interest (Wilk’s  $\lambda = .949$   $F = 3.361$   $df = 3.000$   $p = .020$ ). Moreover, each behavior was also significantly different, in the expected direction, when studied individually.

**Table 3: Manipulation checks: Immediate behaviors, results**

Source	Dependent Variable	Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	Planning	11.892	1	11.892	8.764	.003
	Progress revision	5.716	1	5.716	3.941	.049
	Task assignment	7.175	1	7.175	6.455	.012
Intercept	Planning	1099.559	1	1099.559	810.346	.000
	Progress revision	1262.382	1	1262.382	870.500	.000
	Task assignment	814.134	1	814.134	732.431	.000
Control Structure	Planning	11.892	1	11.892	8.764	.003
	Task assignment	5.716	1	5.716	3.941	.049
	Progress revision	7.175	1	7.175	6.455	.012
Error	Planning	257.811	190	1.357		
	Progress revision	275.534	190	1.450		
	Task assignment	211.195	190	1.112		

These results indicate that the groups in the treatment did recognize the requirement to comply with the requested reporting schedule and that they so did. Moreover, the required reports stimulated successfully the immediate behaviors that they were intended to induce.

### **Portfolio of Communication Media**

One of the main advantages of this study is the wealth of qualitative data recorded in the communication logs. Analyses of the communication logs provide the ability to better qualify the research findings.

In order to rely confidently on the communication logs, it is necessary to ensure their accuracy and completeness. More specifically, while each team was provided with an easily accessible communication hub, and with a portfolio of communication media, it is possible that they did not use the communication hub exclusively. They may have instead relied on alternative media (e.g., personal email, telephone, fax). If the teams employed communication media not provided by the experimenter, the

communication logs would not be complete and analyses based on them would not be warranted.

To evaluate the completeness of the communication logs, all subjects were asked to report the extent to which they used each communication medium upon completion of the main project. The questionnaire covered both the communication hub and any alternative media not provided by the experimenter. The subjects were also asked to rate the percentage of total team communication that occurred through each medium. In aggregate, this information demonstrates that the teams in the experiment relied primarily on the communication media accessible through the communication hub. Their use of alternative media was, on average, negligible (see Table 4).

**Table 4: Individual communication portfolio (self-reported)**

	<b>N</b>	<b>Mean</b>	<b>Median</b>	<b>Mode</b>	<b>Std. Dev.</b>
Personal Email	191	9.9%	5%	0%	23.11%
Distribution List	195	64.3%	90%	100%	25.65%
Asynchronous Conference	191	10.9%	5%	0%	21.75%
Synchronous Discussion	184	12.0%	5%	0%	22.59%
Telephone	179	1.3%	0%	0%	8.62%
Fax	177	0.3%	0%	0%	5.28%
Other	164	1.2%	0%	0%	10.29%

\* The mean percentages of use reported was re-scaled to add up to 100%.

The data is expressed in percentage of use. For example, on average, individuals in the experiment relied heavily on their teams' distribution list for communication. The subjects reported directing about 64% of their total communication during the experiment through it. While the asynchronous

conference and synchronous discussion were used during the experiment, on average, the quantity of communication exchanged through them was limited. The data also indicates that the communication logs can be confidently thought to portray a precise representation of interaction within the teams involved in the experiment. A negligible amount of communication was channeled through media not provided by the experimenter, such as telephone or instant messengers. The amount of communication exchanged through personal email, while not insignificant, is minimal and does not reduce substantially the comprehensiveness of the communication logs.

It is therefore conclude that the data recorded in the communication logs presents an accurate account of team interaction.

## **Instrument Validation**

This section presents the results of convergent validity, discriminant validity, and reliability tests of the survey measures used in the study. The next section reports on the reliability of the observational measures.

### **Unidimensionality Tests: Exploratory Factor Analysis**

Exploratory factor analysis was first performed on each individual scale to ensure that scale items loaded consistently on the hypothesized construct and that the items in the scale accounted for a substantive amount of the variance in their respective factors. The latent root criterion for factor extraction was employed. All factors having an eigenvalue greater than one were retained and evaluated.

### **Psychosocial Outcomes**

One factor was originally hypothesized for the psychosocial outcome scale. The factor was hypothesized to measure the extent to which virtual team members were satisfied with team interaction, the teammates and the team's product, and the extent to which the virtual team experience had been a rewarding and gratifying one.

Table 5 shows the results of the preliminary analysis.

**Table 5: Psychosocial Outcomes - Exploratory factor analysis (Preliminary)**

	Mean	Std. Dev.	N	Factor 1	Factor 2
Enjoyed working with VT members	2.90	1.65	191	.853	.324
Members contributed fair share	3.74	2.00	190	.877	
<i>Time spent on bizPlan was wasted</i>	4.88	1.73	191		-.863
Very proud of bizPlan project	3.13	1.64	191	.609	.543
<i>Couldn't wait for bizPlan to be over</i>	3.24	1.75	189		-.833
Enjoyed working on bizPlan	3.24	1.66	189	.528	.663
Enjoy working with VT members again	3.38	1.95	190	.888	

Contrary to expectations, a two-factor structure emerged. The two negatively worded items were responsible for the second factor, and there was substantial cross-loading of two other items.

Table 5 shows that the two negatively worded items were primarily responsible for the emergence of the second factor. DeVellis (1991) indicates that while reverse scoring might eliminate some negative correlations, it may in fact introduce others. It is thus possible that reverse coded items do not belong in the scale because they do not consistently relate to the other items. In this case the reverse coded items should be eliminated (DeVellis, 1991).

The two negatively worded items were deleted and the psychosocial outcomes scale was factor analyzed a second time. The unidimensional factor structure hypothesized emerged. The items' loadings were substantial and the unique factor accounts for 69% of the total variance explained (Table 6). Thus, this scale was retained to represent individual psychosocial outcomes.

**Table 6: Psychosocial Outcomes - Exploratory factor analysis (Final)**

	<b>Mean</b>	<b>Std. Dev.</b>	<b>N</b>	<b>Factor 1</b>
Enjoyed working with VT members	2.90	1.65	191	.907
Members contributed fair share	3.74	2.00	190	.766
Very proud of bizPlan project	3.13	1.64	191	.797
Enjoyed working on bizPlan	3.24	1.66	189	.761
Enjoy working with VT members again	3.38	1.95	190	.898

### **Team Member Viability**

Team member viability is a measure of the virtual team members' skills and abilities that distinguish productive and valuable virtual team members from unproductive ones. Team member viability represents an assessment of individual skills, and it measures the ability of team members to contribute to the success of future virtual teams on which they will serve.

**Table 7: Team Member Viability - Exploratory factor analysis**

	<b>Mean</b>	<b>Std. Dev.</b>	<b>N</b>	<b>Loading</b>
Produces quality work	2.5596	1.7428	545	.895
Has initiative	2.5872	1.7709	545	.920
Assumes leadership	2.9523	1.9623	545	.886
Can effectively self-manage	2.6055	1.7564	545	.924
Is dependable	2.7890	1.9273	545	.865
Communicates well with tech	2.5560	1.7121	545	.869
Willing to adopt new technology	2.4936	1.5719	545	.805
Provides valuable feedback	2.7615	1.7589	545	.910
Provides constructive criticism	3.0697	1.7705	545	.861
Accepts constructive criticism	2.7174	1.5450	545	.756

According to expectations, all scale items loaded satisfactorily on one factor and they account for 75.8% of the total variance explained (Table 7).

### **Coordination**

Coordination is defined as the degree of functional articulation and unity of effort between the team members. It manifests itself in work activities that are logically consistent and coherent. As hypothesized, one factor emerged, all items loaded satisfactorily on it. The items account for 66.8% of the total variance explained. Table 8 shows the factor structure.

**Table 8: Team Coordination - Exploratory factor analysis**

	Mean	Std. Dev.	N	Loadings
Members' activities were coherent	3.51	1.76	191	.862
Planning well conceived	3.11	1.65	191	.847
Clear sense of direction during the CSLC	3.11	1.69	190	.870
<i>Difficult to reach decisions</i>	4.56	1.72	190	-.723
<i>Did not know who was responsible</i>	4.98	1.76	189	-.737
Interaction well organized	3.51	1.74	190	.885
Always knew what supposed to do	2.78	1.56	190	.768
<i>Had difficulty coordinating our work</i>	4.11	1.84	191	-.827
Satisfied with procedures to communicate	3.44	1.80	191	.822

### **Communication Effectiveness**

Communication effectiveness denotes the extent to which information exchanged by team members is timely, useful and reliable. As expected, one factor emerged and it accounts for 81.6% of the total variance explained (Table 9).

**Table 9: Communication Effectiveness - Exploratory factor analysis**

	Mean	Std. Dev.	N	Loading
Information: Timely	2.87	1.12	189	.846
Information: Accurate	2.43	1.00	189	.943
Information: Useful	2.48	1.01	189	.918

In summary, the preliminary evaluation of the scales employed in this study demonstrates that they all are unidimensional. The next section reports the results

of the confirmatory factor analysis and provides an assessment of both convergent and discriminant validity.

### **Confirmatory Factor Analysis**

Confirmatory factor analysis is performed to take advantage of its ability to test a complete theory based measurement model, provide measures of fit to the data, and yield evidence of convergent and discriminant validity.

Table 10 displays the goodness of fit indices of the basic model and the final model. The basic model was a three-factor model with 26 indicator variables. In this model all indicators for each construct were included in the analysis. The basic model did not provide a satisfactory fit to the data and an iterative procedure was used to purify it until an adequate fit was obtained.

**Table 10: Basic and revised measurement models - Goodness-of-fit indices**

	$\chi^2$	<i>df</i>	<i>p</i>	$\chi^2/df$	RMSEA	GFI	NFI	NNFI	CFI
Basic Model	404.43	116	.000000	3.49	0.11	0.81	0.87	0.88	0.90
Purified Model	105.51	51	.000001	2.07	0.073	0.92	0.95	0.96	0.97

Table 11 displays the final model and the item loadings ( $\lambda$ ) on the respective latent constructs.

Table 12 displays, for each construct in the confirmatory factor analysis, the average variance explained (AVE; on the diagonal) and the squared correlation between each pair of latent variables. This test provides strong evidence of discriminant validity between communication effectiveness and team coordination, and between communication effectiveness and psychosocial outcomes. But it fails to provide evidence of satisfactory discrimination between psychosocial outcomes



and team coordination. In fact, the average AVE between the two constructs does not exceed their squared correlation (average AVE = .655 < .79).

**Table 11: Revised measurement model - Standardized item loadings ( $\lambda$ )**

Scale items	Psychosocial Outcomes	Team Coordination	Communication Effectiveness
Enjoyed working with VT members	0.91		
Members contributed fair share	0.73		
Enjoyed working on the team project	0.65		
Would enjoy working with VT members again	0.91		
Members' activities were coherent		0.89	
Clear sense of direction during the project		0.84	
It was difficult to reach decisions		-0.62	
Interaction well organized		0.87	
Satisfied with procedures to communicate		0.81	
Information: Timely			0.76
Information: Accurate			0.94
Information: Useful			0.89

**Table 12: Revised measurement model - Average variance extracted and bivariate squared correlations**

	Psychosocial Outcomes	Team Coordination	Communication Effectiveness
Psychosocial Outcomes	.65		
Team Coordination	.79	.66	
Communication Effectiveness	.66	.58	.75

A second test of discriminant validity was therefore performed between these two constructs. Namely, it was verified that the confidence interval around the estimated correlation between team coordination and psychosocial outcomes did not contain a value of 1.0 ( $\phi - 2 * SE \leq \phi \leq \phi + 2 * SE$ ). The result,  $0.93 \leq \phi \leq 0.85$ , provides evidence of discriminant validity (Anderson and Gerbing, 1988).

While the weaker test of discriminant validity supported the claim that the psychosocial outcomes and team coordination constructs were highly correlated

but distinct constructs, perhaps the most compelling argument in support of discriminant validity is a theoretical one. Psychosocial outcomes represent an individual assessment that all team members make regarding their satisfaction with teammates and the team's deliverable. The construct measures an individual affective evaluation. Conversely, team coordination represents an assessment that each individual makes of how organized and coherent the team activities were. These two constructs differ with respect to their theoretical definition and their units of reference: respectively the individual team member and the team as a whole. It is therefore concluded that, while strongly correlated, psychosocial outcomes and team coordination do indeed represent distinct constructs.

**Reliability**

Coefficient alpha estimates of reliability were computed for each scale in the analysis.

**Table 13: Scales reliability estimates (Chronbach alpha)**

Scale	Alpha
Psychosocial Outcomes	0.86
Team Member Viability	0.97
Team Coordination	0.90
Communication Effectiveness	0.88

Results exceed the traditionally accepted threshold. Thus, and the use of these scales is warranted.

**Observational Measures**

Not all measures used in this study were gathered using a self-report questionnaire. Specifically, performance measures and communication quantity

were measured by independent raters and by observation of the communication logs respectively.

### **Team Performance**

Team performance was measured in terms of the quality of each team's deliverable. Two independent expert judges, unaware of team assignment to treatments, were asked to evaluate the complete set of business plans produced by each team.

A 100-point evaluation scale was employed. A possible confounding effect of this method is the tendency of different raters to restrict their evaluation range. For example, some raters have the tendency to avoid extreme scores and not take advantage of the full evaluation scale, while others do make use of the full grading range available. To correct this possible problem performance evaluation scores for each rater were standardized prior to averaging them.

Inter-rater reliability was deemed satisfactory ( $\alpha = .77$ ) and the scores were averaged across raters. In order to produce a normal distribution of performance scores the aggregate scores were once again standardized.

### **Communication Quantity**

The quantity of communication occurring through the teams' communication hubs was recorded. Three communication media were available in the hub: team distribution list, asynchronous conference and synchronous chat facility. As shown earlier, on average, the teams in the experiment relied primarily on these three media. Thus, the following analysis focuses on them.

Communication quantity data was collected using both direct observation and a survey. Collecting information from multiple sources provides the ability to evaluate convergent and discriminant validity (Campbell and Fiske, 1959).

Self-reported measures requested that subjects rate their team's use of each medium. Possible answers ranged from "more than once a day" to "never."

Observational measures are obtained by computing the total number of messages exchanged by the team in the distribution list and the size (in kilobytes) of each team's cumulative chat log. As discussed below, observational data for the asynchronous conference was not available.

In this study, multiple sources of communication quantity data provided particularly useful. The database storing the messages posted on the asynchronous conference was corrupted after completion of the experiment, but before the messages could be retrieved. Thus, observational data regarding this medium were not available.

Convergent and discriminant validity of the communication quantity measures was evaluated using the Multi-Trait Multi-Method matrix (MTMM; Campbell and Fiske, 1959). At the same time, the appropriateness of using self-reports of usage of the asynchronous conference was evaluated. Table 14 portrays the MTMM matrix. The matrix contains bivariate correlations between communication media use, for each medium, computed through observational and self-reported data.

Table 14 provides evidence of both convergent and discriminant validity. The data shows that for both the distribution list and the synchronous chat there was significant correlation between the communication quantity measures computed

using the two methods. At the same time, the correlation between the measure of different media use, when the same measurement method was employed, were not significant. This result indicates lack of measurement method bias. Moreover, it indicates that self-reports of use of the communication media were accurate approximations of the observational data. Therefore, the self-report measure of communication quantity through the asynchronous conference can be confidently used.

**Table 14: Communication quantity MTMM matrix**

Communication Logs	Self Reported		
	Distribution List	Asynchronous Conference	Synchronous Chat
	<p><math>\rho = 0.366</math> Sig. = 0.008 N = 51</p>	<p><math>\rho = 0.072</math> Sig. = 0.614 N = 51</p>	<p><math>\rho = 0.291</math> Sig. = 0.038 N = 51</p>
	Asynchronous Conference	<p><b>Missing Data*</b> *The database recording the messages in the asynchronous conference was corrupted after completion of the experiment</p>	
	Synchronous Chat	<p><math>\rho = 0.122</math> Sig. = 0.392 N = 51</p>	<p><math>\rho = 0.160</math> Sig. = 0.263 N = 51</p>

In the remainder of the document observational measures of communication quantity using the distribution list and the team chat room are used. Self-report data is used as an indicator of communication quantity through the asynchronous conference.

## Team Level Aggregation

The present study hypothesizes cross-level relationships between team level and individual level variables. Specifically, psychosocial outcomes and team member viability are individual level variables. Team performance, team

coordination, communication effectiveness, and communication quantity are defined at the team level. While team performance and communication quantity (distribution list and chat room usage) were measured directly at the team level, the remaining constructs were measured through individual responses to a survey instrument.

The technique for aggregation to the team level of analysis was discussed in the previous chapter. The results are presented in Table 15.

**Table 15: Team level variables - Aggregation index**

<b>Team Level Variables</b>	<b>Median <math>r_{wg(j)}</math></b>
Team coordination	0.86
Communication effectiveness	0.83
Asynchronous conference	0.94

The median  $r_{wg(j)}$  (James, et al., 1984) exceeds the threshold of 0.70 recommended for aggregation (Janz, et al., 1997; George, 1990). Therefore, individual perceptions of team coordination, communication effectiveness, and extent of team use of the asynchronous conference, were aggregate at the team level by averaging individual team members' responses.

## **Data Analysis**

In this section each proposition is analyzed in turn and the results are presented. Analysis concerning team performance is based on Ordinary Least Square (OLS) regression and analysis of variance models. Individual level analysis, of psychosocial outcomes and team member viability, is based on Hierarchical Linear Models (HLM) using the HLM2L software package (Bryk, et al., 1996).

## Proposition 1

The first proposition focuses on the impact of internal communication and coordination processes on team effectiveness. The proposition states:

Proposition 1: Virtual teams that achieve higher levels of internal communication and coordination are more effective.

Three testable hypotheses have been derived from this proposition. The first one focuses on team performance.

Hypothesis 1a: The higher the levels of coordination and communication achieved by the team, the higher the quality of the team's project deliverable.

Table 16 and 17 display respectively the fit statistics for the regression model and the regression coefficients for each independent variable in the model.

**Table 16: Team Performance - Regression model summary**

Dependent Variable	R	R <sup>2</sup>	Adj. R <sup>2</sup>	Std. Error	F	df1	df2	Sig.
Team Performance	.365	.113	.037	.9911	1.383	5	45	.249

**Table 17: Team Performance - Regression coefficients**

Independent Variable	b	Std. Error	$\beta$	t	Sig.	Tolerance
Coordination	.079	.276	.079	.286	.776	.251
Communication Effectiveness	.285	.435	.176	.656	.515	.267
Communication Quantity						
Distribution List	.008	.005	.231	1.517	.136	.828
Asynchronous Discussion	-.046	.128	-.051	-.357	.722	.929
Synchronous Discussion	.001	.007	.028	.194	.847	.892

The aggregate results do not appear to lend support to hypothesis 1a. The proposed regression model does not yield significant results and the regression coefficients are not statistically significant. These results indicate that none of the

hypothesized determinants of team performance are significantly related to the outcome variable.

Before accepting these results though, the possible effects of multicollinearity among dependent variables should be evaluated. Tolerance levels for coordination and communication effectiveness, while not dramatically low, call for caution in the interpretation. Multicollinearity may in fact confound the results by masking the unique explanatory contribution of highly correlated variables (Hair, et al., 1995). To better qualify the relation between the independent variables and team performance, the analysis was repeated evaluating the unique explanatory contribution of each independent variable separately. The results are reported in table 18.

**Table 18: Team Performance - Regression coefficients (independent evaluation)**

Independent Variable	b	Std. Error	$\beta$	t	Sig.	R <sup>2</sup>	Adj. R <sup>2</sup>
Coordination	.283	.136	.284	2.073	.043	.081	.062
Communication Effectiveness	.396	.224	.244	1.763	.084	.060	.040
<i>Communication Quantity</i>							
Distribution List	.008	.005	.255	1.847	.071	.065	.046
Asynchronous Discussion	-.082	.127	-.091	-.643	.523	.008	-.012
Synchronous Discussion	.006	.006	.134	.949	.347	.018	-.002

The results of the independent analysis indicate that team coordination, when evaluated independently, provides a significant prediction of performance and accounts for a significant proportion of the variance among the teams in the analysis ( $p = .043$   $R^2 = 8.1\%$ ). This result, consistent with expectations, indicates that the best performing teams were those that were able to achieve the highest levels of internal coordination.



The independent analysis also provides weak evidence of the contribution of communication processes to team performance. While failing the traditional significance test ( $\alpha = .05$ ), both communication effectiveness ( $p = .084$ ) and the extent of use of the team distribution list ( $p = .071$ ) appear to be related to team performance.

Relaxing the test of significance ( $\alpha = .10$ ) appears warranted in this research study for two reasons. The results of a preliminary power analysis indicate that, given the available sample size of 51 teams, the recommended level of power (80%) is only achieved for medium-large and large effect sizes ( $R^2 = 20\%$ ; Cohen, 1977). Moreover, the research study applies traditional collocated team theory to the virtual environment. No prior empirical literature has evaluated the relationship between internal team processes and team effectiveness in virtual teams. Given the exploratory nature of this study, and the relatively small sample size, the decision was made to adopt a less restrictive test of significance.

In summary, when the effect of multicollinearity between the independent variables is explicitly addressed, hypothesis 1a is partially supported. While caution must be used when interpreting this finding and no specific conclusions can be drawn, there is evidence that team coordination, communication effectiveness, and the quantity of use of the team distribution list were positively related to team performance.

The second hypothesis drawn from proposition one refers to individual psychosocial outcomes.

Hypothesis 1b: The higher the levels of coordination and communication achieved by the team, the higher the psychosocial outcomes reported by the individual team members.

Following the analytic procedure outlined in the previous chapter, the null model was evaluated first using HLM. The results are presented in Table 19.

**Table 19: Psychosocial Outcomes - Between and within-group variability**

	<b>Within-group variability</b>	<b>Between-group variability</b>	$\sigma^2$	$\tau_{00}$	$df$	$\chi^2$	<b>Sig.</b>
<b>H 1b</b>	61%	39%	1.44	0.92	50	177.24	.000

The potential amount of variance in psychosocial outcomes that can be explained by level-2 variables (i.e., coordination, communication) is 39%. The null hypothesis  $H_0: \tau_{00} = 0$  is rejected and it is concluded that there are significant differences between teams with respect to their average levels of individual psychosocial outcomes. Further analysis is warranted.

HLM enables the researcher to model both individual level and team level effects on an individual level dependent variable. Level-1 variables can be introduced to achieve two objectives. To estimate the unique effect of the level-1 dependent variable, or to refine the analysis by improving the explanatory power of the level-2 variables. In the present research one level-1 variable, individual contribution to completion of the project, was included. The rationale for this decision is briefly explained.

Individual contributions to the completion of the project were computed through peer evaluation scores. They contribute to refining the analysis because

the individuals who participated least in the interaction, and consequently received low contribution scores, have less information on which to base their assessment of team process variables and outcome variables. For this reason, their assessment is likely less accurate than that of more involved team members and controlling for it increases the precision of the analysis. The measure of individual contributions to the completion of the project was centered around its grand mean, the centering option of choice when the objective is to estimate the contribution of level-2 variables controlling for the effect of level-1 variables (Hofmann and Gavin, 1998).

In summary, the following model was estimated to test hypothesis H1b:

$$\text{Level-1} \quad Y_{ij} = \beta_{0j} + \beta_{1j} \text{CNT}_{ij} + r_{ij}$$

$$\text{Level-2} \quad \beta_{0j} = \gamma_{00} + \gamma_{01} \text{CO}_j + \gamma_{02} \text{CE}_j + \gamma_{03} \text{DL}_j + \gamma_{04} \text{BB}_j + \gamma_{05} \text{CH}_j + u_{0j}$$

$$\beta_{1j} = \gamma_{10} + u_{1j}$$

$Y_{ij}$  represents psychosocial outcomes reported by individual  $i$  in team  $j$  and  $\text{CNT}_{ij}$ , represents this individuals' contribution to the project.  $\text{CO}_j$  represents team coordination in team  $j$ .  $\text{CE}_j$  represents communication effectiveness in team  $j$ .  $\text{DL}_j$  represents the amount of communication through the team distribution list by team  $j$ .  $\text{BB}_j$  represents the amount of communication in the asynchronous conference by team  $j$ .  $\text{CH}_j$  represents the amount of communication in the chat room by team  $j$ .

The model is evaluated following the procedure outlined in the previous chapter. A significant  $\gamma_{02}$  coefficient provides evidence of significant relation

between the  $z^{\text{th}}$  level-2 independent variable and the individual level dependent variable. Table 20 provides a summary of the results for the preliminary model.

**Table 20: Psychosocial Outcomes - HLM coefficients (Level-2 equation)**

		<b>Coefficient</b>	<b>Standard Error</b>	<b>t</b>	<b>Sig.</b>
Intercept	$\gamma_{00}$	3.341	0.080	41.737	0.000
Team Coordination	$\gamma_{01}$	0.566	0.160	3.543	0.001
Communication Effectiveness	$\gamma_{02}$	0.862	0.251	3.423	0.002
Distribution List Use	$\gamma_{03}$	0.002	0.003	0.610	0.544
Asynchronous Conference Use	$\gamma_{04}$	-0.068	0.074	-0.927	0.359
Synchronous Conference Use	$\gamma_{05}$	-0.001	0.004	-0.273	0.786

These results provide partial support for hypothesis 1b and indicate that team coordination and communication effectiveness are significant predictors of individual psychosocial outcomes. Thus, individuals who felt satisfied with their teammates and gratified by the project experience, on average, were more likely to be associated with well coordinated teams where communication was very effective. No similar conclusion is warranted with respect to communication quantity measures.

Based on the results of the preliminary analysis, a more parsimonious model was developed and tested; only the significant independent variables were included. The model confirms the statistical significance of the  $\gamma$  coefficients of team coordination and communication effectiveness.

A test of between-group variance is then performed on this model,  $H_0: (\tau_{00} | \text{CO, CE}) = 0$ , to verify if any residual between-group variance remains unexplained after controlling for team coordination and communication effectiveness. The null hypothesis could not be rejected ( $p > .500$ ) and it is

concluded that all between-group variance in psychosocial outcomes is accounted for by team coordination and communication effectiveness. Further, the test of significant improvement of the deviance statistic showed that adopting the more complex preliminary model is not warranted based on the incremental fit it provides ( $D_0 - D_1 = 2.80$ , 3 parameters,  $p > 0.10$ ). Table 21 displays a summary of the results for the final model.

**Table 21: Psychosocial Outcomes - Revised model**

Variable	Coefficient	Standard Error	t	Sig.	Dev.	Param.
Team Coordination	0.624	0.146	4.269	0.000	618.04	8
Communication Effectiveness	0.781	0.237	3.288	0.002		

The final step in the test of hypothesis 1b consists in evaluating simpler models in order to ensure that they do not provide a better fit to the data. Specifically, the proposed model,  $\beta_{0j} = \gamma_{00} + \gamma_{01} CO_j + \gamma_{02} CE_j + u_{0j}$ , is compared to simpler models with only one of the two significant predictors. Respectively  $\beta_{0j} = \gamma_{00} + \gamma_{01} CO_j + u_{0j}$ , and  $\beta_{0j} = \gamma_{00} + \gamma_{01} CE_j + u_{0j}$ . The results indicate that the use of the more complex model is warranted as the reduction in deviance is highly significant ( $p < .005$ ) in both cases ( $D_0 - D_1 = 10.42$ , 1 parameter;  $D_0 - D_1 = 16.96$ , 1 parameter).

The final hypothesis drawn from proposition one refers to team member viability.

Hypothesis 1c: The higher the levels of coordination and communication achieved by the team, the higher the individual team member's viability.

The first step in the analysis consists in running the null model. Table 22 presents the results of this analysis.

**Table 22: Team Member Viability - Between and within-group variability**

	Within-group variability	Between-group variability	$\sigma^2$	$\tau_{00}$	$df$	$\chi^2$	Sig.
<b>H 1c</b>	71%	29%	0.97	0.39	50	128.08	< .001

The results indicate that 29% of the variability in team member viability is accounted for by team level variables. The null hypothesis  $H_0: \tau_{00} = 0$  is rejected and further analysis is warranted.

Next, the following complete model was evaluated:

$$\text{Level-1} \quad Y_{ij} = \beta_{0j} + \beta_{1j} \text{CNT}_{ij} + r_{ij}$$

$$\text{Level-2} \quad \beta_{0j} = \gamma_{00} + \gamma_{01} \text{CO}_j + \gamma_{02} \text{CE}_j + \gamma_{03} \text{DL}_j + \gamma_{04} \text{BB}_j + \gamma_{05} \text{CH}_j + u_{0j}$$

$$\beta_{1j} = \gamma_{10} + u_{1j}$$

Table 23 provides a summary of the results for the preliminary model.

**Table 23: Team Member Viability - HLM coefficients (Level-2 equation)**

		Coefficient	Standard Error	t	Sig.
Intercept	$\gamma_{00}$	2.588	0.073	35.433	0.000
Team Coordination	$\gamma_{01}$	0.362	0.124	2.918	0.006
Communication Effectiveness	$\gamma_{02}$	0.433	0.198	2.189	0.034
Distribution List Use	$\gamma_{03}$	-0.001	0.002	-0.444	0.659
Asynchronous Conference Use	$\gamma_{04}$	-0.041	0.059	-0.693	0.492
Synchronous Conference Use	$\gamma_{05}$	0.005	0.003	1.650	0.106

These results provide partial support for hypothesis 1c and indicate that team coordination and communication effectiveness are significant predictors of team

member viability. These results indicate that the members of well coordinated teams where communication was very effective, on average, developed into more effective virtual team members. No similar conclusion is warranted with respect to communication quantity measures.

The null hypothesis that no residual between-group variance remains unexplained at level-2 after controlling for the independent variables  $H_0: (\tau_{00} | CO, CE, DL, BB, CH) = 0$  is rejected. This result indicates that other variables, not included in this study, have a substantial effect on team member viability.

Based on the results of the preliminary analysis, a more parsimonious model was developed and tested; only the significant independent variables were included. Again, the  $\gamma$  coefficients of team coordination and communication effectiveness are statistically significant. Adoption of the simpler model is warranted based on the test of model fit ( $D_0 - D_1 = 3.47$ , 3 parameters;  $p > 0.10$ ). Table 24 portrays a summary of the results for the purified model.

**Table 24: Team Member Viability - Revised model**

Variable	Coefficient	Standard Error	t	Sig.	Dev.	Param.
Coordination	0.368	0.115	3.183	0.003	369.52	8
Communication Effectiveness	0.463	0.192	2.408	0.020		

The final step in the test of hypothesis 1c consists in evaluating the following simpler models:  $\beta_{0j} = \gamma_{00} + \gamma_{01} CO_j + u_{0j}$ , and  $\beta_{0j} = \gamma_{00} + \gamma_{01} CE_j + u_{0j}$ . Comparison with the model presented in Table 23 ( $\beta_{0j} = \gamma_{00} + \gamma_{01} CO_j + \gamma_{02} CE_j + u_{0j}$ ) provides the test of best model fit. The results indicate that the use of the more complex

model is warranted as the reduction in deviance is highly significant ( $p > .025$ ) in both cases ( $D_0 - D_1 = 5.50$ , 1 parameter;  $D_0 - D_1 = 8.95$ , 1 parameter).

## **Proposition 2**

The second proposition concentrates on the impact of team control structure on team effectiveness.

**Proposition 2:** Virtual teams where managerial behavior control is enforced are more effective than self-directed virtual teams.

Three testable hypotheses have been derived from this proposition. The first one focuses on team performance.

**Hypothesis 2a:** The project deliverable produced by project virtual teams where managerial behavior control is enforced is of higher quality than the one produced by self-directed teams.

Both the dependent and independent variables are defined at the team level of analysis. Thus, analysis of variance was employed to test this hypothesis. Tables 25 and 26 summarize the results of performance difference between self-directed teams and teams under managerial behavior control.

**Table 25: Team Control Structure - Descriptive statistics (team performance)**

<b>Control Structure</b>	<b>N</b>	<b>Mean Performance</b>	<b>Std. Dev.</b>
Self-directed	26	0.078	1.046
Behavior control	25	-.081	.986
Total	51	.000	1.009

No statistically significant difference between the treatment and control groups emerges from the analysis. Hypothesis 2a is not supported and no claims can be



laid about the difference between teams where managerial behavior control mechanisms were used as opposed to self-directed teams.

**Table 26: Team Control Structure - Team performance difference (ANOVA table)**

Source	Sum of Squares	df	Mean Square	F	Sig.	Effect Size	Observed Power
Corrected Model	.322	1	.322	.311	.579	.006	.085
Intercept	.000	1	.000	.000	.991	.000	.050
Control Structure	.322	1	.322	.311	.579	.006	.085
Error	50.678	49	1.034				

Caution should be used in interpreting the above results. The results of a preliminary power analysis indicated that, given the available sample size of 51 teams, only relatively large differences between the treatment and control groups ( $d = 0.8\sigma$ ) could be detected with reasonable certainty (i.e., power 80%; Cohen, 1977). Indeed, the observed power of the test, reported in Table 25, is very low. On the other hand, the reported estimated effect size is also very small. It is therefore concluded that the treatment had no effect on team performance.

The second hypothesis drawn from proposition two refers to individual psychosocial outcomes.

**Hypothesis 2b: Members of project virtual teams where managerial behavior control is enforced report higher psychosocial outcomes than members of self-directed teams.**

A test of hypothesis 2b was obtained by comparing individual psychosocial outcomes responses of subjects in the treatment and control groups. Team control structure is conceptualized as team level variable. Thus, the following model was tested with HLM:

$$\text{Level-1:} \quad Y_{ij} = \beta_{0j} + \beta_{1j} \text{CNT}_{ij} + r_{ij}$$

$$\text{Level-2:} \quad \beta_{0j} = \gamma_{00} + \gamma_{01} \text{TCS}_j + u_{0j}$$

$$\beta_{1j} = \gamma_{10} + u_{1j}$$

$Y_{ij}$  represents psychosocial outcomes for individual  $i$  in team  $j$  and  $\text{CNT}_{ij}$  represents the individual's contribution to the team's effort.  $\text{TCS}_j$  represents the control structure of team  $j$ . Managerial behavior control and self-direction are represented by values of 1 and 0 respectively. Table 27 displays the results for this model.

**Table 27: Team Control Structure - Psychosocial outcomes difference**

		Coefficient	Standard Error	t	Sig.
Intercept	$\gamma_{00}$	3.33	0.16	21.01	0.000
Team Control Structure	$\gamma_{01}$	-0.63	0.31	-2.00	0.050

The results indicate that different team control structures affect individual psychosocial outcomes differently. The coefficient of team control structure ( $\gamma_{01}$ ) is statistically significant ( $p = .050$ ) and the null hypothesis of no difference between self-directed teams and teams following managerial behavior control mechanisms is rejected.

Unexpectedly though the direction of the means was opposite to the one hypothesized. In other words, individuals associated with self-directed teams reported feeling more satisfied with their teammates and more gratified by the project experience.

The third hypothesis based on proposition two refers to team member viability.

Hypothesis 2c: Team member viability is higher for members of project virtual teams where managerial behavior control is enforced than for members of self-directed teams.

The model tested mirror the one referring to psychosocial outcome where the dependent variable was substituted with the team member viability measure. The results are presented in Table 28.

**Table 28: Team Control Structure - Team member viability difference**

		Coefficient	Standard Error	t	Sig.
Intercept	$\gamma_{00}$	2.61	0.12	21.76	0.000
Team Control Structure	$\gamma_{01}$	-0.3	0.22	-1.36	0.180

The coefficient of team control structure ( $\gamma_{01}$ ) is not statistically significant ( $p = .180$ ). Thus, the null hypothesis, that individuals in self-directed teams and managed teams do not differ in terms of team member viability, can not be rejected. Hypothesis 2c is not supported.

### **Proposition 3**

The third proposition directly assesses the research model and provides a direct evaluation of the hypothesized mediating effect of internal communication and coordination on team effectiveness.

**Proposition 3:** Behavior control in virtual teams stimulates higher levels of communication and coordination that contribute to increase team effectiveness.

The relationship between the independent variables and the dependent variables was established by testing proposition 2. The results indicate that there was no relationship between team control structure and team performance (hypothesis 2a) and between team control structure and individual evaluations of team member viability (hypothesis 2c). Hypothesis 2b was the only one supported and a test of mediation can be carried out on the relationship between team control structure and individual psychosocial outcomes.

Baron and Kenny (1986) indicate that the relationship between the independent variable (i.e., team control structure) and the mediators (i.e., team coordination, communication effectiveness and quantity) should be evaluated next. In this study this is equivalent to testing hypotheses 3a through 3c. Hypothesis 3c was not tested because the correlation between communication quantity and psychosocial outcomes was not significant.

All variables involved in the test of hypotheses 3a and 3b are team level variables. Therefore OLS multiple regression was employed. Table 29 summarizes the results.

**Table 29: Team Control Structure - Team coordination and communication effectiveness difference**

<b>Dependent Variable</b>	<b>R</b>	<b>R<sup>2</sup></b>	<b>Adj. R<sup>2</sup></b>	<b>Std. Error</b>	<b>F</b>	<b>df 1</b>	<b>df 2</b>	<b>Sig.</b>
Coordination	.144	.021	.001	1.014	1.031	1	49	.315
Communication Effectiveness	.238	.057	.037	.612	2.936	1	49	.093

No support is found for hypothesis 3a. Different team control structures had no effect on team coordination in this study. Hypothesis 3b is

supported, but only at the  $\alpha = .10$  level of significance. The final step in assessing mediated models consists in regressing simultaneously the independent variable and the mediators on the dependent variable.

Hypotheses 3d through 3f are designed to test the mediation effects of virtual team internal processes on the relationship between team control structure and team effectiveness. Team control structure was found to significantly influence only psychosocial outcomes. Thus, the hypothesized mediated model can only be evaluated with respect to this variable (i.e., hypothesis 3e).

The following model was tested through HLM:

$$\text{Level-1:} \quad Y_{ij} = \beta_{0j} + \beta_{1j} \text{CNT}_{ij} + r_{ij}$$

$$\text{Level-2:} \quad \beta_{0j} = \gamma_{00} + \gamma_{01} \text{TCS}_j + \gamma_{02} \text{CE}_j + u_{0j}$$

$$\beta_{1j} = \gamma_{10} + u_{1j}$$

Table 30 summarizes the results of this test. These results lend support to hypothesis 3e and to the mediating effect of communication effectiveness on the relation between team control structure and psychosocial outcome. Further, complete mediation can be claimed because the coefficient associated with team control structure, statistically significant when included in the analysis alone ( $p = 0.050$ ), becomes not

significant once communication effectiveness is also included into the analysis ( $p = 0.498$ ).

**Table 30: Communication effectiveness - Test of mediated research model**

		<b>Coefficient</b>	<b>Standard Error</b>	<b>t</b>	<b>Sig.</b>
Intercept	$\gamma_{00}$	3.347	0.085	39.167	0.000
Team Control Structure	$\gamma_{01}$	-0.120	0.175	-0.682	0.498
Communication Effectiveness	$\gamma_{02}$	1.621	0.145	11.143	0.000

These results lead to the conclusion that different team control structures (self-direction vs. managerial behavior control) affect individual psychosocial outcomes through their effect on team communication effectiveness.

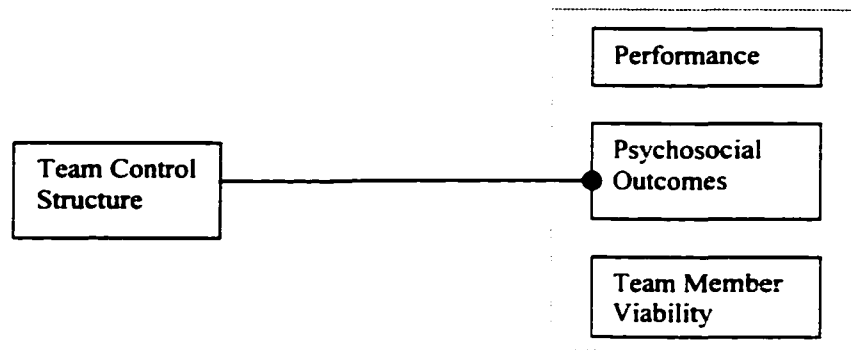
## Summary of Results

This section summarizes the research results. Table 31 provides the list of hypotheses, whether they were supported, not supported or not testable. It also shows the independent variables that had a statistically significant relationship with the dependent variables.

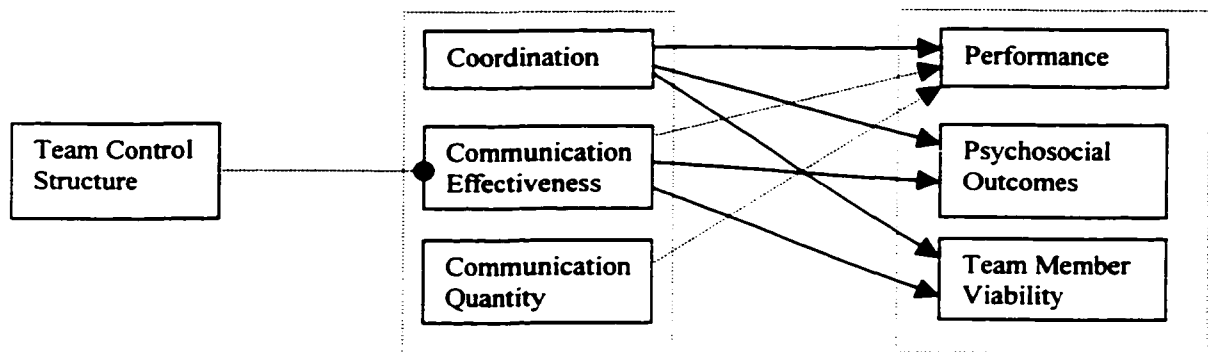
Figure 6 and 7 provides a depiction of the results in graphical form. They portray the research model and the relationships that were found to be statistically significant in this study.

**Table 31: Summary of hypotheses and results**

<b>Hypothesis</b>	<b>Result</b>	<b>Statistically Significant Variables</b>
1a	Partially Supported	Coordination Communication Effectiveness Communication Quantity (Distribution List)
1b	Partially Supported	Coordination Communication Effectiveness
1c	Partially Supported	Coordination Communication Effectiveness
2a	Not Supported	
2b	Supported	
2c	Not Supported	
3a	Not Supported	
3b	Partially Supported	Communication Effectiveness
3c	Not Tested	
3d	Not Tested	
3e	Supported	Communication Effectiveness
3f	Not Tested	



**Figure 6: Treatment effects**



**Figure 7: Revised general research model**

**Legend for figures 6 and 7**

Relationship direction		Relationship strength	
	Expected		Contrary
		$\alpha = 0.05$	$\alpha = 0.1$



## **DISCUSSION**

This chapter discusses the results presented in chapter four and provides an explanation of the findings. The first section focuses on the impact of internal processes on virtual team effectiveness. The results are discussed and an explanation of the findings is provided. The second section focuses on the effect of the two competing control structures (self-direction and behavior control) on team effectiveness. First, the lack of significance difference between the treatment and control groups on team performance and team member viability is explained. Then, follow-up research, designed to clarify why behavior control negatively impacted individual psychosocial outcomes, is introduced.

### **Internal Processes and Virtual Team Effectiveness**

Product development theories point to the considerable role of coordination and communication processes in traditional, collocated, teams (Brown and Eisenhardt, 1995). More specifically, they maintain that effective teams are highly coordinated teams whose members are able to effectively communicate and share information (Ancona and Caldwell, 1992; Dougherty, 1992; Zieger and Maidique, 1990).

Virtual teams, as defined in this research study, share a great number of similarities with traditional project and development teams but face the added burden of being unable to come together face-to-face. The computer mediated communication literature suggests that this constraint precludes secondary communication and contributes to hamper effective information exchange (Hightower, et al., 1997). Thus, it creates further obstacles to coordination and effective communication in virtual teams (Werkentin, et al., 1997).

It was hypothesized that coordination and communication processes are paramount in virtual teams. Teams that are able to overcome the limitations imposed by the virtual environment and achieve high coordination and communication effectiveness should also be very effective.

In this study it was found that team coordination and communication effectiveness were significant predictors of team effectiveness. Contrary to expectations, communication quantity did not significantly correlate with individual effectiveness measures and had only a weak relationship with team performance.

Coordination was a significant predictor of team performance, individual psychosocial outcomes and team member viability. These results confirm that in the virtual environment, as well as in traditional teams, management should focus on coordination processes and ensure that the efforts expended by team members are complementary and are directed toward a common goal without duplication of effort or fragmentation.

The teams that communicated effectively used the available communication technology to exchange accurate information in a timely fashion. In these teams, when information or feedback were requested, teammates responded without delay and with useful comments and contributions. Communication effectiveness was a significant predictor of individual psychosocial outcomes and team member viability. This highlights the role of internal communication processes in the virtual environment. The finding, while not previously confirmed by research in

the virtual environment, is consistent with research results in collocated teams (Brown and Eisenhardt, 1995; Kraut and Streeter, 1995).

Evidence was also found in support of the notion that communication effectiveness mediates the effect of different team control structures on individuals' evaluation of the virtual team experience. This result, albeit in need of corroboration, suggests that organizations that are evaluating the implementation of virtual teams should focus on internal communication processes as an important determinant of employees' satisfaction with the experience.

The findings of prior virtual team research indicate that successful virtual teams engage in extensive and predictable communication (Jarvenpaa, et al., 1998; Iacono and Weisband, 1997). It was therefore hypothesized that communication quantity would be a significant predictor of team effectiveness. No consistent support for this proposition emerged from this study. The link between communication quantity and team effectiveness appears to be a complex one. Particularly, the teams studied had access to and elected to use different communication media, synchronous and asynchronous. They developed radically different procedures to carry out their work, and faced a number of different idiosyncratic challenges during completion of the project. As a consequence, a high level of communication did not seem to bear an immediate relationship to team outcomes. The following discussion corroborates this interpretation by demonstrating some of the competing strategies used by the teams in the study and some of the distinctive challenges they faced.

Three communication media were made available to the study participants: team distribution list, asynchronous discussion conference and synchronous team discussion room. The majority of teams used exclusively the distribution list, and a few teams relied heavily on synchronous discussion. Interviews with some study participants and the analysis of the communication logs indicate that most attempts to use the asynchronous discussion board led to inconsistent use and later abandonment. The reason for the unsuccessful adoption of the asynchronous discussion board is ascribed to the unfamiliarity of the technology to most users and to its intrinsic characteristics. The asynchronous discussion board is a “pull” medium that requires the user to take action and visit the electronic board. It differs from electronic mail in that email messages are automatically delivered to the participants’ inbox and, as long as the users periodically check their electronic mail, they receive the messages. All subjects in the experiment were regular users of electronic mail thus, in this context, electronic mail was in essence a “push” medium requiring no extraordinary action on the recipient part. Conversely, the team members had to make a specific effort to review contributions in the asynchronous discussion board, and often they did not. As a consequence, the asynchronous discussion boards fell rapidly out of use in most teams.

As most teams relied heavily on electronic mail and the team’s distribution list for communication, it is surprising that the amount of use of this communication medium was only weakly related to team performance. This unexpected result can be reconciled by reviewing the communication logs. The analysis of the complete communication logs of several teams involved in the experiment demonstrates that

the various teams adopted different communication strategies. Such communication strategies are determined by the portfolio of communication media employed by the team and by how the team decided to organize its work. Thus, it appears that the way in which communication was organized was more important than the mere quantity of communication.

The quantity of communication within each team seems to depend heavily on the communication strategy chosen by the team. For example, one team studied agreed to clearly divide work among the teammates. The pattern of communication emerging in this team is one where long periods of very limited communication were punctuated by short bursts of extensive interaction. The team had decided to clearly separate the components of the team's deliverable, assign different elements to the team members, and periodically exchange their work to provide feedback. Another team relied on a sequential pattern of communication whereby, after assigning sections to the members of the team, they would work on the same document sequentially and collaboratively edit the final version. A third team relied almost exclusively on bi-weekly synchronous discussions. The team members used these virtual meeting in lieu of traditional face-to-face team meetings. They would convene in the team chat room, discuss the agenda of outstanding issues, and assign tasks to be completed individually. Little interaction took place between meetings when the team members were carrying out their assigned tasks. A number of teams used a more collaborative model and relied on electronic mail to exchange their work frequently to provide and receive feedback.

The relationship between communication quantity and team effectiveness is also confounded by chance events that emerged during the project. For example, one of the teams analyzed, over a three day span, exchanged 23 messages in the futile attempt to schedule a synchronous meeting that would fit the schedule of the four geographically dispersed members. Another team was unable to settle a dispute over what business the team should choose. The merits and drawbacks of two competing proposals were discussed at length. This extended interaction seemed to paralyze the team, rather than benefit it, such that the team was unable to begin the research phase until late in the time allocated. It is difficult to determine how the amount of communication directly affects team effectiveness. The proposed direct relationship between the amount of internal communication and team effectiveness is questioned based on the evidence collected. High levels of communication may be promoted by the team's inability to reach consensus, take swift action, or quickly react to coordination problems or difficulties. In such cases a high level of communication may be symptomatic of a dysfunctional situation rather than a productive one. The principal contribution of this study lies in the application of managerial behavior control to the virtual environment and the empirical evaluation of its contribution to virtual team effectiveness. The results concerning managerial behavior control are discussed next.

## **The Effects of Behavior Control**

The central thesis of this study maintains that managerial behavior control mechanisms, operationalized through planning, role clarification and progress

evaluation, stimulate team coordination and communication processes and ultimately result in increased team effectiveness. The teams where managerial behavior control was enforced were required to report weekly to a coordinator. In each report the teams had to outline short term and long term plans, identify the team members responsible for completing each task in the short term plans, and review the progress toward achievement of these short term plans.

No prior research has explicitly looked at the implementation of control mechanisms in virtual teams. A review of managerial behavior control mechanisms in traditional collocated teams provided the basis for selection of the behaviors required of the teams in the treatment group. Thus, the present study provided both a comparison of the effects of competing team control structures (i.e., managerial behavior control and self-direction) on the effectiveness of virtual teams, and a test of the viability of traditional behavior control mechanisms in virtual environments.

Contrary to expectations, the teams that complied with managerial behavior control mechanism failed to achieve higher levels of effectiveness than the self-directed teams. No differences in terms of performance and team member viability were detected while differences in psychosocial outcomes occurred but were in the opposite direction of expectations.

The following section discusses the lack of significant differences in performance and team member viability. Next, the difference in psychosocial outcomes is discussed and follow-up research is introduced.

## **Lack of Performance and Team Member Viability Differences**

This section focuses on the inability of the managerial behavior controls adopted to stimulate increased performance and team member viability. First, the immediate effects of the weekly reporting requirements are discussed. This analysis shows evidence that the requirement altered the pattern of communication of the reporting teams. This increase in communication seems due to the need to coordinate the filing of reports rather than to the hypothesized increase in planning, revision, and work allocation behaviors.

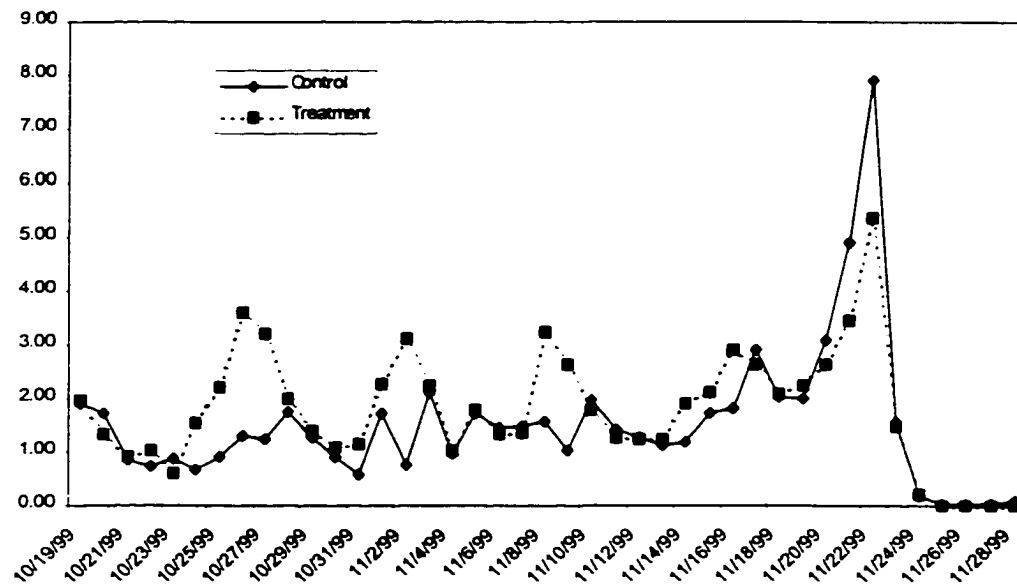
Next, drawing on Adaptive Structuration Theory (DeSanctis and Poole, 1994; Poole and DeSanctis, 1990) the manner in which the control mechanism was appropriated by the teams in the treatment group is evaluated. The analysis indicates that the reporting requirement did not stimulate concerted planning, work assignment, ownership of assigned tasks, and progress reviews. Instead, the members of managed teams split evenly the duty of filing the reports. It appears that the obstacles to effective coordination and communication posed by the virtual environment, and the lack of feedback provided by the coordinator who requested the progress reports, were responsible for these results.

### **The Immediate Effects of the Reporting Requirement**

The immediate effects of the reporting requirement, as expected, were to increase team members' interaction and to modify the communication pattern with heightened communication in the days leading up and immediately following the reporting deadlines.



Figure 8 shows the average number of daily messages per team during the experimental manipulation. A clear communication pattern emerged. The treatment group experienced significant peaks of interaction in correspondence of the due date of each weekly report. The figure suggests that, as the weekly report deadline approached, the teams in the treatment group focused their attention on the project and on the need to file the report.



**Figure 8: Communication patterns (average number of messages per team per day)**

Figure 8 indicates that the teams in the treatment group communicated more in conjunction of the report deadlines. But it is unclear what the purpose of such heightened communication was.

The communication logs of a selected number of teams was analyzed. This analysis shows that the type of communication stimulated was not generally focused on the content of the report. Instead, the bulk of the communication

occurring in the managed teams around the report deadlines was procedural in nature and focused on the “act of filing.” For example, the team members communicated to draw attention to the report (e.g., “the deadline is drawing dangerously close for the submission of our first report”). To share their understanding of the requirement (e.g., “In this report we need both short and long term plans and the breakdown of work allocation.”). To coordinate the filing of the reports and to decide how they should be split fairly among teammates (e.g., “I propose that Steven, Rhonda and myself take the other three weeks to submit the report. If you like I will submit next weeks and then Rhonda and Steven can decide who will do the next one etc.”). In general, rather than promoting team coordination and communication about the project, the control mechanism forced the team to coordinate and communicate about the reporting requirements.

The above interpretation is corroborated by a quantitative analysis of the number of messages exchanged by the treatment and control groups around the weekly reporting deadlines. This analysis shows an evolution over time of the immediate effects of the weekly reporting requirement. Close to the due date of the first progress report, a substantial difference in the number of messages exchanged by managed and self-directed teams was detected. But the difference decreases steadily in conjunction with the other reports.

Table 32 portrays the average number of messages per team on the report due date, and during the three days leading up to its filing (i.e., the due date and the two days prior to it), for the treatment and control groups. The decreasing number of messages follows the decreasing need for communication associated with the

reporting requirement. In conjunction with the first report, the teams had to understand the reports and develop a strategy to complete them. The need for coordination of the filing of the progress report was very high. At this time most teams also tried to address the substantive issue set forth by the reports, but they were unable to do so.

**Table 32: Team Communication - Treatment and control group difference**

	<b>One Day</b>		
	<b>Control</b>	<b>Treatment</b>	<b>Differential</b>
<b>First Report</b>	1.44	2.93	104%
<b>Second Report</b>	1.54	2.55	66%
<b>Third Report</b>	1.53	2.56	68%
<b>Fourth Report</b>	2.15	2.56	19%
	<b>Three Days</b>		
	<b>Control</b>	<b>Treatment</b>	<b>Differential</b>
<b>First Report</b>	1.15	3.00	160%
<b>Second Report</b>	1.03	2.19	113%
<b>Third Report</b>	1.37	2.41	76%
<b>Fourth Report</b>	1.58	2.32	47%

As time progressed, the reports were split among the teammates and the need for interaction decreased. The declining number of messages exchanged reflects this decrease. If the teams had focused the discussion on substantive issues (i.e., long and short term planning, work allocation and evaluation of progress), the communication overhead associated with the reports should have remained fairly stable over time.

### **Appropriation of the Progress Reports**

Adaptive Structuration Theory (AST; DeSanctis and Poole, 1994; Poole and DeSanctis, 1990) provides a theoretical framework that can help to reconcile the discrepancy between the research propositions and findings. AST is a general theory originally developed to understand the interaction between technology use

and social structures in organizations and groups. AST posits that technology is a potential source of social structures (Poole and DeSanctis, 1990) as are tasks, procedures, group norms, and heuristics (Wheeler and Valacich, 1996). AST maintains that any structure is developed and implemented with a given “spirit.” The spirit represents the set of beliefs and expectations with which the structure is introduced (DeSanctis and Poole, 1994). For example, the spirit of an advanced technology may represent management’s expectations for the use of the technology and their objectives for implementing it. Once a structure is in place, groups may use it in a faithful manner (i.e., consistent with its spirit) or in an unfaithful manner (i.e., inconsistent with its spirit). The process of social interaction through which groups adopt a given structure, whether faithfully or not, is dubbed “appropriation process” (DeSanctis and Poole, 1994). AST proposes that the ultimate outcome of the implementation of a particular technology or structure depends on how it is appropriated and that social interaction mediates its effect on group outcomes (Wheeler and Valacich, 1996).

The weekly reports were intended to be a “management tool” developed and enforced to structure collaboration within the managed teams. It was hypothesized that, prompted by the requirement to file the weekly report, the members of the managed teams would discuss their short and long term plans, and that they would review their progress to date. By so doing the reporting tool was expected to increase members' understanding of the team project, their respective contributions and how these contributions would fit with those of their teammates. Moreover, by prompting the team to discuss work assignments, it was hypothesized that the

tool would increase accountability and compel the team members to complete their assigned tasks. Thus, the weekly reporting requirement was developed and implemented with the intent (i.e., spirit) of stimulating increased communication and coordination through concerted planning, work assignment, ownership of assigned tasks, and progress reviews.

The subjects were instructed that “It is important that all team members provide input in the development of the plans and reports and that they approach the process as a valuable and important project management stage.” The communication logs of a selected set of managed teams were analyzed in order to understand how the managed teams appropriated (e.g., faithfully or unfaithfully) the reporting tool.

Substantial evidence indicates that the weekly reports were not appropriated as expected. Analysis of the communication logs and interviews with subjects in the treatment group indicate that the reports were perceived by some not as a tool, but as an added burden and as an overhead task disjointed from the team’s project. A few subjects displayed a negative reaction when the requirement to file weekly reports was announced. For example, Randell stated: “I have read that message too [introducing the reporting requirement]. But that seems like an extra load of work for us, don't you think..... It was never a part of our project. Out of nowhere, they demand us to do these weekly reports? Heck no!” Lori: “Is this new report thing a bunch of (crap) extra work or what?” Anne: “If I may add my opinion that these weekly reports are a pain in the butt, as if we don't have enough to do already!” Adam: “It looks like we need to have that stupid progress report to

Emmet [the coordinator] by Wednesday.” Alan: “i have the report pulled up, and we are also supposed to assign tasks for team members for the coming week (this is kind of silly, i think).” These comments illustrate a common evaluation of the requirement. Some participants perceived the reporting requirement as added work that was not “a part of” the project. Moreover, some participants indicated that, given their age and experience, they felt that they should be trusted to be able to manage the project rather than being required to follow the imposed structure.

As a consequence most teams adopted the practice of evenly splitting among teammates the duty of filing the reports. Thus, the reports were not used as an agenda for discussion of important aspects of the project, but as an overhead requirement disjointed from the team project. Distributing the responsibility to file the report among team members defeated the primary purpose of the requirement, namely, to regularly convene the team, whether in synchronous or asynchronous manner, to discuss important issues and develop mutual understanding of plans and objectives, and buy-in of work assignments from all teammates.

When the reports were split among teammates, the individual in charge of filing any one report still had to envision a course of action for the short and long term, review the progress of the team in the previous week and assign tasks to the teammates. But generally, since the team did not develop the reports as a unit, these objectives and goals were not communicated to others and the reports did not promote a unified understanding of the team’s objectives or unified action. Often there was no explicit acceptance of responsibility by teammates and accountability was not increased as expected.

The report acted as a superimposed structure. Generally, as the team pursued its objectives, in more or less organized and coordinated fashion, a different team member each week would “detach” momentarily and complete the report. Short of the act of filing the weekly reports, the managed teams did not seem to behave differently from the self-directed teams. There is also evidence indicating that often some team members did not know what they were responsible for, or what objectives the team was pursuing, even though the report had been filed. Furthermore, once the reports had been created and filed, the team had ready access to them, but there is no evidence that the team members would regularly review previously filed reports.

Why were the teams studied unable to faithfully appropriate the reporting tool? It appears that this was not a conscious decision on the part of the team members, but a consequence of their interacting in a virtual environment. The communication logs show that most teams did attempt to discuss substantive issues in the reports but were unable to do so due to scheduling difficulty and inability to communicate effectively using the available media. For example, upon learning about the reporting requirement, Xiaoyun stated: "Now I just read the [coordinator's] email and know we should submit a weekly report... we should chat every week and write a weekly report." Even though all teammates agreed to the need to meet in the team chat room, this team was unable to do so until after the second report was turned in.

They attempted to discuss the content of the report and to coordinate its filing through electronic mail, but the process was very difficult, as shown by a later

exchange. Helen indicated she could file the report but needed input: "I will volunteer to e-mail the final draft of this first progress report to the VTe coordinator, but I really would appreciate it if you would add in other ideas and thoughts NOW before I turn it in! So please, e-mail to me and the group your updates! Hope to hear from you soon!" Later Olivia indicated: "I have a lot to add to this so hang in there and I will email ye as soon as I can." The exchange demonstrates the team's understanding of how to faithfully appropriate the reporting tool (i.e., to develop a concerted plan and to ensure that all team members would take responsibility for specific tasks) and its inability to do so.

Generally, as the projects progressed and it became increasingly more difficult for the teammates to find the time to discuss substantive issues, most teams reverted to filing the report without engaging in substantive discussion.

A concurrent reason for the misappropriation of the reporting tool emerged during interviews with a few research subjects. They indicated that the main reason for the unfaithful appropriation of the reporting tool was the lack of perceived benefit from their use, and the inability to enforce the decisions made while developing the report. These shortcomings are a direct consequence of the experimental environment. While the report was filed with a coordinator who had partial responsibility to evaluate the performance of the team, he could not provide any substantial feedback to the reporting teams.

The report was a requirement for which the team was responsible, and evaluated, as a unit. But the coordinator could not enforce its content, for example, if team members failed to complete their assigned tasks. These



restrictions were necessary in order to avoid confounding the results of the experimental manipulation. But the lack of feedback and involvement from the individual requesting the reports appears to have been a powerful disincentive that dissuaded the teams from investing considerable time in discussing the content of the reports. Ultimately, the lack of involvement from the coordinator may have compelled the research subjects to simply comply with the requirement expending a minimal investment of time and effort.

As the managed teams failed to appropriate the reporting tool faithfully, it is not surprising that performance and team member viability in the treatment and control groups did not significantly differ.

An interesting side effect of the reporting requirement was to significantly damage individual psychosocial outcomes and trust within the reporting teams. This surprising result is introduced in the next section.

### **Negative Effect on Psychosocial Outcomes**

The most surprising result of the present research study refers to individuals' satisfaction with teammates and their evaluation of the team interaction. It was hypothesized that managerial behavior control mechanisms would help the team to reduce the incidence of process losses that commonly afflict virtual teams. For example, lack of task focus and awareness of deadlines, lack of accountability, limited feedback on ideas and contributions, unpredictable communication (Jarvenpaa, et al., 1998; Jarvenpaa and Leidner, 1998). It was predicted that the weekly reporting schedule would compel the teams to discuss ideas and contributions, review potential problems and find solutions, while at the same time

increasing individual accountability. As a consequence, it was expected that the members of managed teams would report higher levels of satisfaction with their teammates and that they would feel more gratified by their experience with the project. Contrary to expectations, individuals associated with self-directed teams reported being more satisfied with teammates and that the teamwork experience had been gratifying and rewarding.

Chapter six describes a series of post hoc analyses designed to identify the causes of these unexpected results.

# **INTERACTION WITH TEAMMATES: UNEXPECTED RESULTS**

This chapter presents follow up research, based on the case study method, focusing on the negative influence of managerial behavior control mechanisms on individual psychosocial outcomes. The chapter reviews relevant literature, develops, and tests a possible explanation of the findings.

## **Introduction**

Contrary to the hypotheses of this study, subjects associated with self-directed teams reported higher psychosocial outcomes than their counterparts in managed teams. Moreover, they reported significantly higher levels of trust in their teammates. To better understand these unexpected results, the communication logs of selected teams are analyzed. The logs provide an accurate account of team communication during the experiment. The case study methodology is used to analyze the data. This chapter is organized as follows: First, the theoretical perspective that guides the follow-up research is outlined. Next, the methodology employed to analyze the communication logs is discussed. A first set of four case studies, developed to generate hypotheses and a possible explanation of the unexpected findings, follows. A second set of cases, developed to test these hypotheses, is subsequently described. Finally, the results of the follow-up research are discussed.

## **Theoretical Framework**

While not central to the thesis of this study and to the research propositions, individual trust in the teammates was measured as part of this research. The

results concerning trust parallel those of psychosocial outcomes, and the two measures are highly correlated. While trust before and after the project was unchanged in self-directed teams, it declined significantly in managed teams. The literature on trust in virtual teams and the notion of swift trust (Meyerson, et al., 1996) suggest a possible explanation for the significant decline in psychosocial outcomes and trust experienced by the members of managed teams.

The concept of swift trust (Meyerson, et al., 1996) was developed for collocated temporary teams such as film production teams, airplane crews, and the like. Such temporary teams are collections of highly skilled individuals who share no common history, come together to work on a specific project under tight deadlines, and have no prospect to work together again in the future as an intact work unit. Meyerson and her colleagues (1996) argue that a traditional model of trust development is not appropriate for such temporary systems. They reason that because of the short deadlines and the lack of common history, the team members cannot gradually build trust in the team and teammates but must act swiftly and assume that teammates are trustworthy and will perform as expected. Not doing so and waiting for trust to gradually evolve would likely prevent the team from achieving its goal in the short time available (Meyerson, et al., 1996). Thus, in temporary teams, trust is assumed rather than being slowly developed. Once trust is in place during early interaction, team members must work consistently and continuously to maintain it throughout the execution of the project (Iacono and Weisband, 1997). With such weak underpinning, swift trust is very dependent on events that reinforce it and very vulnerable to incidents that may weaken it. Trust

becomes more thick or more thin over time as the team interacts (Meyerson, et al., 1996).

Virtual teams, as defined in this research study, and temporary teams share a great number of similarities. In essence virtual teams are temporary teams that are unable to meet face-to-face but rely on telecommunication technologies to cooperate and complete their work. Early research on virtual teams has extended the notion of swift trust and tested its applicability to the virtual context (Jarvenpaa, et al., 1998; Jarvenpaa and Leidner, 1998; Iacono and Weisband, 1997). This research stream found consistent support for the idea that trust development in virtual teams does indeed follow the swift trust model. Contrary to the expectations of traditional models of trust development, early research demonstrates that virtual teams are capable of quickly reaching high levels of trust even with no common history or prior interaction (Jarvenpaa, et al., 1998; Jarvenpaa and Leidner, 1998; Iacono and Weisband, 1997).

In this study, trust was measured on a 7 point Likert scale (with 1 being highest and 7 lowest anchor) using a validated scale (Jarvenpaa and Leidner, 1998). Consistent with the model of swift trust, a relatively high level of trust across all teams (mean = 2.29, sd = 0.623) was detected upon completion of the preliminary exercise. The preliminary exercise lasted two weeks and, during that time, all 51 teams were allowed to self-direct. Not surprisingly, no trust differences were detected between the treatment and control groups ( $t = 0.771, p = 0.444$ ). Upon completion of the main project, trust was once again measured. Paired samples t-tests indicate that, on average, individuals associated with self-directed teams did

not revise their assessment of trust (mean = 2.44, sd = 0.851,  $t = -1.34$ ,  $p = 0.192$ ). Conversely, individuals associated with teams under managerial behavior control reported a significant decline in trust (mean = 3.06, sd, = 1.08,  $t = -4.136$ ,  $p = 0.000$ ).

The swift trust literature indicates that after a relatively high level of trust is quickly established within the teams, its maintenance depends on teammates' actions and their responsiveness to one another (Jarvenpaa and Leidner, 1998; Iacono and Weisband, 1997).

In virtual teams, the maintenance of trust requires constant interaction and "consistent access to technology, the forming of good communication habits (e.g., checking and responding to email as demanded by the task), and the ability to attend to requests from a distance while simultaneously handling local work demands." (Iacono and Weisband, 1997).

## **Methodology**

Given the unexpected findings of this research, a series of post hoc analyses of cases were carried out with the objective of determining why and how the weekly reporting requirement significantly hindered the maintenance of trust. First, a set of cases was selected to verify what events the teams that display declines in trust commonly experience. Next, based on the evidence gathered, a set of hypotheses was formulated regarding the negative effect of managerial behavior control mechanisms on trust. Critical tests for these hypotheses were then developed through replication (Yin, 1989).

The logic of replication in case study research is similar to that of experimental replications where the results of one experiment should be confirmed by others that are similar (replication across experiments). In case study research, the investigator should select similar cases in order to verify that results are confirmed, a literal replication, and different cases in order to verify that results differ as predicted, a theoretical replication (Yin, 1989).

It should be noted here that the analysis described below is based on post hoc evaluation of the communication logs. A new research study was not undertaken. Rather, a subset of four representative teams (i.e., cases) was chosen, and their communication logs were analyzed. This analysis suggested a plausible explanation of the findings and two hypotheses were generated, and tested using four more cases.

The initial four cases were selected in order to identify the determinants of trust decline and to develop hypotheses regarding the role of the weekly reporting requirements in such decline. Case selection was based on an index of trust decline. This index represents the trust differential between each team's average trust upon completion of the preliminary exercise and their respective average level of trust after the final project. In order to select representative teams, prior to case selection an analysis of outliers was carried out to eliminate teams that reported abnormal levels of trust either before or after the main project. Four teams that had an average level of trust two standard deviations above or below the grand average were dropped before case selection and from any further analysis because it was felt that they would not be representative. They may have

experienced abnormal events (i.e., teammates drop out, major conflicts or confrontations) that determined such abnormal results. Among the remaining 47 teams, four were selected. These teams display the most dramatic decline in trust during the final project. Two cases represent teams in the control group and two cases represent teams in the treatment group. Cases in the control group were included in an effort to identify general categories of events that undermine trust. The knowledge of such broad categories would allow for the development of hypotheses regarding the negative impact of behavior control mechanisms.

The cases were analyzed following a technique employed in prior virtual team research (Jarvenpaa and Leidner, 1998). The communication logs for each team were analyzed noting the name of the contributor, the date and time of the messages and the content. An average 10 – 12 page case database was developed for each case. The essential evidence from the database was then condensed into 3 – 4 page case reports. A discussion of the findings from the first four cases follows (Appendix 1 contains the complete case reports).

## **The Determinants of Trust Decline**

All four cases analyzed portray teams that experienced a substantial decline in trust during completion of the main project. Two of the teams reported very high trust prior to the start of the main project, while the other two began with an average trust level.

In all four teams a distinct pattern of unmet expectations emerged. Unmet expectations represent events in which one or more team members expected some



action of one or more other teammates and such action was not taken, or was taken later than expected, or produced results below expectations.

The sources of unmet expectations vary. They derive from lack of participation, lack of collaboration, failure to maintain agreement and deliver work when promised, misunderstanding during the life of the team, and similar events. Each of the teams analyzed experienced, during the duration of the project, one or more clearly identifiable incidents when expectations were breached. The different teams experienced these incidents at different times during project completion, and most of them experienced more than one incident. Moreover the individuals involved responded to the incidents in different ways.

Irrespective of what led to the development of an incident or how it was handled, the cases seem to consistently indicate that such incidents created tension among the teammates and dampened trust. Brief descriptions of the crucial incidents in the teams studied follows.

Team 41, which was assigned to the treatment group, had four teammates, and began the main project with an above average trust level. It experienced a set of incidents beginning after about a week into the main project. This team, which had relied heavily on the use of chat room meetings during the initial project, faced scheduling problems and was unable to work effectively in asynchronous mode. When the teammates agreed to rely on email and the asynchronous discussion board to exchange ideas, only two out of the four members did so by the agreed upon deadline. One of the active members (Bridgette) commented: "Well, Eric and I posted our ideas to the Web Board [asynchronous discussion board] but no

one went out to expand on the ideas or add any new ones.” And later: “The only problem is that we say we’re going to use the BB [asynchronous discussion board] and email and no one ever does.”

Later, as the team exchanged 23 messages in three days in an attempt to set up a chat meeting, Bridgette requests feedback on substantive issues. She repeated her request multiple times but received no answer. Bridgette, who had indicated earlier that they were a great team, unlike others she had heard about, commented to Eric a few days after the incident: “... I am thinking I spoke too soon the other day about how great we were comparatively.” The team never recovered its original upbeat positive tone, a few other incidents occurred during the remaining time, and upon completion of the project, the team disbanded with no exchange of pleasantries.

Team 40 also had four members and began the main project with an average trust level. This team had been assigned to the treatment group and experienced its first incident in conjunction with the deadline for the first report (approximately a week after the beginning of the project). The team struggled to decide between two potential topics to pursue.

As the team attempted to decide, one team member drew attention to the upcoming due date and Sandeep, the most active member, immediately called for contributions. His call was ignored, and within eight hours he had reiterated it three times (two times explicitly addressing his request to individual teammates). He eventually submitted the report without notifying teammates.

This incident escalated extremely quickly because of the time constraint imposed by the report and the tendency of Sandeep to treat electronic mail like a semi-instantaneous medium, ignoring the fact that many users check their messages at discrete intervals and with varying frequency.

This incident is important because it highlights the perceptual nature of expectations and the rapidity with which trust can be undermined in the virtual environment. It appears that the lack of face-to-face interaction and the different manner in which the individuals involved used the same communication medium was partly responsible for the swift escalation of this incident.

This team experienced a similar incident when the second report was due a week later. As the team still struggled to reach a consensus, Sandeep called attention to the next report: "Someone needs to take charge and produce a new assignments [progress report]." His call was ignored and the team missed the deadline. Sandeep, after filing the report a day late, emailed the team: "... more attention needs to given to this project. At this point, I feel like I have done the majority of the work....I expect some help.... look at the second report submitted. I am getting extremely upset.... I want you [to come up with] some deliverables by the next report, which is the coming Tuesday." After this incident the team focused on one idea and completed the project. This team also disbanded without any farewell messages.

Team 4, which ranked second overall in terms of performance, had three members, and it was assigned to the control group. It began the main project with

an average trust level. One teammate, Allison, was extremely active and organized and led the team.

This team experienced its first incident very early on. The first day of the project, Allison called for ideas by sending a detailed message outlining a work procedure, a template for responses and a deadline by which the responses were to be sent. This message was immediately acknowledged by teammates who agreed to the deadline, but Allison was the only one to live up to it. One teammate indicated that he would be out for a long weekend, and the other provided his input a day late. Allison seemed unable to move on unless all teammates responded as requested. A few days later she called upon the teammate who had yet to produce his idea: "Jimmy, where is your idea????????? ... Please do this ASAP since we are losing precious time!!!!"

After the team agreed on one topic, a second similar incident occurred. Allison sent a message with a number of ideas and requests for comments on each one (again producing a template for responses). After receiving no response at all for a few days she said: "Are you two out there????????? Did you receive my last message I sent several DAYS ago??????... I would appreciate input from you both.... This is supposed to be a GROUP project." While this team sprung into action after this incident, and Allison commented: "I [am] happy to see that we finally have got the ball rolling! Thanks.", the team never regained a high level of trust, despite producing a high quality product.

Team 26 had three members and no emergent leader and was assigned to the control group. Its members seemed unable to take initiative and the team always

completed the work extremely late. Nonetheless this team started the main project with a very high level of trust. During the preliminary exercise the team received equal and prompt contributions from all members when, near the deadline, attention was drawn to the project. Conversely, during the main project it experienced one significant incident. It occurred quite late in the project when the first teammate finally drew attention to the need to start working on the project. Caroline initiated a request for action and prompted the team for ideas. She received no response and reiterated her request a day later, volunteering her idea at the same time. She received no answer for six days and she stated: "I'm just wondering if you guys are getting my messages?? We really have to start and do some work. We have quite a bit to do..." One member of the team did not contribute any further. The reaction to this incident was very phlegmatic, and there never was any real sense of urgency in this team's interaction. The two active teammates filled the void left by the third one and turned in their work on time. Still the team reported the steepest trust decline of all (with the exception of one of the eliminated outliers).

The above examples, albeit different in terms of the characteristics of the individuals involved and their overt reaction to the incidents, highlight consistently the nature and the dynamics of trust decline in virtual teams. These results are consistent with previous literature. Jarvenpaa and Leidner (1998) cite lack of substantive and timely response and unpredictable communication as two distinctive characteristics of low trust teams.

What was the role of the weekly reports, required of the teams in the treatment group, in undermining trust? The two cases involving managed teams provide the basis for formulating hypotheses regarding the negative impact of the reporting requirement. The reports appeared to create, early on and throughout project completion, a context for the development of trust-threatening incidents. This occurrence is particularly evident in team 40 where the first two incidents that the team experienced developed in conjunction with, and because of, the need to file the report.

There is evidence that the need to coordinate the filing of the report created problems for team 41 as well. The team attempted to schedule a chat before filing the second progress report. With such short time before the report due date, the team had trouble scheduling the meeting. One of Bridgette's comments is indicative: "Anyone able to make a 9pm???? [chat meeting] Who is turning in the progress report? Rebecca or Joe? .... Can someone please offer some feedback?" Only Eric met her in the chat room and later submitted the report. In the chat meeting, Bridgette commented: "Yeah & one of us lucky ones gets to do another Progress Rpt." indicating that once again the others had failed to contribute and live up to expectations as the team had agreed to split evenly the reports (one per teammate).

As discussed in the previous chapter, the reports appear not to be treated as tools to better coordinate and communicate planning and work assignment processes, but as disjointed overhead requirements. As a consequence, the reports were often discounted as unimportant and easily forgotten. Therefore, they likely

created a fertile environment for the occurrence of incidents that would not have occurred otherwise.

While it is clear that incidents may have occurred even if the teams were not required to file weekly reports, as shown by two cases involving self-directed teams, the requirement seems to have produced higher needs for interaction and, in essence, appears to have “set up” the team to experience trust threatening incidents. When a team was unable to cope with the increased requirements and potential incidents, trust was undermined. Thus, it is hypothesized that:

- a) The requirement to file weekly reports inflated the chances for the development of trust threatening incidents, due to higher needs for coordination of effort and the large number of short-term deadlines.
- b) Trust was damaged by the reporting requirements only when the team was unable to effectively coordinate the completion of the reports, and the team members were not equally committed to the project.

## **Replications**

To test these hypotheses, four additional cases, representative of the pool of teams required to file the weekly report, were selected. The selected cases were paired based on their pre-treatment trust levels. The first couple represents teams that had above average trust levels prior to the start of the main project (1.688 and 1.875). The second pair represents teams that had below average level of pre-treatment trust (2.625 and 2.688). Within the pairs, pre-treatment trust differences were negligible, and the team performance was consistent for all four teams. They

ranked respectively 17<sup>th</sup>, 15<sup>th</sup>, 21<sup>st</sup> and 11<sup>th</sup>. The teams in each pair, though, experienced changes of trust in the opposite direction during completion of the main project. The first pair had post-treatment trust levels of 3.250 and 1.438 respectively. Post-treatment trust levels in the teams in the second pool were 3.500 and 1.688 respectively.

It is hypothesized that these teams managed the requirement to file weekly reports differently. More specifically, it is hypothesized that, similar to teams 40 and 41, the declining trust teams experienced incidents in conjunction with, and because of, the weekly reports and were negatively affected by such incidents. Conversely, the increasing trust teams were able to manage the reporting requirement and did not experience incidents due to the requirement. A critical test of these hypotheses is provided:

- a) Support for the first hypothesis can be claimed if potentially trust threatening incidents developed in conjunction with the weekly reporting requirement in both teams, the ones that experience trust decline and the ones that experience trust increases.
- b) Support for the second hypothesis can be claimed if evidence is found that:
  - The teams experiencing trust decline were unable to effectively fulfill the reporting requirements and the added task emphasized unmet expectations and disparities in the work load.
  - The teams experiencing trust improvement elicited consistent effort and contributions by team members and effectively managed the reporting requirements.



Brief descriptions of the effect of the reporting requirement for each pair of equivalent teams and tests of the hypotheses advanced follows. (Complete case analyses are reported in Appendix 2).

During completion of the preliminary project, Teams 44 and team 50 had very similar experiences. Both teams worked extremely well, eliciting contributions from all team members. Expectations for communication frequency and work performance were consistently met. Consequently, both teams reported above average levels of trust before the start of the main project. During the treatment, though, the teams experienced dramatically divergent changes in trust. The reporting requirement seems to have played a central role in this difference.

In team 44, two members, Todd and Michele, focused their attention on the first weekly progress report and began working on the project. The other two members were not focused, and Todd attempted to involve them: "Vincent, Nitin, what do you think? We need to start on this immediately. Our first progress report is due on Wednesday..." Receiving no reply, and as the deadline drew closer, Todd called in frustration: "I am not going to appoint anyone any tasks. You now know the business we are doing... Let me know what you guys think.... We have a project update to send to Emmet [the coordinator] on Wednesday. We need to talk about this." Todd filed the report, and the teammates agreed to split the three remaining ones.

In this team, the reports created great confusion and uncertainty. Michele was responsible for filing the second report, and Todd asked: "Who is doing progress report #2 to Emmet? [The coordinator]." Then, receiving no answer: "Michele, are

you going to write the next progress reports?" and then again two days later:

"Michele, you are writing the next progress report due on Wednesday right?"

After the third query, Todd received an affirmative response.

This team also missed the third report all together as there was confusion regarding responsibility for filing it. This incident frustrated both Michele ("Vincent can you let us know if you are going to write your part? Let us know by tomorrow please") and Todd ("I agree with Michele. We need to communicate more. Nitin and especially Vincent should be more involved.... Nitin, are you going to do the last report by next tuesday? Vincent are you going to answer us back...") And later again: "Nitin, you are going to do the third progress report, I hope?.... Vincent, when are you going to be done with your part?"

Team 50 took a radically different approach to the completion of the main project. Instead of moving quickly after the first project, the team did not interact at all for six days. Moreover, all team members reported being very busy and seemed to hold the virtual team as a low priority. While they communicated and they met in the chat room regularly, there was no apparent sense of urgency as the team made little headway.

This team, as did team 44, experienced some coordination problems due to the need to file the reports and missed one report deadline. Alan volunteered and completed the first report, and the team decided to split the remaining ones evenly: "... i was thinking of splitting up the work load equally--one report per person. i volunteer to do the first week's report." In contrast to team 44, though, no one had been assigned to complete the next report, and all members overlooked the

deadline. In other words, there was no expectation that one person would complete the report. Once the team realized the mistake, the report was quickly filed, and all teammates apologized. One exchange epitomizes the climate in this team. Jay: "Like I said in the email, sorry about missing the last meeting..."  
Randell: "It's okay, we all get busy sometimes or maybe a lot of times for others "  
Jay: "thanks, randell".

Around the deadline for the third report, filed by Robin after she volunteered for it, the team shifted attitude and focused on the project. All team members responded to this shift, and, as they had done during the preliminary exercise, consistently communicate and delivered the work they were responsible for. Another exchange epitomizes this new attitude. Between chat meetings, when the team members were usually working on their respective assignments, Alan posted a message titled "URGENT!!!" in which he explained why the advertising plan they had developed would not work. He detailed an alternative and asked for input. By the end of the day, he had received an answer from each teammate and could move on with his work.

These two cases provide critical tests of both hypotheses. First, they show that the weekly reporting requirements created the potential for trust-threatening incidents in both teams (i.e., both teams missed one report deadline). Second, they show how the reports tended to exasperate differences in attitude toward the work and approach to the project, and led to an increase in unmet expectations. Team 44, where Todd and Michele were much more active and focused on the project than Vincent and Nitin, the reports contributed significantly to hamper trust by

magnifying differences. In team 50, where all teammates took a casual approach to the project early but shifted approach and focused their efforts at the same time, the weekly reports had no negative effect on trust.

Teams 19 and team 24 reported a similar level of pre-treatment trust. Both these teams experienced trust-threatening incidents, and in both teams one member carried a disproportionate amount of the workload, while the others responded with varying levels of effort. These individuals grew visibly frustrated by the end of the project, as demonstrated by the following comments. Tom, team 19: "I think we need to establish some ground rules for the remainder of the course work, starting with organising who does what and when to ensure equal contributions by ALL team members!" Miriam, team 24: "I have put in more than my share, and virtual teams need everyone to pull their weight." During the treatment, though, trust in team 19 progressively worsened. Conversely, team 24 recovered and reported one of the highest levels of post-treatment trust of all teams in the experiment. The teams' different approach to weekly reporting partly explains this divergence.

Team 19 did not interact until the due date of the first report. Ronan drew attention to the deadline and provided two business ideas. Both Asif and Sanjay responded, and the latter outlined his idea, but no one took the initiative to discuss or submit the report. Tom, who had had technical problems, joined the discussion on the report due date: "I have only just been able to pick up any email on this next assignment and I see that it was due yesterday." The report was not late due to time zone differences, but it was due shortly after that. He described his idea in

great detail and explained how it encompassed the many strengths of the teammates' ideas. He added: "So, since we are not going to be able to discuss this before the deadline, I am going to make an Executive decision to run with this idea, on the basis that I can finish the weekly report and submit tonight..." Tom used the report to communicate to the teammates what they should do. There was no discussion or exchange of opinion in this team; Tom pressed on quickly assigning tasks to the other members who were often confused. The teammates' contributions were scant, and Tom perceived them as being of poor quality.

As the second report deadline approached, Tom stated: "Remember we have another deadline to meet this week... so get your stuff to me asap." No response; Tom: "I have submitted the report. Go to the web site to have a look. Some feedback and discussion on this assignment would facilitate a better end result...." During the remainder of the project, Tom received little input and incorporated almost none of it in the draft document. He filed the third and fourth reports in which he stated: "Tom has done a pricing model and cash flow forecast. Tom has done risks section. Tom has done operations and manufacturing section." Ronan and Sanjay complained, and Tom explained: "...I have become so frustrated with the lack of input that I have pressed on by myself - I can't wait until the last moment each time reports and assignments are due. I have divided up the work and it hasn't happened.... I don't have time to run a discussion.... its either got to be top quality input first time that is thorough and detailed, or its quicker for me to do it myself...."

Team 24 approached the weekly reporting requirement very differently. While the team had some problems during the first week of the project (e.g., one team member had a medical emergency to attend to) and some confusion arose, the team encountered no problems filing the reports. Dave took charge of the first one but allowed for feedback: "I will have a go at the report based on what I beleive we should do and then post it on the file exchange for you all to look at prior to sending it to Emmet. [the coordinator]" Some confusion arose as to whether Dave was going to forward the report to the coordinator. As a consequence the report was filed three times by Dave, Steve and Rhonda. Miriam volunteered to file the second report. The day before the deadline she requested input from Rhonda but, as the deadline drew close, she filed the report rather than wait or pass the commitment to Rhonda. Nonetheless, as Dave had done, she allowed for feedback and modifications: "I have filled in the report for Emmet [The coordinator]. I still haven't received Rhonda and Steven's short term tasks for this week, So will you fill these in please on the report and email it to Emmet [The coordinator] please." Rhonda addressed this issue the following day. Steve volunteered to file the third report, and Rhonda completed the fourth one.

This team had four very active members who were aware of the requirements and deadlines that the team had to address. Rhonda's actions upon her return after the medical emergency (and her absence for a week) epitomize this team's approach to the project. She first explained in great detail what the problem had been and stated: "Anyway, I'm back. Now I have to catchup on the tons of email." She then proceeds to address all issues that had been raised during her absence.

Her swift action was likely instrumental in restoring teammates' confidence in Rhonda's commitment to the team and to the project.

These two cases corroborate the results of the above analysis and provide particularly strong support for the second hypothesis. First, the cases confirm that the weekly report had the potential to create confusion and trust threatening incidents within the team. For example, team 24 experienced early confusion and submitted three copies of the first progress report.

More importantly though, these two cases demonstrate how the reporting requirement could damage trust by magnifying and exasperating differences when team members did not provide consistent and uniform efforts. For example, no one in team 19 took responsibility to file the first report, and Tom had to do it at the last minute. Conversely, in team 24, when confusion arose with respect to the status of the first report, three teammates took action and filed it. Moreover, while Tom filed all progress reports for his team, the members of team 24 volunteered to complete one each and did so without being reminded. It is apparent that Tom's growing frustration with his teammates' lack of contribution was punctuated by the need to take charge of the report each week: "I can't wait until the last moment each time reports and assignments are due. I have divided up the work and it hasn't happened.... "

## **Discussion**

In summary, the eight case studies reported above lend support to the notion that trust in virtual teams is negatively affected by patterns of unmet expectations.

It was consistently found that, at the root of trust decline in virtual teams, there was the emergence of expectations regarding communication and work performance, in terms of delivery and quality. Trust was damaged when such expectations were breached by one or more teammates, due to lack of participation, lack of collaboration, failure to maintain agreement and deliver work when promised, lingering misunderstanding during the life of the team, and similar events.

The weekly progress reports, imposed on the treatment teams, had the primary effect of magnifying the coordination and communication needs of the teams while at the same time imposing weekly deadlines and increasing the pressure to complete tasks before such deadlines. As a consequence, the different work ethics and levels of commitment of the team members were amplified in the managed teams, and the potential for trust threatening incidents increased dramatically. The post hoc case analyses show that the managed teams that were able to maintain and develop strong trust bonds were characterized by a uniform approach to project completion by all teammates. This is not to say that all team members worked exceptionally hard. Rather, there was no disproportion with respect to the effort expended by some team members versus the others. For example, team 50 struggled early on, and all team members were absent and minimally committed. But when the deadline approached and the team realized the magnitude of the project requirement, all team members immediately focused their effort, communicated consistently, delivered the work they were responsible for on time,



and as expected. For these teams, the weekly reporting schedule was not disruptive and did not undermine trust.

The findings presented above explain the unintended negative effects of managerial behavior control mechanisms in virtual teams. These results are important as we begin to study this new context for teamwork, and we attempt to develop tools to enhance the effectiveness of virtual teams. The next chapter draws implications for research and practice from the discussion presented in chapters five and six. It also presents the limitations of the study and concluding remarks.

## **CONCLUSIONS**

This chapter presents the limitation of the study. Then, it draws implications for research and practice based on the discussion of the research results in chapters five, and the follow-up analysis in chapter six. The chapter ends with conclusions.

### **Limitations**

Several limitations of this study must be addressed and interpretation of the results should be subject to their understanding. The primary limitation of this work lies in the use of an experimental setting and a student population. The reliance on students albeit mostly graduate students, raises the concern that the grade may not be a powerful enough motivator and that the project itself may be fairly inconsequential to the subjects. In this study a cash prize was instituted to further motivate the subjects and the grade of the project was a substantive portion of their final course grade. Still, the impact of these two motivators remains questionable and likely varies considerably from student to student and even team to team. Moreover, student projects have limited duration and their significance is limited to the duration of the course. Upon completion of the course and assignment of the grade, the project has no further bearing on a student's life. Similarly, in typical work settings team projects, and their success or failure, represent important components of employees' performance evaluation. But they have a more lasting effect. The outcomes of important projects can impact the employee's subsequent career.

Theorists have recently called for research that utilizes the strengths of experimental designs to fill the many gaps in our knowledge of virtual teams

(Furst et al., 1999). To leverage these strengths, and to be able to clearly isolate the effect of different control structures, a field experiment was used. But the use of this methodology raises issues regarding its realism. Particularly, the treatment employed was intended to simulate the team's progress reporting to management. While there is strong evidence that the treatment group recognized the requirement and complied with the required schedule, the management figure to whom they reported (i.e., the exercise coordinators) had no substantial authority over them (e.g., the power to fire or promote, facilitate or hinder career improvements, and the like). Their only clout came through their apparent ability to influence a proportion of the grade. Moreover, after issuing the requirement, the coordinators only intervened to remind students of the requirement if they missed a deadline. The managerial figure was completely absent from the team's life, did not confirm receipts of the reports and never provided any feedback. This lack of involvement represents a weakness of the design, albeit one that could not be avoided without introducing confounding factors. If the coordinator did provide feedback to the treatment group he may have helped them and performance comparisons between the treatment and control group would have been confounded.

A wide range of asynchronous and synchronous communication media was provided to support team interaction. Unfortunately, budget and logistic constraints prevented the use of "non computer based" telecommunication media such as the telephone or videoconferencing connections. This latter limitation reduces the "realism" of the experiment and the generalizability of the results. The project to be completed by the teams in the experiment was fairly complex and

required them to discuss alternative business ventures, reach a consensus, resolve conflicts and misunderstandings. These tasks may have greatly benefited from the use of a richer media, such as the telephone. Organizations implementing virtual teams for important projects will typically provide telephone connections, though time zone differences may still limit their use

One final limitation is the use of inexperienced subjects. Only 10% of the participants had had previous experience working in virtual teams. Virtual teams are an emerging organizational structure and the population studied is likely representative of the general virtual team member population in terms of experience and exposure to the new environment. On the other hand, it must be acknowledged that the findings are likely not generalizable to populations of experienced virtual team members.

## **Implications for Research**

This section reviews the research results and suggests avenues for future research. First, the role of internal processes, coordination and communication, is evaluated. Then, the role of competing team control structures is discussed. Specifically, both the unfaithful appropriation of the weekly reporting requirement, and its negative impact on individual psychosocial outcomes and trust are discussed. Suggestions for future research are also presented.

The results of this research, while often unexpected, are important from both a theoretical and practical stand point. The study demonstrates that in virtual teams, as with traditional teams, internal processes significantly affect team effectiveness.

It also shows that mere quantity of communication has no consistent relation to team effectiveness. The present study shows that effective virtual teams can achieve their goal using a wide variety of collaboration and communication strategies. Thus, some teams collaborate effectively using only asynchronous “push” media (i.e., electronic mail) and clearly dividing tasks among teammates. Others employ a portfolio of media (i.e., synchronous chat, asynchronous discussion and electronic mail) and a consensus approach requiring considerable input from all team members. Extensive communication may often be a sign of the team’s inability to reach a consensus or to effectively coordinate. Therefore, the general communication quantity hypothesis is called into question by the evidence collected. It appears that the relationship between communication quantity and team effectiveness is more complex than previously hypothesized, and that it may be a moderated one.

Potential moderating variables include the strategy the team adopts to complete its work. For example, less communication may be required if the team members clearly subdivide the task at hand and are able to exchange the needed information in a timely fashion. Conversely, when teammates are unable to communicate effectively, a high quantity of communication may be indicative of the team’s inability to steadily progress toward its objectives; here the relationship between high communication and team outcomes will likely be a negative one. Research is needed to fully comprehend the interaction between work strategy, communication portfolio employed, communication quantity, and their effect on team effectiveness.

The findings regarding the role of managerial control in stimulating internal processes and, consequently, improve team effectiveness yielded interesting, albeit surprising, results. Managerial behavior control mechanisms failed to improve team effectiveness over team self-direction. Upon further analysis, it was discovered that the reporting tool used to enforce behavior control was generally unfaithfully appropriated (DeSanctis and Poole, 1994). Teams generally perceived the reporting requirements as an additional task disjointed from the overall project requirements.

While most teams made an effort to use the reporting tool as directed, their inability to regularly meet and easily discuss the reports' content appears to have lead to its unfaithful appropriation. They typically failed to use the reports as an agenda to discuss substantive issues (e.g., activity planning, work assignment, progress revision) and simply divided the reporting task and coordinated to comply as requested. As the appropriation of the reporting tool was unfaithful, it is not surprising that its use did not improve team effectiveness.

This result is very important because it indicates that simply “porting” management practices and control tools used in traditional teams to the virtual environment may be ineffective and may not bring the expected results to bear. This result confirms concerns voiced by other researchers (Furst et al., 1999; Malone and Laubacher, 1998; DeSanctis and Poole, 1997; Victor and Stephens, 1994). Virtual teams face unique challenges due to their context. For example, lack of face-to-face interaction, increased difficulty to “meet” regularly and coordinate effectively, a general increase in time requirements to complete

unstructured tasks (e.g., planning, conflict resolution), constraint to rich communication, a reduction in intrinsic involvement (Finholt and Sproull, 1990). In the present study these contextual constraints and challenges appear to have had considerable influence on how the team appropriated the reporting tool. Arguably, if the teams had had a chance to meet regularly in face-to-face sessions it would have been easier for them to address quickly and effectively the issues presented in the weekly reports. By appropriating the reporting tool faithfully they may have reaped the benefits of its adoption early in the process, and having experienced its benefits, continued faithful adoption as the project continued.

The current study provides circumstantial evidence supporting this argument. A number of teams attempted at first to faithfully appropriate the reporting tool and, as a team, discuss the substantive issues it presented. But the difficulty in scheduling the discussion and the tendency of many team members to not participate actively, as well as their tendency to attend to local commitments before turning to the requirements of the virtual team, stifled these attempts. While the evidence presented is certainly not conclusive and research is needed to establish the veracity of this conclusion, the results show that the virtual environment may not be conducive to the implementation of traditional control mechanisms.

Further research must also focus on finding suitable management control measures for the virtual environment. Behavior control seems well suited for this environment, but the results of this research cast some doubts regarding its value to virtual teams. Indeed, recognizing that the virtual environment presents a

unique set of constraints and advantages, some authors predict that virtual teams will “rely less on formalized procedures and more on information retrieval and sharing systems to accomplish their work.” (DeSanctis and Poole, 1997 p. 168).

The results presented here indicate that formal reporting procedures did not provide the hypothesized benefits and, as discussed in the previous chapter, even contributed to hinder trust within the team and to generate negative individual psychosocial outcomes.

Managerial behavior control mechanisms had no tangible effect on virtual team effectiveness in this study and they provided no improvement over team self-direction. At the same time virtual teams varied widely in their ability to self-organize, elicit substantial contributions from all of team members, and coordinate and communicate effectively. Moreover, for many subjects, the project seemed to have lower priority than local projects. Self-direction does not appear to be a consistently optimal control structure for virtual teams and the questions originally posed by this research still remain unanswered.

Further research is required to deepen our understanding of the techniques that can increase virtual team effectiveness. For example, other control mechanisms traditionally adopted by collocated teams, such as output or clan control, may be effectively implemented in the virtual environment. Alternatively, entirely novel approaches may be necessary.

Future research must also focus on feedback mechanisms. Interviews with a few research subjects indicate that the lack of feedback on the weekly progress reports provided a negative incentive to discuss their content and contributed to



their unfaithful appropriation. Therefore, managerial behavior controls that call for managerial feedback may indeed achieve the expected results and benefit virtual teams. Such feedback, while impossible here because of the need to maintain adequate experimental control, could be both easy to administer and expected, in a traditional business setting. Research that explicitly evaluates the role of managerial involvement and feedback should build on the results of this study. Specifically, the effects of managerial behavior control, managerial involvement, and feedback in virtual teams should be explicitly evaluated.

The most surprising results of this research concern individual psychosocial outcomes and trust. Managerial behavior controls, and in particular the weekly reporting requirement, considerably impaired the maintenance of trust in the managed teams. This result highlights the potentially negative effect of formal procedures and requirements in the virtual environment. It also reiterates that, in the dramatically different context in which virtual teams operate, utilizing accepted management methodologies may bring about unintended negative results.

More specifically, the results show an emerging pattern of unmet expectations that undermined trust and psychosocial outcomes in virtual teams. These patterns of unmet expectations seem to be partly due to differences in effort and commitment to the team by the team members. Some researchers have called for research focusing on uneven teammates contributions in virtual teams and on the possible remedies that management can implement (Furts, et al., 1999). These calls are echoed here in light of the study findings.

## **Implications for Practice**

Virtual teams offer great advantages in terms of flexibility and efficiency to organizations that are implementing them. But great uncertainty still remains regarding the determinants of virtual team effectiveness. This section draws on the study findings to provide some advice to practitioners involved in the implementation of virtual teams. Two implications for practice seem to clearly emerge from the study findings. Managerial behavior control mechanisms need to be legitimized by managerial involvement. Interviews with the study participants indicated that the lack of feedback provided by the coordinator, the individual requesting the weekly reports, undermined the teams' commitment to them. Managers who require progress reporting on the part of the virtual team should therefore explicitly acknowledge the team for submitting the reports and provide substantive feedback on its content. By doing so, the legitimacy of the control mechanism is preserved and the team will be more likely to appropriate the reports faithfully. The need for explicit feedback is particularly important in a virtual environment. In collocated teams, chance interaction and informal meetings can reinforce the importance of the reporting tool, and assure the team members that filing the report is not a futile exercise. In the virtual context, where the team members and managers are not collocated, the possibility of chance interaction and informal feedback are very limited. Thus, it is likely that the team members may perceive the progress reports as an overhead requirement that does not aid them in completing the project.

A related problem that emerged in this study was the lack of acceptance of the control mechanism by some team members and the lack of perceived benefit to the team. Managers who implement virtual teams should consider investing some time introducing the control mechanism adopted and highlighting the benefits of faithful appropriation to the team.

The results of this study indicate that simply adopting traditional managerial control mechanisms in the virtual environment may not positively impact team effectiveness. Virtual teams face unique challenges, such as increased coordination and communication difficulty, inability to easily gather team members for decision making purposes, a general increase in time requirements to complete unstructured tasks. The implications of these problems for the control mechanisms adopted must be explicitly addressed and thoroughly understood. For example, managers of virtual teams may consider requiring that all team members join in a synchronous discussion at regular intervals. Given the difficulty that virtual teams encounter in scheduling such meetings, managers may consider creating a long-term schedule. Moreover, they should consider developing precise agendas for discussion that can easily guide the meeting.

## **Conclusions**

Virtual teams represent a new organizational form that holds the promise to deliver unprecedented flexibility and responsiveness to organizations. Organizations that implement virtual teams have the ability to pool the best talent to complete specific projects irrespective of its geographical location. Virtual

teams can make organizational boundaries permeable allowing for vertical collaboration with suppliers and customers and horizontal cooperation with competitors.

As information and communication technologies continue to grow in popularity, and more employees become accustomed to working without physically meeting coworkers, virtual teams will likely become more and more popular. Given the novelty of this organizational form, there is a paucity of research addressing the many challenges that team-work in virtual environments poses. The growing popularity and the high rate of adoption by businesses and organizations, though, has fueled research interest on virtual teams. Much previous work, particularly empirical work, has focused on self-directed virtual teams. Indeed there appears to be an assumption underling much of this work, namely, that the optimal control structure in a virtual team is self-direction.

The main focus of this study is the above assumption, and a test was developed to evaluate its accuracy. More specifically, drawing on control theories, the notion of managerial behavior control was extended to virtual teams. Managerial behavior control mechanisms are widely used in traditional, collocated, teams to promote their effectiveness and to facilitate their success. Managerial behavior control was operationalized through a weekly reporting schedule. The managed teams were required to report on short and long-term planning, detail work assignments, and provide progress reports.

Two competing team control structures, behavior control and self-direction, were compared through a field experiment involving two hundred and one

graduate and undergraduate students enrolled in six different universities in three continents. It was hypothesized that managerial behavior control mechanism would improve virtual teams' internal processes and ultimately increase team effectiveness. Team coordination, communication quantity and communication effectiveness, were the internal processes studied. Team effectiveness was measured in terms of team performance, individual psychosocial outcomes and team member viability.

The research findings indicate that team coordination and communication effectiveness are significantly related to team effectiveness while the relationship between communication quantity and outcome measures is more complex and may involve moderating variables. Unexpectedly, managerial behavior control mechanisms did not provide any significant improvement over self-direction. Teams that filed a weekly progress report did not outperform their counterparts, and the members of those teams were not rated as being better virtual team members. Follow-up research indicated that the managed teams did not faithfully appropriate the reporting tool. It appears that the communication and coordination challenges posed by the virtual environment and the extensive reliance on computer mediated communication, hindered the team members' ability to produce joint progress reports. The team members split responsibility for filing the reports and, as a consequence, the reports failed to stimulate high levels of coordination and communication, and increase team members' accountability.

Surprisingly, the weekly reports had a negative impact on individual psychosocial outcomes. The members of managed teams reported being less

satisfied with their teammates and with the team's interaction. Trust was also significantly lower in managed teams than in self-directed teams.

Post hoc qualitative analysis, employing the case study method, revealed that the managerial behavior control mechanism adopted in this study hindered trust and satisfaction by magnifying the chances that the individuals expectations would be frustrated by teammates.

The virtual teams developed swift trust. The maintenance of this form of trust requires continuous action and constant interaction by team members. Trust in the virtual teams studied was hindered when one or more team members failed to live up to the expectations of his or her teammates. In the managed teams the weekly reporting schedule, and the deadlines associated with it, tended to create an environment where trust-threatening incidents and failure to perform as expected were more likely to occur.

As virtual teams grow in popularity and more organizations implement them, there is a growing need for research that evaluates team effectiveness and its determinants. This study investigated two competing team control structures, managerial behavior control and team self-direction. The findings indicate that traditional control mechanisms may not suit the virtual environment and may even be detrimental to team effectiveness. Research is clearly needed to identify the determinants of virtual team effectiveness and to provide guidance to forward looking organizations that rely on this new organizational form.

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## **APPENDIX 1 - CASE STUDY REPORTS: HYPOTHESIS GENERATION**

### **Team 41: Treatment**

CSLC: 0.898 (8th); bizPlan: 0.3025 (20th)

Trust 1: 1.500; Trust 2: 3.500

Total messages: 114; bizPlan Messages: 86; Chats Yes; BB Yes.

Bridgette: 32; Joe: 22; Rebecca: 16; Eric: 16

LSU, UCD, Denver, DePaul

Following a pattern of many other teams, the teammates exchange greetings then go quiet until about a week prior to the deadline. The first message is from Joe who calls attention to the deadline and proposes that everyone reads the material within two days. He receives an immediate answer from one teammate. Two days later Joe inquires about how the team would like to proceed (split the report?) and suggests a chat meeting. Immediate response from all team members is received and the chat is set up. The next interaction, started by Bridgette, also spurs responses from all. A total of nine messages is exchanged within two days and a chat time is agreed upon. The chat meeting lasts one and a half-hour and the team engages in brainstorming in which all teammates participate substantially. All interaction is strictly task focused there are no social exchanges. Bridgette clearly takes on the shepherd's role and volunteers to write a rough draft of the report. The team agrees to read it and meet again in the chat room the next day. The following day all teammates meet and indicate that they all have read the draft. This chat session, lead by Bridgette who uses her draft to structure the interaction, lasts two hours and is also marked by uniform and substantial participation. Bridgette volunteers to upload the resulting write-up to the shared area within 30 minutes for everyone to review, Rebecca volunteers to write the conclusions and Eric the executive summary. Joe comments: "I think we are all coming at this from the same angle - amazing!" Bridgette echoes: "Wow! Sounds like we have a good plan. Like Joe said earlier, this is a lot easier than I thought it

would be (working virtually)." The agreed upon reviewing schedule is followed according to plan.

The early interaction in this team is characterized by continuous feedback and involvement of all teammates. The team finds it easy to schedule a time to meet and is able to carry out work effectively using a combination of technologies. The team relies heavily on synchronous meetings (similar to a traditional team) but has no trouble scheduling them. These meetings are very fruitful, apparently because of the structured nature of the task and Bridgette's successful efforts to direct the team following the report template. This team's behavior is, in this phase, marked by continuous interaction, contributions and volunteering by all teammates and the lack of broken promises (all teammates do what they said they would according to the schedule agreed upon).

The team moved quickly to the second project carrying over the momentum from the first one. On the first day of the project Eric solicits ideas and Bridgette quickly provides one along with substantive explanation. Immediately Joe comments that it is a good idea and promises to deliver his own idea after the weekend. Eric also delivers an idea and urges the team to "... get some type of game plan together for this final project and we should try and brainstorm to develop ideas for the project." Eric calls for a chat, all teammates respond and agree to a time. The chat meeting takes place with all members and follows the same pattern of the two earlier ones. Its outcome, however, is not conclusive (Bridgette: "We obviously need to come to our next chat session not only with the ideas but with the research. A selection should probably be made at our next session." Joe: "Let's try to send general ideas via email..."). The next date is agreed upon. No email messages are exchanged in the following four days; Eric and Bridgette post their ideas but receive no comments. This is a very important moment in the history of this team because it marks the first instance in which a major commitment is broken by the teammates. The next chat meeting (Rebecca is absent) provides evidence that the "broken agreement" negatively impacted the team's climate (Bridgette: "Well, Eric and I posted our ideas to the Web Board but

no one went out to expand on the ideas or add any new ones"). Due to the lack of action the goals for the week are not achieved (Bridgette: "So our goals for the week had been to generate more ideas and select one to divy up the work. I don't think we can do the latter part yet. We need to gather some more info on the furniture industry" and "This thing is due in what, 2 1/2 weeks. We can't stand to sit on it too long.") The team has trouble finding a time to chat and Eric suggests asynchronous media. The previous lack of action has made Bridgette unsure about other's commitment: "The only problem is that we say we're going to use the BB and email and no one ever does. I think it's more flexible as long as everyone would participate." Eric suggests requiring "... each person to come up with three ideas for the web site and no two can be the same." Teammates agree (Rebecca joins citing ISP problems and is brought up to date but it is unclear if she understands the requirement as it is not reiterated). This incident is very important in the life of this team. An explicit requirement for action is communicated but not attended to. Moreover, when Bridgette logs on for the next chat she finds no one "Where is everyone?????" Scheduling a new chat proves difficult and interaction proceeds through email. The team seems unable to work effectively through the asynchronous channel. In the next three days the team exchanges 23 messages in an attempt to set up a chat meeting and iron out procedural issues. The only substantive questions come from Bridgette. They all go unanswered even after repetition. On short notice Eric and Bridgette meet in the chat room. After waiting for others, a frustrated Bridgette comments: "... I am thinking I spoke to soon the other day about how great we were comparatively." Eric and Bridgette split the report and assign various parts to the teammates. The team never recovers its original positive climate after this point. Bridgette once again took charge of combining everyone's contributions, Rebecca promised to send a few late changes required of her while Eric and Joe had taken responsibility for the executive summary and the conclusions sections. Apparently these commitments were not met and Bridgette, before turning in the report, commented: "... I'm not too sure what part of 'post any changes prior to 9pm CT on Sunday' was not clear.

**Also, everyone was supposed to contribute to the Executive Summary and Bibliography/Appendices and no one did. .... So much for TEAMwork!!!!!"**

**This team started the second project carrying over the momentum from the first one. The climate in the team was very positive during the early stages as shown by the comments. The team worked well when able to use the chat as the equivalent of face-to-face meetings in the virtual environment. When scheduling chats became difficult the team seemed unable to effectively use asynchronous media. It seems that they suffered from an "out-of-sight out-of-mind problem" and other than Bridgette and Eric they had a hard time keeping commitments. When attempting to use asynchronous communication the team was characterized by a few early incidents where people did not do what had been agreed to and/or did not respond to messages. These incidents negatively influenced climate in the team and likely were responsible for the decrease in trust.**

#### **Team 40: Treatment**

CSLC: 1.195 (3rd); bizPlan: -0.0407 (26th)

Trust 1: 2.250; Trust 2: 4.563

Total messages: 109; bizPlan Messages: 84; No Chats; No BB.

Sandeep: 32; Adam: 20; John: 16; Michael: 16

UCD, LSU, DePaul, Denver

The initial interaction pattern of this team was similar to the previous ones. After introductions the teammates fell silent until one called attention to the project (one week prior to the deadline). Sandeep, who eventually took on the role of shepherd for this project, indicated that he would be reading the material and the other should do the same. John was the first to contribute his input with a long and detailed note four days prior to the deadline. Sandeep followed with comments and Adam complimented John for his work but added no substantive comments, he promised to follow up the next day with his input. As promised Adam delivered his comments. The day before the deadline Michael apologized for having "been slacking" provided some comments and volunteered to finish whatever else remained. He also commented negatively on virtual work and said he preferred to meet face to face. Sandeep volunteered to finish the report and submit it, John followed with another extensive message and comforted Michael "Hang in there Michael it's not that bad." Sandeep quickly responded querying John regarding his comments, John quickly answered and warned that he had to leave shortly. Sandeep sent three more messages that received no answer and submitted the report.

The pattern followed by this team during the first project was similar to that of other teams even though interaction was not as balanced. Sandeep emerged as the shepherd and John contributed substantially. Adam and Michael were less active.

The team has a tough time selecting an idea. They discuss, using only email, the merits of two competing proposals (both submitted by Michael). The team is required to file weekly reports and Michael draws attention to it three days before the first one is due. On the day the report is due Sandeep issues a first call (10am) to John "Send me some comments...The report needs to be filed today..." Two



hours later he issues a second explicit call for help (12am) "Alright, you have convinced me its not that great an idea [referring to the first one]... Do you want to write up the report on the communication hub for the consultancy...[the second idea]" Michael explains why he supports the first idea and Sandeep issues a third call for collaboration on the report (2pm) "Hey Michael, e-mail me your phone number, so we can quickly come up with something to put on the progress report." Again no answer to his messages, Sandeep sends yet another message (6pm) " The progress report is due in 4 hours...I want to greeting cards...e-mail any additional comments..." Again no response. This incident is very important because it highlights, in a very short time, an escalation process typical of other teams too. That is there is a lack of responsiveness and an inability to keep commitment by teammates. In this case the problem is aggravated by the fact that Sandeep appears to treat electronic mail as an immediate (almost synchronous) medium. Sandeep does not mention the lack of response again (when interviewed he indicates that at this stage he did not know what to do to motivate his teammates) and the debate resumes with John advocating changing the topic. Sandeep seems eager to select one idea and move on with the project.

A similar incident happens a week later when the second report is due. Responding to a detailed message from John and Adam's statement of support, Sandeep, eager to move on and motivate the others states: "I am on the consultancy [the second idea] bandwagon... Since you guys are championing...Give me a complete idea of what it is." Neither John nor Adam, the "champions" for the second idea respond to Sandeep's request within the next three days. Michael does join the bandwagon however. Ironically, at this stage all teammates are agreeing on one idea (and Sandeep is requesting the champions to expand on it). Sandeep draws attention to the upcoming report and calls for "someone" to change the focus to the second idea and adds: " Someone needs to take charge and produce a new assignment [weekly report] for all of us if they want to do consultants [second idea]...Until then I am going to keep working on the Greeting cards [first idea]..." This message is rather confusing. Sandeep has

joined the "bandwagon" on the second idea but he states that he will keep working on the first one. But the next day, apparently unaware of where everyone else stands, Adam says: "Though I championed consultants before [the idea all agree to now], let's just get going on the greeting cards [the other idea] and be done with it. All in? (Besides you, Sandeep. I know you are...)" There is no interaction for the next two days, the report due date goes by and the team receives a reminder from the coordinator. Sandeep ends up writing the report (3/11) and then, visibly upset states: "... more attention needs to [be] given to this project. At this point, I feel like I have done the majority of the work....I expect some help.... look at the second report submitted. I am getting extremely upset.... I want you [to provide] some deliverables by the next report, which is the coming tuesday." Adam and Michael apologize, and their state of confusion is apparent " I am sorry but i was unsure as to what idea we were pursuing??? " The team finally focuses on the first idea (the one all had previously rejected), Michael produces a rough draft of his part a day later and Sandeep quickly responds with his feedback. John contributes a draft of his portion three days after Michael (8/11 he had been absent for 11 days). Again Sandeep acknowledges the message right away and provides feedback. A day later Adam submits his part and Sandeep again replies with prompt feedback (Adam's absence had lasted 6 days). John forwards a second draft and, after receiving no response, the following day comments (12/11): "You are all very quiet these days?... Mail me back soon, I'll be around for a while." All three teammates reply by the end of the day citing other project work as an excuse but provide no feedback on John's work. As the final project report approaches Michael who completed the third report asks: "Who can do the progress report this week. I am unable to do it." There is no answer from any teammate but the next day John submits the report and states: "I submitted the last progress report; now all we have to do is finish off the business plan and then we can all go our merry ways." Sandeep then bursts: "... I am not going to put the project together like I did last time. It is someone else's responsibility to do it...I think I have done a major portion of the project already." Nonetheless over the weekend only Sandeep

sends messages (4 consecutive ones) giving directions and submitting his work. Even though he promised he would not do it this time, Sandeep managed the final two days of interaction requesting material, updating and consolidating the final document. He submits the project but does not send a copy to the team.

#### **Team 4: Control**

CSLC: 0.303 (17th); bizPlan: 2.1898 (2nd)

Trust 1: 2.223; Trust 2: 3.917

Total messages: 146; bizPlan Messages: 117; No Chats; No BB.

Allison: 45; Dinesh: 25; Jimmy: 47

UCD, LSU, DePaul

The team introduces itself quickly and with no trouble. There is excitement about the upcoming experience. Following a common pattern the team does not interact until a week prior to the deadline when Jimmy (12/10) draws attention to the deadline: "Our project deadline is looming (Oct 18)..." The message is followed immediately by all teammates as they try to schedule a meeting. Allison sends a detailed message outlining the project requirements and a procedure to complete the work. She suggests that before the chat the teammates email each other ideas, Jimmy agrees with the need to send ideas. As the team struggles to find a time to meet, it is unclear if the request for ideas has been heard/registered by team members. Allison reiterates (13/10): "I also think that before we meet in the chat room we should have individually come up with an initial plan..." and concludes: "Again, let's not wait until then to start writing down our ideas.... I plan to email you both my ideas by Thursday 2 PM (US Central Time). [the next day]" Jimmy promises to do the same Dinesh is silent. As promised Allison sends her work, the only one who does, and the next day (15/10) the team meets in the chat room. Allison inquires about the others' ideas. Jimmy has some notes he did not send, Dinesh had not had time to develop ideas or read Allison's. They brainstorm and agree to meet again the next day. At that meeting Dinesh is missing, but the others go forward. Allison splits the report, Jimmy agrees to do the part assigned to him. Allison then emails the decision to the team and says: "Let me know if this is OK... email me your report sections before Sunday 1 PM US Central Time (7 PM Dublin time)." This message includes two explicit requests. No ones answers the first, perhaps because there is implicit agreement. Jimmy follows up: "Dinesh ... how does tomorrow sound to you?? Did you

forget about todAY????” Jimmy and Allison seem to cooperate well, even though Jimmy is late with his work and the calls to Dinesh intensify. As the deadline approaches Dinesh resurfaces and explains that all the phones in his subdivision are inoperable and won’t be back until (19/10, a day after the deadline). Jimmy acknowledges Dinesh and assumes he will do his part, Allison does not but, filling the void left by Dinesh, and turns in the work.

During the preliminary project this team follows a familiar pattern with Allison taking a strong leadership role. Her initiations are not always responded to (i.e. let’s email each other ideas) Jimmy is very active while Dinesh seems to have had uncontrollable problems. Interaction is not uniform with Allison pulling much of the weight. Still trust at time one is equal to the average for the groups and it is unclear how Dinesh’s incident has affected the team. Even though it may not have had an immediate effect it has set a precedent.

Allison immediately draws attention to the second project (19/10) with a lengthy and detailed email outlining clear procedures, assignments and deadlines: “(1) Please read the description... (2) think about business innovation ideas.... 3) meet in the chat room to discuss our ideas and reach a consensus... Please include **goals, objectives and risks**.... Each of us send our ideas to the team via e-mail **before 10-25**.” She also calls for a meeting in the chat room. The message is immediately acknowledged by both teammates who agree to the deadline, but the team has trouble finding a suitable time to chat. There is no further interaction until (24/10) when, a day early, Allison submits her input. Jimmy indicates he will be gone due to a holiday and he will be unable to submit his input until 27/10 (two days late). The team still has trouble finding a time to chat and the first deadline slides: “Please send your ideas as soon as possible... (even Wednesday [27/10] morning is OK....” Dinesh provides his idea (26/10) one day late. His message is long and detailed. Jimmy does not deliver his idea as promised and Allison calls on him again. As time goes by, deadlines pass and commitments are not kept. Allison grows increasingly frustrated: “[we don’t have to chat] But we can keep things going anyway as I suggest in my earlier email.”

An important question directed at Dinesh and necessary to evaluate his proposal is ignored and frustration mounts: "are you listening to me?" and: "Jimmy, where is your idea????????? ... Please do this ASAP since we are losing precious time!!!!.... More than one week has passed with little accomplished!" Allison does not seem to be able/willing to move on unless everyone has done what they said they would and all her questions are answered. The next incident is crucial in the life of this team and the messages exchanged are very like those involving Sandeep (team 40) and Bridgette (team 41) at a similar time. After Jimmy submits his idea Allison sends a detailed message, structured in the form of the project template, introducing a combination of Dinesh's and her idea. She explicitly calls for comments in a given format (following the template): "<bold>What are your comments?</bold> Here is the business plan template that we MUST follow-[URL and headings follow]." Two days go by and Allison receives no response. 2/11, visibly frustrated, Allison: "Are you two out there??????????? Did you received my last message I sent several DAYS ago???????... I would appreciate input from you both.... This is supposed to be a GROUP project." Both teammates respond to this call but neither provides substantive feedback and no one uses Allison's template. Jimmy proposes a chat and Allison bursts out: "Let's give up on virtual chats, OK?... Would you two please try to respond to my earlier email...which means add comments where I have requested comments." Allison again seems unable to move without consensus and participation from all. Jimmy responds complimenting the teammates for their work but provides no substantive comments. Allison posts the original detailed message once (4/11) more, Jimmy indicates he is very busy and comments will follow. There are no more comments. Allison once again posts the original message (5/11) and adds: "I sent the following message almost 1 week ago and still neither of you have responded directly to any of my specific questions and comments regarding development of our business plan (beyond the initial idea). We need a response from each group member in order to proceed with the research and business plan development. This is a group project.... Please respond today". Two hours later, after no response

has been received she states: "I've decided to go ahead and make my selections for contributing to the business plan development. I really wanted you guys to select first, but since you haven't.....I will." She finally moves on and proceeds to divide up the report and assign work but she adds: "Please realize that even though each of us will work on different sections, it is the responsibility of each of us to email the group our research and writeups SEVERAL times before the final report is due." And "Since we have about two weeks left with which to complete our project, I would like to suggest that each of us email the group progress reports every three days...." Both teammates respond to this message. During the next week the team, pushed by Allison, goes through a phase in which all teammates participate and respond promptly to each other's messages. Confirming the renovated state of cooperation are Allison's comments: "I [am] happy to see that we finally have got the ball rolling! Thanks." And, later in the week, after Dinesh promptly attends to her request: "Here are a few more questions/comments I have. Please try to respond ASAP. THANKS." Allison states: "Thanks for such a quick reply." During the last week though one more incident plagues this team. Allison sets a deadline for contributions four days before the due date (18/11), again, she turns in her material a day early but when she receives no input from the team she states: "HI Jimmy & Dinesh, Where are your sections? We have only 4 days remaining until the due date!!!! Please send whatever you have completed so far..." Jimmy responds the next day saying he is working on it and will send soon then proceeds to compliment her. No sign of life from Dinesh who will re-emerge, after many repeated calls from his teammates, the day before the due date indicating that he did not know the deadline was the next day and that he "... had to catch up on a few things." Jimmy reacts angrily but Dinesh replies very calmly and produces immediately some work on his sections. He also agrees to combine all sections and turn in the report. He send six consecutive messages between the evening prior and the morning of the due date. Allison provides comments on his work. Dinesh will turn in the report on time and the team produces the second best plan.

**This team resembles very much team 40 with one driven member who is very aware of deadlines and continuously tries to involve and motivate the others. This team is characterized by an early incident as well where the leader, who had taken charge of submitting the first assignment and had done most of the work there receives no cooperation from others.**



### **Team 26: Control**

CSLC: 0.303 (17th); bizPlan: -1.7408 (49th)

Trust 1: 1.417; Trust 2: 3.750

Total messages: 44; bizPlan Messages: 21; No Chats; BB yes.

Ben: 1; Caroline: 12; Tim: 8

UCD, LSU, DePaul.

The most striking characteristic of this team was the widespread lack of initiative and the phlegmatic approach to the work and the crisis that arose during the project. Similar to most other teams the first mention of the first project was a week before the deadline. These first initiations were just sensing ("Any ideas on what "Innovations" we could use for our Report?"), no commitment no volunteering, no pushing. Two days prior to the deadline Ben posts an idea, there is no debate on it and the work is split. All teammates acknowledge and guarantee a date by which their work will be in. Ben volunteers to put it together and he delivers, as well as all other teammates. Once one member took action (Ben took on the shepherd's role) and expectations were set, all teammates responded and delivered.

During the next project this pattern of inaction at the start was repeated. There is absolutely no interaction for seventeen days. And the process again starts with sensing non-committal messages (Caroline: "How have you guys been? I was just wondering when you want to start working on the Business Plan? It doesn't really matter to me, whenever, but I think we should start working on it sooner than we did on the CSLC report."). There is no interaction in this team and the Caroline promotes three more initiations, one of which briefly highlights an idea. All three go unanswered. Four days prior to the deadline the team has produced nothing and a sense of urgency is reflected in Caroline's next message "I'm just wondering if you guys are getting my messages?? We really have to start and do some work. We have quite a bit to do..." She is acknowledged by one teammate (Tim) who indicates he has done nothing so far and concludes "Any ideas?". He does not comment on Caroline's idea. She does not respond. Two days later Tim splits the work and takes one section, he also volunteers to combine and edit the final draft

(the only idea ever proposed is deemed good with no discussion and it is adopted). On the deadline date Caroline promises to finish her part on time, Tim tries to contact Ben in vain and asks Caroline: "Do you want to split the rest up or what?" There is no acknowledgment of this request but Tim will receive two more message from her with her part and part of the missing sections, it is unclear who completed the rest.

Lack of leadership, no attention to deadlines, and a general apathetic attitude of all members characterized this team throughout its life. During the first project the team was able to rally once the work was split. All members delivered on their promises once agreement had been reached on a course of action. During the second project the team's shortcomings were magnified by the more difficult project. Moreover, most initiations of communication were not acknowledged until four days prior to the deadline with the initiating member becoming progressively more frustrated. One member disappeared and there is no indication that he did any work, thus apparently leaving the other two to fill his void.

## **APPENDIX 2 - CASE STUDY REPORTS: HYPOTHESIS TESTING AND REPLICATIONS**

### **Team 44: Treatment**

CSLC: 0.120 (3<sup>rd</sup>); bizPlan: 0.385 (17<sup>st</sup>)  
Trust 1: 1.688; Trust 2: 3.250  
Total messages: 122; bizPlan Messages: 80; No Chats; No BB.  
Todd: 37; Michele: 14; Vincent: 18; Nitin: 17  
UCD, LSU, DePaul, UCDenver

The team begins interacting very early and with statements of excitement. On team member, Todd, is very aware of deadlines and from the early going takes up a strong leadership role setting: "We need to break down tasks for this project. It is due one week from today!! Let's get on this and get it over with!" Upon request from Nitin, Todd allocates tasks to all teammates who agree with the plan and take responsibility of their "piece" the next day. Todd has split the document template sequentially and has created a schedule following which the teammates, in turns, complete their assigned section and pass it on to the next team member. Todd appears to be the referent point to whom all team members turn for clarification. All four teammates follow the schedule closely acknowledging each hand off and complimenting each other. Vincent, who was responsible for the conclusion piece volunteers to write the executive summary (not previously assigned) and does so. When done Vincent states: "Todd is our coordinator and you have the honor to submit our proposal after proofreading." Todd takes the responsibility and replies: "I would also like to commend everyone on a great job.... I am very impressed with the final product..... Consider this project done."

During the completion of the preliminary project this team worked extremely well. Todd took a leadership role and the teammates followed. They tackled the project early, created a sequential schedule that was honored by all team members. Expectations for both communication frequency and work performance were consistently met. As a result, the team reported a level of trust well above the

average and the teammates complimented each other profusely through and after completion of the project.

Todd moves immediately on and, one day before the main project begins, posts his idea to the team. Since this team was assigned to the treatment group, it was required to comply with the weekly reporting schedule. Immediately after being informed of the requirement by the coordinator, Todd emailed him asking clarification and stating: "I just want to make sure we do not miss any deadlines." He is very aware of deadlines and very conscious about the requirement. Michele is also focused on the first report and after detailing his idea comments: "We haven't yet started the second phase and it seems like we are already late. From my understanding we have to submit 4 weekly reports with the first deadline being on October 27th." Todd echoes this message calling on the other two teammates: "Vincent, Nitin, what do you think? We need to start on this immediately. Our first progress report is due on Wednesday..." Todd receives no response and the next day, and, apparently frustrated comments: "I am not going to appoint anyone any tasks. You now know the business we are doing, find a part of the plan you would like to do. Let me know what you guys think.... We have a project update to send to Emmet [the coordinator] on Wednesday. We need to talk about this." All teammates respond to this message but the ensuing interaction is a source of great confusion. First Michele provides a comprehensive schedule of tasks to be completed before each weekly report. Nitin supports Todd's idea and Michele's schedule and adds: "I think Todd is doing the first report right? Michele is doing the second, so I guess myself and Vincent can take up the 3rd and 4th part respectively. Is that fine with you all?" Finally Vincent states: "I think it's a good project and agree with you guys. I think I can take part 4 and Executive Summary, as Nitin mentioned." Vincent is unaware of the requirement to file the reports and interprets the message as indicating that he is responsible to provide the fourth section of the business plan. This misunderstanding is very important in the life of this team. Relieved Todd states: "It was great to hear from all of you, finally we can make progress. I will be writing up the first report tomorrow.... I think that by

this report, you will see where I am going with this idea. Then you can give me any of your ideas..." The report conflicts with Michele's schedule and confuses him: "I am kind of confused, could you please let me know what I am supposed to do? Is the schedule I sent earlier ok or you think we should change it?" Todd follows up assigning specific responsibilities to all teammates.

A second incident is also induced by the weekly reporting requirement. As the deadline for the second report approaches Todd asks: "Who is doing progress report #2 to Emmet? [The coordinator]." Receiving no response he asks: "Michele, are you going to write the next progress reports?" and then again two days later: "Michele, you are writing the next progress report due on Wednesday right." Michele, who has been replying to substantive questions but not addressing Todd's concern finally answers affirmatively. While it is not clear how deeply this incident affected trust in the team, it clearly shows that the filing of the weekly reports introduced a new component of uncertainty and a new weekly task in need of coordination. Moreover, since the reports are subject to short and strict deadlines, coordinating them is even more difficult.

The third incident afflicting this team is also induced by the reporting requirement. Nitin volunteers to file the third weekly report six days before its due date. The day prior to the report deadline Todd checks on his teammate's progress creating confusion: "How are you doing Nitin and Vincent? Vincent, are you writing the next progress report?" Vincent is absent and his participation has been really scant (He has posted one message in the last 9 days and none in the last 4). Nonetheless, Nitin following Todd asks: "... are you giving the update report tomorrow Vincent?" Todd, rather than Vincent, replies: "Vincent should be writing the progress report this week." Even though the report is due that same day (9/11) and Vincent has not sent a message in the last 5 days, the teammates assume he will file the report. He does not. His failure to fill the report is cause of distress to the team. While Todd and Michele are not as "vocal" as the team members who carried the load in other teams, their disappointment and decline in trust toward the teammates is apparent. Michele: "Vincent can you let us know if

you are going to write your part? Let us know by tomorrow please." Todd: "I agree with Michele. We need to communicate more. Nitin and especially Vincent should be more involved.... Nitin, are you going to do the last report by next tuesday? Vincent are you going to answer us back..." And later again: "Nitin, you are going to do the third progress report, I hope? Vincent, you will do the fourth progress report.... Vincent, when are you going to be done with your part?" This message again adds to the confusion because at this stage there is only one report left which Nitin submits on time.

The team started the main project with one of the highest levels of trust of all teams in the experiment. Trust in this team seems to steadily decline though. The weekly reports appear quite strongly to have been instrumental in the steady decline of trust. They created misunderstandings (i.e., who is responsible for the third one), added uncertainty (i.e., Todd asking Michele three times if he is going to do it before getting an answer), and failure to deliver (i.e., the missed third report).

### **Team 50: Treatment**

CSLC: -0.29 (33<sup>rd</sup>); bizPlan: 0.412 (15<sup>th</sup>)

Trust 1: 1.875; Trust 2: 1.438

Total messages: 69; bizPlan Messages: 44; Chat Yes; No BB.

Jay: 9; Robin: 5; Alan: 10; Randell: 6

UCD, LSU, DePaul, CSUP.

Like team 44, this team reported above average trust at the beginning of the main project. This team made heavy use of synchronous meetings in the team chat room. The team was able to find mutually agreeable times on Sundays and Wednesdays. At the first meeting all teammates are fairly unprepared and spend time learning how to use the technology before moving on to the requirements. As they discuss them the teammates read the material and review the template to be used for the first project. Once they understand the requirements the teammates brainstorm until Alan focuses their attention on "where we are heading" in terms of customers, services offered, etc. As the team wraps up the first session Alan adds: "We've got a lot of awesome ideas. When we're done here, I'll go through our notes and summarize them all so we can all be on the same page come writing time." Each teammate takes responsibility for a different section of the project and they agree to post their work by the end of the week (in two days) and decide to meet again in the chat room (the day before the due date, in four days).

As promised Alan immediately posts the summary of the meeting. By the agreed upon deadline all teammates have contributed their part. The team faces problems scheduling the next chat meeting, mainly because Alan is late returning from a trip. He apologizes and offers: "listen, it's my fault we didn't get together today, so I'll compile our individual parts and bang out a summary. I'll post it in the comm-hub early morning (9:00 CST). again, please accept my apologies for being unavailable for meeting." Both Jay and Randell indicate that they can meet and that: "it seems fairer than putting it all on Alan." Pooling all sections together Alan finds the project to be too long. The team handle the crisis within the end of the day all teammates provide a summarized version of their work. Randell pools them and submits the project.

Like team 44, this team was able to work extremely well because all teammates contributed promptly and communicated extensively. By constantly keeping each other informed and their ability to follow through with planned action, even on very short notice, the team was able to successfully handle crises and build strong trust bonds.

The team did not interact for a week following the end of the preliminary project. Randell is first to break the silence (24/11) indicating that he does not think they should comply with the required reporting schedule. Within the next two days all teammates comment that they should do them and Alan states: "...so seeing as we are responsible for four reports and there are four of us in the group, i was thinking of splitting up the work load equally--one report per person. i volunteer to do the first week's report" Jay indicates: "it seems like the first step would be to agree on the 'viable business innovation' to pursue." And calls for a chat meeting. All three teammates immediately agree.

In the chat meeting the team decides to split the report by week but no one takes responsibility for file any specific one. During this meeting the team also evaluates a number of ideas and chooses one. As they had done before, the teammates agree to split the work, mainly research at this stage, and post their contributions to the team before meeting in the chat room. During the next week no team member carries out the commitment and Alan misses the next chat meeting in which the other three team members conclude little and decide to keep researching and meet again in three days to discuss and file the next weekly report. The team overlooks the fact that the report is due a day earlier than the scheduled chat meeting. Two days later, the day the report is due, Alan messages the team and apologizes for missing the meeting and cites technical connection problems. He states: "unfortunately this leaves me completely out of the loop as to what's happening regarding our second report due today... all in all i have proven to be a poor addition to this week's project discussion. to make matters even worse i am exceedling busy with other class work for the next three days. sorry for the inconvenience i have caused. i shall try to make it up by researching later this



week" Immediately Jay apologizes: "I also apologize - I was supposed to send you an email yesterday after we got together on the web and have not been able to do it until now...."

Like team 44, team 50 misses the second report deadline and files a day late. The reaction to the mistake though is much different. In this team all members have been busy and absent. For example, an exchange that takes place in a chat meeting some time after is telling. Jay: " Like I said in the email, sorry about missing the last meeting..." Randell: " It's okay, we all get busy sometimes or maybe a lot of times for others " Jay: "thanks, randell". No one has been able to deliver the work promised and no member feels like he or she is "carrying the load." They all state to be busy and apologize. More specifically, no one had personally taken, or had been given, responsibility to complete the report, thus no expectations are broken in this particular incident. Also, while missing deadlines and not delivering what promised, all teammates are "visible" and no one is absent for extended stretch or misses more than one chat meeting.

This incident also shows that most teams found it difficult to coordinate the completion of the weekly reports. The following week, while the team has not made much headway, Robin assumes responsibility for the third report in a chat meeting and as promised files it the next day. To this day (10/11) the team has had a careless approach to the project and has not focused. A radical shift in attitude takes place in a chat meeting that day when the team goes through the requirements for the project and realizes the magnitude of the work assigned to them. From this point forward all teammates become strongly committed to the project. The team meets consistently twice a week and no one misses another meeting. The team still share a strong sense of trust as shown by the following exchange: Jay: " do we need to post findings before then [the next chat meeting]?" Robin: "i'll check on it but we can probably discuss it on sun. as long as we all work on our parts" Randell: "These parts are just our rough drafts. right?" Robin: "... i'll be checking the file exchange to see if anyone posted any ideas, but we probably don't have to if everyone is real busy." In this team no one appears to

feel the need to control that work is being done. Moreover, by relying only on chat meetings the team unconsciously reduces the chances that commitments are broken. As long as the teammates come prepared to the bi-weekly chat meeting, trust should be easily maintained. Finally, working as a traditional team (and meeting periodically in synchronous mode, rather than relying on asynchronous, and potentially continuous, media) the team reduces drastically the chances that different user styles (e.g., checking mail at different intervals) affect expectations and ultimately trust. This working style was also beneficial with respect to filing the weekly reports. During the meetings in the chat room the team members would remind each other to file the report and the designated person would acknowledge his or her commitment immediately.

Once the team shifted to an active stance toward the project all teammates were strongly committed as the following example demonstrates. Between two scheduled chat meetings, Alan posts a message titled "URGENT!!!" in which he explains why the advertising plan they had developed would not work. He details an alternative and asks for input. Within the end of the day he had received an answer from each teammate.

This team had a similar experience as team 44 during the preliminary project but an opposite one during the final project. The potential for trust threatening incident was very high and the team was unable to focus on the project until after mid point. But this team was characterized by consistent input from all teammates and, once they realized the magnitude of the project they all focused and carried the work-load. Moreover, all members of this team were active and no one fell out of sight for extended periods of time. With respect to the missed weekly report, the team missed it "as a unit." No one had been invested with the responsibility to file it.

**Team 19: Treatment**

CSLC: -0.29 (33<sup>rd</sup>); bizPlan: 0.287 (21<sup>st</sup>)

Trust 1: 2.625; Trust 2: 3.500

Total messages: 64; bizPlan Messages: 44; No Chats; BB yes.

Ronan: 11; Tom: 15; Asif: 2; Sanjay: 16;

UCD, LSU, UCDenver; Massey

This team encountered small technical problems early on but quickly solved them and followed a similar pattern of interaction as most other teams at the beginning of the first project. The first set of email the teammates exchange after attention is drawn to the deadline cross each other and the teammates seem not to receive one another's. Even though all teammates have contributed one message, Tom, who had been the first to bring the project to the attention of the teammates, states: " Hello again! Are you out there?! I think we need to show a bit of urgency, since this is due on the 18th, i.e. 4 days, so here is a start.... Team, I look forward to hearing from you soon!!" From the first day Tom seems to force a fast pace on the team. This strategy did not prove beneficial because the teammates were often confused as to what they had to do. Also, Tom seems to immediately take charge of the project as if he were personally in charge of it and the others covered a minor role. This interpretation is corroborated by Tom's comments who, after receiving ideas from Ronan and Sanjay, indicates that he will incorporate them in the document is creating and send them out for review. He adds: "This will ensure that I have time to finish and dispatch without a mad panic at the last second!" As promised two days later he sends the document and states: "Would welcome feedback/suggestions, but must have these by this time tomorrow." Asif, the fourth member, has not communicated for four days and Tom calls on him simply to put his name on the cover page: "Asif, if you are out there, you need to let me know your full name for the cover page." Tom then states: "I think we need to establish some ground rules for the remainder of the course work, starting with organising who does what and when to ensure equal contributions by ALL team members!" This comment is very confusing but indicative of the pattern of conflicting expectations that plagued this team. Tom, who had essentially decide on his own

to relegate the teammates to a secondary role, seems to expect greater effort and contributions from them.

After receiving feedback from all three teammates Tom thanks them, revises the document and submits it. This team reported a slightly below average level of trust upon completion of the first project.

This team does not interact again for eight days. Tom, who is clearly the leader of this team, is unable to access his mail. Ronan is the first one to draw attention to the first report: "Once again the deadline is drawing dangerously close for the submission of our first report to Emmet Carrol [the coordinator]. It is due tomorrow!" He then details two ideas. Sanjay compliments him and provides his ideas. Asif compliments the teammates and provides his contribution. No one takes action to submit the report or plan how to meet the deadline. Tom joins the discussion the next day: "I have only just been able to pick up any email on this next assignment and I see that it was due yesterday." He then compliments the teammates for their ideas and highlights strengths and weaknesses of each one. He then details his idea and shows how it encompasses all the many strengths of the teammates' ideas. He also takes the initiative with respect to the first progress report: "So, since we are not going to be able to discuss this before the deadline, I am going to make an Executive decision to run with this idea, on the basis that I can finish the weekly report and submit tonight..." In the progress report Tom assigns tasks to each teammate and states: "let's not worry too much about what the underlying idea is - we just need to be creative and thorough. In order to progress this, can I suggest that you all come back by email with your initial work by 9 PM time tomorrow" This message sets an unreasonable deadline and there is no request for input regarding procedures. Moreover it is extremely unclear what each teammate should do exactly. Ronan and Asif support Tom's idea but no one provides any of the required material. Tom modifies his idea slightly and sets a new deadline and work assignments: "Ronan, do you fancy having a go at a pricing model and delivery and payment issues? Asif and Sanjay - can you please investigate the availability of graphics packages, costs, technology requirements in

terms of servers, domains etc etc... Please get this out to the team by Tuesday (2/11) night," The deadline is now clearer, the tasks are clearer but only Sanjay will deliver his work (which is unreadable due to a virus). Tom states: "Remember we have another deadline to meet this week - we need to send the report in tomorrow night ideally, so get your stuff to me asap." He receives no response and submits the second report: "I have submitted the report. Go to the web site to have a look. Some feedback and discussion on this assignment would facilitate a better end result. Look forward to hearing from you all and receiving some input." Only Ronan responds to this call by forwarding the material he has written. There is no interaction until the day prior to the third report (8/11) when Tom addresses each teammate individually asking Ronan to format his work following the template provided, addresses Sanjay: "Still hoping to receive your work sans virus!" and Asif: "Anything to add?" (Asif has been absent since 29/11 and did not participate again).

Tom is clearly unsatisfied with the quality of teammates' contributions: "I am not going to do all of this one [the main project] - this assignment requires some significant work and I don't see any evidence that we are on track to complete this satisfactorily. It's time to deliver some quality work guys!" The next day, without alerting the teammates he submits the progress report. Very limited interaction takes place before the next report. Mainly Tom feedback on others' work asking for more precision and evidence supporting the material presented. On 16/11 Tom files the last progress report. The weekly progress section reads: "Tom has done a pricing model and cash flow forecast. Tom has done risks section. Tom has done operations and manufacturing section." This report stirs Ronan's and Sanjay's reaction. Ronan: "I appreciate the effort you have put, and the leading role you have taken in but it seems from the report I have been shut out in spite of work done.... Executive Summary. I would, Tom, be able to help you with this element of the proposal if you sent me the latest draft." Sanjay: "I would also like to be more involved, atleast at this time with executive summary. I have done more on the technology part, but if you do not want it please let me know...." The lack of

trust that Tom has toward his teammates is apparent in his response: "...I have become so frustrated with the lack of input that I have pressed on by myself - I can't wait until the last moment each time reports and assignments are due. I have divided up the work and it hasn't happened... I saw your contribution to pricing etc., but this is supposed to be a business plan, requiring specifics; cash flow forecasts and detail on how the business will operate. I don't have time to run a discussion group on these issues - its either got to be top quality input first time that is thorough and detailed, or its quicker for me to do it myself...." Tom seems to hold higher standards for quality than his teammates yet no common standard was agreed upon and Tom never gave any explicit feedback in this realm. Moreover his frustration with the teammates seems to have been building throughout completion of the project and the weekly reports represent one of the sources of frustration. Each time a report came due and there was no action The team completes the project with Tom incorporating the work sent by his two teammates.

This case study confirms the pattern of trust decline of the other cases. Namely, as the team interacts there are one or more incidents in which expectations are unmet. In this case expectations about communication, work delivery and work quality are broken. The weekly reports seem to contribute to the occurrence of such incidents. They introduce two sources of friction. First the added work burden to the team. While the reports did not take much to complete, they still represented one more task that the team had to coordinate and cooperate on, and one more task to complete. The weekly report also had deadlines and often the team did not work ahead and found itself pressed to make decisions and file the report right before the deadline. This time pressure, and the different reaction that teammates had to it (urgency, phlegmatic, oblivion, etc) contributed to misunderstanding and broken promises and expectations that damaged trust as epitomized by Tom's comment: "I can't wait until the last moment each time reports and assignments are due."

### **Team 24: Treatment**

CSLC: 0.303 (17<sup>th</sup>); bizPlan: 0.708 (11<sup>st</sup>)

Trust 1: 2.688; Trust 2: 1.688

Total messages: 144; bizPlan Messages: 103; Chats Yes; No BB.

Dave: 27; Miriam: 20; Rhonda: 33; Steve : 23;

UCD, LSU, UCDenver; Massey

The early interaction in this team follows a familiar pattern with teammates introducing themselves and then not sending any messages until a week before the due date of the first project. Miriam, the most active member in this team, draws attention to the project first. She suggests that teammates email ideas by the following day and meet two days later in a chat session. None of the teammates volunteered ideas before the deadline but they focus on trying to set up the meeting. Once the deadline elapsed Miriam urged the team to: "email each other with our ideas and thoughts beforehand (asap), so that we at least know what everyone thinks" Only Dave provides substantive feedback and only Dave and Miriam make the first chat meeting. After the meeting Dave sends a message to the team outlining what he and Miriam agreed upon and how the team should proceed. A new chat meeting scheduled. The second chat meeting is attended by all teammates who agree to work on their assigned sections and meet again in three hours. Only Miriam and Steve make it back. Dave is at work and he is not expected but Rhonda, who had a medical emergency does not show up unexpectedly. This incident, occurring a day before the deadline, frustrates Miriam. The chat logs show her growing frustration: "I wonder where Rhonda is?" then: "Rhonda said that she was going to be here," Once Steve asks: "will you be sending the final version to the coordinator?" Miriam snaps: "No I won't be sending the final version to the co-ord as the summary and the conclusion are still not written " and later she adds: "I have put in more than my share, and virtual teams need everyone to pull their weight." After the chat session Miriam sees Rhonda's message and wishes her well. Once Rhonda returns she takes responsibility to turn the project in to the coordinator and she does so on time.

During the first exercise this team reported a below average trust score, slightly worse than team 19. Conversely though this team will recover and report one of the highest post-treatment trust scores. During the first project the pattern of missed deadlines, lack of timely delivery of work and confusion that characterize low trust team is apparent. Miriam's reaction to the incident involving Rhonda is indicative.

Miriam is once again the first to draw attention to the project. The team experiences some confusion early on and a schedule chat meeting fails. Miriam: "I feel as if I missed out on a mail message or something !!!" The project was be plagued by missed chat meetings until the team decided not to use the chat anymore at about the midpoint in the project. These missed meetings do not seem to affect the team though. The likely reason is that the team was spread across 17 time zones and Dave had suggested the concept of "rolling" meetings were teammates would connect as they came available. This concept never worked well but it had the benefit of training the team members to connect and, while doing other things, check back from time to time. Thus, the teammates did not seem to expect the meetings to be "all or none" and were not affected by the many missed engagements. Confirming the lack of negative effect of these missed meetings is one of Dave's comments: "I think we have done it again team. We have all missed each other by an hour. Steve appears to have gone in an hour after me. Rhonda has gone in two hours after me"

As the first report came available, Dave, who had suggested that Miriam take care of it states: "I will have a go at the report based on what I beleive we should do and then post it on the file exchange for you all to look at prior to sending it to Emmet. [the coordinator]" This exchange is very important. Dave takes responsibility to do the report (rather that wait for consensus or call for a meeting) but he is also sensitive to other's reaction and builds a fail-safe system that allows for teammates input. Some confusion arises as to who is to submit the report. As a consequence the report is submitted three times by Dave, Steve and then Rhonda. Rhonda, who had been missing for seven days due to the same family medical



emergency that kept her away during the preliminary project, returns. She explains in detail the reason for her absence and concludes: "Anyway, I'm back. Now I have to catchup on the tons of email." She immediately addresses all outstanding issues rapidly sending more messages to the team. Miriam provides a division of labor and she takes responsibility for the next weekly report asking Rhonda and Steve to take responsibility for the other two. It is interesting to note that Miriam assigns tasks to subgroups rather than individuals.

Miriam took responsibility for the second report but she requested input from Rhonda and Steve regarding their short term tasks for the week. Even though she did not receive an answer by the end of the day she filed the report and advised Rhonda to modify it as needed. She did the next day. This team was very cohesive, but was not paralyzed by inaction. A case in point is the fact that Miriam filed the report before receiving what requested from Rhonda. Another is the fact that the first report was submitted three times when different members were unsure whether it had already been done.

By virtue of having split the work in subgroups, there is very little interaction recorded in the team distribution list as the subgroups work independently through private email messages. Nonetheless the subgroups coordinate and update each other periodically. Miriam: "We have completed the first few sections and we are meeting on Monday nite to discuss some ideas. Please feel free to comment on what we have prepared so far. If you feel that we have omitted something just let us know.... How is the other half of the project going ?" Steve provided substantive feedback and Rhonda commented: "Miriam, you guys did a good job. I'm working on ours. I'll email it to you in the morning " As the third report came due Steve stated: "as far as the weekly report goes, i will get it together this afternoon and send it off." And later: "hey you guys. i just sent the weekly report off to the coordinator.... it is sent and in on time." Rhonda filed the fourth report on time also. There are a few more days with no interaction when the subgroups seem to work independently and other instances in which they coordinate across subgroups. Finally the team comes together for final revisions and editing. In the

last two days of the project the team members exchange 23 messages and all are involved. Rhonda filed the project with the coordinator and the team disbands after congratulating and complimenting each other profusely.

This team was characterized by four very active team members. Miriam took on the role of the shepherd and helped structure the work a bit. Some potential incidents did happen in this team but had no effect. Particularly Rhonda's absence for a week. It appears that it did not have a great impact for several reasons. First, the team was in the early stages of project and there were no work assignments missing. When the report came due the team was able to move forward and, even though they kept Rhonda in the loop, and queried her repeatedly her absence did not paralyze them. When she came back she had a very valid reason for her absence and also she went through all messages and replied or addressed all outstanding issues. Thus she likely restored teammates' confidence in her while getting up to speed so she was no drag later on. She instead was very active and proficient member.

The reports did not cause any trouble for this team. The team split them but all members were aware of deadline and constantly on the ball. The first report was submitted three times because of misunderstandings, not skipped all together as in other teams. Also, once the reports were split the responsible persons did them without the need to be reminded. When reminded they confirmed immediately, with the exception of Rhonda.

## **APPENDIX 3 - PRELIMINARY SURVEY**

# Virtual Team exercise (VTe) Entry Form

Welcome to the Virtual Team exercise! Before we begin the exercise it is important that you complete the following questionnaire. The questionnaire is designed to collect information regarding your background, experience, and interests. It will help us creating the teams for the exercise.

This is the first of three surveys that we will ask you to complete throughout the duration of the exercise. Each survey requires about 15 minutes of your time. Your responses and feedback are important to us and they will help us improve the exercise. The Virtual Team exercise is also part of a study of virtual team dynamics that will help us further our understanding of this new organizational form.

All information that you provide will be strictly confidential and your course instructor will not have any access to it. No information will be associated with your name and any results will be reported only in aggregate form.

If you have any questions or concerns regarding this survey please contact the exercise coordinator at: VTeCoordinator@isds.bus.lsu.edu

Thank you for taking the time to fill this form and we hope you will have great fun participating in the Virtual Team exercise.

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## Identifying Information

1) First Name (Given name)

2) Last Name (Surname)

3) Please type the email address you will be using during the exercise.

4) What university are you attending?

5) What is your country of origin?

## Background Information

6) What is your academic classification?

If you selected other please specify:

7) What is your major field of study?

If you selected other please specify:

8) What is your gender?

☐ Female

☐ Male

9) In what year were you born?

10) For how long have you been employed full time? (please, report the total number of months in any full time position you have held to date).

## Team Experience

In this section we are interested in your experience working in teams

11) To this date, how many work teams have you been a member of? (in your estimate please include all teams you have been on whether at work or as part of a class, but exclude sports teams).

12) Did you ever receive any formal project management training?

☐ No

☐ Yes

13) To this date, how many team projects have you managed?

14) A virtual team is a group of people that are jointly responsible for completion of a project but are not all physically at the same

☐ No

☐ Yes

## Technology Experience

In this section we would like you to indicate your familiarity with communication technologies. Please, indicate how you would rate your knowledge of the following software applications

15) Personal Computer

16) Electronic Mail

17) Electronic Mailing List (also known as electronic distribution lists or Listserv)

18) Electronic Bulletin Boards (also known as newsgroups, electronic conferences, threaded discussions)

19) Electronic Chats (also known as online chatrooms)

20) File Transfer Protocol (also known as file exchange software)

21) Web Browsers (e.g. Netscape, Internet Explorer)

## Attitudes toward Information Technology

Please, indicate your level of agreement or disagreement with the following statements.

22) Computers make work more interesting

23) Working with computers is fun

24) Working with computers is so complicated it is difficult to understand what is going on

25) It takes too long to learn how to use computers to make it worth the effort

26) I believe that computers can be valuable tools in many aspects of my life

## New Technology

Often virtual teams decide to adopt software applications that some members are not yet familiar with. For the following questions, imagine that you were given a new software package, one that you have never used before, to communicate with your virtual team.

## I COULD USE THE SOFTWARE APPLICATION EFFECTIVELY...

27) ... if there was no one around to tell me what to do as I go.

28) ... if I had never used a package like it before.

29) ... if I could call someone for help if I got stuck.

30) ... if someone showed me how to do it first.

31) ... if I had used similar packages before this one to do the same job

## Expectations for the Virtual Team exercise

In this section we would like you to indicate your general expectations for the Virtual Team exercise

32) This exercise will be a valuable learning experience for me

33) I am excited about the opportunity to work with people around the globe

34) I will have no problems communicating effectively with my teammates even though we can not meet face-to-face

35) I expect to communicate with my teammates at least:

## Comments

36) Please, let us know any comment, concern or question you have regarding the Virtual Team exercise (VTe).

		▲
		▼
◀		▶

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**Thank you for completing this survey! Please, click the **Submit Survey** button. If submission is successful you should automatically be returned to the Virtual Team exercise web site.**

**Submit Survey**

**Clear all answers**

This survey was produced with WebSurveyor.

## **APPENDIX 4 - SECOND SURVEY**



# Intermediate VTe Survey

As you have had a chance to work in a virtual team for some time now we would like to gather some feedback on your experience. This questionnaire will take approximately 15 minutes of your time.

Please, read all questions carefully, this is not a test and there are no right or wrong answers, we are simply interested in your opinions. The information that you provide is stored at Louisiana State University and your course instructor will not have access to it. He will only be notified that you completed the survey to ensure that all VTe participants complete the questionnaire.

If you have any questions or concerns regarding this survey please contact the exercise coordinator at: VTeCoordinator@isds.bus.lsu.edu

Thank you for taking the time to fill out this survey.

---

## Participant Information

1) What Virtual Team are you a member of?

2) Please type the email address you have been using during the exercise.

3) Please type your VTe User Name (i.e. the one you use to log on to the communication hub).

4) Approximately how many hours did you devote to the Customer Service Life Cycle project?

 hours

5) Before this project, have you ever been a member of a virtual team?

☐ No

☐ Yes

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The following questions ask for your assessment of your virtual team experience during completion of the Customer Service Life Cycle (CSLC) project. When answering, please think of the CSLC project that your virtual team completed during the past two weeks.

Please, select the option that best describes your level of agreement with the opinion stated by clicking the corresponding button. A black dot should appear once you select an option.

	Strongly Agree	Agree	Slightly Agree	Undecided	Slightly Disagree	Disagree	Strongly Disagree
6) I enjoyed working with the members of my team	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
7) Each team member contributed his/her fair share	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
8) The time I spent on the CSLC project was time wasted	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
9) I am very proud of my team's CSLC report	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
10) I could not wait for the CSLC project to be over	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
11) I enjoyed working on the CSLC project	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
12) I will enjoy working with these team members again	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
13) During the CSLC project, the activities of the team members were coherent (they were logically connected, not fragmented).	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

The following questions ask for your assessment of planning and coordination activities in your virtual team during completion of the Customer Service Life Cycle (CSLC) project. Please, when answering, think of the CSLC project that your virtual team completed during the past two weeks.

Please, select the option that best describes your level of agreement with the opinion stated by clicking the corresponding button. A black dot should appear once you select an option.

	Strongly Agree	Agree	Slightly Agree	Undecided	Slightly Disagree	Disagree	Strongly Disagree
14) Planning of activities in my team was well conceived during the CSLC project	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
15) My team had a clear sense of direction during the CSLC project	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
16) My team found it difficult to reach decisions during the CSLC project	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
17) During the CSLC project, my teammates and I often did not know who was responsible to complete specific tasks	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
18) During the CSLC project, my team was well organized	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
19) During the CSLC project I always knew what I was supposed to do	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
20) My teammates and I had difficulty coordinating our work	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
21) I am satisfied with the procedures that my team used to communicate	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

The following questions ask for your assessment of communication activities in your virtual team during completion of the Customer Service Life Cycle (CSLC) project.

During the Customer Service Life Cycle (CSLC) project, to what extent was the information that you received from your teammates usually ...

	Teammate2	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	Teammate3	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
58) This teammate provides team members with valuable feedback	Teammate1	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	Teammate2	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	Teammate3	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
61) This teammate provides team members with constructive criticism	Teammate1	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	Teammate2	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	Teammate3	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
64) This teammate accepts constructive criticism	Teammate1	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	Teammate2	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	Teammate3	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
67) Overall this teammate contributed substantially to the team during the CSLC project	Teammate1	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	Teammate2	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	Teammate3	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

- 70) Overall I would evaluate teammate 1 as a(n)   Excellent virtual team member  
Very good virtual team member  
Good virtual team member  
Adequate virtual team member  
Mediocre virtual team member  
Poor virtual team member  
Inept virtual team member
- 71) Overall I would evaluate teammate 2 as a(n)   Excellent virtual team member  
Very good virtual team member  
Good virtual team member  
Adequate virtual team member  
Mediocre virtual team member  
Poor virtual team member  
Inept virtual team member
- 72) Overall I would evaluate teammate 3 as a(n)   Excellent virtual team member  
Very good virtual team member  
Good virtual team member  
Adequate virtual team member  
Mediocre virtual team member  
Poor virtual team member  
Inept virtual team member
- 73) How would you describe leadership on your team?   A strong leader emerged  
A strong leader was formally appointed  
A weak leader emerged  
A weak leader was formally appointed  
We had different leaders at different times  
We had no leadership  
Other
- 74) Please, type here any specific comments about your teammates and their participation in the CSLC project

The following questions are intended to assess communication frequency in your virtual team during completion of the Customer Service Life Cycle (CSLC) project.

Please, select from the drop down menu the option that best describes your assessment. Again, there are no right or wrong answers, we are interested in your honest assessment.

During the completion of the CSLC project, with what frequency (on average) did you do the following?

Please, for each of your teammates complete the following evaluation form. Focus on your teammates' contribution during the Customer Service Life Cycle (CSLC) project.

Type the name of each member once in the space provided. We will then refer to them as teammate1, teammate2 and teammate3. **Do not fill an evaluation for yourself.** Please, keep in mind that your evaluation is anonymous and your name will not be associated with it. All evaluations for each team member will be aggregated and provided to the respective course instructors.

34) Teammate1: Please, type his or her name

35) Teammate2: Please, type his or her name

36) Teammate3: Please, type his or her name (Skip if you only have 2 teammates)

		Strongly Agree	Agree	Slightly Agree	Undecided	Slightly Disagree	Disagree	Strongly Disagree
37) This teammate produces high quality work	Teammate1	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	Teammate2	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	Teammate3	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
40) This teammate has initiative and contributes actively to the team	Teammate1	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	Teammate2	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	Teammate3	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
43) This teammate is able to assume a leadership role when needed	Teammate1	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	Teammate2	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	Teammate3	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
46) This teammate is able to effectively self-manage	Teammate1	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	Teammate2	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	Teammate3	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
49) This teammate is very dependable	Teammate1	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	Teammate2	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	Teammate3	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
52) This teammate communicates well using the technology available to the team	Teammate1	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	Teammate2	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	Teammate3	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
		Strongly Agree	Agree	Slightly Agree	Undecided	Slightly Disagree	Disagree	Strongly Disagree
55) This teammate is willing to adopt new technology needed for teamwork.	Teammate1	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

	To a very great extent	To a great extent	To some extent	To a little extent	To a very little extent
22) ... timely (you got information when you needed it - not too early or too late)?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
23) ... accurate (you could rely on the information - it was generally correct)?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
24) ... useful (you could use the information in your work)?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

The following questions ask for your assessment of your team's cohesiveness during completion of the Customer Service Life Cycle (CSLC) project. Please, when answering, think of the CSLC project that your virtual team completed during the past two weeks.

Please, select from the drop down menu the option that best describes your feelings and opinions. Again, there are no right or wrong answers, we are interested in your honest assessment.

25) During the CSLC project, did you feel that you were really a part of your team?

I felt really a part of my team  
I felt included in most ways  
I felt included in some ways but not other  
I did not feel I really belonged too much  
I did not feel I belonged at all

26) If you had a chance to do the same kind of work in another virtual team, how would you feel about switching team?

I would want very much to stay where I am    
I would rather stay where I am than move    
It would make no difference to me    
I would rather move than stay where I am    
I would want very much to move

The following questions ask for your assessment of your virtual team compared to others that you are familiar with.

Please, select the option that best describes your assessment by clicking the corresponding button.

On each of the following characteristics, how does your virtual team compare with other teams (virtual or not virtual) that you have been a member of or that you are familiar with.

	Very much better	Better than most	About the same	Worse than most	Very much worse
27) The way people get along together	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
28) The way people work together	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
29) The way people help each other	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

The following questions ask for your assessment of the level of trust among the members of your virtual team during completion of the Customer Service Life Cycle (CSLC) project.

Please, select the option that best describes your level of agreement with the opinion stated by clicking the corresponding button. A black dot should appear once you select an option.

	Strongly Agree	Agree	Slightly Agree	Undecided	Slightly Disagree	Disagree	Strongly Disagree
30) Overall the people in my team were very trustworthy during the CSLC project	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
31) Members of my team were usually considerate of one another's feelings during the CSLC project	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
32) The people in my team were friendly during the CSLC project	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
33) I could rely on those with whom I worked in my team during the CSLC project	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

75) Sent email messages to <i>individual</i> teammates	More than once a day ▾
76) Sent email messages to multiple team members using their personal email address	Once a day ▾
77) Sent email messages to all team members (to the team as a whole) using the team's distribution list (either through the communication hub or by addressing your message to vteXX@cvoc.bus.lsu.edu, where XX is your team number)	About once every two days ▾
78) Posted messages to your team's discussion board (team's bulletin board)	About once every three days ▾
79) Had chat sessions with your team	About once every five days ▾
80) Telephoned a teammate (or teammates)	About once per week ▾
81) Sent a fax to a teammate (or teammates)	Less than once per week ▾
82) Communicated with teammates using any other means (please specify in the comments field below)	Never ▾
Additional Comments: <input type="text"/>	

The following questions are intended to assess communication tools selection in your virtual team during completion of the Customer Service Life Cycle (CSLC) project.

Please, select from the drop down menu the option that best describes your assessment. Please, indicate what percentage of your team's communication was done through the following communication technologies:

83) Person-to-person electronic mail (this category represents messages sent to <i>individual</i> team members)	0% ▾
84) Email messages to multiple team members (using their email address)	5% ▾
85) Teams distribution list. This category represents messages sent to the team as a whole using the team's distribution list (either through the communication hub or by addressing your message to vteXX@cvoc.bus.lsu.edu, where XX is your team number)	10% ▾
86) Bulletin board (this category represents messages posted to your team's discussion board )	40% ▾
87) Chat	70% ▾
88) Telephone	90% ▾
89) Fax	95% ▾
90) Any other means (please, specify percentage of use, )	100% ▾
What other communication media did you use (if any)? <input type="text"/>	

Please, let us know any comment, concern or question you have at this stage regarding the Virtual Team exercise.

Thank you for completing this survey! Please, click the **Submit Survey** button. If submission is successful you should automatically be returned to the Virtual Team exercise web site.

**Submit Survey**

**Clear all answers**

This survey was produced with WebSurveyor.

## **APPENDIX 5 - THIRD SURVEY**



## VTe Final Evaluation

You have now completed your experience in a virtual team. As you reflect on this experience, we would like to gather some feedback on your experience. This questionnaire will take approximately 15 minutes of your time.

Please, read all questions carefully, this is not a test and there are no right or wrong answers, we are simply interested in your opinions. The information that you provide is stored at Louisiana State University and your course instructor will not have access to it. He will only be notified that you completed the survey to ensure that all VTe participants complete the questionnaire.

If you have any questions or concerns regarding this survey please contact the exercise coordinator at: VTeCoordinator@isds.bus.lsu.edu

Thank you for taking the time to fill out this survey.

---

### Participant Information

1) What Virtual Team were you a member of during the VTe?

2) Please type the email address you have been using during the exercise.

3) Please type your VTe User Name (i.e. the one you use to log on to the communication hub).

4) Approximately how many hours did you devote to the VTe Business Plan project?

---

The following questions ask for your assessment of your virtual team experience during completion of the Business Plan project (*not the Customer Service Life Cycle project*). When answering, please think of the Business Plan project that your virtual team completed during the past four weeks.

Please, select the option that best describes your level of agreement with the opinion stated by clicking the corresponding button. A black dot should appear once you select an option.

	Strongly Agree	Agree	Slightly Agree	Undecided	Slightly Disagree	Disagree	Strongly Disagree
5) I enjoyed working with the members of my team	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
6) Each team member contributed his/her fair share	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
7) The time I spent on the business plan project was time wasted	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
8) I am very proud of the business plan project	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
9) I could not wait for the business plan project to be over	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
10) I enjoyed working on the business plan project	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
11) I would enjoy working with these team members again	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
12) In my team, during the business plan project, the activities of the team members were coherent (they were logically connected, not fragmented).	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

The following questions ask for your assessment of planning and coordination activities in your virtual team during completion of the Business Plan project. Please, when answering, think of the Business Plan project that your virtual team completed during the past four weeks.

Please, select the option that best describes your level of agreement with the opinion stated by clicking the corresponding button. A black dot should appear once you select an option.

	Strongly Agree	Agree	Slightly Agree	Undecided	Slightly Disagree	Disagree	Strongly Disagree
13) Planning of activities in my team was well conceived during the business plan project.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
14) My team had a clear sense of direction during the business plan project	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
15) My team found it difficult to reach decisions during the business plan project	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
16) During the business plan project, my teammates and I often did not know who was responsible to complete specific tasks	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
17) Interaction in my team was well organized during the business plan project	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
18) During the business plan project I always knew what I was supposed to do	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
19) My teammates and I had difficulty coordinating our work during the business plan project	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
20) I am satisfied with the procedures that my team used to communicate during the business plan project	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

The following questions ask for your assessment of communication activities in your virtual team during completion of the Business Plan project.

During the Business Plan project, to what extent was the information that you received from your teammates usually ...

	To a very great extent	To a great extent	To some extent	To a little extent	To a very little extent
21) Timely (you got information when you needed it - not too early or too late).	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
22) Accurate (you could rely on the information - it was generally correct).	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
23) Useful (you could use the information in your work).	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

The following questions ask for your assessment of your team's cohesiveness during completion of the Business Plan project. Please, when answering, think of the Business Plan project that your virtual team completed during the past four weeks.

Please, select from the drop down menu the option that best describes your feelings and opinions. Again, there are no right or wrong answers, we are interested in your honest assessment.

24) During the business plan project, did you feel that you were really a part of your team?

I felt really a part of my team

I felt included in most ways

25) If you had a chance to do the same kind of work in another student virtual team, would you want to move (upon completion of the business plan exercise)?

☐ I would want very much to stay where I am

I felt included in some ways but not other

I did not feel I really belonged too much

I did not feel I belonged at all

☐ I would rather stay where I am than move

It would make no difference to me

☐ I would rather move than stay where I am

☐ I would want very much to move

The following questions ask you to compare your virtual team to others that you are familiar with.

Please, select the option that best describes your assessment by clicking the corresponding button.

On each of the following characteristics, how does your virtual team compare with other teams (virtual or not virtual) that you have been a member of or that you are familiar with.

	Very much better	Better than most	About the same	Worse than most	Very much worse
26) The way people get along together	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
27) The way people work together	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
28) The way people help each other	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

The following questions ask for your assessment of the level of trust among the members of your virtual team during completion of the Business Plan project.

Please, select the option that best describes your level of agreement with the opinion stated by clicking the corresponding button. A black dot should appear once you select an option.

	Strongly Agree	Agree	Slightly Agree	Undecided	Slightly Disagree	Disagree	Strongly Disagree
29) Overall the people in my team were very trustworthy during the business plan project	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
30) Members of my team were usually considerate of one another's feelings during the business plan project	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
31) The people in my team were friendly during the business plan project	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
32) I could rely on those with whom I worked in my team during the business plan project	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Please, for each of your teammates complete the following evaluation form. Focus on your teammates' contribution during the Business Plan project.

Type the name of each member once in the space provided. We will then refer to them as teammate1, teammate2 and teammate3. **Do not fill an evaluation for yourself.** Please, keep in mind that your evaluation is anonymous and your name will not be associated with it. All evaluations for each team member will be aggregated and provided to the respective course instructors.

33) Teammate 1: Please, type his or her name

34) Teammate 2: Please, type his or her name

35) Teammate 3: Please, type his or her name (Skip if you only have 2 teammates)

		Strongly Agree	Agree	Slightly Agree	Undecided	Slightly Disagree	Disagree	Strongly Disagree
36) This teammate produces high quality work	Teammate1	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	Teammate2	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	Teammate3	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
39) This teammate has initiative and contributes actively to the team	Teammate1	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	Teammate2	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	Teammate3	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
42) This teammate is able to assume a leadership role when needed	Teammate1	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	Teammate2	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	Teammate3	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
45) This teammate is able to effectively self-manage	Teammate1	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	Teammate2	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	Teammate3	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
48) This teammate is very dependable	Teammate1	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Please, indicate what percentage of your team's communication was done through the following communication technologies:

83) Person-to-person electronic mail (this category represents messages sent to individual team members)	0% ▼
84) Email messages to multiple team members (using their email address)	5% ▼
85) Teams distribution list. This category represents messages sent to the team as a whole using the team's distribution list (either through the communication hub or by addressing your message to vteXX@cvoc.bus.lsu.edu, where XX is your team number)	10% ▼
86) Bulletin board (this category represents messages posted to your team's discussion board)	40% ▼
87) Chat	70% ▼
88) Telephone	90% ▼
89) Fax	95% ▼
90) Any other means (please, specify percentage of use)	100% ▼
What other communication media did you use (if any)?: <input type="text"/>	

This last section is intended to gather information about how your team organized its work during completion of the Business Plan project.

Please, respond to the following questions by clicking on the appropriate button:

91) My team was required to submit weekly reports to the bizPlan liaison.

- ☐ No  
☐ Yes

	Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree
92) My team planned its future tasks on a regular basis during the Business Plan project (i.e. since the beginning of the Business Plan project, not only toward the end of it).	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
93) My team reviewed its progress toward attainment of team goals on a regular basis. (i.e. since the beginning of the Business Plan project, not only toward the end of it).	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
94) My team formally assigned specific tasks to individual team members on a regular basis. (i.e. since the beginning of the Business Plan project, not only toward the end of it).	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Please, let us know any general comment or suggestions you have regarding the Virtual Team exercise.

<input type="text"/>	▲
<input type="text"/>	▼
<input type="text"/>	▶

72) Points allocated to Teammate 3:

Provide any comments regarding Teammate 3's contribution:

73) How would you describe leadership on your team during completion of the business plan project?

If a leader emerged, please type his or her name:

- A strong leader emerged
- A strong leader was formally appointed
- A weak leader emerged
- A weak leader was formally appointed
- We had different leaders at different times
- We had no leadership
- Other - their participation in the business plan project

74) Please, type here any specific comments about your teammate's participation in the business plan project

The following questions are intended to assess communication frequency in your virtual team during completion of the Business Plan project.

Please, select from the drop down menu the option that best describes your assessment. Again, there are no right or wrong answers, we are interested in your honest assessment.

During the completion of the Business Plan project, with what frequency (on average) did you do the following?

75) Sent email messages to <i>individual</i> teammates	More than once a day
76) Sent email messages to multiple team members using their personal email address	Once a day
77) Sent email messages to all team members (to the team as a whole) using the team's distribution list (either through the communication hub or by addressing your message to vteXX@cvoc.bus.lsu.edu, where XX is your team number)	About once every two day
78) Posted messages to your team's discussion board (team's bulletin board)	About once every three day
79) Had chat sessions with your team	About once every five days
80) Telephoned a teammate (or teammates)	About once per week
81) Sent a fax to a teammate (or teammates)	Less than once per week
82) Communicated with teammates using any other means (please specify in the comments field below)	Never
Additional Comments: <input type="text"/>	

The following questions are intended to assess communication tools selection in your virtual team during completion of the Business Plan project.

Please, select from the drop down menu the option that best describes your assessment.

Please, indicate what percentage of your team's communication was done through the following communication technologies:

83) Person-to-person electronic mail (this category represents messages sent to individual team members)	0% ▾
84) Email messages to multiple team members (using their email address)	5% ▾
85) Teams distribution list. This category represents messages sent to the team as a whole using the team's distribution list (either through the communication hub or by addressing your message to vteXX@cvc.bus.lsu.edu, where XX is your team number)	10% ▾
86) Bulletin board (this category represents messages posted to your team's discussion board)	40% ▾
87) Chat	70% ▾
88) Telephone	90% ▾
89) Fax	95% ▾
90) Any other means (please, specify percentage of use)	100% ▾
What other communication media did you use (if any)?: <div style="border: 1px solid black; height: 15px; width: 280px;"></div>	

This last section is intended to gather information about how your team organized its work during completion of the Business Plan project.

Please, respond to the following questions by clicking on the appropriate button:

91) My team was required to submit weekly reports to the bizPlan liaison.

- ☐ No  
☐ Yes

	Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree
92) My team planned its future tasks on a regular basis during the Business Plan project (i.e. since the beginning of the Business Plan project, not only toward the end of it).	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
93) My team reviewed its progress toward attainment of team goals on a regular basis. (i.e. since the beginning of the Business Plan project, not only toward the end of it).	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
94) My team formally assigned specific tasks to individual team members on a regular basis. (i.e. since the beginning of the Business Plan project, not only toward the end of it).	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Please, let us know any general comment or suggestions you have regarding the Virtual Team exercise.

Thank you for completing this survey! Please, click the Submit Survey button. If submission is successful you should automatically be returned to the Virtual Team exercise web site.

**Submit Survey**

**Clear all answers**

This survey was produced with WebSurveyor.



## **VITA**

Gabriele Piccoli received his bachelor degree in Italy from Università di Pavia. He received his degree, Laurea in Economia e Commercio, with a double major in economics and business administration. His senior thesis, titled *Positive Accounting Theory and the Information Content of Net Income: the Case of the Milan Stock Exchange*, investigated the relationship between the stock market's reaction to the announcement of net income by traded companies.

During completion of the requirements for the doctorate, Gabriele also completed the requirements for the degree of Master of Business Administration. He concentrated in Management Information Systems.

Gabriele's current research interests revolve around advanced information technology, in particular Internet technologies. He is pursuing research projects on virtual teams, electronic commerce, and Internet based training. He will receive the degree of Doctor of Philosophy in Business Administration in August 2000.


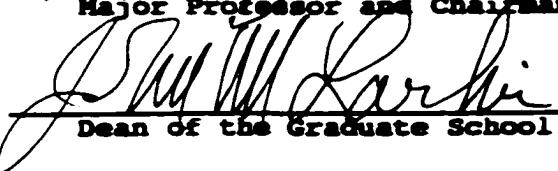
# DOCTORAL EXAMINATION AND DISSERTATION REPORT

**Candidate:** Gabriele Piccoli




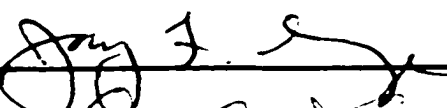

**Major Field:** Business Administration  
(Information Systems and Decision Sciences)

**Title of Dissertation:** Virtual Teams: An Investigation of the Determinants  
of Team Effectiveness and the Contribution of  
Managerial Behavior Control

**Approved:**

  
Major Professor and Chairman  
  
Dean of the Graduate School

## EXAMINING COMMITTEE:

**Date of Examination:**

15 May 2000