

**UNDERSTANDING VIRTUAL TEAM EFFECTIVENESS:  
AN EXPLORATION**

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## ABSTRACT

Virtual teams, which are comprised of individuals who collaborate without being in the same place at the same time, are receiving increased attention in the literature. This thesis responds to frequent appeals for field-based research that is specifically designed for virtual teams by studying 30 intact virtual teams in a Canadian telecommunications company. This thesis had four objectives: to develop a measure of degree of virtuality and explore its role in virtual team effectiveness; to develop measures of support of virtual teams; to investigate and quantify the construct of virtual team effectiveness; and to develop models to be used for future research.

This research indicates that the virtuality of teams can be quantified as a continuum and that teams of varying degrees of virtuality do operate effectively in industry. Further, degree of virtuality was found to be negatively associated with virtual team effectiveness. It was also determined that the behaviours of organizations and managers are associated with virtual team effectiveness: the supportive behaviours were positively associated and the non-supportive behaviours were negatively associated. The measures of managerial and organizational support/non-support of virtual teams developed in this study were both reliable and valid.

The results for the five types of effectiveness examined in this study indicate that virtual teams have measurable outcomes that are different from those of proximate teams and that different aspects of virtual team effectiveness should be described using different types of models. An IPO framework was found to best describe the links between virtual

team inputs, processes and two of the measures - members' perceptions of performance and member satisfaction. A third measure, VT managers' perceptions of performance, was also found to be described, to a lesser degree, by an IPO framework. An IO framework was found to best describe the remaining two dimensions of virtual team effectiveness – members' perceptions of their professional development and their capacity for future virtual teamwork.

This thesis contributes to the literature by providing a better understanding of virtual teams, their support, and their effectiveness, and provides models for different dimensions of virtual team effectiveness which can be tested in future research.

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## **1 INTRODUCTION**

Changing societal, technological, and economic trends have fundamentally affected both the nature and form of organizations (Bal & Teo, 2001; Carletta, Anderson, & McEwan, 2000; Joy-Matthews & Gladstone, 2000; Kayworth & Leidner, 2000; Lurey & Raisinghani, 2001). An increasingly diverse workforce, changing family forms, shifting motivational priorities, rapid advances in technology, the expanding knowledge base, an increase in specialization, and the rise of the knowledge worker, have affected the structure of work, the nature of work, and work relationships. In addition, fierce competition, market volatility, specialization, and customization require a responsiveness and closeness to the customer that can be difficult to achieve using conventional organizational models (Fulk & Desanctis, 1995; Henry & Hartzler, 1997; Mohrman, Cohen & Mohrman, 1995; Tjosvold, 1991). As technology advances and knowledge becomes more specialized, it becomes increasingly difficult for individuals and management to gather and represent the diverse collective knowledge and skills of the organization.

In response, organizations are striving to become flatter, more flexible, more versatile, more responsive, and team-oriented (Kayworth & Leidner, 2002; Lurey & Raisinghani, 2001). Modern organizations are becoming more and more dependent on the diverse, specialized, and unique experience, expertise and knowledge of their members.

Increasingly complex situations require a combination and variety of specialized

expertise and skills, which in turn, necessitate interdisciplinary collaboration and interaction (Cooley, 1994).

The use of teams as a means of dealing with these changes, as well as enhancing creativity, effectiveness, decision-making quality, and innovativeness, has become widespread (Cohen & Gibson, 2003; Tjosvold, 1991; Townsend, DeMarie, & Hendrickson, 1996). Organizational teams and groups go by many labels, including work teams, work groups, task groups, parallel teams, quality circles, project teams, project groups, cross-functional teams, management teams, etc. Such “groupings” have become a standard means of organizing (Keller, 1986), and have become “the basic building blocks of excellent companies” (Peters & Waterman, 1982: p. 126). The subject of organizational teams and groups has garnered a significant amount of attention from both the academic and business environment. The academic journals and practitioner press both emphasize the importance of teams for success in the modern economy (Cohen & Bailey, 1997) and much research has been undertaken to determine the elements affecting team performance in organizations.

In light of their increased reliance on experience and expertise, modern organizations face the additional challenge of leveraging their organizational knowledge and maintaining regional visibility without constantly relocating and potentially losing key employees (Henry and Hartzler, 1997). The global market necessitates “tapping the best brains [for the job], no matter where those brains may be” (Geber, 1995: p.36).

Fortunately, advances in information systems and communication technology have also provided organizations with new options for organizing. *Virtual teams* (VTs) are a burgeoning form of organization that allows teams to be composed according to qualifications and expertise, without the limitations of time, space, and the costs and disruptions of relocation (Geber, 1995; Townsend et al., 1996). A universal definition of virtual teams has yet to be established but there seems to be some agreement that virtual teams are primarily teams that do not share a common workspace all of the time, and must often collaborate using communication and collaboration tools such as email, video-conferencing, etc.

Virtual teams can take many forms, including task forces, project teams, etc., with members who do not work out of a common office-space and therefore must rely heavily on technology for communication (Henry & Hartzler, 1997). Although statistics on the exact number of virtual teams currently in existence are unavailable (Cascio & Shurygailo, 2003), a study commissioned by WorldCom in 2001, reports that 61 percent of employees in large companies have worked on virtual teams (Worldcom, 2001). Furst, Reeves, Rosen, and Blackburn (2004) noted that in the United States, 8.4 million employees are estimated to work in virtual teams or groups. The use of virtual teams can only be expected to increase with corporate globalization, partnerships and joint ventures and technological complexity requiring specialization (Henry & Hartzler, 1997). The Gartner Group predicted that 60% of the professional workforce will work in virtual

teams (Kanawattanachai & Yoo, 2002). Unfortunately, the Gartner Group also estimated that 50% of virtual teams will fail due to the lack of management knowledge and expertise (Kanawattanachai & Yoo, 2002).

As collaborative systems, virtual teams would be expected to experience much of the same challenges as traditional (i.e. co-located or proximate) teams, with the added complications of long-distance management, alternate methods of communication and limited face-to-face interaction. The application of proximate team approaches and attitudes to virtual teams may also result in greater discord. Such a scenario is likely, as few organizations employing virtual teams “have addressed virtual management skills” (Griffith & Neale, 2001: p.381), despite their growing popularity.

The benefits of virtual teams are purported to exist at many levels. At the organizational level, oft-cited benefits of virtual teams include increased flexibility and responsiveness (Furst, Blackburn & Rosen, 1999; Henry & Hartzler, 1997; Lipnack & Stamps, 1999; Pauleen & Yoong, 2001; Potter, Balthazard & Cooke, 2001; Ratcheva & Vyakarnam, 2001; Solomon, 2001; Townsend, DeMarie & Hendrickson, 1998). Team members can be stationed throughout the globe, ensuring local presence and corporate collaboration (Van der Smagt, 2000). Virtual teams can be created relatively quickly, as the organization does not have to worry about the commitment of re-location or extensive travel (Lurey & Raisinghani, 2001; Solomon, 2001). Costs can be cut through reductions in travel, re-locations, and office-space (Cascio, 2000; Johnson, Heimann & O’Neill,

2001; Lurey & Raisinghani, 2001; Ratcheva & Vayakarnam, 2001; Robey, Schwaig & Jin, 2003; Solomon, 2001; Townsend et al., 1998; Van der Smagt, 2000).

In addition to the above, virtual team work, interactions, and processes that are performed electronically are more likely to be “captured”, which could enhance organizational knowledge and learning. Expertise can also be harnessed from anywhere in the world, allowing for recruitment of the best candidates, exclusive of their location (Cascio, 2000; Geber, 1995; Henry & Hartzler, 1997; Johnson et al., 2001; Robey et al., 2003; Solomon, 2001; Townsend et al., 1998). This ability to recruit the best is believed to result in higher quality outputs.

At the individual level, the cited benefits of virtual team work include both personal and professional aspects. Professionally, virtual teams allow members to choose projects of interest, regardless of where the projects are being done, provide the opportunity to work with experts that would otherwise not have been available, and improve efficiency by reducing time for travel/commuting (Johnson et al., 2001; Van der Smagt, 2000).

Personally, virtual teams have the potential to improve work-life balance (Cascio, 2000; Johnson et al., 2001) by reducing the time spent on travel, allowing work to be done anywhere, anytime, and reducing the need for re-location. Finally, virtual teams provide a potential benefit to society by reducing car emissions and travel (Cascio, 2000; Johnson et al., 2001; Robey et al., 2003).

One of the most commonly cited disadvantages of virtual teams is the lack of physical interaction among team members (Cascio, 2000), which may result in difficulties in relationship building, low levels of trust, lack of cohesion, and less effective communication (Warkentin, Sayeed & Hightower, 1997). Other disadvantages of virtual teams include the costs of setting up remote offices (Robey et al., 2003), a lack of managerial control of outcomes, differences in culture and work habits, logistic difficulties of working across time zones (Boutellier, Gassman, Macho, & Roux, 1998), professional stagnation due to an “out of sight out of mind” attitude (Furst et al., 1999), and individual feelings of isolation (Henry & Hartzler, 1997; Robey et al., 2003).

## **1.1 OBJECTIVES**

To date, very little empirical research has been conducted to enhance the understanding of the functioning and effectiveness of virtual teams (Ratcheva & Vyakarnam, 2001). The research that does exist is generally based on proximate team research. This is cause for concern because the application of proximate team approaches, attitudes, and expectations when dealing with virtual teams, may not fully capture the unique identity and benefits of virtual teams. One consequence of the lack of sound research in this area is noted by Workman, Kahnweiler and Bommer (2003), who observed that “practitioners can only speculate why [virtual teams] succeed or fail” (p. 199). The research is further limited by the fact that the majority of the research that has been done is based on the assumption that the effectiveness of virtual teams should be measured using the same criteria that were developed for proximate teams. As a result, the concept of virtual team effectiveness as well as key elements contributing to effective virtual teams “remain

comparatively unknown” (Ratcheva & Vyakarnam, 2001: p.512). The issue is further obscured by the fact that the majority of the empirical research in this area treats all virtual teams as a single phenomenon, without considering that there may be degrees of virtualness (proportion of time that a team spends working virtually) that may affect their functioning and effectiveness. As Martins, Gilson and Maynard (2004) noted, “there is a lack of clarity on what we know and the direction that future research should take” (p. 806).

This thesis was undertaken to help fill the void in the current body of research. As such, this research had four main objectives. The first objective was to investigate the construct of virtuality of teams, including the development of an approach to measuring a team’s *degree of virtuality*. The second objective was to develop a better way of defining and measuring virtual team effectiveness that reflects the differences between proximate and virtual teams. The third objective was to develop a better understanding of how managers and organizations can contribute to virtual team effectiveness through the development of four behaviourally-based measures of support: organizational support of virtual teams, organizational non-support of virtual teams, managerial support of virtual teams, and managerial non-support of virtual teams. Such measures could not be found in the current virtual team literature. The fourth objective was to develop a better understanding of the relationship between virtual team effectiveness, virtual team inputs, contextual inputs, virtual team processes, and degree of virtuality. Specifically, this final objective

included the development of models describing virtual team effectiveness which can be used in future research in this area.

This research was a modest step in providing researchers, managers and organizations with a better understanding of how to assemble, equip, develop and manage virtual teams. It was exploratory in nature and adopted a design perspective in that it explored the relationship between controllable team characteristics and selected outcomes (Campion, Medsker & Higgs, 1993).

The inspiration for this research came from personal experiences with virtual teams, both successful and unsuccessful, and an in-depth empirical case study of an existing virtual team which indicated that virtual teams can be both effective and rewarding, despite their purported limitations.

## **1.2 OUTLINE**

This thesis is comprised of six chapters, including the introduction. The second chapter begins by defining the constructs at the centre of this research: teams, virtual teams, degree of virtuality, and team effectiveness. Chapter 2 also includes a brief examination of the existing research on proximate teams and a review of the research dealing with virtual teams is then presented. This review is followed in Chapter 3 by a description of the study, including the specific research questions that were addressed, and the research framework used to guide the research. The research methodologies that were employed, the measures used, and the statistical analysis conducted in this research is, addressed in

Chapter 4. The results of the research are presented and discussed in Chapter 5, beginning with the sample descriptions and the results for each component of the research framework, followed by an examination of each of the relationships between virtual team effectiveness, team and contextual inputs, team processes and degree of virtuality. The final chapter of this thesis presents the conclusions, including the development of proposed models of virtual team effectiveness, the limitations of the research, and suggestions for future work to be done in this area.

## **2 LITERATURE REVIEW**

The literature review is divided into three sections. It begins with a review of the key definitions used in this thesis. This is followed by a review of the research on proximate teams. An overview of the existing models of team effectiveness and their major components are included in this section. Finally, a comprehensive review of the literature on virtual teams is presented.

### **2.1 DEFINITIONS**

The majority of research on virtual team (VTs) is based on what is already known about proximate teams. This means that an investigation of VTs cannot begin without an exploration of how VTs are similar to, and differ from, proximate teams. One of the difficulties with the study of teams, be they virtual or proximate, is the lack of generally accepted definitions in the area. This section reviews the team and VT literature with the goal of providing working definitions of the concepts under study (teams, VTs, team effectiveness, virtuality) that were used for the purposes of this research.

#### **2.1.1 Teams Defined**

Despite the predominance of teams in both organizational practice and management theory, a precise definition has proven elusive. Given the long list of the popular types of teams and groups present in modern organizations, it is evident that they can take many forms, be implicated at different levels of the organization, perform different types of work, interact in different ways, and possess other differentiating characteristics (Caproni, 2000).

A review of the diverse literature on the subject of teams reveals some confusion between the terms “team” and “group”. Teams are infrequently defined and rarely contrasted with groups (Kinlaw, 1991). In fact, the two terms are often used interchangeably, to the extent that authors often employ the word “team” in the title or introduction of the piece and then proceed to use the word “group” throughout the article. Generally, the academic literature tends to use the word “group”, whereas “team” seems more popular in the practitioner press (Cohen & Bailey, 1997). The lack of a generally accepted definition of the term “group” adds to the confusion. Difficulties with respect to the definitions likely stem from the fact that team research draws considerably from the larger, more established, field of group research. At this time, there is a lack of a defined distinction between groups and teams which makes it difficult to distinguish which studies have focused on what. Some authors (i.e. Guzzo & Shea, 1992; Ilgen, 1999) feel that the two terms can be used to represent very much the same concept. Others, however, make a point of differentiating between groups and teams (i.e. Baker & Salas, 1997; Caproni, 2000; Kinlaw, 1991; Robbins & Langton, 2001). It is important, therefore, before embarking on a discussion of research on teams, to investigate the meaning of “team” and its distinction, if any, from “group” in the organizational context. This section will explore the commonalities and differences in order to form the basis of this paper’s working definition of the term “team”.

#### 2.1.1.1 Groups

Groups are pervasive in our society (Goodman, Ravlin & Schminke, 1987). As Tindale and Anderson (1998) noted, “Most social behaviour occurs in groups” (p. ix). All

individuals have belonged to numerous groups throughout their lives (Shaw, 1971). As noted by Hackman (1990), "The label group is casually and commonly used to refer to an enormous variety of social and organizational forms" (p.3). Perhaps because of their pervasiveness, the literature is not clear on what exactly constitutes a "group".

Despite the lack of an accepted definition of the term "group", the literature does consistently indicate that not all social aggregates qualify as groups (Lewin, 1951; McGrath, 1983; Shaw, 1971). It is generally agreed that a group is a set of 2 or more people who have *something* in common (Brown, 1988; McGrath, 1983; Shaw, 1971), but the identity of the requisite common aspect can be quite varied. Examples of shared characteristics that have been used to define groups include common perceptions, awareness, motivation, goals, interdependency, and interaction (Shaw, 1971). Lewin (1951) suggested that, despite the various required attributes of groups found in the literature, the only thing that is required to set a group apart from a mere social aggregate is the interdependency of its members. Lewin (1951) further stressed that all of the requisite attributes listed above could be viewed as differing forms of interdependency. Shaw (1971) supported this view by stating that the very basic definition of "group" is best delineated in terms of interdependency or interaction. Shaw considers that none of the various other attributes of groups are "either necessary or sufficient to define group" (Shaw, 1971: p.10). He noted:

If a group exists, then it may be assumed that its members (1) are motivated to join the group (and hence expect that it will satisfy some of their needs), and (2) are aware of its existence, i.e. that their perceptions are veridical [accurate]. Furthermore, it is a common observation that

when individuals interact, even for brief periods, differentiations begin to develop. Some persons contribute more to group processes than others, some are valued more than others, and certain approved patterns of behaviour appear. In short, group organization begins to take place. Finally, it is not obvious that a common goal is an essential characteristic of a group. It is at least theoretically possible for a group to meet only individual goals. To summarize, motivations of members may account for the *formation* of a group; the group members may *veridically perceive* that the group exists or that they are members of a group; and organization (the formation and interrelation of roles, statuses, and norms) may be an inevitable *consequence* of group process. But none of these aspects is either necessary or sufficient to define “group”. (Shaw, 1971: pp.9-10)

McGrath (1983) further loosened the definitions of Lewin and Shaw by suggesting that “‘groupness’ is a matter of degree”, (Guzzo & Shea, 1992: p.272), and although most social aggregates will display some of the characteristics of a group, some should be considered more of a group than others. McGrath (1983) seems to concur with Lewin and Shaw in identifying interdependence as a necessity for groups, but stated that the existence of any level of interdependency is sufficient to identify a group. McGrath (1983) identified the lower bound of “groupness” by defining mutual awareness and the *potential* for interaction as providing “at least a minimum degree of interdependence” (McGrath, 1983: p.8).

Using the broadest terms, based on McGrath (1983), Lewin (1951), and Shaw’s (1971) definitions, groups could be considered as those social aggregates (a collection of two or more individuals) whose members have, at the very least, a minimal degree of interdependence (mutual awareness and a potential for interaction).

### 2.1.1.2 Teams

Although there are relatively few authors contrasting the terms “group” and “team”, the literature that *does* address this topic does not present the two as mutually exclusive concepts. Guzzo and Dickson (1996) stated that “there may be degrees of difference, rather than fundamental divergences,” (p. 309) between teams and groups.

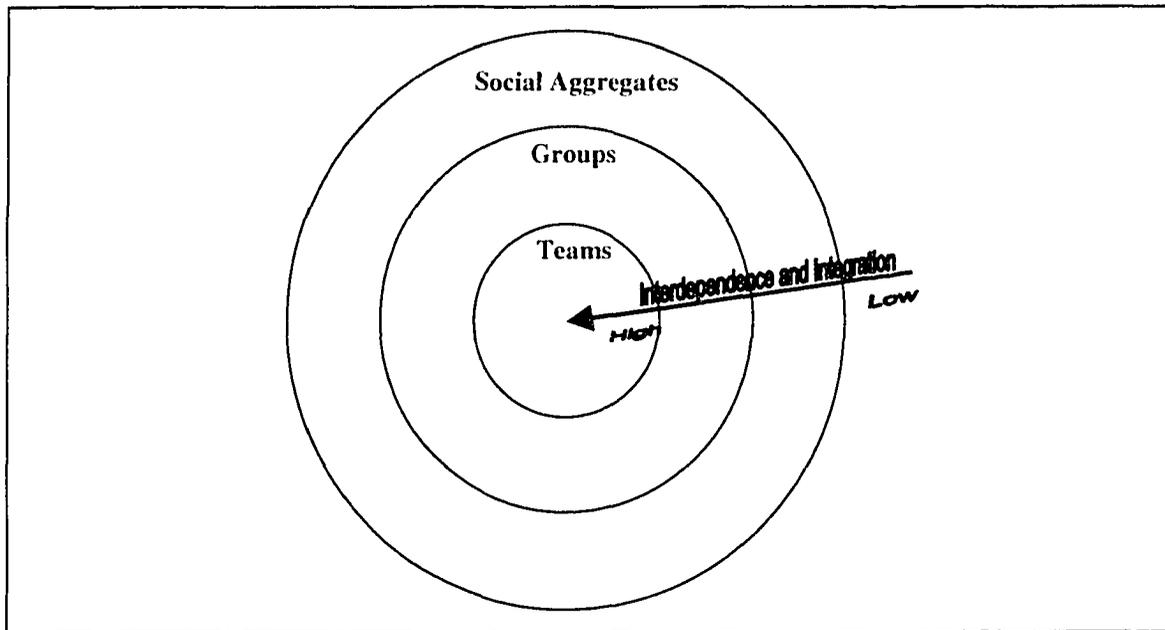
Much like the relationship between social aggregates and groups described in the previous section, in general, teams are viewed as a subset of groups. “Put another way, while all teams are groups, the converse is not necessarily so” (Klimoski & Mohammed, 1994: p. 404).

Using the same approach that was used with groups, teams might then be defined using the characteristics that make them a distinct type of group. As with groups, the literature varies in the identification of the defining attributes of teams, including combinations of interdependence (Baker & Salas, 1997; Cohen & Bailey, 1997; Kinlaw, 1991; Klimoski & Mohammed, 1994; Lipnack & Stamps, 1999; Sundstrom & Altman, 1989), common goal (Baker & Salas, 1991; Katzenbach & Smith, 1993), task orientation (Lipnack & Stamps, 1999; Sinclair, 1992), shared leadership (Katzenbach & Smith, 1993), shared outcomes (Baker & Salas, 1997, Furst et al., 1999; Sundstrom & Altman, 1989; Sundstrom, DeMeuse & Futrell, 1990; Wageman, 1997), limited size (Katzenbach & Smith, 1993), and mutual accountability (Furst et al., 1999; Katzenbach & Smith, 1993; Mohrman et al., 1995).

Following Lewin's (1951) lead, the majority of the above characteristics could be considered as types of interdependence. The most common distinction then is the definition of a team as a group whose members have a high degree of interdependence: they are highly integrated in terms of their goals, tasks, accountability, and responsibility for outcomes. "If the tasks are all independent, then a team is unnecessary" (Lipnack & Stamps, 1999: p.18). By comparison, in a group, the members have varied degrees of interdependence and integration and "may work in parallel, perhaps not even seeing their work combined" (Shea & Guzzo, 1987a: p. 26). For example, in a team, multidisciplinary members may work iteratively or collaboratively, with all members sharing responsibility for the quality and quantity of the output. A functional department, whose members work independently and may even work on separate teams or projects, would not, using this definition, be considered a team (Cohen & Bailey, 1997).

Whereas a group is a social aggregate with at least a minimal level of interdependence and no integration, a team, then, is a group that has a relatively high degree of interdependence and integration (Cohen & Bailey, 1997). As alluded to by Cohen and Bailey (1997) and Guzzo and Dickson (1996), it would seem logical, following the above definitions, to locate all social aggregates on a continuum, where the degree of "groupness" or "teamness" would depend upon the extent of member interdependence and integration. As conceptualized in Figure 1, teams can be considered a type (or

subset) of group, while groups, in turn, can be considered a type (or subset) of social aggregate.



**Figure 1: Social Aggregates by Level of Interdependence and Integration**

Some authors take another approach and differentiate teams and groups on the basis of their output or performance. In this case, teams are defined as “high performing groups” (Katzenbach & Smith, 1993; Kinlaw, 1991; Robbins & Langton, 2001). As Robbins and Langton (2001) stated, a team is “a group whose individual efforts result in a performance that is greater than the sum of those individual inputs” (p. 242). This definition of teams has not been widely accepted (Cohen & Bailey, 1997) and therefore, in this thesis, performance will not be included as a defining characteristic of teams.

Adding to the confusion is the use of another term, “work group”, which is common in the literature (Friedlander, 1987; Guzzo & Dickson, 1996; Hackman, 1990; Sundstrom &

Altman, 1989). This term *does* seem to represent substantively the same concept as team, as authors generally contrast work groups with groups using similar distinctions as are used to contrast teams and groups. For example, Hackman (1990) defined work groups as groups with interdependent members sharing a common purpose, and performing a task for which they are mutually accountable. The terms work groups and teams will therefore be considered as synonymous for the remainder of this thesis.

For the purposes of this thesis, a team was defined to be a social aggregate or group with a relatively high degree of interdependency and integration. As such, much of the research on groups would seem to be relevant to this investigation, particularly that research which includes groups with high degrees of interdependence and integration (Guzzo & Dickson, 1996).

#### 2.1.1.3 Types of Teams

The team literature indicates that teams come in many forms. Examples include: task forces, management teams, project groups, new product development teams, design teams, quality circles, flight crews, parallel teams, computer assisted teams, self-managed teams, and VTs. There is no clear consensus, however, on either a typology or classification scheme of team types, or on the attributes upon which classification might be based. A number of popular classification schemes are outlined below.

Hackman (1990) classified groups into seven types: top management groups, task forces, professional support teams, performing groups, human service teams, customer service teams, and production teams.

Katzenbach and Smith (1993) classified teams into categories according to their function: teams that recommend things, teams that make or do things, and teams that run things. These authors also distinguished between these types of groups according to their expected lifespan. Teams that recommend things, which include task forces, project groups, problem solving teams, and audit, quality and safety groups, are described as almost always having predetermined completion dates. Teams that make or do things, such as marketing, sales, service, operations, and development teams tend to be ongoing and have no set completion date. Teams that run things, such as management teams, also have no set completion date.

Mohrman et al. (1995) classified teams according to their purpose: work teams, integrating teams, management teams, and improvement teams. Work teams, such as production teams, product development teams, concurrent engineering teams, and service teams perform the “core” work of the organization by producing the products or services. Integrating teams coordinate efforts across various parts of the organization. Management teams (a type of integrating team) provide direction and manage the overall design and performance of their unit. Improvement teams design improvements in the production, processes or products and/or manage their implementation.

Sundstrom et al. (1990) differentiated teams according to their application: advice, involvement, production/service, project/development, and action/negotiation. Each type of team is characterized according to its differentiation from other work units (specialization, independence and autonomy), their degree of integration with the greater organizational system, the length of their work cycles (not life span), and their typical outputs. Advice/involvement teams include committees, quality control circles, employee involvement groups, and advisory councils. Production/service teams include assembly teams, manufacturing crews, flight attendant crews, mining teams, maintenance crews, and data processing groups. Project/development teams include research groups, planning teams, architect teams, engineering teams, development teams, and task forces. Action negotiation teams include sports teams, entertainment groups, expeditions, negotiating teams, surgery teams, and cockpit crews. The authors also discussed team life spans, but recognized that these may vary within each type of team.

McGrath (1983) also provided a typology of groups according to what they do (scope of activity) and their life-span (temporal scope). Four types of groups were identified.

Embedding systems, such as families are both long term and very wide in scope.

Expeditions, such as space crews, are wide in scope, but have a short life-span. Standing crews, such as work teams, have a limited scope, but may be long term. Task forces are both limited in time span and scope of activities.

Cohen and Bailey (1997) classified four types of teams: work teams, parallel teams, project teams, and management teams. Work teams are long term teams which are responsible for producing goods or services. Parallel teams have limited authority and make recommendations. Examples of parallel teams include task forces, quality circles, employee involvement groups, and quality improvement teams. The authors did not note the expected lifespan of this type of team, but the list they included under this heading indicated that their lifespans may vary (task forces tend to be short term; employee involvement groups have a longer lifespan). Project teams are short-term teams which produce one-time outputs such as a new product, design, or service. Management teams provide coordination and direction for their sub-units. This type of team would be expected to have a long life span.

Dunphy and Bryant (1996) provided three generic team attributes which “form the basis for team design, team responsibility, and team purpose” (p. 681): breadth of technical expertise, degree of self-management, and degree of self leadership.

In general, all teams have multiple distinguishing characteristics. Teams are most often described according to their task or output (i.e. product, service, decision, coordination), their expected life-span (i.e. temporary, on-going), and their level of autonomy and self-direction. Some teams, such as skunkworks, hot teams, or VTs, have other, distinguishing characteristics, which further differentiate them.

### 2.1.2 Virtual Teams Defined

A universal definition of virtual teams has yet to be established, and the concept seems to be confused with other, overlapping, concepts such as the virtual organization, the virtual workplace, virtual working (teleworking), and virtual communities (Kimble, Li & Barlow, 2000). Nevertheless, the literature which focuses on VTs generally agrees that VTs are primarily teams that do not share a common workspace all of the time, and must collaborate mainly using communications tools such as the telephone, email, video-conferencing, etc. In this vein, VTs have also been referred to as *geographically dispersed teams* and *teams that are not co-located*.

Much VT research is descriptive in nature, and as such, many authors, rather than defining criteria, provide numerous and varied descriptors of the VTs under study. This has resulted in some confusion. In their review of the literature, Bal and Teo (2000) made the distinction between criteria which have been presented as *requirements* for the definition of VTs and characteristics which have been found to describe “typical” VTs. They contended that to be considered a VT, a team must meet the following criteria. VTs must be:

- Geographically dispersed (i.e. not co-located; not working at the same location);
- Boundary spanning (i.e. there must be cross-boundary collaboration; there must be members from different organizations or organizational units);
- Driven by common purpose (i.e. have a common goal aside from the overarching organizational goals); and

- Enabled by communication technology (i.e. use technology to communicate, make decisions, etc.)

They also noted that the typical VT displayed the following characteristics. VTs tended to be:

- Of limited duration (i.e. short-term mandate, temporal);
- Interdependent and mutually accountable;
- Of limited size;
- Changing with respect to membership (i.e. members come and go); and
- Populated with knowledge workers.

In the interest of defining VTs in a parsimonious fashion, it should be noted that one of the criteria (common purpose) and one of the characteristics (interdependence and mutual accountability) of VTs cited by Bal and Teo (2000) fall within this discussion's definition of a team. Under the assumption that VTs are "first of all, teams" (Cohen & Gibson, 2003) and are therefore a subset of teams, these two components were considered as redundant. Further, if communication technology can be interpreted to include such things as the telephone, fax, email and internet, it would be difficult to envision any modern team of knowledge workers functioning without any of these tools. In addition, if VTs can be considered as teams who do not share a common workspace all of the time, the use of communication technology would seem to be an *inevitable consequence* of VTs rather than a necessary condition. Thus, for the purposes of this paper, neither

common purpose, nor use of communication technology was used as defining characteristics of VTs. They are simply part of being on a virtual team.

Not all authors concur, however, with Bal and Teo's (2001) criteria of VTs. George (1996), Johnson et al. (2001), and Joy-Matthews and Gladstone (2000) identified an additional criterion of VTs: asynchronicity (i.e. work across time differences). This criterion requires VTs to work asynchronously, either across different time zones, or at the same location, but with different work hours/shifts. George (1996) and Jarvenpaa and Leidner (1999) also listed temporality (limited team duration) as a required criterion of VTs rather than just a typical characteristic, as Bal and Teo (2001) did. Additionally, authors doing research in the area of global or transnational VTs add the requirement of members who are culturally diverse and/or work and live in different countries (Jarvenpaa & Leidner, 1999; Maznevski & Chudoba, 2000).

#### 2.1.2.1 A Working Definition of Virtual Teams

In order to define VTs for the purposes of this research, it is necessary to consider whether or not to include each of the four potential criteria identified in the previous section (i.e. geographic dispersion, boundary spanning, asynchronicity, temporality). It must also be determined if all four criteria are necessary to define a VT, or can each of them individually be considered a sufficient condition? This second question is a source of contention in the literature. Although Bal and Teo (2001) stated that all of the criteria must be met in order for a team to be considered virtual, George (1996) specified that any

one of the criteria is sufficient to identify a team as virtual. Similarly, Martins et al. (2004) defined VTs as having varying degrees of all of these criteria.

To establish whether any or all of these four potential criteria should be used to distinguish between a proximate and a VT, it is necessary to look at each criterion in isolation and determine if teams that have this single characteristic would be considered virtual. Under the assumption that all teams must have a common goal and the use of technology is a necessary consequence rather than a requirement for virtuality, the four criteria that were explored as conditions for VTs in this thesis are as follows:

- Geographic dispersion (team members work at a distance from one another or across space);
- Asynchronicity (team members perform their work at different times; they are not present at work at the same time);
- Temporality (the team is formed for only a limited time duration); and
- Boundary Spanning (there is cross-boundary collaboration between team members) .

In the following sections, each of the four criteria are examined in isolation through an extreme case.

#### *2.1.2.1.1 Geographic dispersion*

Is a permanent team whose members are all of the same organizational unit and have the exact same work hours, but work at different locations, a VT? Geographic dispersion is one of the few unanimous criteria of VTs found in the literature (Arnison & Miller,

2002). Even the most minimalist definitions of VTs include geographic dispersion as a the prime example of how VTs differ from proximate teams (Bell & Kozlowski, 2002). Thus, working in different physical locations is sufficient to warrant the term *VT*.

#### *2.1.2.1.2 Asynchronicity*

Is a permanent team whose members are all of the same organizational unit and work at the same location, but have work hours that do not overlap, a VT? The classification of the team in this second scenario is less obvious. The practical difference between the first two scenarios is not so great, however: in neither case are the team members actually *working together* in the literal sense. They are never working together at the same place at the same time. The logistics of such a scenario are not significantly different from that of a team whose members work in time zones that differ to the extent that their work days do not overlap. Thus, the second criterion would also seem to be a sufficient condition for virtualness.

#### *2.1.2.1.3 Temporality*

Is a team whose members are all of the same organizational unit, have the exact same work hours and work at the same location all the time, but which has a short-term mandate, a VT? It would seem counter-intuitive to classify the team in this third scenario as a VT. If team members are working together, for the same organizational unit, at the same place, at the same time, the length of the mandate should not determine virtualness. Thus for the purposes of this research, the third criterion, temporality, was not considered a sufficient condition for classification as a VT.

#### 2.1.2.1.4 *Boundary-Spanning*

Is a permanent team whose members work at the same location all the time and have the exact same work hours, but belong to differing organizations or organizational units, a VT? As in the third scenario, it does not follow that the team in this fourth scenario is a VT. Despite the fact that it describes a team that may not be considered traditional, neither does it seem to describe a VT. If team members are working together, at the same place, at the same time, their organizational origin should not determine virtualness. For the purposes of this research, the fourth criterion, boundary-spanning, was not considered a sufficient condition for classification as a VT.

To summarize, neither the criteria of temporality, nor boundary-spanning were considered as defining characteristics of VTs. Only geographic dispersion and asynchronicity were considered to be criteria for differentiating VTs from proximate teams. In addition, since both criteria were deemed sufficient to ensure virtuality, it can be concluded that in isolation, both need not be present to determine virtuality (i.e. *either* geographic dispersion *or* asynchronicity or both, determine virtuality,). For the purposes of this research, a VT, then, was defined to be a team whose members do not work in either the same place and/or the same time and must therefore collaborate across space and/or time. It was assumed that most VTs use some form of telecommunications technology to communicate and have varying life spans. Some VTs may also span organizational/national boundaries and/or be diverse with respect to expertise, profession, culture, etc.

### 2.1.3 Degree of Virtuality

Historically, the literature has defined VTs as a single, identifiable phenomenon (Bell & Kozlowski, 2002). In other words, a team is virtual or it is not. A growing number of authors (Bell & Kozlowski, 2002; Cohen & Gibson, 2003; Griffith & Neale, 2001; Joy-Mathews & Gladstone, 2000; Kirkman, Rosen, Gibson, Tesluk & McPherson, 2002; Kirkman, Rosen, Tesluk & Gibson, 2004; Leenders, Ratcheva & Vyakarnam, 2001; Van Engelen & Kratzer, 2003; Zigurs, 2003) have suggested, however, that the view of VTs found in the literature may be too simplistic. These authors have suggested that the identification of VTs may not be simply a matter of classifying a team as either proximate or virtual, as the earlier literature (and the previous discussion) might imply. Given the above literature and based on the two criteria of team virtuality (time and distance) discussed in the previous section, the following questions need to be addressed with respect to the operationalization of VTs in this thesis:

- To what *extent* (what proportion of time) must team members work separately in order to be considered virtual? For example, would a team that works apart, but meets once a week be considered virtual?
- How *many* of the team members (what proportion of members) must be working virtually in order for the team to be considered virtual? For example, would a team in which the majority of the members (51%) members work virtually (and 49% proximately), be considered virtual? and

- How *dispersed* (how far apart) must the team members work in order to be considered virtual? For example, would a team whose members work on different floors of the same building be considered virtual?

A number of authors (Geber, 1995; Henry & Hartzler, 1997; Jarvenpaa & Leidner, 1999; Lurey & Raisinghani, 2001) have addressed at least part of this issue by including the condition that to be considered virtual, the team must work apart “most of” or “the majority of” the time (Maznevski & Chudoba, 2000). This condition is both imprecise and vague, as it does not satisfactorily answer any of the above questions.

Lipnack and Stamps (1997) introduced the question of distance by stating that the farther apart that team members are located, the more likely they are to be working virtually. Some authors have also highlighted the concept that some teams are more virtual than others (George, 1996; Griffith & Neale, 2001; Joy-Mathews & Gladstone, 2000; Kirkman et al., 2002; Ratcheva & Vyakarnam, 2001). In discussing his criteria, George (1996) implied that team virtualness is not a condition, but a degree: the greater the extent of each characteristic, the more virtual a team becomes. As Joy-Mathews and Gladstone (2000) summarized, “the extent to which team members collaborate proximately as opposed to virtually across distance, and perhaps time, is a continuum” (p.25).

In the review of the literature for the purposes of this paper, the condition of virtuality was rarely found to be applied in an evaluative way to aid in identification of subjects,

sample selection, or included as a variable of interest. As such, research in this area offers little insight into the effectiveness (and management) of different kinds of VTs. Cohen and Gibson (2003) included degree of virtuality as a variable in their conceptual model of VT effectiveness; unfortunately, their research has not yet extended to empirical testing of the model. Leenders et al. (2003) described virtuality as a continuum, but included only teams with low virtuality in their study. Maznevski and Chudoba (2000) included member distribution as a variable in their case study of VTs, but draw no conclusions specific to member dispersion. Kirkman et al. (2004) also defined virtuality as a continuum but included only the number of face-to-face meetings a team as had as a variable representing virtuality.

When viewed as a continuum, virtuality can be seen as a variable state rather than a dichotomy (Griffith & Neale, 2001). The concept of *degree of virtuality* can then be used to describe any team. A team with zero degree of virtuality would be a wholly proximate team. A team that never works together in the same place at the same time, whose members *never* meet, would be wholly virtual. Although the extreme of VTs, teams with members who never meet, undoubtedly exists, most teams would fall between these two extremes (Griffith & Neale, 2001). As Joy-Mathews and Gladstone (2000) noted, “VT working has always existed because team workers can rarely do the whole of a team’s tasks together” (p. 25). Even those extremely VTs who never share a workspace may occasionally need (or choose) to meet face-to-face (Bal & Foster, 2000).

In order to fully explore all VTs, rather than identifying a threshold of virtuality, it would be appropriate to “explore what happens along the continuum between proximate and wholly virtual teams” (Joy-Mathews & Gladstone, 2000: p.25), in what have been referred to as “hybrid teams” (Griffith & Neale, 2001).

Griffith and Neale (2001) introduced a two-dimensional concept of virtuality, using both the percentage of the time a team spends working apart and the level of technology available to the team. They conceded, however, that a team that works apart one hundred percent of the time but uses no technological support whatsoever, would still be considered a wholly virtual team. This implies that despite their two-dimensional definition of virtuality, a team’s degree of virtuality actually depends on the degree that the members work apart (i.e. not at the same place at the same time).

Kimble et al. (2000) also provided three dimensions of virtuality: time (asynchronicity), place (distance), and organization (boundary-spanning). They purported, however, that the spatial and temporal dimensions will have an effect on VT effectiveness, regardless of the existence of the third dimension (boundary-spanning).

Leenders et al. (2003) described three aspects of virtuality: degree of physical proximity, reliance on communication through electronic means, and the degree to which the task requires lateral communication. Kirkman et al. (2004) discussed two similar dimensions

of virtuality: the richness of the communication media used and the extent that the team members are distributed across space.

Kirkman et al. (2002) identified three dimensions of virtuality: the proportion of time members work virtually; the proportion of members who work virtually; and the proportion of their workday each member dedicates to the VT (as opposed to their other duties). While the first two dimensions (proportion of time and proportion of members) are similar to the questions posed at the beginning of this section, the third dimension is unique and must be addressed. The third dimension is concerned with the extent to which each member is dedicated to the VT. Would a VT whose members dedicate 10% of their time to the team's work be *less* virtual than a VT whose members dedicate 50% of their time to the team's work? This dimension would seem to be more closely related to the degree of virtual work done by the *individual* members as opposed to the virtuality of the team. At the team level, this dimension would seem to hinge on the size of the team mandate (or the resources required) as opposed to the degree of their virtuality (i.e. a team working on a large-scale project, requiring greater resources and time, would have a greater degree of virtuality than a team working on a small-scale mandate). This can be illustrated by comparing the following two scenarios:

- A VT is assembled to work on a small-scale project which will require 10% of each member's time. The remaining portion of the members' work days would be spent on other projects (or other VTs). One hundred percent of the team-related work is executed virtually.

- A VT is assembled to work on a large-scale project which will require 50% of each member's time. The remaining portion of the members' work days would be spent on other projects (or other VTs). One hundred percent of the team-related work is executed virtually.

At the individual level of analysis, the individuals in the first scenario would seem to work virtually to a lesser degree than those in the second scenario. However, at the team level of analysis, the teams in both scenarios work virtually for 100% of the team-related work time, and thus represent the same degree of team virtuality. As such, this dimension will not be included in the definition of the degree of virtuality at the team level.

Cohen and Gibson (2003) discussed virtuality in terms of degree of dependency on electronically-mediated communication, geographic dispersion and differences in profession, function, business unit, organization, country and culture. Zigurs (2003) identified four dimensions of virtuality that are somewhat similar to Cohen and Gibson's (2003). She defined virtuality on the basis of organizational, geographic, temporal and cultural dispersion.

Based on the discussion above, it would be expected, however, that the degree of dependence on telecommunications would depend upon the degree of virtuality, rather than define it. Additionally, characteristics such as profession, function, and culture,

would describe the diversity in the composition of any type of group, not just VTs, and therefore should not be considered to determine virtuality.

This thesis extends the research on VTs by exploring how a team's degree of virtuality affects its effectiveness and other elements associated with effectiveness. To summarize and respond to the questions posed at the beginning of this section, a team's degree of virtuality was defined in this study as a construct of three dimensions: the proportion of work time that the team members spend working apart; the proportion of team members who work virtually; and the degree of separation of the team members (distance). Each dimension is examined separately in the following sections.

#### 2.1.3.1 Proportion of Team Work Time Spent Working Virtually

This dimension represents the degree to which the team's work is done in a different place or at a different time. It can be conceptualized as the proportion of total team-related work hours spent working virtually (i.e. the proportion of the team's task which is performed virtually). A team which performs the entire team task without meeting would score 100% on this dimension.

### 2.1.3.2 Proportion of Member Virtuality

The second dimension represents the degree to which the members are dispersed. It can be represented as the proportion of team members stationed at different locations (total number of locations divided by the number of team members). A team whose members all work at different locations would score 100% on this dimension.

### 2.1.3.3 Degree of Separation

The third dimension represents the distance between team members. It can be represented as the distance between members, or the amount of effort or travel time necessary to meet as a team. For example:

- same – building impromptu, short meetings possible;
- same city – half-day required to meet (including travel time);
- same region – 1 day required to meet (including travel time);
- same continent – 2 days required to meet; or
- different continents – more than 2 days required to meet.

A team whose members are all located at great distances from one another (scattered throughout the globe), such that they all would be required to travel a great distance to meet, would score the highest on this dimension. To some extent, this dimension represents the degree of choice (i.e. the closer the team members, the more their virtuality might be considered a choice). For example, Robey et al. (2003) describe a VT whose members chose to communicate solely through electronic means. Due to their physical proximity, however, coincidental and then informal meetings began to take place

between team members. Finally, formal team meetings were scheduled. A team with a low degree of separation could meet regularly if they so chose. A team with a high degree of separation might never be able to meet .

#### **2.1.4 Team Effectiveness Defined**

Groups have been the focus of study for over 100 years (Tindale & Anderson, 1998) and “the importance of groups to organizations has long been recognized” (Guzzo & Shea, 1992: p. 270). Initial research in this area was concentrated in the field of social psychology and focussed on individual behaviour, group behaviour, group dynamics, and other effects of the group on individuals (Tindale & Anderson, 1998).

More recently, groups were recognized as “essential performing units in organizations” (Guzzo & Shea, 1992: p.270) and the group itself has become a unit of interest rather than the context for the study of individuals (Shaw, 1971). To a great extent, the interest in and allure of groups in the organizational setting is based on the assumption that individuals can be more effective when working in a group: that a group or team can accomplish something that a mere collection of individuals cannot. The whole-hearted buy-in of this assumption is demonstrated by the pervasiveness of the term “synergy” (Hackman, 1998) in the team literature and practitioner press. In this context, synergy has come to mean the state where team members achieve something together that is greater than the sum of their individual contributions (Hackman, 1998).

Research in this area has identified a number of potential benefits to using groups and teams, including such things as improved decision making (Caproni, 2000; Stough, Eom & Buckenmyer, 2000), improved problem solving (Caproni, 2000; Wright & Brauchie, 1994), improved productivity (Caproni, 2000; Stough et al., 2000; Van Der Vegt, Emans & Van De Vliert, 1998), greater creativity (Caproni, 2000; Sinclair, 1992; Wright & Brauchie, 1994), increased capacity for innovation (Montebello & Buzzotta, 1993; Stough et al., 2000), greater flexibility (Hackman, 1998; Sinclair, 1992), increased motivation (Stough et al., 2000; Van Der Vegt et al., 1998) and greater job satisfaction (Beck & Yeager, 1996; Campion et al., 1993; Van Der Vegt et al. 1998).

The examination of the potential organizational benefits of teams has been the focus of some research, but the results have not been conclusive (Neuman, Wagner & Christiansen, 1999). Nevertheless, the great potential of teams, particularly in view of the highly successful Japanese team-based approach (Ilgen, 1999), led to a view of the team as “a tantalizingly simple solution to some of the intractable problems of organizational life” (Sinclair, 1992: p.612). One interpretation is that the establishment of a team is in and of itself an assurance of increased performance (i.e. the performance of a problem group can be improved by converting it to a team). In 1987, Peters observed that “the power of the team is so great that it is often wise to violate common sense and force a team structure on almost anything” (p. 297). With such high expectations of the potential of teams, “some backsliding was inevitable” (Ilgen, 1999: p. 130). Many teams were created when the use of a team structure was not appropriate

(Wagemen & Baker, 1997), and anecdotal evidence indicated that many organizations implemented teams without reaping the expected benefits. In 1994, the cover story of *Fortune* magazine was titled "The Trouble with Teams". In his article, Dumaine (1994) cautions against the implementation of teams in inappropriate situations and without sufficient understanding and support. For his book describing a study of 33 work groups, Hackman (1990) had originally planned the title *Teams That Work*. After reviewing the results of the study (only about 4 of the 33 teams were considered effective), the book was more aptly named *Teams that Work (and Those That Don't)* (Hackman, 1998). Dumaine (1994), Hackman (1998) and Katzenbach and Smith (1993) noted that teams haven't lived up to their expected potential and caution that the simple grouping of various individuals into a team or group does not ensure that they will function effectively. In 1998, Hackman published an article entitled "Why Teams Don't Work".

In keeping with this line of study, much of recent research has concentrated, not on the question of whether or not groups and teams add value, but on the question of what makes teams effective. Researchers seek answers to applied questions, such as how teams can be designed, managed, and made more effective (Ilgen, 1999). A consequence of this focus is that most team research is efficiency-based and prescriptive in nature, focusing on the identification of issues associated with team effectiveness, with the purpose of identifying characteristics and interventions that will improve team results (Campion, Papper & Medsker, 1996; Ilgen, 1999).

The issue is further complicated by the fact that there is some disagreement over the exact definition of team effectiveness and what constitutes successful team outcomes (Cooley, 1994; Goodman et al., 1987). Furthermore, even amongst those authors who agree on the dimensions of effectiveness, there is some dissonance in terms of the levels of analysis (team effectiveness could be conceived at the organizational, team, and individual level), the sources of information collected (internal or external to the team), and the measurement of team effectiveness (Cooley, 1994).

How can team effectiveness best be defined? There is no doubt that team effectiveness must encompass some measure of output. As Shea and Guzzo (1987b) noted, team effectiveness is appropriately measured according to the output, which is specified as the goal or task of the team. How the output is defined does, however, vary considerably. Whether it is determined by client satisfaction, timeliness, cost, quantity or quality of output, most researchers include at least some component of productivity or efficiency in their conceptualization of team effectiveness (Goodman et al., 1987).

As Sundstrom et al. (1990) noted, however, “many experts agree that effectiveness includes more than performance”...what is meant by ‘more’ “remains an issue” (Sundstrom et al., 1990: p.130 ). Appendix A presents a table listing some of the dimensions and antecedents of effectiveness contained in the literature. Given that the potential benefits of teams include components that are not productivity related (e.g. motivation, job satisfaction), it is appropriate that many authors also include at least one

attitudinal or behavioural component in the definition of team effectiveness (Cohen & Bailey, 1997). This contention is supported by Sundstrom and Altman (1989) who noted:

effectiveness implies more than productivity...if the members experience working in the group as frustrating or dissatisfying or if they develop relationships non-conducive to future cooperation, their capacity to operate as a team diminishes (p.177).

As Hackman (1990) added, “if, for example, an on-going group burns itself up performing one of its tasks, it surely should not be counted as effective, even if that specific task was well-done” (p. 6).

Although much team research has been done using only productivity-related measures of effectiveness (Dunphy & Bryant, 1996), a number of studies include one or two aspects of effectiveness that are not productivity-based. The most common attitudinal measures include job satisfaction, the team’s ability to work together (both now and in the future); or a combination of these two.

McGrath (1964) presented one of the earliest definitions of team effectiveness that included two components. He defined effectiveness as a combination of objective performance outcomes (quality, speed, errors) and other, more intangible, subjective, outcomes (satisfaction, cohesiveness, attitudes, sociometric structure). This two-dimensional approach to team effectiveness has been widely used since that time (Campion et al., 1993, 1996; Goodman, Ravlin & Argote, 1986; Van Der Veegt et al., 1998). Hackman and Morris (1975) expanded on McGrath’s (1964) definition by

providing a three-dimensional definition of team effectiveness, which they defined to include:

- “the degree to which the group’s productive output...meets the standards of quantity, quality and timeliness of the people who receive, review, and/or use that output” (p. 6);
- “the degree to which the group experience contributes to the growth and personal well-being of team members” (p. 7); and
- “the degree to which the process of carrying out the work enhances the capability of members to work together interdependently in the future” (p. 6).

The definition of team effectiveness employed in this thesis proposal was based on Hackman and Morris’ (1975) three-dimensional conceptualization (i.e. productivity, member satisfaction, and development for future collaboration), with the caveat that the three dimensions may not always be equally important to researchers and managers. Hackman and Morris’ (1975) definition of effectiveness has been echoed by many authors (Caproni, 2000; Gladstein, 1984; Guzzo & Dickson, 1996; Sundstrom & Altman, 1989). Sundstrom et al. (1990), also embraced these three components of effectiveness, but merge the latter two into one concept which they call team viability. Hackman (1990) noted, however, that the three dimensions are not always equally relevant. For example, the last component (capacity to work together in the future) and team viability would only seem to be applicable to ongoing teams with a relatively long life span (Hackman, 1990). Similarly, in extreme circumstances, it would not be fair to evaluate a

team's effectiveness according to the members' satisfaction (i.e. a situation where performance takes precedence over the members' experiences: an emergency crew, a downsizing task force, etc.). It would follow that team effectiveness should depend upon the team's objectives (explicit and implicit).

The results of research on team effectiveness depend, to a large extent, on the conceptualization of team effectiveness. For example, research that includes only performance or productivity-based measures of effectiveness would be expected to produce differing results than research which looks at only behavioural components.

Given this multi-dimensionality of team effectiveness, it would, therefore, be fair to suggest, as Goodman et al. (1987) did, that each component of team effectiveness (i.e. performance and behavioural) be analyzed separately both with respect to its operationalization and its antecedents. It is entirely possible that the separation of the components of effectiveness would lead to the development of separate models, which in turn, may improve the overall understanding of team effectiveness.

The situation is further complicated by the fact that the use of objective measures or managers' judgments of team performance produces different results than measures of effectiveness that rely on team members' perceptions of performance (Cohen & Bailey, 1997). Gladstein (1984) for example, reported that team members seem to rate the team's performance based on their perceptions of the team's processes, rather than on the

outcomes or the completion of the task. The clarification of whether team effectiveness is being measured objectively (through sales data or managers' judgments) or subjectively (through member perceptions), can ensure appropriate interpretations.

*Compounding the confusion over the definition of effectiveness are questions of how these varying components are related to one another, how they are related to the determinants of effectiveness and how they can be measured. These issues are discussed in the next section, which begins with a review of the elements associated with team effectiveness, the existing models of team effectiveness, and the limitations of the available research in the area.*

## **2.2 PROXIMATE TEAM LITERATURE**

This section reviews the existing proximate team literature and present examples of the most commonly cited models for team effectiveness. The major components of these models are described, followed by a discussion of the limitations of the existing team research and its applicability to VTs. This review serves to frame this research study.

### **2.2.1 Existing Models/Frameworks of Team Effectiveness**

As previously noted, the majority of the available research in this area focuses on groups and frameworks of group effectiveness. Existing models of effectiveness tend to be very general and resemble frameworks representing classes of variables that impact on group effectiveness (Goodman, et al., 1987). Although these models are numerous and well cited, "there is no clear specification of the critical variables in the models, nor do

the interrelationships among variables get specified” (Goodman, et al., 1987: p. 126). Available models are generally descriptive in nature and tend to provide “intellectual maps for arranging the conceptual data” (Goodman et al., 1987, p. 128).

Perhaps because of the complexity of the task, very few of these models have been empirically tested (see Gladstein (1984) for one notable exception), and researchers do not tend to build on the work of others (Goodman et al., 1987).

The majority of the models contain similar components or classes of variables: the inputs, the process variables, and the outputs. Inputs generally refer to contextual variables with respect to organizational characteristics, group characteristics and group composition. Process variables include such things as the interactions between group members and their behaviours. Output variables refer to group effectiveness criteria. Most of these models take the form of “flow-charts”. Conceptually the models can be divided into two main groups according to the role that the process variables play in the conceptual map (i.e. as independent or intervening variables). These two types of models will be presented in the next sections, along with a third, less common type of model, the ecological model. After the models are outlined, the most common components of the models will be discussed.

#### 2.2.1.1 The Input → Process → Output Models

By far the most widely accepted conceptualization of group performance is in the form of input → process → output (IPO) models (Guzzo & Shea, 1992; Marks, Mathieu and

Zaccaro, 2001). In these models, process variables are hypothesized to play an intervening role between input and output variables through which the “determinants of group effectiveness get translated” (Goodman, et al., 1987: p. 126).

One of the earliest conceptualizations of the workings of groups was presented by McGrath (1964). McGrath’s frame of reference for analysis of groups provided the foundation upon which the IPO models were built. McGrath’s (1964) framework is presented in Appendix B. McGrath described group phenomena as a “recurrent cycle of ‘input, process, and output’” (p. 71). This framework proposes that the inputs (group composition, group structure, task and environment) affect group processes, which in turn affect group outputs (task performance, group development, effects on members). The outputs are then recycled: “the output, or results at one point in time alter the input conditions for the next period of time” (p. 71).

By far the most commonly cited model of group effectiveness, Hackman’s (1983) normative model (Presented in Appendix C) is based on McGrath’s (1964) framework and Hackman and Morris’ (1975) paradigm of group effectiveness (also based on McGrath (1964)). Hackman’s (1983) model has served as the basis for much of the current group research using IPO models (Goodman et al., 1987). Hackman (1983) conceptualized inputs to include both organizational (i.e. rewards, training and information) and group elements (i.e. task, group composition and norms). These inputs are proposed to contribute to team processes (i.e. effort, knowledge, task strategies). The

relationship between inputs and processes is seen to be moderated by group synergy (i.e. reduction of process losses). Hackman postulated that providing the group with assistance with the goal of reducing process losses will improve the group's efforts and create synergy. Team processes are conceptualized to affect group effectiveness. Hackman (1983) employed Hackman and Morris's (1975) three dimensions of effectiveness (i.e. performance, satisfaction and future collaboration). The relationship between outputs and processes is also proposed to be moderated by the availability of sufficient resources. The reasoning here is that even a well-designed and synergistic team will be affected by the adequacy of its resources.

Hackman (1990) noted that "there are many different ways a group can behave and still perform work well, and even more ways for it to be nonproductive" (p. 8). This view implies that "there is no single performance strategy that will work equally well for different groups" (Hackman, 1990: p. 8).

Some IPO models, although similar in form, focus on the interactions between members. These models searched for ways to explain team interactions or activities and manage group behaviours (through interventions) (Cooley, 1994; Marks et al. 2001). Hackman (1990) suggested that rather than managing group behaviour as it occurs, researchers and managers would be better off focusing on the creation of conditions which would increase the likelihood of group performance. Hackman's (1983) model highlighted process criteria (referred to by Hackman (1990) as enabling conditions) which must be

met in order to enable a group to perform. These process criteria represent the attitudes and behaviours of the team members (referred to by Marks et al. (2001) as “emergent states” (p. 375)), rather than the actual interactions that occur between team members. In other words, the process components and variables in these most popular models are more in the form of “checkpoints” or indicators of the state of the team processes, rather than representing the processes themselves. For example, a common variable used to represent team processes is cohesion. Cohesion measures the extent that the team members are attracted to the group. Although cohesion is not itself an interaction or process, it is considered an indicator of the health of the team processes.

Hackman also identified three organizational conditions (inputs) that increase the likelihood that the process criteria will be met: group structure, organizational context, and the availability of process assistance. In his model, he proposes that if the initial conditions are met, a group is more likely to meet the process criteria. In turn, if the process criteria are met, the group is more likely to perform well. Although Hackman (1990) stated very clearly that the satisfaction of the process criteria does not guarantee group performance, he does indicate that these criteria could be used to diagnose problems that might lead to poor performance.

Gladstein (1984), Gist, Locke and Taylor (1987), and Cohen and Bailey (1997), all presented models that are similar in form to Hackman’s (1983) model and are based on McGrath’s (1964) original work. With one exception however (Gladstein, 1984), none of

these models have been empirically tested in their entirety. Available research on groups and teams is limited in that it focuses on pieces of these models and investigates the relationships between subsets of the components, rather than testing the entire framework. As such, it yields an incomplete view of team effectiveness. These relationships will be discussed in the next section when the model components are presented in greater detail.

Gladstein's (1984) model of team effectiveness is presented in Appendix D. Gladstein's (1984) research is relatively unique in that it tested a comprehensive IPO model of team effectiveness. The Gladstein (1984) model differs from that of Hackman (1983) in that it suggested that the structural (input) variables would have both a direct effect on team effectiveness (outputs) and an indirect effect, through their influence on group processes. Gladstein included four classes of inputs: group composition, group structure, resources available, and organizational structure. Task structure, a component which played the role of an input in Hackman's (1983) model, is included in Gladstein's (1984) model as playing a moderating role between process and effectiveness. She postulated that the characteristics of the task (i.e. complexity, uncertainty and interdependence) will constrain group processes. For example, a very complex and ambiguous task would require the group to develop methods and performance strategies. Conversely, with a simple task with low ambiguity, group members would rely on established operating procedures. Gladstein (1984) defined group effectiveness using Hackman and Morris'

(1975) three-dimensions, but only includes two of them in her model (productivity, satisfaction).

The results from Gladstein's (1984) research underline questions of how the varying and possibly contradictory components of effectiveness should be studied and measured.

Gladstein used structural equation modeling to test the model on a sample of 100 sales teams within a single firm. She found limited support for the IPO relationship as well as for the direct relationship between inputs and outputs, but was not able to establish task as a moderator. The results also identified an endogenous variable (boundary-spanning activities) that had not been part of the model. Boundary-spanning activities were found to have a significant relationship with team effectiveness. It should be noted, however, that there was great disparity between the results for objectively and subjectively rated measures of effectiveness, with the two groups of variables forming two uncorrelated clusters. Very little of the variance in the objective measures of performance was explained (only market growth and tenure were found to be related). The group processes which were found to influence self-reported effectiveness (satisfaction and performance) "read like a textbook on team building" (Gladstein, 1984: p. 511). Open communication, supportiveness, active leadership, training, and tenure were all found to be positively related to group ratings of satisfaction and performance, but had little or no relationship with more objective data (actual group sales revenue). Gladstein (1984) theorized that the group members' knowledge of how group processes should relate to

performance led them to *attribute* positive outcomes to the group when the appropriate processes had been utilized.

#### 2.2.1.2 The Input → Output Model

A second approach to the conceptualization of team effectiveness can be described as the input → output (IO) model. The major difference between this type of model and the IPO models is that in this case processes are hypothesized to play the part of an input, rather than an intervening variable (i.e. process variables are conceptualized as having a direct relationship with effectiveness, but no relationship is depicted between process and the other input variables). The variable set is otherwise similar. Campion et al. (1993) provided an example of this conceptualization (Presented in Appendix E). Campion et al. (1993) identified five classifications of inputs: job design, interdependence, composition, context, and process. Each of these components is depicted as having a direct relationship with the output (work group effectiveness). The output is comprised of three effectiveness criteria: productivity, satisfaction and manager judgments. The IO conceptualization does not explain how inputs are transformed into outputs, but rather focuses on the associations between the two. Campion et al. (1993) tested the relationships in their model with 80 ongoing groups within a large financial services company. The analysis was done using primarily correlation analysis, testing the relationship of each input component with each criteria of effectiveness. All of the five components were found to be related to some of the effectiveness criteria. This study did not, however, test the form of the model (i.e. whether or not process should be viewed as an input or mediator).

### 2.2.1.3 The Ecological Framework

A third approach, presented in this thesis primarily because it differs radically from the other two, is the ecological framework of Sundstrom et al. (1990) (Presented in Appendix F). Although containing similar components as the other two types of models, it deviates from the flow-chart approach and is based on the “premise that work teams can best be understood in relation to external surroundings and internal processes” (Sundstrom et al., 1990: p.121). The four components of the framework include: organizational context, boundaries, team development, and team effectiveness. This framework does not reflect causal or directional relationships between the components as the other two types of models do. Rather, it implies that team effectiveness is an ongoing process rather than an end state. A reciprocal interdependence between the components is shown, depicting team effectiveness as a type of input into a cyclical process. This view is supported by Hackman (1987) who suggested that the success (or failures) that teams experience may also serve as an antecedent for future performance. This type of framework does not lend itself to testing, and as such has never been empirically challenged.

### 2.2.1.4 Limitations of the Existing Models/Frameworks

All of the models outlined above aid in the conceptualization of team effectiveness and its contributing elements. Indeed, the fact that the team effectiveness models are very comprehensive and generic in nature suggests that they can be generalized to all types of teams (i.e. proximate and virtual), performing any kind of task. However, the strength of the comprehensiveness also tends to contribute to the limitations with respect to the refinement and empirical validation of the models. In general, there seems to be a

tradition of presenting all-inclusive models, rather than refining existing ones. One model is expected to represent all of the various different dimensions of effectiveness. This results in very cumbersome models with a large number of variables which are difficult to test without relatively large sample sizes. These limitations, which include a lack of model refinement, an assumption that all three dimensions of effectiveness should be represented by one model, and a lack of attention to the interactions between the variables, will be discussed in detail below.

**LACK OF MODEL REFINEMENT:** The variables included in the current models of team effectiveness would seem to be chosen because they have been traditionally included, rather than because previous, confirmatory research, has shown them to be important (Cohen & Bailey, 1997). As such, the set of variables tends to be exhaustive, rather than refined (Goodman et al., 1987). This is unfortunate, as an approach of refinement would aim to simplify the models by testing and excluding those variables whose links are not supported. Although much research has been conducted on small sections of the models (and some of the individual links have been supported), this empirical research is generally not incorporated into the team models (Goodman et al., 1987). As a result, the models remain too general, “and the constructs too broad in nature” (Goodman et al., 1987) to be useful to researchers and practitioners. These highly general models, which incorporate a large number of variables, make empirical validation difficult as such testing requires relatively large sample sizes. It should, however, be noted that while small sample sizes have traditionally limited the

generalizability of research done in the area, researchers appear to be making an effort to overcome this situation (Cohen & Bailey, 1997). For example, in the six years between 1990 and 1996, almost half of the available studies had sample sizes of over 50 teams and eight had samples greater than 100 (Cohen & Bailey, 1997).

### THREE DIMENSIONS OF EFFECTIVENESS REPRESENTED BY ONE MODEL:

One of the possible reasons for the inclusive approach (i.e. including all possible variables, rather than seeking refinement) is the explicit intent of all of the theoretical models of team effectiveness to explain all of the stated dimensions of effectiveness.

Despite the multi-dimensional conceptualization of team effectiveness, these models are based on the assumption that a common set of variables is similarly related to each dimension of effectiveness (Goodman et al., 1987). The components of effectiveness are not necessarily related, however, and effectiveness in one dimension may preclude, or interfere with, effectiveness in another dimension. It is counterintuitive to aggregate across these dimensions and calculate a comprehensive construct of effectiveness (Goodman, et al., 1987). In reality, researchers rarely attempt to do this because “outcomes can be related to one another in complex and sometimes conflicting ways” (Cohen & Bailey, 1997: p. 243). Despite this, researchers *do* attempt to determine the relationships of the three differing dimensions of effectiveness to a common set of determinants. As outlined above, one comprehensive framework or model is generally presented to represent all of the differing dimensions of effectiveness. In other words, despite the fact that these dimensions may not be related or may even be incompatible,

they are depicted as having the same antecedents and the same relationships with them.

As Goodman et al. (1987) noted:

the assumption appears to be, even at the heuristic level of specification, that a common set of determinants relate to different effectiveness criteria. There is no theoretical reason to believe that this assertion is true (p. 138).

It is possible that the drivers of output and satisfaction may be theoretically different and that different models should be developed to represent these two dimensions of effectiveness (Goodman et al., 1987). Such models have not, however, been conceptualized.

Further complicating the concept of team effectiveness is the fact that differing dimensions of effectiveness represent differing levels of analysis (Goodman, et al., 1987) (e.g. performance is a group variable, but satisfaction must be measured at the individual level). This issue is rarely dealt with in the studies of team effectiveness. Data is most often collected from individuals and aggregated to the group level. However, as shown by Gladstein (1984), individual perceptions of group performance may differ from group level measures (i.e. manager judgments) and should be interpreted differently.

**RELATIONSHIPS BETWEEN VARIABLE SETS NOT MODELED:** In addition, the models of team effectiveness outlined above do not take into account the potential relationships between the numerous variables within the model components. This is likely because to do so would render them impractically complex and to test them prohibitively expensive (Goodman et al., 1987). As a result, the models may be missing

critical relationships that would better explain effectiveness (i.e. performance may lead to satisfaction and/or satisfaction may lead to performance).

In summary, it would be fair to conclude that, given the current state of the research on teams, it is difficult to assess the relative value of the differing models and their sets of variables. It is not clear which model best represents team effectiveness. This critique implies that much more research is required in the area of team effectiveness, regardless of the type of team being studied (i.e. proximate or virtual). There is a need for a focus on model refinement, perhaps the development of differing models for differing dimensions of team effectiveness, and a cumulative approach where future research encompasses and builds upon existing research.

The following section discusses the various components of the theoretical models of team effectiveness. Although the models differ, they do include similar classes of variables or components (i.e. input, process and output). These components, as well as the most commonly researched variables within them, will be presented in detail in the next section. This review will help place the present research on VTs within the context of what has already been done with respect to proximate teams.

### **2.2.2 Components of the Models**

Although the differing frameworks and models presented in the literature are numerous and may include some different variables, they generally do include similar components (i.e. inputs, process and outputs) or classes of variables (i.e. effectiveness, group

characteristics, organizational characteristics and processes) (Goodman et al., 1987). Given the large number of variables that have been included in the available research, only those most commonly investigated in the group and team literature will be described below. Despite the many different variables considered to be involved in team effectiveness, similar classes of variables emerge across the various models. These elements can be classified according to the major components found in these models of effectiveness described in the previous section as: inputs, processes, and outputs. The following section will discuss two of these components (input and outputs) in terms of the variables that comprise them. This discussion will then be used to support the formulation of the framework presented in this thesis. Team effectiveness was discussed in detail in Section 2.1.4 and will not be reiterated here.

#### 2.2.2.1 Inputs Associated with Team Effectiveness

A list of elements that have been associated with team effectiveness is presented in Appendix A. Many of these input variables seem to have been included in team effectiveness models because of past practice, not because they have been empirically linked to team effectiveness (Cohen & Bailey, 1997). This section will present the input variables that have been most commonly studied in the team research.

When reading the following discussion of the elements of team effectiveness, the reader should keep two things in mind. First, as noted earlier, a significant amount of team research has distinguished between different types of teams. As a result, the inputs that

have been included for study as well as the results of the research have varied according to the type of team being evaluated (Guzzo & Dickson, 1996).

Second, the relationships between the inputs and the outputs (team effectiveness) may vary according to the definition (and operationalization) of team effectiveness as well as the source of the data (i.e. objective versus perceptual data). Research that includes only performance or productivity-based measures of effectiveness has produced differing results than those including only behavioural components (or both).

The term inputs refers to any condition or characteristic which can be considered to affect the effectiveness of the team. These input variables can be internal or external to the team and may or may not be controllable. For example, teams can be designed for size and member composition, but some external factors, such as market trends or organizational culture, cannot necessarily be manipulated.

The models of team effectiveness presented in the previous section depict input variables as independent variables contributing to team effectiveness. The relationship of these independent variables with team effectiveness is theorized to be either direct or indirect, depending on the nature of the model of team effectiveness. In the input → process → output models, the relationship between the input variables and team effectiveness is hypothesized to be mediated by the team processes. In contrast, the input → output models posit a direct relationship between the input variables and team effectiveness.

Gladstein's (1984) model of team effectiveness shows the input variables as having both a direct and indirect relationship with team effectiveness.

Input variables can be divided into two groups: contextual inputs (external to the team) and team inputs (internal to the team). Key contextual and team inputs will be discussed in turn in the sections below. This review is not intended to be exhaustive, but rather to identify and discuss the key inputs that have been included in the majority of the research.

#### *2.2.2.1.1 Contextual Inputs*

Contextual inputs, often referred to as organizational inputs, represent the environment in which the teams function. Contextual inputs are present in most models of effectiveness. Adequate training, appropriate reward systems, inter-group communication and adequate resources have all been theorized to have a positive relationship with group effectiveness. Details on each of these contextual elements are provided in the following sections.

**REWARD SYSTEM:** Recognition and group-oriented rewards have been linked to team effectiveness (Hackman, 1990). This component has also been referred to as outcome interdependence (Guzzo & Shea, 1992), which is defined as the "extent to which team members believe that their personal benefits and costs depend on successful goal attainment by other team members" (Van Der Vegt et al., 1998). It is theorized that performance evaluation and rewards that are concentrated at the team, rather than the individual level, will lead to greater collaboration and performance (Campion et al.,

1993). Campion et al. (1993) found that team-based feedback and rewards were linked to the behavioural aspects of team effectiveness. However, more recent research in this area has been contradictory (Cohen & Bailey, 1997; Sundstrom et al., 1990). Future research needs, therefore, to examine the link between rewards and team effectiveness.

**TRAINING:** Training has also been linked to team effectiveness (Hackman, 1990), but the empirical work in this area is limited. The subject of training, which includes both team-related and technical skills, has been researched, but evidence of a relationship to team effectiveness is mixed (Campion et al., 1993).

**INTER-GROUP COMMUNICATION:** The interaction between teams and between a team and its environment has also garnered interest as a component affecting team effectiveness (Sundstrom et al., 1990). Little research exists on this relationship. Campion et al. (1996) did, however, find some positive relationships between inter-group relations and team effectiveness.

**RESOURCES:** Resources, both in terms of information, tools and support have also been theorized to have a positive relationship with team effectiveness (Guzzo & Shea, 1992; Sundstrom et al., 1990). It is expected that teams with adequate access to the resources required to accomplish the task will be more likely to succeed. Again, however, little supportive research exists (Campion et al., 1993).

#### 2.2.2.1.2 *Team Inputs*

Components which apply to or describe the group are present in most models of team effectiveness. Team size, team longevity, team composition, task design, team goals, team proximity, and interdependence of members have all been theorized to have a relationship with team effectiveness. Details on each of these team elements are provided in the following sections.

**TEAM SIZE:** The most commonly researched team input, size, has been shown to have an inverted “U” shaped relation with team effectiveness, depending on the complexity of the task. Teams that are too small will lack the manpower to reasonably accomplish the task. Teams that are too large will have trouble interacting, collaborating and agreeing (Katzenbach & Smith, 1993). The team must be large enough to accomplish the task with a reasonable individual workload, but small enough so that interaction and coordination do not become cumbersome (Campion et al., 1996; Campion et al., 1993; Goodman et al., 1986; Gladstein, 1984). While there appears to be some consensus that team size depends on the task, recommendations of “ideal” range from 12 (Robbins & Langton, 2001) to 25 (Katzenbach & Smith, 1993).

**TEAM LONGEVITY OR TEAM EXPERIENCE:** A similar relationship to that of team size has been empirically found between team longevity and effectiveness: a team requires a certain amount of time to become efficient, but a team that has been together too long may stagnate (Cohen & Bailey, 1997; Guzzo & Shea, 1992). Again, however,

there has been little effort to quantitatively define “too long” or “time required to be efficient”.

**TEAM COMPOSITION:** Team composition is one of the most frequently studied components of team effectiveness (Guzzo & Dickson, 1996). Some demographics describing the team composition (i.e. age, gender and education level) are included in all models of effectiveness (Campion et al., 1993). Researchers, however, often use these demographic components as control variables and their impact on team effectiveness has not been widely explored (Campion et al., 1993). Team composition components which have been linked to team effectiveness include team diversity (e.g. in terms of member gender, culture, experience, preference for group work) and member skills (e.g. task-related and interpersonal skills).

Team diversity has been described as a “double-edged sword” (Caproni, 2000: p. 249). Member diversity has long been believed to contribute to team effectiveness, because members of diverse teams contribute a variety of perspectives, skills, and interactional styles (Caproni, 2000). This is particularly true for complex, creative tasks, where a range of input and competencies is required (Campion et al., 1993; Gladstein, 1984; Goodman et al. 1986). However, diversity in teams has also been found to have a negative relationship with team performance (Magjuka & Baldwin, 1991).

Heterogeneous teams experience more difficulties with team dynamics in terms of communication, conflict, and relationship building. The outcome of these difficulties has

been shown to be greater levels of absenteeism and turnover (Caproni, 2000; Guzzo & Dickson, 1996). These negative effects abate with time, however, as the heterogeneous group members become more comfortable with one another and form relationships (Caproni, 2000; Guzzo & Dickson, 1996). Again, it should be noted that specific recommendations with respect to team diversity and different types of diversity (i.e. gender, culture and experience) have been shown to contribute to team performance in different ways. Drach-Zahavy and Somech (2002) found that some types of diversity (i.e. gender and function) are positively related, while others (i.e. tenure) are negatively related to team effectiveness.

A second important component of team composition is member skills (Hackman, 1990). This variable represents whether or not the members have the necessary interpersonal and task-related (e.g. technical or problem solving) skills. Member skills can include both the existence of skills and/or the mix of skills (complementary skills of members) (Katzenbach & Smith, 1993). Little research, however, has focused on this issue (Campion et al., 1993).

**TASK DESIGN:** Hackman (1990) states that an effective group needs a clear and engaging task that the members feel is meaningful. Task design has been theorized as playing either a direct role (Hackman, 1983) or a moderating role (Gladstein, 1984) in the theoretical models of team effectiveness. Characteristics of the team task, including degree of self-management, task variety, task significance, and task identity, have all

been theorized to enhance team effectiveness (Campion et al., 1993). Robbins and Langton (2001) defined each of the terms as follows:

- The degree of self-management refers to the autonomy of the group and the level of participative decision making;
- Task variety refers to the sharing of the different individual tasks amongst the team members;
- Task significance is the group's belief that work has important consequences to the organization or others; and
- Task identity is the degree to which the team task includes a complete, separate and identifiable piece of work.

It is presumed that these job-design characteristics have motivational value at the team level and will encourage the team members by providing them with a sense of ownership, and make the task more meaningful and interesting (Campion et al., 1993).

Task design has garnered some attention as a variable in team research and has been shown to have an effect on team outcomes. Higher levels of self-management, task variety and task significance were found to correlate with increased levels of team effectiveness (Campion et al., 1993; Campion et al., 1996).

Gladstein (1984) theorized that task complexity would play a moderating affect between input and process variables and team effectiveness. However, the relationship was not supported (Gladstein, 1984).

**TEAM GOALS:** There is evidence that the existence of well-defined team goals can contribute to team effectiveness (Guzzo & Dickson, 1996). Clear and engaging goals align the team members in terms of direction and motivation (Bushe & Johnson, 1989; Caproni, 2000). However, goals must be shared by team members in order to be effective. While in this thesis team goals are considered to be an input variable, some research views team goals as a process variable. Rather than being assigned by leaders, goals can be perceived as being negotiated within the team (Katzenbach & Smith, 1993). The creation of a meaningful purpose builds commitment and ownership (Katzenbach & Smith, 1993). There exists some empirical evidence that specific, challenging goals (Guzzo & Dickson, 1996) that are shared by the team members (Rickards, Chen & Moger, 2001) can improve team performance.

**INTERDEPENDENCE OF MEMBERS:** The interdependence of members, a component that is implicit in most models, is considered to be a defining characteristic of teams and groups (Campion et al., 1993). Interdependence is the division of labour between group members (Van Der Vegt et al., 1998) and refers to the dependence of team members upon each other to complete their individual tasks. It is expected that interdependence will be positively related to team effectiveness “because highly interdependent tasks can be completed more efficiently by a team” (Campion et al., 1996: p.430).

Interdependence has been shown to have a positive relation with motivation and work outcomes (Campion et al., 1996; Van Der Vegt et al., 1998).

It is interesting to note here that teams were defined previously as groups with a high degree of interdependence. Although this variable seems to be of use in group research, as a defining characteristic of teams, it would be expected to be used as a selection criteria, rather than a dependent variable in team research.

**TEAM PROXIMITY:** Although it no longer garners the attention it used to, the effect of physical distance between team members has been the subject of some research. It has been shown that the amount of interaction between team members increases with their proximity (Leenders et al., 2003). Team members who have face-to-face contact with one another (even sporadically) have the opportunity to form relationships, identify common interests, experience mutual understanding, and develop trust (Leenders et al., 2003).

#### 2.2.2.2 Process Components Associated with Team Effectiveness

Process components are indicators of the interactions and processes that go on inside the group that may influence team effectiveness (Campion, 1993). They are checkpoints that provide insight into the state of the team dynamics. Components that are expected to have a positive relationship with team effectiveness are cohesion, efficacy and potency, trust, norms, and communication. Details on each of these process elements are provided in the following sections.

COHESION: The most commonly studied process component is cohesion, which is often defined as the extent that team members feel an attraction to the group and the desire to remain part of the group (Goodman et al., 1987). It is important to note that a significant body of research exists on the subject of group identity (See Kramer (1997, 1998) for examples of this body of research).

Guzzo and Shea (1992) described cohesion as “the forces that bind members to each other and to their group” (p. 284). Cohesion can be associated with the power of the group to induce members to conform to group standards (Goodman et al., 1987).

Components which have been shown to foster group cohesion include small group size, similarity in attitudes of members, physical proximity, external pressures, and performance-based rewards (Sundstrom et al., 1990).

Cohesion has been shown to have a positive relationship with team effectiveness (Guzzo & Dickson, 1996). In fact, it has been used as an output variable to represent team effectiveness in some studies (e.g. Kolodny & Kiggundu, 1980). However, inconsistent results have been found, with some studies producing a negative relationship between cohesion and team effectiveness (Gonzalez et al., 2003; Guzzo & Shea, 1992). The reasons for this may include be such things as the possibility that some teams will work cohesively towards the wrong goals, that groupthink may be present, or that definitional problems exist with the concept of cohesiveness.

Guzzo and Shea (1992) noted that the relationship between cohesion and team performance may be contingent upon other elements, such as group norms. As such, if the group standards include high performance, the members of highly-cohesive groups will be influenced to perform. In his study of factory workers, Seashore (1955) determined that when group norms were aligned with high productivity, cohesion was positively related to team productivity. Conversely, when group norms were aligned with low productivity, cohesion was negatively related to productivity. Another common example of how cohesion may lead to ineffectiveness is the phenomenon of groupthink (Sundstrom et al., 1990). Groupthink occurs in highly cohesive groups when a norm for conformity and consensus overrides the rational decision making process of the group (Robbins & Langton, 2001).

Gonzalez et al. (2003) speculate that the confusing results of studies of group cohesion may also be due to the multidimensionality of cohesion, which can include both interpersonal attraction and task cohesion. Interpersonal attraction refers to attractiveness of the group due to the interpersonal relationships with group members. Task cohesion refers to the attractiveness of the task (Gonzalez et al., 2003). Similarly Goodman et al. (1987) differentiate between the attractiveness of the group and the commitment to the task. They noted that interpersonal attraction focuses on the desire to participate, whereas task cohesiveness refers to the desire to produce. The relationship between cohesiveness and team effectiveness might also depend upon the definition of effectiveness. Member satisfaction would likely be related to interpersonal attraction,

whereas commitment to the task would be more likely to contribute to team performance or productivity.

**GROUP EFFICACY AND POTENCY:** Group efficacy and potency are two concepts which are very similar. Group efficacy is defined as the group's belief in their ability to perform successfully (Gonzalez et al., 2003). Similarly, potency is defined as "the belief by a group that it can be effective" (Campion et al., 1993: p. 830). Components that are believed to contribute to potency include the composition of the team, adequate resources, the contextual environment, the clarity of the goals, and the availability of feedback (Guzzo & Dickson, 1996; Guzzo & Shea, 1992).

The literature argues that efficacy is positively related to team effectiveness because confidence will lead to greater persistence and effort in the face of adversity (Gonzalez et al., 2003). Guzzo and Shea (1992) consider potency to be a motivator in groups (i.e. efficacy leads to a motivation to be effective). This relationship has not been widely tested, however (Cohen & Bailey, 1997). Similar to cohesion, it is also postulated that the performance history of a group will also affect group potency (Guzzo & Shea, 1992) (i.e. if they have succeeded in the past, they will be more likely to believe that they can succeed in the future). In their study of the relationship between potency and team effectiveness, Pearce, Gallagher and Ensley (2002) found support for both of these hypotheses: group potency was positively related to future team effectiveness and team effectiveness was positively related to future team potency.

**TRUST:** Trust is defined as the expectation that others will not take advantage of us and act solely in their own interests (Robbins & Langton, 2001). A great deal of research has been conducted on the subject of trust in organizations (Kramer (1999) and Kramer & Tyler (1996) provide insight into this area of research). Trust is associated with risk and has been linked to openness and sharing of information and knowledge. Trust between team members is theorized to lead to team effectiveness. Trust has been found to increase team commitment, motivate members to perform and reduce monitoring activities (Kanawattanachai & Yoo, 2002).

**NORMS:** Team norms are the implicit and explicit agreement about how things will be done. Norms represent the team's central values (Caproni, 2000). Team norms have been shown to have a relationship with team effectiveness. However, the nature of that relationship (i.e. positive or inverse) would seem to depend on whether the norms are in keeping with the tasks of the group (Goodman et al., 1987).

**TEAM COMMUNICATION:** Recent research seems to have concentrated more on inter-team communication rather than communication internal to the team. Internal communication has, however, been studied in terms of the effect of communication frequency on team effectiveness (Cohen & Bailey, 1997). It is theorized that greater communication frequency reflects greater collaboration and should enhance team effectiveness. The results, however, have been mixed (Cohen & Bailey, 1997).

## **2.3 VIRTUAL TEAM RESEARCH**

This section begins with an exploration of the VT literature with attention being paid to existing models of VT effectiveness and the empirical literature. This is followed by an overview of the theoretical and empirical limitations of the VT literature including a discussion of the problems inherent in this literature as well as its limitations in furthering the knowledge of how VTs function.

### **2.3.1 Models of Virtual Team Effectiveness**

Four comprehensive models of VT effectiveness are presented in the literature (Cohen & Gibson, 2003; Lurey & Raisinghani, 2001, Martins et al., 2004; Maznevski & Chudoba, 2000). All of these models have an IPO form.

Bal and Gundry (1999) also developed a framework for effective VTs which describes the components that are theorized to be associated with VT effectiveness and their interactions (see Appendix G). The framework is based on the work of Lipnack and Stamps (1997) which identified three major challenges associated with VT effectiveness (people, technology, process). The people are the members of the team. People are characterized by their abilities, motivation, concerns and attitudes. The technology represents the tools that are provided to the team. The process is the integration, interactions and relationships of the team members amongst themselves and with the rest of the organization. These three components are all linked together in that each has a reciprocal relationship with the other two. In addition, Bal and Gundry (1999) provided the variables that contribute to each major component.

Bal and Gundry's (1999) framework has several limitations, including the fact that it is geared towards illustrating the elements required for effective teamwork rather than to provide a testable model of VT effectiveness. The use of the framework, for research purposes, is further limited by the fact that it does not include team effectiveness as a variable. Despite the fact that this is not a testable model, Bal and Gundry's (1999) conceptualization of VT effectiveness is helpful in identifying potential variables to be included in a more testable model of VT effectiveness.

Maznevski and Chudoba (2000) presented a model describing how VT interaction creates decision outcomes. The model is presented in Appendix H. The model was developed as a result of their qualitative study of three VTs and is a variation of the input → process → output model of team effectiveness. It presents task characteristics, group characteristics and technology as inputs. Decision processes, message complexity, and communication form, play the role of intervening variables. It is theorized that VT effectiveness is a function of interaction incidents, which are in turn affected by task and group characteristics. In keeping with the proximate team research, Maznevski and Chudoba (2000) used both performance and behavioural outcomes as representing VT effectiveness. Unlike Hackman and Morris' (1975) three dimensions of team effectiveness (performance, satisfaction, future viability), Maznevski and Chudoba (2000) defined the behavioural aspect of effectiveness as including task commitment and cohesion. Both of these variables are presented as process variables in the majority of the

team research and both have had mixed results in predicting the traditional measures of team effectiveness (i.e. high cohesiveness may not lead to performance).

Maznevski and Chudoba (2000) were focused solely on decision-making teams, and as such, the process variables reflect only decision making processes. Their goal was to determine if VT interactions form a temporal rhythm. They define temporal rhythm as “regular intense face-to-face interactions, followed by less intense shorter interactions” (p. 489) using other communication media. Their research focuses on communication patterns and the model represents the relationships between the variables for a single interaction incident. The model was one of the outcomes of their research, and as such, was not tested.

Cohen and Gibson’s (2003) model of VT effectiveness (referred to as a research framework) is presented in Appendix I. The model is very similar to Hackman’s (1983) input → process → output model. There are two notable differences. Cohen and Gibson have divided the traditional process variables into two parts. The first, referred to as *enabling conditions* (after Hackman (1990)), includes shared understanding, integration and trust. The enabling conditions are presented as intervening variables in the framework. The second set of process variables (labeled *process* in the model) includes communication, decision making and conflict resolution. These aspects of process are presented as inputs in the model. This model has not been empirically tested.

Cohen and Gibson (2003) also introduced degree of virtuality (dependence on telecommunications and geographic dispersion) and degree of differences (culture, language, organization function) as moderating variables in the model. The degree of virtuality and the degree of difference are theorized to moderate the relationship between the input and the enabling conditions.

It is interesting to note that Cohen and Gibson (2003) also included the role of technology as an input to VT effectiveness. Technology has been used as a component of effectiveness in proximate team research, but not as a separate component of a model. The inclusion of technology in VT research highlights the possibly greater importance of technology when working virtually.

In keeping with Hackman and Morris' (1975) definition of team effectiveness, the model depicts VT effectiveness as having both performance and behavioural outcomes (commitment, satisfaction, capacity to work together in the future). The only difference between Cohen and Gibson's (2003) conceptualization of VT effectiveness and that of proximate team effectiveness is the addition of organizational learning as a performance outcome. However, there is no reason to expect that organizational learning is an outcome unique to VTs.

Martins et al.'s (2004) model of VT functioning is very similar to that of Cohen and Gibson (2003) and Mazneveski and Chudoba (2000) in that it follows Hackman's (1983)

input → process → output form and contains many similar variables as the other virtual and proximate team effectiveness models. Martins et al.'s (2004) model, which is presented in Appendix J, was developed from a review of the VT literature. Although the model contains similar variables and the same major components (input, process, output) as the other models, it differs from the others within each component. First, the processes which play a mediating role in the model, are divided into three classes of variables: planning (goal setting), action (communication, participation) and interpersonal (cohesion, identity, trust). The outputs in the model are also classified into three types: affective (satisfaction), performance (quality, timeliness), and behavioural (knowledge management, creativity, learning). Second, this is the only model of VT effectiveness that identifies three classes of outputs: performance, behavioural and attitudinal outcomes. The output variables within the three classes are similar, however, to those in the other VT models and research. For example, Leenders et al. (2003) investigated team creativity as a performance outcome (rather than a behavioural outcome). Third, this model is different from the typical IPO models because it does not group the input variables into classes (e.g. team inputs, contextual inputs, etc.).

Similar to that of Cohen and Gibson (2003), Martins et al.'s (2004) model also contains a moderating component (in addition to processes as a mediator). It is hypothesized that variables such as task type, time, social context, leadership and culture will moderate VT performance. It is not clear from the model whether these variables are hypothesized to moderate the relationship between the inputs and processes or the process and outputs (or

both). Interestingly, Martins et. al.'s (2004) is the only model of VT effectiveness that includes support and facilitating. These variables are included as moderators of team performance. Degree of virtuality is not included in this model.

In their model, Martins et al. (2004) distinguished between variables that have been included in existing research and those that require future investigation. The model has not been empirically tested.

Lurey and Raisinghani (2001) presented an input → process → output model at the meta-level (i.e. containing only the major components rather than the variables). This model is presented in Appendix K. In their study, Lurey and Raisinghani (2001) also provided a research framework which is more in keeping with the input →output form. This framework, which is also presented in Appendix K, provides the predictor variables that are hypothesized to impact VT effectiveness. The predictor variables are divided into three major areas: internal group dynamics, external support mechanisms, and design process. In keeping with the IO form, all predictor variables in this framework are shown to have a direct relationship with VT effectiveness. Although the purpose of Lurey and Raisinghani's (2001) research was not to test their framework, their results did call into question the IO framework. Many of the variables (i.e. job characteristics, design processes and tools) did not exhibit significant relationships with the outcome variables, but did, however, suggest relationships between themselves.

The review of the VT literature also identified several other VT models containing only a subset of variables (e.g. models by Alge et al., 2003; Andres, 2002; Driskell, Radtke and Salas, 2003; Kirkman et al., 2004). Andres (2002) presented a partial model based on the IPO form. Although the process and output components are quite similar to those of Cohen and Gibson (2003), and Maznevski and Chudoba (2000), Andres includes only one input variable in his model (communication medium). Alge et al.'s (2003) partial model is very similar to that of Andres (2002), in that it is basically an IPO model and includes similar process and output variables to those found in the other models. Alge et al.'s partial model differs from that of Andres (2002), however, in that it included two input variables: communication medium and temporal scope (team longevity). Alge et al. also included task interdependence as a moderating variable, moderating the relationship between process and output. Similarly Driskell et al. (2003) presented an IPO model with four process variables as mediators (cohesion, communication, status processes and counter-normative behaviour) and only one input variable (the use of computer-mediated communication). The task and type of computer-mediated communication were included as moderators. Finally, Kirkman et al. (2004) presented a model with three components: performance as the output; the number of face-to-face meetings as the moderator; and team empowerment as the only input. Only Alge et al. (2003), Andres (2002), Gonzalez et al. (2003), Kirkman et al. (2004), and Lurey and Raisinghani (2001) tested their models.

### 2.3.2 Empirical Research

Notwithstanding the growing popularity of VTs, in practice, empirical research in this area is less than voluminous. Although the body of literature is growing, both theoretical and empirical research in the area remains limited (Workman, et al., 2003). A lot of the existing literature on VTs is anecdotal and descriptive (Furst et al., 1999: p. 250) and there a lack of a unified and systematic approach to VT research (Powell, Piccoli & Ives, 2004). As such, very little is known about the basic functioning of VTs, their processes, the key elements for success, or how they differ from proximate teams (Kirkman et al., 2002; Ratcheva & Vyakarnam, 2001).

An initial search of the literature for publications on the subject of VTs was performed on three different online databases (*Ingenta*, *ScienceDirect* and *Web of Science*) using the term “virtual team”. While this search yielded over 200 unique results, not all of these articles focused on VT research. Based on their titles, abstracts and contents, more than half of the articles (145) were eliminated from the set, as they are extraneous to the topic of VTs within organizations (i.e. articles which dealt with virtual reality, virtual medical procedures, virtual libraries and museums, virtual classrooms, virtual organizations, teleworking and virtual learning). Numerous articles from an adjacent, but highly related area, computer mediated groups, were retained in the set, however, as the subject matter has relevance to VTs.

It is important to note that a significant body of research exists on the subject of virtual communities and their interactions (See Smith & Kollock (1999) for insight into this area of research).

It is also important to note that the term “virtual” can also be used to describe something that is not “real” (i.e. virtual reality) or something that is *almost* true (i.e. virtually done). The term “virtual team” has been employed in the literature to describe “fuzzy” teams (i.e. teams that are not really teams in that they have no fixed set of members or boundaries). There would seem to be some confusion over the double meaning of the term. Articles focusing on such fuzzy teams have been cited in the VT literature (e.g. Kristof, Brown, Simps, & Smith,1995). It is possible that the inclusion of these publications in the VT literature has contributed to one of the commonly cited characteristics of VTs (i.e. boundary-spanning). Publications in which virtuality was defined only as boundary-spanning (i.e. co-location or geographical dispersion was not considered) were also removed from the list.

This left only 55 articles whose focus was specifically on VTs in organizations. A “snowball” approach was then used to identify other publications on the subject of VTs, culminating in a list of 99 articles and eight books. This literature hails from a wide range of disciplines, including organizational behaviour, human resources, communication, psychology, information systems, production and operations, project management, medicine, strategy, and small group research.

The earliest publication in this collection specifically focused on VTs was in 1995 (Geber). The earliest empirical research specific to VTs was dated 1997 (Warkentin et al.). Almost half (44%) of the articles in this review were published in 2002, 2003 or 2004. This means that the volume of VT empirical research has almost doubled in less than three years, reflecting the need for sound empirical research in this area. The literature included three reviews of the virtual team literature (Martins et al., 2004; Paré & Dubé, 1999; Powell et al., 2004).

Of the 99 articles identified in this search, only 37 include empirical studies. The focus, sample size, approach, and findings of the empirical studies are presented in Appendix L.

Many of these studies focussed on exploring the advantages and disadvantages of VTs (McDonough et al., 2000; Sharifi & Pawar, 2002) and the challenges associated with them (Carletta et al., 2000; Kayworth & Leidner, 2000; Knoll & Jarvenpaa, 1998; Sarker & Sahay, 2004). Gassman and von Zedtwitz (2003) explored the trends of VT use and the reasons for adopting them. May and Carter (2001) investigated the savings in terms of cost and time of virtual collaboration over relocation. In general, these studies determined that VTs are employed to save time and costs and to take advantage of resources when relocation is difficult.

VT challenges include effective leadership, coordination and collaboration, creating trust, sharing information, having positive interpersonal relations (including cohesion) and effective communication (Carletta et al., 2000; Kayworth & Leidner, 2000; Knoll & Jarvenpaa, 1998; McDonough et al., 2000). VTs also face challenges of goal clarity, budget and schedule control. McDonough (2001) reports that these challenges are greater when the team is globally dispersed (i.e. when distances are greater).

Three articles reviewed for this thesis explored the development of VTs. Johnson et al. (2002) and Furst et al. (2004) assessed VT development and compared it to that of proximate teams (using proximate team development theories). VTs were found to follow the same development patterns as proximate teams. Furst et al. (2004) provided recommendations on interventions for each stage of VT development. Ratcheva and Vyakarnam (2001) determined that the development process of virtual partnerships is cyclical and self-energizing, with success being determined by the confidence, satisfaction and enjoyment of the team members.

Three of the articles studied learning in VTs. Larsen and McInerney (2002) investigated the learning experience of students assigned to work in VTs for the first time. Conflicting schedules, technological frustrations and lack of goal clarity were perceived to hinder the VTs' progress. Trust and time management were perceived to contribute to successful learning. Similarly, Knoll and Jarvenpaa (1998) studied the learning experience in VTs and determined that success was tied to perceptions of collaboration, conflict, cohesion,

technology and participation. Rockett et al. (1998) conducted an in-class experiment to provide students with experience with VTs. The students in this study identified team building, goal clarity, and accountability as the challenges discovered in VT work.

The majority of the empirical articles included review tested the relationships between variables that are commonly found in the IPO and IO models. Appendix M presents a table listing some of the variables within each component which have been reported in the literature. The variables within each model component (input, process, output) are discussed in detail in the following sections.

#### 2.3.2.1 Inputs Associated with Virtual Team Effectiveness

The input variables that were most frequently studied in relation to VT effectiveness included: the type of communication medium, effective leadership (and leader type), coordination mechanisms, team-building activities, task and team type, size, longevity, composition, rewards systems, and training.

Six of the articles reviewed in this thesis included the communication medium as a variable of interest. For the most part, these studies compared the outcomes associated with teams using face-to-face versus computer mediated communication. Results were mixed. For example, Andres (2002) reported that richer communication media (face-to-face) resulted in higher team productivity and greater quality in the team's interactions, but had no effect on member satisfaction. Workman et al. (2003) reported that richer media enhanced the commitment of VT members. Lurey and Raisinghani (2001)

reported that team meeting history was associated with team processes. Kirkman et al. (2004) reported that the number of face-to-face meetings moderates the relationship between team empowerment and performance. Conversely, Warkentin et al. (1997) found no differences in the performance of virtual and proximate teams. Alge et al. (2003) concluded that face-to-face teams have greater trust and openness than VTs. This advantage, however, was lost over time (i.e. given time, computer mediated teams were just as open and trusting as computer teams with less rich media). Hollingshead et al. (1993) found that member experience with the medium moderated the relationship between media richness and performance. Huang et al. (2002) determined that although face-to-face teams outperformed VTs, when a virtual coordination mechanism was introduced, the performance differences were mitigated. Kayworth and Leidner (2000) reported that teams that had access to a variety of communication technologies had greater success. Similarly, Carletta et al. (2000) reported that greater availability and convenience of communication tools improved team interactions.

Three articles investigated leadership of VTs. Kayworth and Leidner (2002) studied the effects of different leadership roles on the effectiveness of VTs. Leaders that were perceived to be effective played a mentoring role and exhibited empathy, exerted authority and ensured consistent communication. Effective leadership, in turn, was found to be related to team performance. Pauleen (2003) explored how VT leaders built relationships with their teams. In this study, VT leaders expressed a need to build interpersonal relationships with members before task activities are addressed. Lurey and

Raisinghani (2001) found a moderate association between VT leadership and team performance and satisfaction.

Seven of the empirical studies included in this review introduced specific interventions or mechanisms into the VT interactions and studied their effects. This was sometimes accomplished with the use of a control group. Tan et al. (2000) introduced a dialogue technique to half of the VTs in the study and determined that it improved team performance. Montoya-Weiss et al. (2001) and Massey et al. (2003) introduced a temporal coordination mechanism to half of the teams in each study and determined that providing teams with guidance with respect to their interactions reduced negative conflict, and improved interaction behaviours. They did not, however, find a direct relationship between the mechanism and team performance. Holton (2001) introduced team-building activities and a web-conferencing system to a VT and determined that the members' perceptions of team development were enhanced with the use of the system. Jang et al. (2002) studied the effects of a web-based collaborative system to determine its effect on the team member awareness and satisfaction (no effect was found). Similarly, Huang et al. (2002) introduced a group support system embedded with a goal-setting structure into VTs to determine its affects on teambuilding.

Four articles investigated the role that team type and task play in VT effectiveness. Alge et al. (2003) reported that task interdependence moderated the relationship between VT processes and performance. Hollingshead et al. (1993) and Kirkman et al. (2004)

reported that task type and degree of empowerment were related to performance. In addition, Gonzalez et al. (2003) reported that teams with engaging tasks worked harder to perform. Similarly, Rockett, Valor, Miller and Naude (1998) reported that VTs with goals that were very clear were more likely to succeed. Lurey and Raisinghani (2001) however, found no relationship between job characteristics and VT outcomes.

Other variables which have been studied less frequently include: team size, team longevity (Alge et al., 2003; Leenders et al., 2003), team composition (Leenders et al., 2003), training, skills, and reward systems (Lurey & Raisinghani, 2001). In their study of effectiveness in VTs, Leenders et al. (2003) found that team creativity decreases with team longevity and team size. Alge et al. (2003), on the other hand, reported that experienced teams (i.e. teams that have worked together longer) have greater levels of trust and perform better than inexperienced teams. Lurey and Raisinghani (2001) investigated the relationship between VT performance and member skills (selection procedures), member training and team-based rewards. Teams with rewards that are team-based and members who are chosen according to their skills were found to have greater performance. No significant relationship was found between performance and training. Warkentin et al. (1997) reported that team member skills with technology were related to team interactions and effectiveness.

### 2.3.2.2 Processes Associated with Virtual Team Effectiveness

Process variables that were associated with VT effectiveness included interaction frequency and type, trust, communication effectiveness, cohesion, efficacy, task commitment, and openness.

Seven studies investigated the communication between VT members. Lurey and Raisinghani (2001) and Sarker and Sahay (2004), investigated communication in VTs in terms of their patterns. Ratcheva and Vayarkanam (2001) reported that computer mediated teams had less frequent communication and less information exchange than proximate teams, but neither measure of communication was found to be related to team effectiveness. Leenders et al. (2003) found that decentralized communication and moderate communication frequency (i.e. neither high nor low levels) enhanced creativity. Jarvenpaa and Leidner (1999) reported that task-related and social communication can increase member trust. Potter and Balthazard (2002) studied the interaction styles (aggressive, passive, constructive) of VTs as compared to proximate teams. For both types of teams, constructive communication was associated with greater performance. Alge et al. (2003) studied communication effectiveness as a mediator in the relationship between performance and VT inputs.

Five of the empirical studies included trust as an antecedent of VT effectiveness. Larsen and McInerney (2002), Alge et. al. (2003) and Kanawattanachai and Yoo (2002) reported that trust was positively associated with VT performance. In their study of student teams,

Larsen and McInerney (2002) reported that VT effectiveness was related to trust. Kanawattanachai and Yoo (2002) reported that high-performing VTs developed and maintained trust better than low-performing VTs. Jarvenpaa and Leidner (1999) related the type of communication between team members to trust. They reported that initial communication between team members built trust, task communication maintained trust, and social communication strengthened trust. Jarvenpaa, Shaw and Staples (2004) reported the effects of trust on VT outcomes depended on the situation. They found that trust may have a direct or a moderating effect on outcomes and that the effect of trust depended the structure of the task (i.e. the effect of trust was lower for tasks with greater structure).

Nine studies included what are generally viewed as process variables as outcomes: communication effectiveness (Kayworth & Leidner, 2002), communication satisfaction (Jang et al., 2002), task commitment (Huang et al., 2002; Workman et al., 2003), trust (Jarvenpaa & Leidner, 1999), interaction quality (Andres, 2002), cohesion (Tan et al., 2000) and collaborative climate (Huang et al., 2002). Gonzalez et al. (2003) envisioned behavioural outcomes as contributors to productivity rather than measures of effectiveness.

Two studies included task cohesion or task commitment as an indication of VT processes. Huang et al. (2002) reported that the attraction that team members feel towards their task

will lead to greater performance. Gonzalez et al. (2003) reported that task commitment mediated the relationship between efficacy and performance.

Other process variables which have been studied less frequently include: participation, negotiation, clarification (Andres, 2002), conflict management (Montoya-Weiss et al., 2001), climate (Holton, 2001), efficacy (Gonzalez et al., 2003), and relationships (Pauleen, 2003).

### 2.3.2.3 Virtual Team Effectiveness (Outputs)

All but five of the studies reviewed for this thesis included some form of team performance as an outcome. The exceptions are Holton (2001), Jang et al. (2002), Jarvenpaa and Leidner (1999), Pauleen (2003), and Workman et al. (2003) who employed process variables as the outcomes in their studies.

Nine studies included only performance-related outcomes in their studies of VT effectiveness. Some of the performance outcomes which were included in these studies are productivity, quality, quantity, customer satisfaction, efficiency, and grades (students). Seven studies included behavioural/attitudinal as well as productivity-related outcomes (Andres, 2002; Gonzalez et al., 2003; Hollingshead et al., 1993; Lurey & Raisinghani, 2001; Potter & Balthazard, 2002); Tan et al., 2000, Warkentin et al., 1997). Six of these seven studies included member satisfaction as the behavioural outcome. Only Gonzalez et al. (2003) included effort and facilitation instead of satisfaction.

### **2.3.3 Limitations in the Virtual Team Literature**

This section begins with an overview of the theoretical problems that are inherent in the VT literature. This is followed by a discussion of the limitations of the empirical research on VTs.

#### **2.3.3.1 Theoretical Problems with the Virtual Team Research**

VT research is based upon the proximate team research described in the previous section. As such, the problems discussed with respect to the research in this area apply equally to the research on VTs. Unfortunately, as will be noted below, the VT research also has a number of unique limitations which further hinder the applicability of such research in organizational settings.

Before beginning the detailed critique the VT literature, it is important to note a major theme that underlies it. The VT research is largely based on what is already known about proximate teams and seems to be concentrated on comparisons and determining whether VTs are as effective as proximate teams. The results have, for the most part, been contradictory, although the general impression is that VTs are not as effective as proximate teams, and that given the choice, proximate teams would seem to be the best bet. As confirmed by Overholt (2002), "if companies had unlimited travel budgets and teams had endless amounts of time, then face-to-face meetings would be the best way to work, right?" (p. 4). Although the application of proximate team research to VTs seems appropriate, and comparisons can be useful, the limitations of this approach are two-fold.

First, despite the fact that intuition suggests that VTs and proximate teams differ from each other in significant ways, the methods used to evaluate VTs are almost always based on proximate team models (Furst et al., 1999). There is little or no adaptation of the constructs of team effectiveness. Nor is there adequate recognition of the potential differences between proximate and VTs that bring into question the appropriateness of using the existing proximate team models. The underlying assumption of most of the current research in this area is that VTs and traditional teams have similar definitions, expectations and antecedents of effectiveness. Unfortunately, this assumption does not appear to be grounded in research. There is a growing agreement, however, that VTs face “different and more difficult challenges from those facing proximate teams” (Joy-Matthews & Gladstone, 2000: p. 24). Ratcheva and Vyakarnam (2001) argue that “VTs are not simply a result of evolutionary developments of the traditional management/work teams with the only difference being that their members are connected through technology and transcend time, space and culture” (p. 512).

As a unique form of team, VTs face additional challenges with respect to their interaction and relationships (ambiguity, uncertainty, role identities, context, and team identity) (Knoll & Jarvenpaa, 1998). Most notable is the fact that many of the social cues associated with human interaction that individuals generally learn throughout their lives, are reduced or eliminated (Kayworth & Leidner, 2002). Further limiting the current research in the area of VTs is the fact that the definition of team effectiveness used is either based entirely on traditional team constructs or on intermediate variables used to

represent effectiveness (e.g. communication, cohesiveness). As discussed in the review of the proximate team literature, the links between such proxy variables and team effectiveness are not clear-cut.

In addition to the above, much of the research on VTs ignores the fact that VTs have been widely touted as providing a number of benefits over traditional teams. As such, conceptualizations of effectiveness that are based on proximate team constructs may potentially disadvantage the measured success of VTs as they do not assess the key areas of strength of VTs.

Second, the current literature reflects the assumption that the use of VTs is a matter of preference. In fact, many VTs are created out of necessity, not choice. They are formed to address new inter-organizational alliances, the need for specialized expertise, the time and monetary cost of (and recent reluctance to) travel, and the fact that today's knowledge workers are not interested in being bound to a physical work location (Kayworth & Leidner, 2002).

This suggests that one of the primary research questions underlying this field should be "how can VTs be made effective?" (Montoya-Weiss, Massey, & Song, 2001), rather than "all things being equal, which form of team is better?" If you were to ask corporate executives whether they would prefer to execute a project with a proximate or VT, most would choose proximate (Geber, 1995). As Geber noted, however, "if you were to ask

them if they wanted to do the project by computer or not at all, there wouldn't really be a choice" (p. 36).

### 2.3.3.2 Limitations in the Empirical Literature

This literature review supports the idea that the field of VTs is lacking in sound empirical research. The following highly notable limitations of the VT empirical literature were noted in this literature review:

- many studies are atheoretical (no model specified);
- there is no common definition of VTs;
- many studies employ small sample sizes;
- most studies use simulated conditions (i.e. are laboratory based, rather than field based and use students as subjects); and
- many studies are focused in the information systems field.

Each of these limitations will be discussed in detail below.

**NO MODEL SPECIFIED:** First, there is a severe lack of theoretical grounding with respect to VT research. Few of the studies included in Appendix L are based on a model of team effectiveness. Only seven of the 37 studies reviewed used a model or partial model (i.e. used only a subset of the variables or components of the comprehensive models) to describe the variables and relationships under study. Nor are the studies on VTs effectively linked to existing models of (proximate) team effectiveness. Few are

comprehensive, in that they do not address a complete set of variables. Nor do they discuss the selection of variable subsets.

**LACK OF COMMON DEFINITION OF VT:** The vast majority of the literature fails to define VTs in a meaningful way. The definitions employed in these empirical studies vary and definitional issues are rarely discussed. Some studies do not define the concept at all. The underlying assumption is that virtual and proximate teams form two distinct groups and researchers assume that a team can be identified as either one or the other. As discussed previously, the literature tends to limit its definition of VTs to those with a high degree of virtuality. Only a very small number of authors address the question of degree of virtuality (Cohen and Gibson, 2003; George, 1996; Joy-Mathews & Gladstone, 2000; Ratcheva & Vyakarnam, 2001). Cohen and Gibson (2003) include it as a variable in their model. In reality, most teams have varying degrees of virtuality and the wholly VT is still a rarity. As such, the available research on VTs has limited applicability to teams of varying virtuality. Some studies even limit the proximate teams to face-to-face communication (Alge, Wiethoff & Klein, 2003), a situation which would be extremely rare in reality, as most teams, virtual or proximate, use some form of information technology to collaborate at some point. The lack of a common concept of VTs makes it difficult to compare and aggregate the current research. The limitations of the most common definitions of VTs discussed previously may offer another explanation for the limited research on VTs. It may be difficult to find a large number of real teams which

are virtual enough to conform to this definition. It may be more productive to define the concept of degree of virtuality and employ it in the study of all teams.

**SMALL SAMPLE SIZES:** There is a marked lack of large-scale, empirical, field research in this area. The VT literature, like the proximate team literature has very limited sample sizes (Powell et al., 2004), which limit both the types of analysis that can be done and the generalizability of the studies. The more recent literature does, however, address the need for greater sample sizes. Prior to 2001, the largest sample size was 24 teams (Warkentin et al., 1997). In 2002 and 2003 a few studies include larger sample sizes (i.e. Gonzalez et al. (2003) studied 71 teams and Alge et al. (2003) studied 66 teams). In 2000, McDonough, Kahn & Barczak included 103 managers in their study. However, this research was focused on the managers' experiences with VTs (only 54 had experience with VTs), rather than on the teams themselves. The small sample sizes are particularly evident in the field studies where the only research to include more than 12 teams were Leenders et al. (2003) (n=44) and Kirkman et al. (2004) (n=35).

**SIMULATED CONDITIONS:** A fourth problem with the current research in this area is the high reliance on laboratory experiments (Powell et al., 2004). Of the 30 empirical studies included in Appendix L, 60% are laboratory studies, based on university students under highly simulated conditions. The tasks range from term papers to simulated desert survival exercises. These laboratory studies provide limited insight into the functioning of real teams in the organizational context.

In addition, studies that compare virtual and proximate teams simulate real virtuality by limiting the “virtual” teams to either electronic communications (e.g. Alge et al, 2003, Andres, 2002; Gonzalez et al. 2003) or to a single system as a mode of communication (e.g. Alge et al., 2003; Andres, 2002; May & Carter, 2001; Montoya-Weiss et al., 2001; Warkentin et al., 1997; Warkentin & Beranek, 1999). In some instances, communication within teams is also restricted and team members are permitted to communicate only through face-to-face interaction. The limitation to a single mode of communication decries reality and the benefits of media choice, which would be expected to be enjoyed by all real teams, proximate or virtual. Such a limiting condition would be expected to hinder both interactions and, perhaps, team effectiveness. It also limits the generalizability of the findings from such studies.

*The combination of simulated conditions and small sample sizes has limited the significance of the findings and the ability to generalize results (i.e. How can the results from a study of students who were performing a two-hour simulated exercise using only text-based messaging be applied to a real VT?).*

No study could be found that included a comparison of virtual and proximate teams in a field setting. Rather, studies report on simulations where proximate and VTs are designed to operate under identical conditions (as a kind of case-control), with the goal of concluding whether VTs are “better or worse” than proximate teams. Such studies have

limited usefulness, as they do not consider the reality that virtuality is sometimes a necessity. Nor do they help managers understand and respond to the challenges that VTs face (Furst et al., 1999).

**FOCUS ON INFORMATION SYSTEMS:** Finally, a quarter of the VT literature (26% of the literature reviewed here) is published in the information systems field. The focus of much of this stream of research has been technological: focusing on the potential of technology tools to support virtual collaboration (Joy-Matthews & Gladstone, 2000) or the effectiveness of particular collaborative systems (Ratcheva & Vyakarnam, 2001). Studies in this literature do consider the functioning of the teams themselves. As such, although much is known about the technological aspects of virtuality, the knowledge of how VTs function remains limited (Furst et al., 1999; Lipnack & Stamps, 1999) and the research that has been conducted has not taken a cumulative approach (Powell et al., 2004).

Furst et al. (1999) proposed two possible reasons for the paucity of VT research: 1) the concept is still new and rare enough not to have generated a large, cumulative body of research; and/or 2) there is an assumption of similarity between virtual and proximate teams that decries the need for separate, distinctive research.

The review performed for this thesis supports both of Furst et al.'s (1999) proposals. The dearth of VT literature can likely be attributed to both the newness of the concept of VTs and/or the lack of clarity of the differences between proximate and VTs. To date, there

has been no significant accumulation of literature upon which a theoretical foundation can be built. Furthermore, no testable model of VT effectiveness has been developed and refined. These issues result in a fragmented approach to the VT research.

The research that does exist is further limited by the fact that it is primarily based upon the assumption that proximate teams provide the basis upon which VTs should be measured. This assumption disregards the possibility that virtual and proximate teams differ in significant ways (Furst et al., 1999). It ignores the fundamental rationale underlying VTs: to reap the benefits of collaboration without the constraints of proximate teams. Although much of the literature recognizes these differences and expounds on the benefits and drawbacks of VTs, the majority of empirical research does not reflect nor embody this idea in either their measures or their models.

Finally, the approach of comparing the effectiveness of proximate and VTs requires the study of both virtual and proximate teams operating under similar circumstances. The logistic difficulties in locating both proximate and VTs under sufficiently similar circumstances may explain the reliance on laboratory-style research. In addition, the definitions employed by the researchers (*i.e.* requirements that VTs be wholly or mostly virtual) eliminate a great many partially VTs from the population.

In summary then, in order to better understand the functioning of VTs, there is an ongoing need for the reconstruction of VT research from the ground up: the

establishment of a definition of VT effectiveness and the investigation of its antecedents. Given the recent interest in VTs, there is a need for a base upon which future research can be built.

The research outlined in this proposal was designed to address many of the shortcomings in the VT literature. The following sections will describe the proposed study, beginning with the research questions and the theoretical framework. This will be followed by sections outlining the proposed methodology and the contributions and limitations of the study.

### **3 RESEARCH QUESTIONS AND FRAMEWORK**

The preceding literature review indicates an ongoing need for a better understanding of the functioning and effectiveness of VTs. In addition, it brings into question the wholesale applicability of proximate team/group models in VT research. There is a need for both theory development and empirical research on the unique challenges and benefits of VTs (Furst et al., 1999). The research outlined in this thesis was intended to address these needs. The following section outlines the underpinnings of the research undertaken. First, the research questions which were addressed in this thesis will be offered. This will be followed by a presentation of the theoretical framework used to guide this study.

#### **3.1 RESEARCH QUESTIONS**

This primary goal of this research was to develop a model (or models) of VT effectiveness that would be used in future research on VTs. Specifically, this research pursued four objectives. The first objective was to operationally define a VT's degree of virtuality and develop a way to empirically measure virtuality. This objective reflects the movement of the existing literature towards the view that virtuality/proximity is not a dichotomy and that virtuality is a continuum. The second objective was to develop an operational definition and a measure of VT effectiveness. This objective addresses the call for research which is designed specifically for VTs and reflects the differences between proximate and VTs. The third objective was to develop a better understanding of how managers and organizations can contribute to VT effectiveness through the

development of four behaviorally-based measures of support of VTs: organizational support of VTs, organizational non-support of VTs, managerial support of VTs, and managerial non-support of VTs. Such a measure was not found in the current research, but should prove useful to organizations who use VTs. The fourth objective was to explore the relationship between VT effectiveness, VT inputs, contextual inputs, VT processes, and degree of virtuality. Specifically, this final objective addressed the following key issues: 1) Whether or not different models are required for different dimensions or conceptualizations of VT effectiveness; 2) Which form of model (IO or IPO) best describes the relationship between VT inputs, processes and outputs; 3) The role that degree of virtuality plays in VT effectiveness; and 4) the development of a model (or models) of VT effectiveness. This final objective provides researchers, managers and organizations with a better understanding of how to study, assemble, equip, develop and manage VTs.

To meet these objectives, this research addressed the following specific research questions:

- 1) How can the degree of virtuality of teams be best conceptualised and measured?
- 2) How can the effectiveness of VTs be best conceptualised and measured?
- 3) How can organizational support/non-support and managerial support/non-support for VTs be conceptualized and measured?
- 4) How do various VT input and VT process elements relate to VT effectiveness?

Specifically:

- a) Are different input and process elements related to different dimensions of VT effectiveness?
- b) Is the relationship between VT inputs, outputs and processes best described with IO or IPO models?
- c) What role does degree of virtuality play in VT effectiveness?
- d) How can the different dimensions of VT effectiveness be best represented theoretically?

It is important to note that this study of VTs does not address the question of whether or not a VT *should* be established in the first place. This question should be studied separately.

### **3.2 RESEARCH FRAMEWORK**

One of the primary goals of this research was to improve the understanding of VT effectiveness and identify the components associated with it. This thesis attempts to bind the fragmented literature in this area by developing models of VT effectiveness.

Based on the existing models of proximate and VT effectiveness presented in this paper, a guiding framework of VT effectiveness was developed to provide a basis upon which to organize the research in this study. The framework employed in this research is presented in Figure 2. The framework was based on Hackman's (1983) input→process→output model, which is the form most often found in the VT literature. As with Hackman's (1983) model, in this framework the team processes represent the

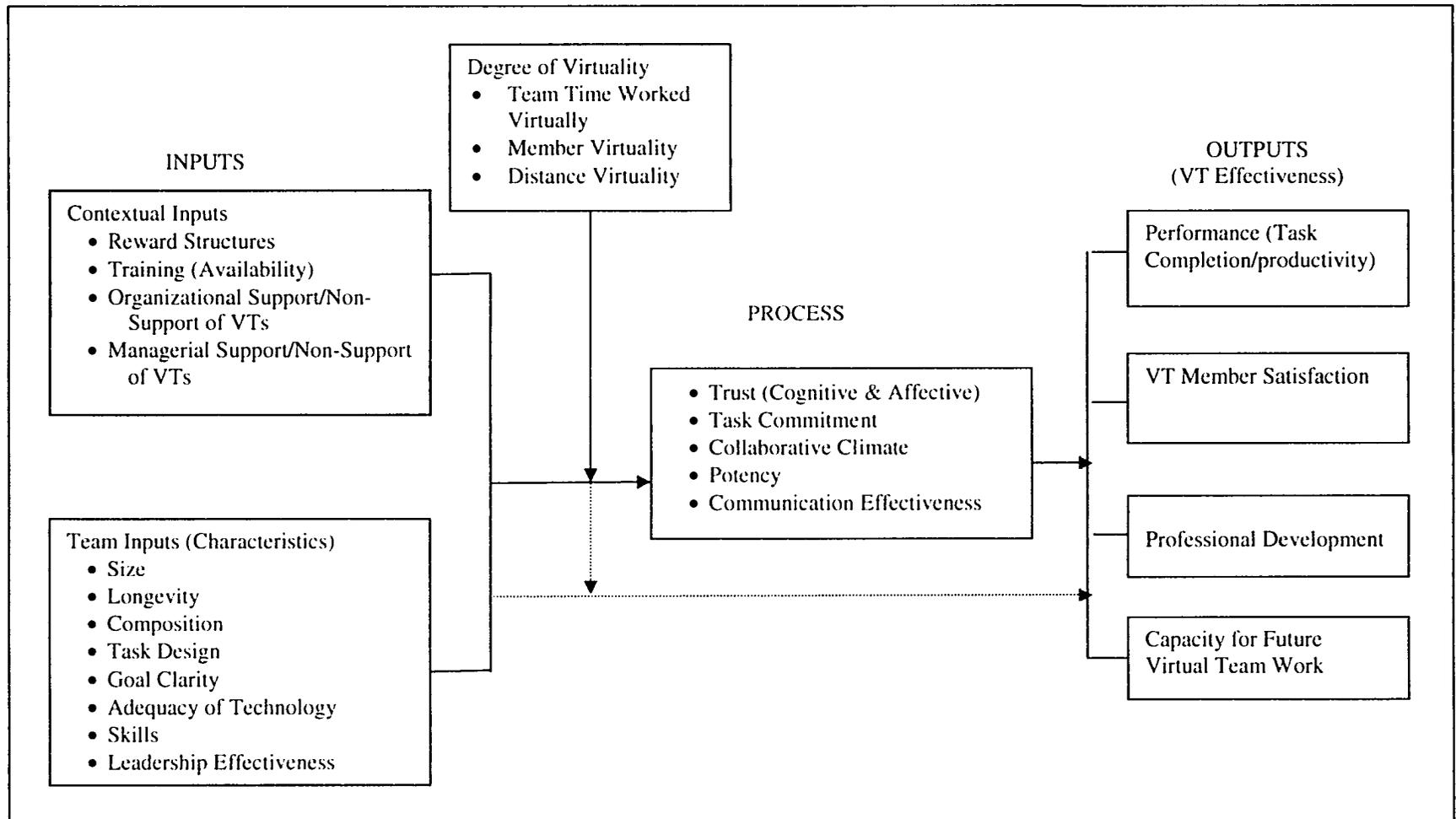
conditions through which the input variables are translated. As such, process variables are represented as intervening variables. The IPO form of VT effectiveness has not yet been confirmed through research. As such, in keeping with Gladstein (1984) and as recommended by Weingart (1997), the possibility that the input variables also have a direct relationship with VT effectiveness was also allowed for in this framework. In order to clarify the most appropriate form of the model for VT effectiveness (i.e. IPO or IO or both), the relationships between the output measures (VT effectiveness) and the other components of the framework (inputs, processes) were evaluated in two different ways in this thesis. First, the direct relationship between inputs and outputs was evaluated. Second, the indirect relationship between inputs and outputs through processes was also evaluated (i.e. the relationship between inputs and processes then processes and outputs).

Following Cohen and Gibson (2003), the degree of team virtuality was conceptualized to have a moderating effect on the relationship between inputs and processes. This represents a relationship where the virtuality of the team would be expected to affect its interactions, which, in turn would contribute to its success. The alternate, potentially moderating effect of degree of virtuality on the relationship between processes and outputs was also tested (but is not depicted in the framework). The potential role of degree of virtuality was explored in terms of both an input and a moderating variable.

The framework was considered as a starting point for this research, and as such, a large number of variables were included. It is important to note, however, that the framework is not all-inclusive. Practical considerations limit the number of constructs that can be examined in only one study. Accordingly, the research framework was created to include only those variables from the proximate team research that would be expected to be related to VT effectiveness, as well as components from the VT literature that have been identified as potentially playing a role in VT effectiveness.

Although not all-encompassing, the framework is, however, complex enough that it falls prey to one of the criticisms inherent in the team literature: complex models with an abundance of variables are very difficult to study empirically, particularly at the team level (because of limitations in sample sizes). The goal of the framework is to include a robust set of variables, with the intention of model refinement based on the results of this study. In other words, this research can be considered as the first step in an ongoing research agenda whose objective is to identify a more parsimonious model (or models) of VT effectiveness by determining which variables should be studied further.

The following sections will discuss each of the major components of the IPO framework (inputs, process, and outputs) proposed in this thesis in terms of the variables that are included in each of them. Degree of virtuality is also reviewed.



**Figure 2: Framework for VT Effectiveness**

### **3.2.1 Inputs Perceived to Contribute to Virtual Team Effectiveness**

The proposed framework includes two categories of variables that are hypothesised to contribute to VT effectiveness: inputs external to the team (contextual inputs - often called organizational inputs) and inputs internal to the team (team inputs). As a starting point, it was assumed that for the most part, the components associated with proximate team effectiveness would be applicable within a VT setting. This study should help clarify the extent to which the relative importance of some of these existing components may change in a virtual setting by determining which of the proximate team variables are significant in this context.

#### **3.2.1.1 Contextual Inputs**

Contextual inputs are seen to provide the framework for VT effectiveness by providing the context in which the VTs work. Gibson and Cohen (2003) described these components as “levers that can be pulled to promote effectiveness” (p. 7). As they noted:

How an organization’s reward system is structured, how its policies are designed, and how its practices are implemented may make it more likely (or less likely) that its VTs will succeed (Gibson & Cohen, 2003: p. 7).

As such, appropriate reward structures, organizational and managerial support of VTs, and the availability of training are viewed as potentially important variables with respect to VT effectiveness and are included in the proposed framework. Details on each component are provided below.

### *3.2.1.1.1 Reward Structures*

VT members must be motivated to perform and collaborate as a team. As Bal and Gundry (1999) noted, the reward structure for VTs is particularly important because it must overcome the “out of sight’ syndrome” (p.189). Lurey and Raisinghani (2001) provided additional support for the inclusion of reward structures in the model. In their research, they found that team-based rewards were related to VT effectiveness.

Organizational and Managerial Support of VTs: Organizations and managers can provide support to VTs through tangible (i.e. tools, training and rewards) or intangible (culture, policies, behaviour) means. One of the purported drawbacks of VTs is the fact that employees are remote from their managers and their organization. This may cause what Furst et al. (1999) referred to as an attitude of “out of sight out of mind” (p. 254). If the VT structure is being supported within the organization, managers have to trust that their virtual employees are working efficiently. Also, it is important that dispersed employees do not feel disadvantaged with respect to advancement opportunities. As such, it is expected that organizational and managerial support of VTs would contribute to VT effectiveness, particularly in terms of the acceptance of the reduced visibility of team members and support for working at a distance (Furst et al., 1999).

### *3.2.1.1.2 Training*

Training may take on an added importance when applied to VTs. The enhanced technological requirements elevate the need for appropriate hardware, software and user

training (Furst et al., 1999). Although most individuals have some experience with teamwork, it can be expected that fewer are versant in VT work. The extent to which VT members are trained with respect to their technical or professional skills, as well as their VT skills, has been purported to contribute to their effectiveness (Lurey & Raisinghani, 2001). It was therefore it was included in the proposed framework as an input.

#### 3.2.1.2 Team-Level Inputs

As noted previously, team inputs are included in virtually all models of proximate team effectiveness. Team inputs are those characteristics of the team and its task that may contribute to its effectiveness. Team characteristics include, such as team size, longevity, composition, skills, task design, goals and available technology. While little empirical research has addressed this issue, it is likely that most, if not all, of these team inputs will be related to VT effectiveness in a manner similar to that observed with proximate teams. The relationship between each of these components and VT effectiveness is summarized below.

##### *3.2.1.2.1 Team Size, Longevity and Face-to-Face Meeting History*

As with proximate teams, VT effectiveness may vary according to team size and age (Alge et al., 2003; Leenders et al., 2003). All teams need enough members to be able to distribute the work into manageable portions. In addition, virtual collaboration, like proximate collaboration should be more difficult with unmanageably large teams (Leenders et al., 2003).

Despite the fact that much of the research defines VTs as teams who never or rarely meet face-to-face, in reality, many VTs meet at least once in their life span (Geber, 1995) and some have regular face-to-face meetings (Kirkman et al., 2004; Maznevski & Chudoba, 2000). Kirkman et al. (2004) used team meeting history (number of face-to-face meetings) to represent degree of virtuality and reported that it had a moderating effect on the relationship between VT empowerment and team process improvements. Lurey and Raisinghani (2001) suggested that team meeting history is a critical input component affecting team interactions (processes).

#### *3.2.1.2.2 Team Composition*

Team diversity, with respect to such things as age, gender, and experience is a common variable in proximate team research. The existing research suggests that the composition of the team is a critical input with respect to the team's effectiveness. VT members' competence with the various information technologies can also be a contributor to VT interactions and effectiveness (Warkentin et al., 1997)

#### *3.2.1.2.3 Task Design*

Task design must be appropriate to virtual work, both in terms of the task itself (task-technology fit) (Furst, et al., 1999), and its complexity. In addition, if VT members feel that their task is engaging and motivating, they will be more likely to work hard to overcome difficulties (Gonzalez, et al., 2003). As such, it is seen to be a potential predictor of VT effectiveness.

#### *3.2.1.2.4 Goal Clarity*

Clearly defined goals that are shared by all team members focus and align the team towards their common task (Bushe & Johnson, 1989; Caproni, 2000). A number of authors link goal clarity and VT effectiveness. As Bal and Gundry (1999) noted, a common purpose may be the only unifying aspect for VTs, as they are expected to have little else in common and require a common purpose to “stay in tune” (p. 189). Goal clarity and explicit norms in a VT may take on additional importance, as VTs may have less opportunity for negotiating and resolving perceived differences. Other researchers have suggested that in VTs goals must be explicit and crystal-clear in order to ensure that the VT members are working in harmony (Lurey & Raisinghani, 2001). As Rockett et al. (1998) noted, goals should be defined to the point of redundancy because “misunderstandings and miscommunication can usually be overcome in face-to-face encounters, but are more difficult to reconcile over distance” (p. 181).

#### *3.2.1.2.5 Adequacy of Technology*

Kayworth and Leidner (2000) identified technology as one of the areas of concern in VTs. Kayworth and Leidner (2000) reported that VTs using a variety of communication technologies expressed a greater satisfaction with their teams' communication and performance. Teams which relied on a single medium, on the other hand, reported greater difficulties in the accomplishment of their tasks. Technical difficulties (i.e. systems breaking down, dial-ups and internet connections disconnecting), and incompatibilities were identified as critical issues in VT effectiveness (Kayworth &

Leidner, 2000). In addition, Carletta et al. (2000) reported that the availability and convenience of communication technology for opportunistic interactions improved the quality of the interactions. As such, the availability, appropriateness and effectiveness of the technology used by the team is included as an input in the proposed framework.

#### *3.2.1.2.6 Skills*

Member skills have also been shown to have an effect on VT effectiveness (Lurey & Raisinghani, 2001). The available research on VTs suggests that the skills required for effective VT work may be unique due to the fairly distinct set of conditions encountered in such situations (relative isolation from team, autonomy, and virtual collaboration). As such, it may be important that VT members be selected, not just for their task-related expertise, but also for their skills with respect to communication technology and their soft skills (Bal & Gundry, 1999). For virtual collaboration, team members require a mastery of the technological tools required to collaborate. Errors and slow response rates can significantly affect the functioning of a VT. In addition, individuals who are insecure and concerned with the high visibility of errors may hesitate to contribute (Bal & Gundry, 1999).

#### *3.2.1.2.7 Team Leader Effectiveness*

The role of the team leader, whether it is played by one individual or rotated among team members, is to ensure that the team stays on track and that all members are kept in the loop (Bal & Teo, 2001). VT leaders appear to face unique challenges. Kayworth and Leidner (2002) studied the effect of leader roles and leadership effectiveness on VT

effectiveness. They found that the roles adopted by the leader (i.e. innovator, producer, director, coordinator, monitor, facilitator and mentor) affected the members' perceptions of leader effectiveness. Effective leaders of VTs acted in a mentoring role and exhibited a high degree of empathy toward other VT members, asserted their authority, and provided regular, detailed and prompt communication. A relationship between leadership effectiveness and team effectiveness was also inferred. Leader effectiveness was included in the proposed framework, as more research needs to be done in this area.

### **3.2.2 Virtual Team Processes**

VT processes seem to have garnered most of the attention of researchers in VTs. The proposed framework included a link between five critical team processes (trust, commitment, collaborative climate, potency, and communication effectiveness) and VT effectiveness. While these processes are seen to be important, it should be noted that when compared to proximate teams, the relative importance may be reduced, as VTs have less opportunity for in-depth interaction. As Gonzalez et al. (2003) noted, "social forces, like cohesion, may have less impact or take longer to achieve" (p.4) in VTs. Details on each of these processes are noted below.

#### **3.2.2.1 Trust**

While there is a lot of research linking trust to VT effectiveness, the exact relationship is still largely unknown. For example, there is an increasing interest in the question of how technology-based interactions will impede trust-building and interpersonal relations in VTs (Jarvenpaa et al., 2004; Ratcheva & Vyakarnam, 2001). The concern is that

electronic communication discourages informal, spontaneous, interactions and sanitizes communication by eliminating the cues and feedback found in more rich media.

Ratcheva and Vyakarnam (2001) described this as “stripping off everything but the message” (p. 514). At the same time, VTs often must work quickly and don’t have the time to develop relationships with teammates (Larsen & McInerney, 2002). Further, because of the distance between team members, VTs may require a higher level of trust than proximate teams, since trust plays the role of the “glue that holds the VT together” (Kanawattanachai & Yoo, 2002: p.188). Jarvenpaa and Leidner (1999) noted that trust was often built through initial communication. Jarvenpaa et al. (2004) reported that the importance of trust to a virtual team may depend upon the situation (task structure, time). Kanawattanachai and Yoo (2002) divided trust into two components: cognitive and affective trust. Cognitive trust relates to the perceived competence, reliability and professionalism of the team members. Affective trust relates to the perceived caring and emotional connection between team members. Kanawattanachai and Yoo (2002) reported that cognitive trust is more important to VTs than affective trust.

#### 3.2.2.2 Task Commitment

While the proximate team literature often measures cohesion as the attraction that the team members feel for one another, team task commitment measures the attraction that team members have to the task. This construct appears to be more relevant to VTs, as task commitment may lead to greater involvement and effort by VT members (Huang et al., 2002). Since VT members interact less frequently in person, this type of cohesion may be achieved through task-related processes rather than more traditional components

of cohesion, such as similarity and interpersonal attraction (Gonzalez et al., 2003). The role of task commitment in VT effectiveness was explored in this thesis.

#### 3.2.2.3 Collaborative Climate

Huang et al. (2002) defined collaborative climate as “the degree to which a team can work well together” (p.360). One of the key reasons for forming teams is that the collaboration of team members will result in something that the individuals could not have accomplished alone. Holton (2001) relates collaborative climate to trust, in that the diversity of team members, the geographic dispersion, and the isolation of members may make collaboration more difficult. Holton found that a positive climate contributed to VT development. This thesis further explored the role of collaborative climate in VT effectiveness.

#### 3.2.2.4 Potency

Potency is the extent that the team members feel that they will be successful in their task. Teams that are confident that they will be able to achieve their goals will be motivated to exert efforts towards accomplishing them (Gonzalez et al., 2003). Potency has been related to team effectiveness in proximate teams (Campion et al., 1993). This research looked at the relationship between potency and VT effectiveness.

#### 3.2.2.5 Communication Effectiveness

Much of the research on VTs explores the issue of communication. Components such as the communication frequency, the message content, information exchange, and the distribution of communication across team members have been explored with respect to

VTs (Ratcheva & Vyakarnam, 2001). In comparison to proximate teams, computer-mediated teams have been found to have less communication in terms of frequency, and information exchange (Ratcheva & Vyakarnam, 2001). The time-delay of asynchronous communication has been theorized to reduce the efficiency of VTs as compared to face-to-face teams. The lack of social cues in telecommunication has also been associated with lower productivity and members' satisfaction (Andres, 2002). However, it has also been shown that higher levels of communication frequency and information exchange are not always necessary for communication and team effectiveness (Ratcheva & Vayarkanam, 2001).

It is possible that more information rich media can overcome the absence of face-to-face communication in VTs and it is expected that VTs using rich media will be as effective as face-to-face teams (Alge et al., 2003). In addition, Alge et al. (2003) reported that VTs may not communicate as effectively as proximate teams when newly formed. Given time to "gear up", however, the VTs reported similar levels of communication effectiveness as the proximate teams (Alge et al., 2003).

The discussion above supports the inclusion of communication effectiveness in the proposed framework.

### **3.2.3 Virtual Team Effectiveness (Outputs)**

The effectiveness of teams can be considered to occur at many levels: individual, team, and organization. In this research, it is the effectiveness at the team level that is the focus

of interest. For example, if member satisfaction is considered a dimension of VT effectiveness, rather than asking the question, “What makes a VT member satisfied?”, this research asked, “What leads to the overall satisfaction of the VT?”

The research on VT effectiveness overwhelmingly uses one or more of Hackman and Morris' (1975) three dimensions of team effectiveness: productivity/performance, member satisfaction, and the capability to work together in the future (Hackman & Morris, 1975). As noted above, however, this may not be the best way to evaluate VT effectiveness, given the different conditions under which VTs work. In this thesis, VT effectiveness is conceptualised to include the following four dimensions:

- The degree to which the VT has achieved its task successfully;
- The level of VT member satisfaction;
- The degree to which the VT's experiences have contributed to the individual's professional development; and
- The degree to which the VT's experiences have contributed to the individual's capacity to work on a VT in the future.

Inarguably, team productivity/performance is integral to any type of team, including VTs (Furst et al. et al., 1999). The justification for the other three dimensions of VT effectiveness used in this thesis is provided below.

This research also includes satisfaction with the VT experience as an indicator of VT effectiveness. While positive work experiences and well-being are generally viewed as an

important team outcome (Furst et al. et al., 1999), it may not be appropriate to assess the work experiences of VT members based on the criteria developed for proximate teams (Furst et. al., 1999). Most measures of member satisfaction used in the proximate team research include questions specifically asking about the team members' satisfaction with personal relations within the team. Similarly, using an overall measure of job satisfaction to evaluate a VT's effectiveness is equally inappropriate, because the time spent participating in a VT may be only a portion of an individual's job.

One component of proximate team effectiveness used in many studies, the capability to work together in the future, may or may not be applicable to VTs considering that one of the touted benefits of VTs is the ability to form and reform quickly. Again, it may be that when evaluating VTs, it is more appropriate to look at the members' capacity to work on a VT in the future, rather than their capacity to work on that particular team again. The VT members' perceptions of their capacity for future VT work was included as a dimension of VT effectiveness in this study.

One of the most commonly cited benefits of VTs is the opportunity to select members based on qualifications rather than location. As such, it would seem appropriate to include the potential benefit that this provides to the team members, and indirectly, the organization. This study included the VT members' perceptions of the professional development provided by their work on the VT as a dimension of VT effectiveness.

To accommodate the fact that the four dimensions of VT effectiveness used in this thesis measure different (and potentially conflicting) aspects of effectiveness, that may have different antecedents, the research framework shown in Figure 2 was evaluated four times: once using VT performance as the measure of VT effectiveness, once using VT member satisfaction, once using VT member professional development, and once using VT member capacity for future virtual collaboration. The relationships between the four dimensions of VT effectiveness were also examined to determine whether they are similar, related, or unconnected, concepts.

### **3.2.4 Degree of Virtuality**

This thesis will extend the research on VTs by exploring how a team's degree of virtuality affects its effectiveness. A team's degree of virtuality was defined previously in this thesis as a construct of three dimensions: the proportion of work time that the team members spend working apart (team time worked virtually); the proportion of the team members who work virtually (member virtuality); and the degree of separation of the team members (distance virtuality). The proportion of virtual work time represents the degree to which the team's work is done in a different place or at a different time. The proportion of team members who work virtually represents the degree to which the members are dispersed. The degree of separation represents the distance between team members or the amount of effort or travel time necessary to meet as a team.

Although some authors have begun discussing the concept that some teams are more virtual than others (George, 1996; Griffith & Neale, 2001; Joy-Mathews & Gladstone,

2000; Kirkman et al., 2002; Ratcheva & Vyakarnam, 2001), few include the degree of virtuality as a variable in their conceptual model of VT effectiveness (e.g. Cohen and Gibson, 2003). However, their research has not yet extended to operationalization of the construct or empirical testing of the model. Kirkman et al. (2004) used a proxy (number of face-to-face meetings) to represent virtuality in their study of VT empowerment. This thesis, therefore, provides a significant contribution to the field by empirically examining degree of virtuality and its role in the framework of VT effectiveness.

#### **4 METHODOLOGY**

This research had four objectives: 1) to define the concept of degree of virtuality of teams and develop a way to measure this construct; 2) to define and measure VT effectiveness; 3) to develop a better understanding of how organizations and managers can contribute to VT effectiveness through the development of four behaviorally-based measures of support: organizational support of VTs, organizational non-support of VTs, managerial support of VTs, and managerial non-support of VTs; and 4) to develop a better understanding of the relationship between the different dimensions of VT effectiveness (i.e. team-level inputs, contextual inputs, VT processes and degree of virtuality).

This thesis encompasses two separate stages of research. The first stage of the research addresses the third research question regarding the development of the measures of organizational support/non-support of VTs and managerial support/non-support of VTs. The second stage of the research addresses the remaining research questions regarding: 1) Conceptualizing and measuring degree of virtuality; 2) Conceptualising and measuring VT effectiveness; and 4) Modelling VT effectiveness.

Details on the data collection and analysis used in each stage of the research can be found in the following sections.

#### 4.1 SOLICITATION OF THE SAMPLE

The study of a relatively large number of real VTs is typically very rare. VTs are still a relatively uncommon phenomenon and such teams are difficult to locate and to persuade to participate in time-consuming empirical research. This obstacle has been overcome in this study as a large private sector telecommunications company, with numerous locations in many cities in Canada, expressed interest in this research and provided access to a significant number of VTs. The organization's participation in the study was two-fold. First, they were interested in examining the functioning of their own VTs. Second, they were interested in expanding the body of knowledge on VTs with the hopes of encouraging their use and increasing the market for many of their products.

The organization agreed to participate in the study with the understanding that their identity would be protected and that they would receive access to the results. In order to do meaningful analysis, the goal was to collect data from the majority of the members of at least 30 VTs.

The opportunity to study real VTs, and collect sufficient data to use teams as the level of analysis, is very rare within the VT literature and provides a sample that overcomes many of the limitations identified in the literature.

The participation of the organization was initiated through a senior Vice President of the organization, who expressed an interest in the subject matter. A senior-level manager in

the Human Resources Department was identified as a contact point within the organization.

As an initial step, the organization was asked to contact all known VT managers within the organization and relay a letter explaining the purposes and requirements of the research and asking for participation. As the organization did not have a comprehensive list of all VTs within the organization, departmental managers were asked to forward the information to their subordinates. All interested parties were asked to contact the researcher by email or phone. A copy of the information letter that was used to solicit interest is presented in Appendix N.

Team managers that expressed an interest in participating in the research were telephoned by the researcher and given more detailed information on the study (if required). An interview was then set up with those managers who agreed to be in the study.

The great majority of the respondents were solicited through the information letter which was sent out by the organization and, presumably, word of mouth. In addition, during the interviews, the team managers were asked to forward the researcher's contact information to any other parties that might be interested in participating in the study. On several occasions, the VT managers indicated that some of their team members (direct reports) also played the role of team manager for their own virtual sub-teams. These sub-team

managers were invited to have their teams participate in the study. Three of the sub-team managers agreed to participate.

Thirty-one VT managers expressed interest in participating in the study. Six of these managers decided not to participate after receiving further information from the researcher regarding their (and their teams') required time commitment. The remaining 25 managers who agreed to participate in the study managed a total of 33 VTs. The great majority of managers (23) managed only one VT. Three managers were responsible for two VTs and one manager was responsible for four VTs.

In keeping with the definition outlined for the purpose of this study, a VT is a group of two or more individuals with a relatively high degree of interdependency and with some degree of virtuality. Only those teams which fell within this study's definition of a VT were included in the study. As such, there were three criteria for team inclusion in this study:

- 2 or more team members;
- relatively high degree of interdependence; and
- some degree of virtuality.

As virtuality was defined as a continuum in this study, team size and interdependence were the key selection criterion.

Information on each of the teams with respect to the criteria for inclusion was collected from the team managers during the interviews. It was the intention that any team not meeting these two requirements would be excluded from the subsequent stages of the study (i.e. team member survey).

In order to determine team size, team managers were asked, "How many members are on this VT?" All 33 teams in the initial sample had at least 2 members and as such were eligible for inclusion in the study. Team sizes ranged from 2 to 14 members.

All team managers were then asked a set of questions relating to team interdependence (See Appendix O and Section 4.2.4) to ensure each team met the requirement for moderate to high interdependence. All 33 teams met this additional selection criterion and were included in the final sample.

At the end of each manager interview, the 25 participating VT managers were asked to provide contact information (email addresses) for the team members in each of their VTs. This information was used to solicit the sample for the next stage of the study (VT member survey).

## **4.2 DATA COLLECTION**

Two types of team data were collected in this thesis: 1) Data on the team itself, which were collected from the organization or the team manager; and 2) data on the team, which were gathered from the individual VT members, and aggregated to the team level. The

method of aggregation itself is an issue of contention in the literature and will be discussed in detail in Section 4.8.1.

The data collection tools, which were developed in conjunction with the organization, included: document review, semi-structured interviews with team managers, and questionnaires for all VT members. Secondary data were provided through the organizational document review. The interviews with team managers yielded qualitative data. Qualitative data were also collected in the online survey of VT members. Table 1 presents the sources and methods of data collection for each component of the proposed framework. Details regarding each data collection procedure are provided in the following sections.

In order to provide context and rigor, whenever possible, data were collected from more than one source (Sekaran, 1992). For example, data on the company reward policies comes from two sources: company documents and team members. Company documents provided information on the existing reward policies and members' perceptions of rewards provided insight into the implementation and effectiveness of these rewards. In another example, the availability of training (document review) was collected as well as the actual use of the training (member perceptions). The comparison of data from different sources has been shown to aid in the interpretation of the data. This was demonstrated by Gladstein (1984), who reported great variances between members' perceptions of team success and manager judgements of success.

Table 1: Sources of Data

Data/Model Component	Company Documents	Team Managers	VT Members
	Document Review	Interview	Survey
<b>BACKGROUND</b>			
Company Structure & Policy	X		
Names & Contact info		X	
Team Face-to-Face Meeting History		X	X
Team Interdependence		X	X
Demographics			X
<b>OUTPUTS</b>			
Performance (Task Completion)		X	X
VT Member Satisfaction			X
Capacity for Future VT Work			X
Professional Development			X
<b>INPUTS</b>			
Contextual Inputs			
• Reward Structures	X		X
• Organizational Support/Non-Support	X		X
• Managerial Support/Non-Support			X
• Training	X		X
Team Characteristics			
• Size		X	
• Longevity		X	
• Composition			X
• Goal Clarity			X
• Task Design			X
• Technology			X
• Skills			X
• Leadership Effectiveness			X
<b>PROCESS</b>			
• Trust			X
• Team (Task) Commitment			X
• Collaborative Climate			X
• Potency			X
• Communication Effectiveness			X
<b>DEGREE OF VIRTUALITY</b>			
Team Work Virtuality			X
Member Virtuality		X	
Distance Virtuality		X	

#### **4.2.1 Document Review**

The first step of this research was the review of corporate documents. Cooper and Schindler (1998) suggested that secondary data can be used as a reference against which to interpret and test primary data. As the sample from this study was based in a single organization, secondary data with respect to the organization, the structure, the strategies and the policies with respect to the use of VTs. The corporate information was used in this thesis to provide a basis for interpreting the data provided by the VT managers and members.

##### **4.2.1.1 Documents Examined**

The organization was asked to provide documents with respect to their workforce demographics, their strategies and policies with respect to teams and VTs, their reward structure and training programs.

General information on the organization was sourced from the following corporate publications:

- Annual Report (2003);
- Corporate Profile (2003); and
- Workplace Profile (2003).

Detailed information on the organization's reward and training programs was sourced from the following Human Resource-specific documents:

- Rewards and incentive plan presentations (used to describe the plan to employees);
- Team Leadership Training Manual; and
- Training brochures (used to inform employees of available training);

The organization did not provide access to all corporate documents. The contact person within the organization was, however, able to provide excerpts from protected internal documents and answer most questions through numerous telephone interviews and emails. Excerpts from documents and interview information were provided on a question by question basis. For example, in order to receive corporate policies, the organization was asked, “Do you have any policies with respect to VTs?” or “Do you have any official policies with respect to teleworkers?”. If the answer was affirmative, the contact person was asked to provide them. The following information was collected in this manner:

- Corporate workforce demographics with respect to gender, age and education level (this was provided in a spreadsheet format); and
- Excerpts from the corporate policy manual regarding telework (this was received as an electronic document).

No documents were provided with respect to VTs, as the organization had no policies or training specific to VTs.

The organization was also asked to provide client contact information or data with respect to client satisfaction with the teams in the sample. As some of the clients were external to the organization, they declined to provide this information.

#### 4.2.1.2 Analysis of Corporate Documents

The organization was only willing to provide documentation on the basis of specific requests (i.e. each demographic had to be requested specifically). As such, it was necessary to rely on the contact person to know (or find out) if the requested information existed, to find out if it was accessible to the researcher, and finally to provide the information to the researcher. In each case, the existence, accessibility, and provision of the information was recorded. For example, the organization had no policies specific to VTs. In this case, the absence of such policies was recorded.

As the corporate profile, corporate report and workplace profile were public documents, it was assumed that they were accurate. Similarly, although the training manuals, presentations, and brochures were published internal to the organization, their accuracy was also assumed. In the case of the policy excerpts and demographic information, the accuracy of the information was less certain (i.e. the demographic spreadsheet had apparently been “cut” out of a larger database and stripped of all of its identifying information). Since there was no reason to suspect that this information was not correct, it was taken as given.

#### 4.2.2 Interviews with Virtual Team Managers

Although much of the team and VT research has focused on data collected from team members, team managers are also a source of valuable information with respect to group components and team effectiveness. In this thesis, information on the VTs was collected using structured telephone interviews with the managers of all participating VTs. For the

purposes of this study, the VT manager was defined as the person, *exterior* to the VT, who is responsible for the VT and its outcomes.

The VT manager interviews served four purposes in this study: 1) to solicit the VT sample and collect data regarding the criteria for inclusion in the study; 2) to collect data regarding the characteristics of the VTs (e.g. age, history, virtuality, etc.); 3) to measure VT performance from the manager's perspective; and 4) to identify the VT member sample. It should be noted that although data were collected from the VT managers, they were not the subject of this study and, as such, no data pertaining to the managers themselves were collected.

Whenever possible, the interview questions were based on prior research on virtual and/or proximate teams. The VT manager interviews consisted of four sections. The first section consisted of questions necessary for sample selection (i.e. size and interdependence). The second section consisted of questions regarding the VT's longevity and face-to-face meeting history. The third section contained questions regarding VT managers' perceptions of the VT's effectiveness. The fourth, and final section asked for contact and location information on the VT members. The telephone interviews with VT managers lasted between 20 and 30 minutes. The VT manager interview questions are presented in Appendix O. Each of the sections of the manager interviews are discussed in detail below.

SECTION 1: Team size was identified as a criterion for inclusion in this study. Team managers were asked to provide the number of members on the team.

Task interdependence was also identified as a criterion for inclusion in the study, as only teams with a relatively high level of interdependence conform to this study's definition of teams. Team managers were also asked to provide their perceptions of their VT's interdependence. No measure of interdependence from the managers' perspective was found in the literature. As such, the measure of VT managers' perceptions of interdependence was adapted from measures designed to assess interdependence from the team members' perspective. The questions and measure are described in detail in Section 4.2.4.

SECTION 2: Managers were asked to provide quantitative data on some of the VTs' characteristics. Data on the age of the team (how long the team had been in operation) was collected from the managers (the members' perceptions of team longevity would be expected to reflect the length of their membership on the team, rather than the age of the team itself). They were also asked a number of questions outlining the history of the teams with respect to their face-to-face meetings (i.e. whether or not they had met and how frequently) (Lurey & Raisinghani, 2001).

SECTION 3: The team managers were also asked to provide their perceptions of the effectiveness of the VTs in terms of their task performance. The VT managers' perceptions of performance were determined using a measure developed by Lurey and

Raisinghani (2001), which reflects the perceived success of the team in reaching its goals, its business objectives, its budget and its schedule. The questions are provided in Appendix O and the measure of performance is described in detail in Section 4.4.1.

SECTION 4: Finally, the managers were asked to provide information necessary for the next stage of the study: the names and contact information of the VT members. The team members were identified and contacted based on this information. Information on the location of the team members was also collected in this section of the interview. Specifically, team managers were asked to state the city in which each team member was located. In the event that two or more team members were located in the same city, the managers were asked to determine whether the members were in the same building or on the same floor. These data were used to determine one of the dimensions of the teams' degree of virtuality. Degree of virtuality is discussed in detail in Section 4.3.

#### **4.2.3 Survey of Team Members**

Although the team is the level of analysis for this study, the majority of the data were collected at the individual level (i.e. VT members). The VT member sample was solicited through the information gathered from the team managers. The 25 participating VT managers were asked to provide contact information (email addresses) for the team members in each of their teams. All members of participating VTs were sent an email describing the research, inviting their participation, and providing the access information for the online survey. A copy of the email that was used to solicit interest is presented in

Appendix P. An information letter outlining the study (Appendix N) was sent as an attachment. In order to be able to aggregate the individual responses into team level data, it was necessary to identify which surveys belonged to which team. The teams were assigned ID numbers, which were used to identify team mates.

All of the members of the VTs participating in this study were asked to complete an online self-report questionnaire. Based on the contact information provided by the VT managers, 171 individuals representing 32 VTs were sent the link to the online questionnaire<sup>1</sup>. A total of 108 team member questionnaires were completed, for an individual response rate of 63%.

The online questionnaire was equivalent to approximately 15 printed pages and included questions corresponding to all of the components in the research framework in Figure 2. The survey was comprised of five sections: 1) Team background, which included questions pertaining to meeting history, availability of tools, member skills, team task, goals, commitment, potency, and interdependence; 2) Team leader, which included questions to determine whether or not the team had a leader, the leader's management style, and the members' perceptions with respect to the leader's effectiveness; 3) Team work environment, which included questions regarding rewards, training, organizational support/non-support of VTs and managerial support/non-support of VTs; 4) Team experiences which included questions pertaining to communication, trust, climate, and

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<sup>1</sup> After completing the interview, one of the team managers contacted the researcher to request that the team be excluded from the rest of the study due to unforeseen work constraints. The members of this team were not contacted to participate.

team effectiveness; and 5) Member demographics, which included data on the gender, age, education, tenure, work hours, technological comfort and experience, and area of expertise of the VT members. These demographics were collected for descriptive purposes as well as to determine team composition and degree of virtuality. Whenever possible, the survey questions were based on prior research on virtual and/or proximate teams.

#### **4.2.4 Criterion for inclusion in Study: Virtual Team Interdependence**

As noted previously, task interdependence was identified as a criterion for inclusion in the study. Both the VT manager interviews and the team member survey contained a measure of task interdependence. The decision to measure interdependence twice from two different perspectives (i.e. managers and members) was made in order to increase the reliability of the measure of task interdependence (i.e. the reliability of the measure of interdependence could be tested on data from at least 30 VT managers plus over 100 team members).

The measure of interdependence used in this study was comprised of four items adapted from Campion et al. (1993), Knoll and Jarvenpaa (1998), and Fields (2002). All of these scales were designed to measure interdependence from the members' perspective. No empirically tested measure of interdependence from the managers' perspective was found in the literature. As such, the measure for managers was identical to that of the members. The resulting scale included the following four items:

- The VT members cannot accomplish their tasks without sharing information or materials with the other members of the team (Campion et al., 1993);
- Task related activities performed by the VT members are related to one another (Campion et al., 1993);
- The VT members must coordinate their efforts with one another in order to accomplish their tasks (Pearce & Gregersen, 1991, from Fields, 2002); and
- The members of this VT must collaborate to produce a common output (Knoll & Jarvenpaa, 1998).

The respondents were asked to rate each statement on a five-point scale (1=strongly disagree, 5=strongly agree). An overall interdependence score for each team was determined by calculating the summed average of the questions. Higher scores on this measure represent greater interdependence.

The reliability of this scale (and all of the other scales used in this thesis) was tested using Cronbach's Alpha. Carmines and Zeller (1979) suggested that it is desirable to have a Cronbach's Alpha of 0.7 or greater. This was the benchmark for testing the reliability of all of the measures in this study. The Cronbach's Alpha was 0.79, indicating good reliability.

#### **4.2.5 Criterion for inclusion in Study: Team Response Rates**

As previously noted, while the majority of the data for this study was collected at the individual level, the focus of the study was the team itself. Team data were created using

the aggregate of the team member responses. In order to ensure that the individual data reflected that of the team, it was critical that a sufficient proportion of the members of each team be included in the study. “Sufficient” was operationally defined in this study to include those teams where 50% or more of the members of the team completed the survey. This requirement, while arbitrary, seems to make sense from a research perspective. Twenty-eight of the 32 VTs met the requirement. The requirement was relaxed to 43% of the members of the larger teams (i.e. responses from at least 3 individuals from the teams with 7 or more members). Two of the teams with seven members met this requirement. For one of the teams, no members completed the survey. For one of the two-member teams, only one of the members completed the survey. These two teams were excluded from the sample. The team sizes and response rates are presented in detail in Appendix Q.

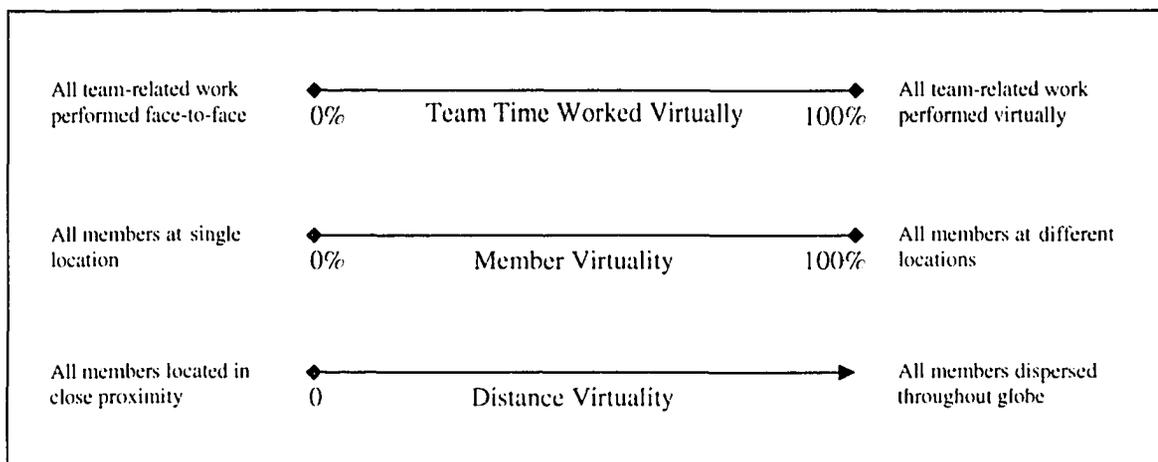
#### **4.3 DEVELOPMENT OF A MEASURE OF DEGREE OF VIRTUALITY**

The idea that a team’s virtuality may be a matter of degrees is a relatively new one. While the recognition that some teams may be more virtual than others has begun to enjoy some attention in the literature, there is no agreement as to the nature or dimensions of the concept of degree of virtuality. Furthermore, no empirical measure of this construct was found in the existing literature. The development and testing of a measure of degree of virtuality was one of the major objectives and contributions of this thesis.

Degree of virtuality has been defined in this study as a multi-dimensional construct with three dimensions:

- 1) Team Time Worked Virtually: The proportion of team work time that the team members spend working apart (WV);
- 2) Member Virtuality: The proportion of the team members who work virtually (MV); and
- 3) Distance Virtuality: The degree of separation of the team members (distance) (DV).

These three dimensions of virtuality are shown in Figure 3. As defined previously, for the purposes of this research, a VT is a team whose members do not work at the same place at the same time and must collaborate across space and/or time. Team time worked virtually (WV) addresses the possibility that team members who are working at the same location may not always be present at the same time (i.e. shift work or flex hours). In addition, it recognizes that even highly dispersed members (many locations) may meet frequently to work proximately. Member virtuality (MV) measures the degree to which members do not work at the same place. Finally, distance virtuality (DV) distinguishes between the virtuality of a team whose members are all located in the same city versus one whose members are dispersed throughout the globe. It recognizes the cost and difficulty in organizing face to face meetings. The value of DV is also dependent on the size of the team (i.e. a highly dispersed, two-member team would be able to meet face-to-face much more easily than a very large dispersed team).



**Figure 3: Dimensions of Degree of Virtuality**

The data for the degree of virtuality were collected from two sources: the team members and the team managers. Each dimension will be examined in detail in the following sections. This is followed by a discussion of the interpretation of the dimensions of virtuality and how they will be employed in this thesis.

#### **4.3.1 Team Time Worked Virtuality (WV)**

This dimension of degree of virtuality represents the degree to which the team's work is done in a different location or at a different time. In other words, it seeks to determine the proportion of time that team members work virtually on the team's tasks. Again, WV can be conceptualized as a continuum with a wholly VT (i.e. a team that performs all team-related activities without ever meeting face-to-face) on one end of the continuum and a wholly traditional team (i.e. a team that performs all of their team-related activities face-to-face, either through co-location or travel). Again, most VTs would likely fall between the two extremes (e.g. a team that works at different locations, but meets once a week).

WV is operationalized in this thesis as the proportion of the total team-related work hours spent working virtually. The data used to calculate the proportion of VT work time were collected from the team members using the following two questions:

- “How many hours in total do you spend each week on work activities related to this VT?”
- “How many hours do you spend each week working *virtually* (i.e. not face-to-face) on work activities related to this VT?”

The team’s WV was calculated as the total number of hours the team’s members spent working virtually (the sum of all of the team members’ responses) divided by the total number of the members’ team-related work hours (the sum of all of the team members’ responses) and multiplied by 100. A team which performs the entire team task without ever meeting would score 100% on this dimension. A team that performs all of the team’s tasks face-to-face would score zero.

#### **4.3.2 Member Virtuality (MV)**

This dimension of degree of virtuality defines virtuality in terms of the proportion of team members who work in different locations. It allows for the real possibility that the co-location or dispersion of a team’s members is not a dichotomy, but rather a continuum with traditional teams (i.e. all members working in one location) at one end and wholly VTs (i.e. each of the team’s members working at a different location). Most VTs would

likely fall between the two extremes (e.g. a team of six members working from 3 locations, where the members are co-located in pairs).

The data used to calculate the MV were collected from the team managers who were asked: “Can you provide the locations of each of the members on your VT?” Member virtuality was then calculated as the total number of different member locations divided by the number of team members and multiplied by 100. A team whose members each work at different locations (i.e. the number of locations equals the number of team members) would score 100% on this dimension. A team of four members who worked in pairs at two locations would receive an MV score of 50%.

#### **4.3.3 Distance Virtuality (DV)**

The third dimension of degree of virtuality, distance virtuality, is conceptualized as the distance between the team members’ locations (i.e. the spatial distance between members, or the amount of effort or travel time necessary to meet as a team).

DV is operationalized in this thesis as the total distance between team members. The data used to calculate the DV for each team were collected from the team managers who were asked to provide the locations of the team members with respect to their proximity to one another using the following question: “Can you provide me with the locations of each of the members on your team - Not their specific addresses, but the city in which they are based – or, in the event that they are in the same city, whether or not they are in the same building, same floor, etc.?”

Distance scores were established to represent travel time and effort required to meet (planning and cost). Teams with members who are fairly proximate (same city) can have inexpensive, impromptu meetings, where travel time and method are less of an issue. Teams requiring airplane travel require greater planning (reservations, accommodations) and resources (money) to meet. Potentially, the greater the distance, the more lead time and money required for a meeting. The coding scheme used to calculate distance scores is presented in Table 2.

Unlike the other two dimensions of virtuality, *DV* is not a proportion.

For each team, the total *DV* score was calculated as a sum of individual members' distance scores. In order to calculate the *DV*, it was necessary to choose a hypothetical meeting location for each team, as the distance scores would vary according to where a meeting would take place. For each team, the location that would require the least total amount of travel by the members was chosen (i.e. the location that would minimize the *DV* score). A large team whose members are all located in such a way that they require more than 3 days to meet as a team at a central location would score the highest on this dimension. A small team with all of its members in the same city would score the lowest.

**Table 2: Distance Scores Used in Calculation of Distance Virtuality**

<b>Travel</b>	<b>Score</b>
Same City (1/4 day – walk, car, public transit))	0.25
Montreal to Ottawa Hamilton to Toronto (1/2 day – car, train) London to Toronto	0.50
Montreal to Toronto (1.5 days – car, train, airplane) Ottawa to Toronto	1.50
Toronto to Vancouver (2 days – airplane)	2.0
Toronto to Europe (2 days – airplane)	3.0
Toronto to Asia (3 or 4 days – airplane)	5.0

For example, the distance virtuality for a team with a total of four members, two located in Montreal (different buildings), one in Ottawa, and one in Vancouver was calculated as follows:

- Team distance scores assuming meeting was in Montreal:
  - Score for host member (first member in Montreal) = 0
  - Score for second member in Montreal = 0.25
  - Score for member in Ottawa = 0.5
  - Score for member in Vancouver = 2.0
- DV for team: Total summed score for team = 2.75

#### 4.3.4 Interpretation of the Measure of Degree of Virtuality

These three dimensions of degree of virtuality theoretically measure three different aspects of virtuality. This assumption was supported by the fact that when grouped together in one scale, the three dimensions of degree of virtuality had a Cronbach's Alpha of 0.33, indicating that these items do not measure the same construct.

The correlations (2-tailed Pearson correlations) between the three dimensions of degree of virtuality are presented in Table 3. None of the correlations were significant ( $r < 0.21$ ). As it was impossible to determine, apriori, the relative impact of these three dimensions of virtuality on the research framework, the three dimensions were considered separately in the analysis. This was done by testing the research framework of VT effectiveness three times; once for each dimension of virtuality.

**Table 3: Correlations of Dimensions of Degree of Virtuality**

<b>Dimension</b>	<b>MV</b>	<b>WV</b>
<b>MV</b>	-	
<b>WV</b>	0.208	-
<b>DV</b>	0.155	0.055

**\*\*Correlation significant at  $p < 0.01$ ; \*Correlation significant at  $p < 0.05$**

#### **4.4 DEVELOPMENT OF A MEASURE OF VIRTUAL TEAM EFFECTIVENESS (OUTPUTS)**

Existing VT research is largely based on what is already known about proximate teams, with little or no adaptation of the constructs of team effectiveness to the unique conditions of VTs. No measure of effectiveness geared specifically towards VTs was found in the literature. The development and testing of a number of measures of VT effectiveness was one of the major objectives and contributions of this study.

In general, proximate team effectiveness has been defined as the degree to which a team satisfies all of its objectives, be they productivity or behaviour related. For this study, VT effectiveness was operationalized to include the following performance-related objectives and attitudinal outcomes:

- 1) The achievement of the team's task (quality, budget, schedule);
- 2) The satisfaction of the team members with respect to their VT experiences;
- 3) The professional development VT members received from working on a VT (i.e. challenge, knowledge, skills and goal attainment); and
- 4) The contribution that the VT experience has made to the members' ability and desire to work on VTs in the future.

Each dimension of VT effectiveness is discussed in detail in the following sections. This is followed by a discussion of the interpretation of the measure of VT effectiveness in this thesis.

#### **4.4.1 Task Performance (Productivity/Task Completion)**

The performance dimension of VT effectiveness is defined in this thesis as the degree to which the team achieved its task, with respect to quality, budget, and schedule. Data on the perceived performance were obtained from two sources: self-rating by team members and the judgements of the managers. The use of multiple sources for the evaluation of performance is supported by Gladstein (1984) and Campion et al. (1996). Each of these measures of task performance is discussed below.

##### **4.4.1.1 Members' Self-Assessment of Virtual Team Performance**

The individual VT members' perceptions of their team's performance was measured using a scale developed by Lurey and Raisinghani (2001). The scale consists of 4 items, reflecting the perceived success of the team in reaching its goals, its business objectives, its budget and its schedule. The questions are presented in Appendix R. The respondents were asked to rate their agreement with the statements on a five-point scale (1=strongly agree, 5=strongly disagree). An overall score was determined by calculating the average of the four questions. Higher scores represent greater perceived performance. In this study, the scale had a Cronbach's Alpha of 0.88.

##### **4.4.1.2 Managers' Assessment of Virtual Team Performance**

The teams' performance was also assessed during the interviews with VT managers. No empirically-tested measure of managers' judgements of team effectiveness was found in the literature. The questions used were, therefore, identical to those asked of the team members (Presented in Appendix R). The managers were asked to rate their agreement

with each of the four statements on a five-point scale (1=strongly agree, 5=strongly disagree). An overall score was determined by calculating the summed average of the four questions. Higher scores represent greater perceived performance. In this study, the scale had a Cronbach's Alpha of 0.88.

#### 4.4.1.3 Interpretation of the Measure of Task Performance

Ideally, the managers and members of the VTs would express similar perceptions of task performance and the two measures could be combined for the analysis. Realistically, however, it was likely that this would not be the case, as it is possible that the members and managers of teams use different criteria to determine their task performance (as found by Gladstein (1984)). Two-tailed Pearson correlations were performed to determine the extent to which the perceptions of task performance were shared by the team members and managers. The two assessments of performance from the two different sources were not significantly correlated ( $r=0.262$ ). As it was impossible to determine whose view of task performance was the most appropriate for further study, the two measures were both included in the research framework and considered separately in the analyses.

#### 4.4.2 Virtual Team Member Satisfaction

The satisfaction dimension of VT effectiveness is defined in this thesis to include the degree to which team members perceive that the VT experience contributes to the growth and personal well-being of the members. The individual team members' satisfaction with their experiences on their team was assessed using a five-item scale developed by

Lurey and Raisinghani (2001). This scale was augmented with a global team satisfaction item used by Gladstein (1984). The resulting 6-item scale asked members to quantify how satisfied they were with respect to the following:

- The degree to which the VT members' input is valued;
- The respect shown for VT members;
- Team morale;
- The amount of enjoyment they derived from VT membership;
- Their interest in future VT work; and
- The overall satisfaction with the VT experience.

The questions are presented in Appendix R. The respondents were asked to rate their agreement with the statements on a five-point scale (1=strongly agree, 5=strongly disagree). An overall score of VT member satisfaction was determined by calculating the summed average of the 6 questions. Higher scores reflect greater satisfaction. In this study, the 6-item scale had a Cronbach's Alpha of 0.80.

#### **4.4.3 Perceptions of How Virtual Team Membership Affects Professional Development**

The extent to which work experience on VTs is perceived to contribute to the professional development of its members was also considered in this analysis as a dimension of VT effectiveness. No empirically tested measures of professional development were found in the available literature.

The measure used to assess professional development was adapted from two existing studies: Lurey and Raisinghani (2001) and Duxbury, Dyke and Lam (1999). The resulting 4-item scale asks members to assess the degree to which their experiences on the VT have provided them with challenging work and the opportunity to increase their knowledge and skills and progress towards their professional goals. The questions are presented in Appendix R. The respondents were asked to rate their agreement with each of the items on a five-point scale (1=strongly disagree, 5=strongly agree). An overall score of VT members' perceptions of VT professional development opportunities was determined by calculating the summed average of the four items. Higher scores reflect greater perceptions of professional development opportunities. In this study, the 4-item scale had a Cronbach's Alpha of 0.85.

#### **4.4.4 Perceptions of How Virtual Team Membership Affects Capacity for Future Virtual Team Work**

The final dimension of VT effectiveness included in this thesis, capacity for future VT work, was defined as the extent to which the VT members' experiences on the VT has affected their ability and willingness to work on other VTs in the future. Since no empirically tested measures of capacity for future VT work were found in the available literature, a two-item measure quantifying capacity for future VT work was developed for this thesis. The measure, shown in Appendix R, asks team members to what extent they agree or disagree (on a five-point scale: 1=strongly disagree, 5=strongly agree) that their experiences on their VT has improved their ability and their desire to work on VTs in the future. Higher scores represent a greater capacity for future VT work. No reliability

analysis was performed on this 2-item scale. The two items were, however, significantly correlated ( $r=0.580$ ,  $p<0.01$ ).

#### **4.4.5 Interpretation of the Measure of Virtual Team Effectiveness**

As noted previously, the four dimensions of VT effectiveness used in this thesis (task performance, VT member satisfaction, professional development, capacity for future VT work) measure theoretically different, and potentially conflicting, aspects of effectiveness. In addition, perception of task performance was collected from two different sources: VT members' perceptions, and VT managers' perceptions of team effectiveness. To determine how these measures could best be represented in the framework, it was necessary to verify that they were, in fact, distinct concepts. This was done by calculating two-tailed Pearson correlations. The correlations for the aggregated virtual team output data are shown in Table 4 (the approach for data aggregation is discussed in Section 4.8.1). Examination of these correlations indicates little agreement between the managers' views of VT performance and the views of the VT members. There was, however, high correlation with respect to the measures of VT effectiveness collected from the team members themselves. With the exception of the correlation between the team members' perceptions of VT performance and the VT members' perceptions with respect to capacity for future VT work, all of the correlations between variables collected from the members were high and significant at the  $p<0.01$  level.

Tabachnick and Fidell (1996) state that highly correlated variables ( $r>0.90$ ) may reflect multicollinearity, which means that the two variables, in essence, are measuring the same

concept. The danger of including somewhat redundant variables in an analysis is the resulting increase in error due to the inclusion of a variable that contributes little. As such, Tabachnick and Fidell (1996) suggested caution when employing variables with a bivariate correlation higher than 0.70. In the interests of parsimony, variables within the same component of the framework were considered redundant if their correlations were greater than 0.80. Variables with correlations higher than 0.70, but less than 0.80 are flagged for the reader, but were not removed. None of the correlations between the different measures of VT effectiveness exceed the cut-off for redundant variables.

**Table 4: Correlations of the Measures of VT Effectiveness (Outputs)**

<b>OUTPUT</b>	<b>VT Member's Perceptions of Performance</b>	<b>VT Member Satisfaction</b>	<b>VT Members' Perceptions of Professional Development</b>	<b>VT Members' Perceptions of Capacity for Future VT Work</b>
<b>VT Member's Perceptions of Performance</b>				
<b>VT Member Satisfaction</b>	.669**			
<b>VT Members' Perceptions of Professional Development</b>	.537**	.540**		
<b>VT Members' Perceptions of Capacity for Future VT Work</b>	.393*	.525**	.741**	
<b>VT Manager's Perceptions of Performance</b>	.262	.055	.300	.007

\*\*Correlation significant at  $p < 0.01$ ; \*Correlation significant at  $p < 0.05$

These correlations indicate that VT managers' perceptions of performance is distinct and unrelated to the other measures. The other four measures of VT effectiveness are related, but also distinct. Accordingly, the five measures of VT effectiveness gathered from the

two sources were considered separately in the analysis. In other words, the framework was evaluated five times: once for each of the assessments of VT effectiveness.

#### **4.5 DEVELOPMENT OF MEASURES OF SUPPORT OF VIRTUAL TEAMS**

Organizations and managers can provide support to all teams through various means.

The remoteness of VTs may require specific kinds of support, particularly in terms of the acceptance of the reduced visibility of team members and support for working at a distance (Furst et al., 1999). No empirically tested measure of perceived support for a VT structure was found in the available literature. A small number of empirical studies of proximate teams include some measure of support (Campion et al, 1993; Sundstrom et. al., 1990), but none was appropriate for the unique circumstances of VTs. The development and testing of the measures of organizational support/non-support of VTs and managerial support/non-support of VTs was one of the major objectives and contributions of this study and fills a void in the current VT literature. The development of these measures provides researchers, managers and organizations with a better understanding of what can be done to support VTs and contribute to their effectiveness.

The *act frequency approach* was used to develop and test four measures: organizational support of VTs, organizational non-support of VTs, managerial support of VTs and managerial non-support of VTs. The act frequency approach consists of three phases: the identification of supportive behaviours, the rating of behaviours to develop a measure,

and the testing of the measure. The act frequency approach and its use in this study are discussed in detail in the sections that follow.

#### **4.5.1 The Act Frequency Approach: An Overview**

The act frequency approach has been used previously to develop behaviourally-based measures of support (Szamosi & Duxbury, 2002). This technique has been recommended to researchers in organizational behaviour as a psychometric technique to employ when no measures of a construct exist and there are no alternate measures that can be used in the measurement validation process (Cooper, Dyke & Kay, 1990).

The act frequency approach was developed by Buss and Craik (1980; 1981; 1983; 1984) as a methodology for the study of personality traits. It seeks to identify the set of behaviours that represent a given disposition (Buss & Craik, 1980). These identified behaviours are then used to represent and determine the presence of that disposition. The assumption is that if a person, group or organization has a certain disposition, that person, group or organization will have exhibited a high frequency of behaviours that are characteristic of that disposition, and will continue in a similar manner in the future (Buss & Craik, 1983).

The act frequency approach has two initial stages: act nominations and prototypical ratings. The testing of the developed measure can be viewed as a third stage. The goal of the first stage (act nominations) is to develop an exhaustive list of representative behaviours. This is accomplished by asking respondents to list any and all behaviours

that they associate with the disposition being studied. The goal of the second stage (prototypical ratings) is to refine the lists of nominated behaviours into a set of key behaviours which best represent the disposition (support). This is accomplished by providing a second set of respondents with the list of nominated behaviours and asking them to assess how prototypical each of the behaviours is of the disposition (i.e. how well each behaviour exemplifies the disposition). The prototypicality of the behaviours is assessed on a 7-point scale, with higher scores indicating greater prototypicality. The measure is constructed using only those behaviours scoring high prototypicality ratings. The goal of the final stage is to test the reliability, validity and predictive ability of the developed measures.

#### 4.5.1.1 Criticisms of the Act Frequency Approach

It should be noted that there are numerous criticisms of the act frequency approach. Key criticisms are presented below. Most, however, apply to the measurement of personality, for which the approach was developed, rather than to the area of organizational behaviour and, as such, do not apply to this research.

In his summary of the criticisms of the act frequency approach, Szamosi (1999) noted four major concerns. First, the act frequency approach has been criticized for providing less value than traditional methods of inventory scale development (Block, 1989).

However, as Dyke (1990) points out, this approach provides several benefits over methods that are more traditional: empirical methods are used in item construction; redundancies are not eliminated until an exhaustive list has been produced; and

respondents are asked to relate behaviour to disposition, rather than reflecting on their own behaviour.

The act frequency approach has also been criticized for its claim that act ratings imply a true zero and can therefore be used as ratio measurement (Block, 1989). While this criticism could only be overcome by including the entire universe of behaviours in the measure, it does not outweigh the benefits of this approach: in the absence of existing measures, and alternate measures for comparison, the act frequency approach provides a pragmatic solution.

The third criticism is that the act frequency approach does not take into account the context in which the behaviours occur (Block, 1989). This is not a primary concern in this study because the measures are to be used within the context in which they were developed: VTs.

Another criticism is that the method relies on the retrospections of the respondents (Block, 1989). Traditional methods have also been criticized based on recall bias (Dyke, 1990), and it has been proposed that if the observer and self reports converge, the self-reports can be considered to be appropriate (Buss, 1984). In other words, the act frequency approach uses two independent samples. The self-reports nominate the behaviours and the observers assess to what extent the nominated behaviours actually represent the disposition under study. Any behaviour that has been nominated *and* highly

rated can be considered to be appropriate. In this study, it was intended that any nominated behaviours that were not rated as highly representative of the disposition, would be eliminated from the study.

One final criticism of the act frequency approach is that it assumes that dispositions can be accurately represented by their associated behaviours. The criticism is that any single behaviour could be perceived as representing many different dispositions (Moser, 1989). In other words, using a behaviour as a proxy for a single disposition may be misleading (Moser gives the example of singing as a behaviour which may represent many dispositions, depending on the context). In this study, however, the goal was not to identify a single behaviour that would be used to represent managerial or organizational support or non-support of VTs, but rather to identify four sets of behaviours that represent such support or non-support. Each set of behaviours represents support and provides context.

#### **4.5.2 The Application of the A.F.A. in this Study: Development of Measures of Managerial Support and Non-Support of Virtual Teams**

The extent to which the VT members perceived that their manager supported or did not support VT work was assessed using two measures developed within this study using the Act Frequency Approach. These measures were developed and tested through the following 3 stages: act nomination, prototypicality rating and testing the measure. Each stage is discussed in detail below.

#### 4.5.2.1 The Act Nomination Sample

During the act nomination stage, respondents are asked to identify behaviours that are representative of dispositions (in this case, managerial support and managerial non-support of VTs). The goal is to develop an exhaustive list of representative behaviours for each disposition.

In order to compile the list of managerial behaviours that are supportive and non-supportive of VTs, semi-structured telephone interviews were conducted with employees having experience with VTs. The interviews lasted between 15 and 20 minutes. The goal was to conduct telephone interviews with 30 individuals with experience working on or managing VTs.

The sample used in the first stage of the act frequency approach was obtained as follows: The main contact at the organization was within the Human Resources Department. Prior to the beginning of the study, the main contact was asked to send an email to all departmental directors explaining the purposes and requirements of the research and asking for participation in this phase of the study. Departmental directors were asked to pass on the message to their employees and all interested parties were asked to contact the researcher by email. The Director of at least one department (Human Resources) announced the study at their departmental meeting. A sample of 30 individuals was selected to participate.

Before beginning the act nomination interviews, demographic data (gender, team size, age, area of expertise, education, tenure, experience and expertise with information technology) were collected from the respondents for the purposes of describing the sample. The data on the sample are summarized in Table 5 and discussed below.

The Act Nomination sample consisted of 25 females (83%) and 5 males (17%). This is not representative of the organization as a whole, which reports 47% females overall. It is, however representative of the HR department, from which the majority (70%) of the sample was drawn. When selecting the act nomination sample, employees in the HR department were over sampled. There were two reasons behind this decision. The first is expediency. In the act nomination phase of this research the Human Resources Department served as the main point of contact for the organization and, as such, ensured that their members were informed of the study and encouraged them to participate (by announcing it at their departmental meeting).

Second, it was felt that the HR personnel represented a good source of data on support and non-support of VTs and could provide insight into how these teams could best be supported. They had a lot of experience with VTs, as working with these teams was part of their job function. With respect to the area of expertise of the respondents, the remaining 30% of the sample came from the following areas: marketing (7%), operations (7%), communications (7%), finance (3%) and other areas (7%).

**Table 5: Sample Description**

<b>Demographic</b>	<b>N=30</b>
Gender (Female)	83%
Age <ul style="list-style-type: none"> <li>• under 26</li> <li>• 26 to 35</li> <li>• 36 to 45</li> <li>• 46 to 55</li> <li>• over 55</li> </ul>	7% 50% 17% 23% 3%
Team size	mean = 11.3 members (s.d. = 7.78)
Area of Expertise: <ul style="list-style-type: none"> <li>• HR</li> <li>• Marketing</li> <li>• Operations</li> <li>• Communications</li> <li>• Finance</li> <li>• Other areas</li> </ul>	70% 7% 7% 7% 3% 7%
Education: <ul style="list-style-type: none"> <li>• High School diploma</li> <li>• Some Post-Secondary</li> <li>• Post-Secondary Degree</li> <li>• Post Graduate Degree</li> </ul>	0% 10% 74% 17%
Tenure <ul style="list-style-type: none"> <li>• With employer</li> <li>• With VT</li> </ul>	Mean = 10.28 (s.d. 9.53) Mean = 2.44 (s.d. 2.53)
Comfort with Technology <ul style="list-style-type: none"> <li>• Very Comfortable</li> <li>• Comfortable</li> <li>• Somewhat Comfortable</li> <li>• Not Very Comfortable</li> <li>• Not at all Comfortable</li> </ul>	47% 37% 17% 0% 0%
Experience with Technology <ul style="list-style-type: none"> <li>• Expert</li> <li>• Advanced</li> <li>• Intermediate</li> <li>• Beginner</li> <li>• No Experience</li> </ul>	13% 23% 57% 7% 0%

The respondents were primarily between the ages of 26 and 55, with half of the respondents falling between the ages of 26 and 35. The relatively young age of the

sample is not surprising, given that the respondents are knowledge workers and were selected because they either had worked on or managed a VT, not because of their job experience or their position in the company. The age of the sample is in keeping with the reported tenure. The team members reported a mean of 10.28 years with their present company. As expected with knowledge workers, the respondents were well educated, with the great majority reporting a post-secondary education (74%), with 17% having completed graduate studies.

The size of teams on which the respondents served had a mean of 11.3 members. This is slightly higher than is reported in the literature (i.e. VT sizes of between 3 and 7). The respondents had been members of a VT for an average of 2.44 years.

Again, in keeping with what is expected of knowledge workers, particularly those in the telecommunications industry, the respondents reported high levels of comfort and experience with information technology. As can be seen in Table 5, all of the respondents had experience with information technology, most considered themselves comfortable with it and one-third rated their level of experience as expert or advanced. All of the respondents were comfortable with information technology.

Overall, the sample employed in this study for the act nomination stage of the act frequency approach was representative of what is expected of knowledge workers working at the middle to lower ranks of the organization. They were younger, well-

educated, had a moderate amount of tenure, and were well-versed in information technology. They also had personal experience with working on a VT.

#### 4.5.2.2 Stage 1: Act Nomination – Identification of Managerial Behaviours that are Supportive and Non-Supportive of Virtual Teams

The phone interviews included two open-ended questions designed for the process of act nomination. Specifically, respondents were asked:

- “What has your manager *done* to support VTs?”
- “What has your manager *done* that is not supportive of VTs?”

For each question, respondents were asked if there were any additional behaviours that could be identified (e.g. “Is there anything *else* that your manager has done to support VTs?”). It was ensured that respondents focused on behaviours rather than attitudes or sentiments. Respondents were asked to clarify how any attitudes or sentiments that were mentioned had manifested themselves in terms of behaviours. The interview only moved on to the next question when the respondents could no longer provide any new behaviours pertaining to that disposition.

After completion of all of the interviews, a complete list of all nominated behaviours was compiled for each question. This resulted in a list of 70 supportive behaviours and 43 non-supportive behaviours. These lists were analyzed and pruned of all redundancies and unclear statements. During this stage of the research, it became apparent that there was a high degree of consensus on what kinds of behaviours were displayed by managers who were perceived to be supportive of their VTs and those who were perceived to be non-

supportive. Most behaviours were identified by numerous respondents and the final “pruned” lists consisted of 14 unique supportive behaviours and nine unique non-supportive behaviours. There were no differences found in the responses between gender or area of expertise. This suggests that the results from this stage of the study can be generalized to the organization as a whole.

Another researcher, experienced with the act frequency approach, evaluated the lists to ensure that they adequately represented the data collected. She obtained an identical set of behaviours as the author, which increases confidence in the process. The two resulting lists of unique behaviours which represent managerial support and non-support of VTs are presented in Appendix S. These two sets of behaviours were used as the basis for the prototypicality rating in Stage 2.

#### 4.5.2.3 Stage 2: Prototypicality Rating – Refinement of Nominated Behaviours

The goal of the second stage of the act frequency approach is to refine the lists of nominated behaviours into a set of key behaviours which best represent the dispositions. This is usually accomplished by asking respondents to rate the behaviours for prototypicality (i.e. “the degree to which a particular behaviour represents the disposition being tested” (Szamosi, 1999: p.89)). Each of the nominated behaviours is rated on a 7-point scale, with higher scores indicating greater prototypicality of that behaviour (i.e. the extent that each behaviour represents the disposition under study).

The ratings for each behaviour are then analyzed to determine respondent consensus or near consensus, based on the mean rating. Behaviours which result in low mean ratings are then eliminated from the lists of nominated behaviours.

Given the relatively small set of nominated behaviours generated in the previous stage, and the high degree of agreement between the respondents with respect to what constitutes managerial support and non-support of VTs, the goal of determining consensus through prototypicality rating was considered unnecessary. In this study, the full set of nominated behaviours for managerial support and non-support of VTs were carried into the third stage of the act frequency approach – testing the measures.

#### 4.5.2.4 Stage 3: Testing the Measures of Managerial Support and Non Support of Virtual Teams

The goal of the final stage of the act frequency approach is to test the reliability, validity and predictive ability of the developed measures of managerial support and non-support of VTs. The exhaustive item generation procedure contained in the Act Frequency Approach improves face validity. The following techniques were used to test the measures in this thesis:

- Factor analysis (measure refinement);
- Cronbach's Alpha (internal reliability of the measures); and
- Correlation (predictive validity of measures).

Data related to the testing of the proposed measure for managerial support and non-support of VTs were collected through the online team member questionnaire described

previously in Section 4.2.3. The questionnaire included outcome measures which have been previously associated with management (Campion et al., 1993) and organizational (Gladstein, 1984) support of proximate teams (i.e. team member perceptions of performance and VT member satisfaction). These measures were used in this thesis to test the validity of the developed measures of managerial support and non-support of VTs.

The lists of unique nominated behaviours, representing the proposed measures of managerial support and non-support of VTs were included in the online questionnaire made accessible to the 171 members of the VTs.

The respondents were asked to rate their agreement with statements that their manager exhibits each of the representative supportive and non-supportive behaviours. The rating was made on a five-point scale (1=strongly agree, 5=strongly disagree). The forms of the questions were as follows:

- Managerial support of VTs: My VT manager makes it easier for our VT to be effective by being a role model (i.e. using technology, communicating/managing virtually, being open to new approaches, etc.); and
- Managerial non-support of VTs: My VT manager makes it more difficult for our VT to be effective by focusing on presence at work rather than performance or contribution.

As the second stage of the act frequency approach was not used to rate and refine the lists of unique nominated behaviours, the sets of supportive and non-supportive behaviours were explored for themes and refined through factor analysis. This method is reported by Tabachnick and Fidell (1996) as a strategy that is used by researchers to help understand the underlying structure of a set of questions and to determine if there are “coherent subsets that are relatively independent of one another” (p. 635). As Tabachnik and Fidell (1996) noted that factor analyses performed with sample sizes less than 150 can be considered weak, the results of this analysis ( $n=107$ ) were interpreted with caution.

A principal factor analysis was performed on the list of nominated behaviours, using varimax rotation with a Kaiser Criterion of inclusion. Only factors with an eigenvalue of one or greater were retained (Kaiser, 1970). Tabachnick and Fidell (1996) noted that a factor with an eigenvalue less than one “is not as important, from a variance perspective” (p. 672) as an individual variable.

With respect to variable retention, Tabachnick and Fidell (1996) state that the selection of cut-off point is at the discretion of the researcher and describe a factor loading of 0.45 to 0.55 as “fair” to “weak”. In this study, only those variables with maximum factor loadings greater than 0.55 were retained. Another criterion for factor analysis is that the variables load significantly onto only one factor (Tabachnick & Fidell, 1996). Only those variables with a difference of 0.2 or greater between the highest and second highest loading were retained (Ferguson & Cox, 1993).

The reliabilities of the proposed factors for the measures of managerial support and non-support were then tested using Cronbach's Alpha. The validity of the measures was tested by exploring the relationship between the factors of managerial support and non-support and the two of the variables of VT effectiveness which had been included in previous research. This was done using Pearson correlations.

#### **4.5.3 The Application of the A.F.A. in this Study: Development of a Measure of Organizational Support and Non-Support of Virtual Teams**

The extent to which the VT members perceived that their organization supported or did not support VT work was assessed using two measures developed within this study using the Act Frequency Approach. Each stage is discussed in detail below.

Additional data on this issue were collected during the document review when the organization's policies with respect to VT structure were investigated.

##### **4.5.3.1 Stage 1: Act Nomination - Identification of Organizational Behaviours that are Supportive and Non-Supportive of Virtual Teams**

The description of the act nomination process, the sample identification, and data collection for the act nomination stage were described in Section 4.5.2. In this case, however, the two open-ended questions used for the process of act nomination were modified as follows:

- “What has your organization *done* to support VTs?”
- “What has your organization *done* that is not supportive of VTs?”

For each question, respondents were asked if there were any additional behaviours that could be identified (e.g. “Is there anything *else* that your organization has done to support VTs?”). The interview only moved on to the next question when the respondents could no longer provide any new behaviours pertaining to that disposition.

After completion of all of the interviews, a list of all nominated behaviours were compiled. The interviews generated a total of 73 behaviours that typified organizational support of VTs and 45 behaviours that represented non-support.

The lists were analyzed and pruned of all redundancies and unclear statements. Once refined, these lists were reduced to ten unique supportive behaviours and nine unique non-supportive behaviours. This result, which was similar to that observed with respect to the measures for managerial support and non-support of VTs, suggests a high degree of consensus on what constitutes organizational behaviours which are supportive and non-supportive of VTs. Most behaviours were identified by numerous respondents, and one behaviour (providing effective communication tools and budgets) was identified by all but one of the respondents. No differences were found in the responses between gender or area of expertise, suggesting that these results can be generalized to the organization as a whole. To increase confidence in these findings, another researcher, experienced with the act frequency approach evaluated the lists to ensure that they adequately represented the data collected. Again, their findings confirmed those noted above.

The two resulting lists of unique behaviours which represent organizational support and non-support of VTs are presented in Appendix T.

#### 4.5.3.2 Stage 2: Prototypicality Rating – Refinement of Nominated Behaviours

The process for the prototypicality rating was described in Section 4.5.2.3. The goal of the second stage of the act frequency approach is to refine the two lists of nominated behaviours into sets of key behaviours which best represent the dispositions.

Given the relatively small set of nominated behaviours generated in the previous stage, and the high degree of agreement between the respondents, the goal of determining consensus through prototypicality rating was considered unnecessary. In this study, the full set of nominated behaviours for organizational support and non-support of VTs were carried into the next step in the development of the measure.

#### 4.5.3.3 Stage 3: Testing the Measures of Organizational Support and Non-Support of Virtual Teams

The goal of the final stage of the act frequency approach is to test the reliability, validity and predictive ability of the developed measures of organizational support and non-support of VTs. The process for testing the measures of organizational support and non-support (i.e. the sample, data collection, and data analysis) were described in Section 4.5.2.4.

As was the case with managerial support and non-support of VTs, respondents were asked to use a five-point Likert-type scale (1=strongly agree, 5=strongly disagree) to rate their agreement with statements on organizational support/non-support of VTs. The forms of the questions were as follows:

- Organizational support of VTs: My organization makes it easier for a VT to be effective by making sure that the technology used within the organization is compatible; and
- Organizational non-support of VTs: My organization makes it more difficult for a VT to be effective by not providing to VTs the communication tools they need to work virtually (hardware & software: no laptops, slow network, outdated tools, incompatible software).

#### **4.6 MEASUREMENT OF VIRTUAL TEAM INPUTS**

Inputs were described previously to refer to any condition or characteristic that can be considered to affect the effectiveness of the team. Input variables can be divided into two groups: contextual inputs (external to the team) and team inputs (internal to the team).

Data regarding key contextual and team inputs of the VTs were collected from two sources: VT managers, and VT members. As the study was based in a single organization, the information collected from the document review (discussed in Section 4.2.1) was used in this study to provide context, rather than as a variable.

In order to ensure the validity and reliability of the results, existing measures were employed whenever possible. Due, however, to the limited set of empirical studies on

VTs, very few well-established measures could be identified for the constructs in the research framework. Consequently, some of the measures had to be adapted from other areas of research. Other than the background and demographic items, the questions used Likert-type scale items to collect responses. Details regarding the measurement of each variable in the research framework are discussed in detail in the following sections.

#### **4.6.1 Team Inputs**

This section outlines the measures used to quantify the following team-level inputs: team size, team age (longevity), team meeting history, team composition, task design, goal clarity, tools, member skills, and leadership effectiveness.

##### **4.6.1.1 Team Size, Longevity, and Meeting History**

Team size, longevity and meeting history were determined during the interviews with the team managers. The questions asked of the managers were as follows:

- How many members are on the VT?
- How long has the VT been operating (in months)?
- Has this VT ever met face-to-face? (yes, no). If yes, how many times in the last year?
- Does this VT have regular, face-to-face meetings? (yes, no) If yes, how often? (1=weekly, 2=bi-weekly, 3=monthly, 4=quarterly, 5=yearly);
- Did this VT have a face-to-face meeting when it was initially formed? (yes, no).

All of the variables were collected at the team level and, as such, no manipulation or aggregation of data was required prior to analysis.

The last three questions regarding team meeting history were also asked of the VT members in the online survey. The rationale for this was to allow for the possibility that some teams, particularly those in closer proximity to one another, may have met without the managers' express knowledge. These data were compared to those given by the managers to assess the level of agreement between the two groups. For each question, if the VT manager and the great majority of the VT members (operationally defined as 80% or more of the team), gave the same response, the team managers' data were used. If the great majority of team members (i.e. 80% or more) agreed with each other, but not the manager, the VT member data were used. When there was no agreement between the team members, the team manager data was used in the analysis, under the assumption that the lack of consensus within the teams was due to changing team membership (members arrived after meeting had taken place). This interpretation of the data is supported by the fact that some teams had high variances with respect to member tenure on the VT.

#### 4.6.1.2 Team Composition

The team member questionnaire collected the following demographic information from the VT members: their gender, age, level of education, area of expertise, tenure with the company, tenure in their current position, and tenure with the team. Additional data on the VT members' comfort level with technology, and overall experience with technology were collected as per Nemiro's (1998) *VT Background Survey*. This information was

used both to describe the sample and to provide data for the team composition variables.

The demographic questions that were included in the questionnaire were as follows:

- What is your gender? (male, female)
- What is your age? (under 25, 26-35, 36-45, 46-55, over 55)
- Please indicate which choice best describes your educational background (1=high school, 2=some post-secondary, 3=post-secondary degree, 4=graduate degree)
- Which of the following best describes your area of expertise (HR, finance, operations, marketing, engineering, R&D, communications, other)
- How long have you worked for your present employer? (months, years)
- How long have you been in your present position? (months, years)
- How long have you been a member of this VT? (months, years)
- Please indicate your comfort level with information technology (1=not at all comfortable, 3=somewhat comfortable, 5=very comfortable) (Nemiro, 1998)
- Please indicate your experience with information technology (1=novice, 3=intermediate, 5=expert) (Nemiro, 1998)

As team demographics were the level of interest (not the characteristics of the individual VT members), the demographic data were aggregated to the team level. The method of aggregation depended on the type of data collected. For continuous variables (tenure in the organization, time in current position, team tenure) and interval variables (education, comfort and expertise with information technology), means were calculated to represent

team demographics. Team mean age was similarly calculated using category midpoints. Team gender was calculated using frequencies (percent female).

Team diversity represents the degree that the team members are different from one another with respect to a number of key demographic variables (i.e. age, education level and organization, position and team tenure). Team diversity with respect to each of these demographic characteristics was calculated as follows for each demographic variable. First, the within team standard deviation was calculated for each demographic variable for each team. Standard deviation was chosen to operationalize diversity with respect to each of these demographics because it represents the degree of spread in these data for each VT. Second, the VTs were rank-ordered from highest to lowest according to their standard deviation with respect to this variable. Third, the range of the standard deviations was divided into three equal-sized groups (low, medium, high). Finally, each VT was then classified into the appropriate group. Their standard deviation score was used to do this classification (i.e. classified as low if their standard deviation fell into the lowest group, middle if their standard deviation was in the second group and third if their standard deviation was in the highest group).

For VT diversity with respect to area of expertise, a continuous variable was created using the number of different areas of expertise represented by the team members (i.e. how many areas of area of expertise were represented on the team).

#### 4.6.1.3 Task Design

The degree to which a VT has a clear and engaging task, potentially motivates the members to work as a team and perform effectively. Data on this aspect of task design was collected from individual team members using a scale adapted from Bushe and Johnson (1989). The scale consists of four items which measure the VT members' perceptions of how motivating their task is. Questions include such items as: "The nature of the VT's task is such that we know whether we are making progress as we work". The complete scale is presented in Appendix U. The respondents were asked to rate their agreement with each of the statements on a five-point scale (1=strongly disagree, 5=strongly agree). An overall score was determined by calculating the summed average of the four questions. Higher scores represent more engaging tasks. In this study, the 4-item scale had a Cronbach's Alpha of 0.74, which is in the desirable range as defined by Carmines and Zeller (1979).

#### 4.6.1.4 Goal Clarity

The extent that VT members have a common and clear goal or purpose is considered to be a strong predictor of VT success, as it is posited to focus the members and align them in the pursuit of the task (Nemiro, 1998).

Data on the clarity of the VT goals were collected from the individual team members using a scale adapted from Rickards and Chen (2001). The 3-item-scale assesses the degree of clarity and commonality of team goals. The questions are presented in Appendix U. A sample question was: "The team tends to have a shared view of team goals". The respondents were asked to rate their agreement with each of the statements

on a five-point scale (1=strongly disagree, 5=strongly agree). An overall score was determined by reverse coding (R ) the third item and calculating the summed average of the three questions. Higher scores represent greater levels of goal clarity. In this study, the 3-item scale had a Cronbach's Alpha of 0.61, which is in the acceptable range as defined by DeVellis (1991) and Anastasi (1990).

#### 4.6.1.5 Adequacy of Technology

The extent that VT members have the necessary information technology/communication tools to collaborate virtually has been shown to be critical to the teams' success. Data on the extent to which the members perceive that they have the communication tools necessary to do their jobs were collected from the individual team members using a 4-item scale adapted from Lurey and Raisinghani (2001). The questions were in the form of: "Team members are equipped with the information technology necessary to perform our task". The four questions are presented in Appendix U. The respondents were asked to rate their agreement with each of the statements on a five-point scale (1=strongly disagree, 5=strongly agree). An overall score was determined by calculating the summed average of the four questions. Higher scores represent greater adequacy of the available technology. In this study, the 4-item scale had a Cronbach's Alpha of 0.80.

The VT members were also asked if the following tools were available to them at work (yes/no): telephone, fax, teleconference, videoconference, email, chat facilities, groupware/shareware, shared database, netmeeting, intranet, cell phone, pager, laptop. Virtually all of the team members reported having access to telephones, facsimiles,

teleconference facilities, shared databases, Netmeeting, intranet and laptops. The majority of VT members also had access to the rest of the tools listed in the survey: videoconference facilities, chat facilities, groupware/shareware, cell phones, and pagers. The high availability of tools is not entirely surprising since the organization is in the telecommunications industry and would be expected to be at the forefront of such technology. Given the lack of variance with respect to the availability of the majority of the tools listed in the survey, these variables were eliminated from further analysis.

#### 4.6.1.6 Skills

The extent that VT members have the necessary skills to collaborate and perform their task is believed to be critical to a VT's success. The members' perceptions of the VT's skills were collected from the individual team members using a five-item scale adapted from Lurey and Raisinghani (2001). The questions included such things as: "Team members were selected based on their individual talents and abilities to contribute to the team." The five questions are presented in Appendix U. The respondents were asked to rate their agreement with each of the statements on a five-point scale (1=strongly disagree, 5=strongly agree). An overall score was determined by calculating the summed average of the five questions. Higher scores represent greater perceived VT skills. In this study, the 5-item scale had a Cronbach's Alpha of 0.87.

#### 4.6.1.7 Leadership Effectiveness

For the purposes of this study, the VT leader is defined as any team member who plays a leadership role within the team. Previous research has linked the behaviours (Lurey &

Raisinghani, 2001) and effectiveness (Kayworth & Leidner, 2002) of the leader to team success. Data on the perceived effectiveness of the team leaders were collected from the individual VT members as follows.

First, the VT members were asked whether or not the team had a leader and how that leader was chosen. The specific questions included in the survey were as follows:

- Please indicate which situation applies to your VT:
  - One of the team members plays the role of leader;
  - The leader role is rotated throughout the team (please skip to question #);  
or
  - My team has no identifiable leader (please skip to question #).
- The team leader was:
  - Appointed by management;
  - Voted in by the team members;
  - Informally assumed the role of leader; or
  - Other (please specify):

How the VT members perceived their internal team leader's effectiveness was then measured using a six-item scale adapted from Kayworth and Leidner (2002) and Bushe and Johnson (1989). A sample question was: "My VT leader effectively dealt with team conflict". The complete set of questions are presented in Appendix U. The respondents were asked to rate their agreement with each of the statements on a five-point scale (1=strongly disagree, 5=strongly agree). An overall score was determined by calculating

the summed average of the six questions. Higher scores represent greater perceived leader effectiveness. In this study, the scale had a Cronbach's Alpha of 0.87.

#### **4.6.2 Contextual Inputs**

Data at the organizational level were collected from two sources: document review and VT member perceptions. Measures of reward structure, training, and managerial and organizational support, will be discussed in detail below.

##### **4.6.2.1 Reward Structure**

Reward structures that encourage teamwork are tied to the team level. The members of effective teams are motivated to collaborate if their rewards are based on team performance (Robbins & Langton, 2001). Data on the VT members' perceptions that rewards offered to the VT are effective at the team level were collected from team members using a five-item scale. Items in this measure were adapted from those used by Lurey and Raisinghani (2001), Gladstein (1984), Campion et al. (1993), and Fields (2002). A sample question was: "My performance evaluation is strongly influenced by how well the entire VT is performing". The full set of questions are presented in Appendix V. The respondents were asked to rate their agreement with each of the statements on a five-point scale (1=strongly disagree, 5=strongly agree). An overall score was determined by calculating the summed average of the five questions. Higher scores represent greater perceptions of team-based rewards. In this study, the 5-item scale had a Cronbach's Alpha of 0.81.

#### 4.6.2.2 Training

The extent that VT members receive technical, professional, and VT skill training is posited to contribute to the effectiveness of the VT.

Data on the extent to which VT members perceive that the organization provides adequate training for their VT work were collected from team members using a scale adapted from Lurey and Raisinghani (2001) and Campion et al. (1993). The resulting scale consists of five items, measuring the perception of the adequacy of the VT's training. The measure included questions such as:

- *I receive sufficient training from the organization to develop my core skills; and*
- *The organization provides adequate technical training for my work on a VT.*

The five items are presented in Appendix V. The respondents were asked to rate their agreement with each of the statements on a five-point scale (1=strongly disagree, 5=strongly agree). An overall score was determined by calculating the summed average of the five questions. Higher scores represent perceptions of greater adequacy of training. In this study, the 5-item scale had a Cronbach's Alpha of 0.85.

#### 4.6.2.3 Organizational Support/Non Support and Managerial Support/Non-Support of Virtual Teams

The literature review suggested that the extent to which an organization or a manager supports the low-visibility and remoteness of the VT may contribute to its effectiveness. The development of these measures, which was one of the objectives of this study, was discussed in Section 4.5.

## **4.7 MEASUREMENT OF VIRTUAL TEAM PROCESS**

VT processes represent what goes on inside the team. Data on VT processes were collected from the individual team members. Measures of team trust, commitment to the task, collaborative climate, potency, and communication effectiveness are discussed in detail below.

### **4.7.1 Trust**

Trust is one of the most commonly cited challenges for VTs. Trust between VT members is believed to be necessary for quality and productive relationships (Lipnack & Stamps, 1997).

The extent to which the members trust one another was measured using scales of cognition-based and affect-based trust from Kanawattanachai and Yoo (2002). Each scale consists of 4 items. The two measures include items such as:

- I see no reason to doubt my teammates' competence and preparation for the job (cognitive trust); and
- If I shared my problems with my team, I know they would respond constructively and caringly (affective trust).

The eight questions comprising the two measures are presented in Appendix W. The respondents were asked to rate their agreement with each of the statements on a five-point scale (1=strongly disagree, 5=strongly agree). An overall score was determined by calculating the summed average of the four questions in each of the measures of

cognitive and affective trust. Higher scores represent greater trust. In this study, these scales had Cronbach's Alpha of 0.85 and 0.81 for cognitive and affective trust respectively.

#### **4.7.2 Team Task Commitment**

Team task commitment is related to task-based cohesion. Rather than measuring the attraction that the team members feel for one another, team task commitment measures the attraction of the task. It can lead to greater involvement and effort by team members (Huang et al., 2002).

The extent to which the VT members are committed to the team task was measured using a scale developed by Larson and Lafasto (1989) and used by Huang et al. (2002). The scale consists of three items. An example of a question in this scale is, "Team members believe that personal success is achieved through the accomplishment of the team goal (s)". The full measure is presented in Appendix W. The respondents were asked to respond to each question on a five-point scale (1=strongly disagree, 5=strongly agree). An overall score was determined by calculating the summed average of the three questions. Higher scores represent greater task commitment. In this study, this scale had Cronbach's Alpha of 0.65, which is in the acceptable range (DeVellis, 1991; Anastasi, 1990).

### **4.7.3 Collaborative Climate**

Collaboration is the key to teamwork. A number of researchers posit that a team's collaborative climate will determine the extent that team members have positive interactions (Huang et al. 2002; Holton, 2001).

The extent to which the VT members perceive that their team has a collaborative climate was measured with a scale used by Nemiro (1998). The scale consists of eight items. The questions were in the form of: "When interacting with one another, the members of our team usually exhibit an acceptance of diverse behaviours". The eight questions are presented in Appendix W. The respondents were asked to respond to each of the statements on a five-point scale (1=strongly disagree, 5=strongly agree). An overall score was determined by calculating the summed average of the eight questions. Higher scores represent a VT climate that is perceived to be more collaborative. For this study, this scale had a Cronbach's Alpha of 0.85.

### **4.7.4 Potency**

Potency is the extent that the team members feel that they will be successful in their task. Potency has been related to team effectiveness (Campion et al., 1993).

The extent to which the VT members perceive potency was measured using a scale adapted from Champion et al. (1993). This scale was augmented by one additional question based on Shea and Guzzo's (1987a: p. 26) definition of potency. This question took the following form: "My team has, or can get, everything it needs to succeed" (i.e.

training, skills, talent, budget, time, feedback, etc.). The resulting 3-item scale is presented in Appendix W. The respondents were asked to respond to each of the statements on a five-point scale (1=strongly disagree, 5=strongly agree). An overall score was determined by calculating the summed average of the three questions. Higher scores represent greater potency. For this study, this scale had a Cronbach's Alpha of 0.73.

#### **4.7.5 Communication Effectiveness**

Communication is a major concern in the functioning of a VT. In order to complete a collaborative task, VT mates must communicate. In VTs, the communication occurs virtually at least part of the time. The concern for VTs is that they cannot communicate as effectively as face-to-face teams.

The effectiveness of VT communication was measured using a scale adapted from Kayworth and Leidner (2002). The scale consists of six items, such as "When you have required important information about your task, how sufficient was the detail with which your teammates communicated this information?" (1=highly insufficient, 3=neutral, 5=highly sufficient). The six questions are presented in Appendix W. The respondents were asked to respond to each of the questions on a five-point scale. An overall score was determined by calculating the summed average of the six questions. Higher scores represent greater communication effectiveness. For this study, this scale had a Cronbach's Alpha of 0.85. Table 6 presents a summary of the measures used in this study, as well as their sources and reliabilities, where applicable.

**Table 6: Summary of Measures**

Framework Component	Source of Measure	Reliability	
		Literature	This Study
<b>OUTPUTS:</b> VT Effectiveness <ul style="list-style-type: none"> <li>• Perceived Performance</li> <li>• VT Member Satisfaction</li> <li>• Professional Development</li> <li>• Capacity for Future VT Work</li> </ul>	<ul style="list-style-type: none"> <li>• Lurey &amp; Raisinghani (2001)</li> <li>• Lurey &amp; Raisinghani (2001)</li> <li>• Lurey &amp; Raisinghani (2001), Duxbury, Dyke &amp; Lam (1999)</li> <li>• Developed in study</li> </ul>	0.82 0.82 0.80, n/a n/a	0.88 0.80 0.85 n/a
<b>MODERATOR:</b> Degree of Virtuality <ul style="list-style-type: none"> <li>• Work Virtuality</li> <li>• Member Virtuality</li> <li>• Distance Virtuality</li> </ul>	<ul style="list-style-type: none"> <li>• Developed in study</li> <li>• Developed in study</li> <li>• Developed in study</li> </ul>	n/a n/a n/a	n/a n/a n/a
<b>INPUTS:</b> Team Inputs <ul style="list-style-type: none"> <li>• Team Size, Longevity &amp; Meeting History</li> <li>• Team Composition</li> <li>• Motivating Task Design</li> <li>• Goal Clarity</li> <li>• Adequacy of Technology</li> <li>• Member Skills</li> </ul> Leadership Effectiveness Contextual Inputs: <ul style="list-style-type: none"> <li>• Reward Structure</li> <li>• Training</li> <li>• Managerial Support/Non-Support of VTs</li> <li>• Organizational Support/Non-Support of VTs</li> </ul>	<ul style="list-style-type: none"> <li>• Bushe &amp; Johnson (1989)</li> <li>• Rickards &amp; Chen (2001)</li> <li>• Lurey &amp; Raisinghani (2001)</li> <li>• Lurey &amp; Raisinghani (2001)</li> <li>• Kayworth &amp; Leidner (2002), Bushe &amp; Johnson (1989)</li> <li>• Kayworth &amp; Leidner (2002)</li> <li>• Lurey &amp; Raisinghani (2001), Gladstein (1984), Campion et al. (1993), Fields (2002)</li> <li>• Lurey &amp; Raisinghani (2001), Campion et al. (1993)</li> <li>• Developed in study</li> <li>• Developed in study</li> </ul>	n/a n/a n/a 0.78 0.79 0.71 0.95, 0.82 0.67, 0.61, 0.59, 0.89 0.73, 0.81 n/a n/a	n/a n/a 0.74 0.61 0.80 0.87 0.87 0.81 0.85 0.84-0.89 0.83-0.85
<b>PROCESSES</b> <ul style="list-style-type: none"> <li>• Cognitive &amp; Affective Trust</li> <li>• Task Commitment</li> <li>• Collaborative Climate</li> <li>• Potency</li> <li>• Communication Effectiveness</li> </ul>	<ul style="list-style-type: none"> <li>• Kanawattanachai &amp; Yoo (2002)</li> <li>• Larson &amp; Lafasto (1989)</li> <li>• Van Gundy (1984)</li> <li>• Campion et al. (1993)</li> <li>• Kayworth &amp; Leidner (2002)</li> </ul>	0.89, 0.86 0.90 0.90 0.80 0.78	0.85, 0.81 0.65 0.85 0.73 0.85

## **4.8 DATA ANALYSIS**

Given the relatively small sample size and the large number of variables contained in this study, only limited analysis could be performed on the data. Various methods of analysis were utilised in accordance with the types of variables and their role in the research framework. A description of each of the methods analysis and the context in which they are used is explained in detail in the following sections.

### **4.8.1 Aggregation to the Team Level**

As the primary focus of this study was the effectiveness of VTs, the team was the level of analysis. This approach is consistent with the advice offered by McGrath (1986) who strongly suggested that those studying groups focus on the group as the level of analysis. He stated that to understand groups, “We need to ask, ‘What goes on at the group level?’” (p. 368).

Two types of team data were collected in this thesis: 1) Data on the VT itself, which was collected from the organization or the team manager; and 2) data on the VT which was gathered from the individual team members. For each variable measured at the individual level, the data was aggregated to the team level.

Much has been written about the issue of aggregation (Campion et al., 1993; Goodman et al., 1987; Keller, 1986; Leenders et al., 2003; Magjuka & Baldwin, 1991; Potter & Balthazard, 2002). It has been suggested that team-level data can be effectively collected

from individuals if the characteristics under study can be considered “‘macro perceptions’ or shared views of the group” (Campion et al., 1993; p. 832). Campion et al. (1993) suggested that the effectiveness of using individual-level data for team-level research can be improved by wording the measures to reflect the team level of analysis (e.g. *The team* has - rather than *I* have - a say in how the work gets done). This approach has been frequently used in team and group research (Campion et al., 1993; Goodman et al., 1987; Keller, 1986; Leenders et al., 2003; Magjuka & Baldwin, 1991; Potter & Balthazard, 2002).

In order to employ aggregated data, it is necessary to determine if the aggregation of individual data results in a variable that “speaks for the group” (George, 1990).

Although there has been much criticism of the practice of aggregation, there is considerable agreement in the team literature (both proximate and virtual) with respect to justifying aggregation.

Intuitively it can be theorized that aggregation is appropriate if within-group variance can be shown to be significantly less than between group variance. This can be evaluated using ANOVA or intra-class correlation coefficient (Keller, 1986). James, Demarie and Wolf (1984) suggested that indices that compare internal and external variances may provide inaccurate or artificially low measures of agreement (George, 1990). They noted that when the different groups are in the same setting, there can be expected to be a limited level of variance amongst all of the individuals. Schneider and Bowen (1985)

noted that individuals within the same organization will tend to agree somewhat. This means that using between-group variances as a benchmark for comparison, may be setting the bar too high (i.e. within one organization, the between-group variances may be quite small and within-group variances cannot be expected to be much smaller). As Schneider and Bowen (1985) suggested, a measure of homogeneity would be a more accurate justification for aggregation.

James et al. (1984) provided a method for estimating within group agreement for measures employing discrete scales. The estimator, called the *within-group interrater reliability coefficient* (IRR) is a function of two variances. The first is the variance of the individual scores. The second is the variance that would be expected if the IRR were zero. This is based on the assumption that if the individual data were random, the IRR would be zero (i.e. on a 7-point scale, if the responses were random, the distribution would be uniform). The interrater reliability coefficient for single item constructs is calculated as follows (James et al., 1984):

$$r_{WG} = 1 - (s_{X_j}^2 / \sigma_{EU}^2) \quad \text{where} \quad \begin{array}{l} X_j \text{ is the variable being tested for agreement} \\ s_{X_j}^2 \text{ is the variance of } X_j \\ \sigma_{EU}^2 \text{ is the expected error} = (A^2 - 1) / 12 \\ A = \text{number of items on the scale} \end{array}$$

For multiple item scales:

$$r_{WG(J)} = \frac{J[1 - (s_{X_j}^2 / \sigma_{EU}^2)]}{J[1 - (s_{X_j}^2 / \sigma_{EU}^2)] + (s_{X_j}^2 / \sigma_{EU}^2)} \quad \begin{array}{l} \text{where } J \text{ is the number of items} \\ s_{X_j}^2 \text{ is the mean of the variances} \end{array}$$

George (1990) recommends that an inter-rater reliability of 0.70 provides sufficient justification for aggregation.

The inter-rater reliability was calculated for each of the 31 scales used in this study for every one of the 30 teams in the sample. Out of the 930 inter-rater reliabilities calculated, 6.6% fell below the 0.70 cut-off for aggregation. Of the 61 reliabilities falling below 0.70, 24 (2.6%) were between 0.60 and 0.70 (i.e. close to the cut-off point).

The problematic reliabilities (i.e. below 0.70) were explored for patterns with respect to team membership, team size, and scale. The low inter-rater reliabilities were randomly distributed amongst the different teams and the different scales.

While the low inter-rater reliabilities are cause for caution, given the relatively low number of inter-rater reliabilities below the cut-off point, and the lack of patterns amongst them, none of the data was discarded. In other words, aggregate team data was available for all of the teams that participated in the study for each variable included in the research framework .

#### **4.8.2 Testing the Paths in the Research Framework**

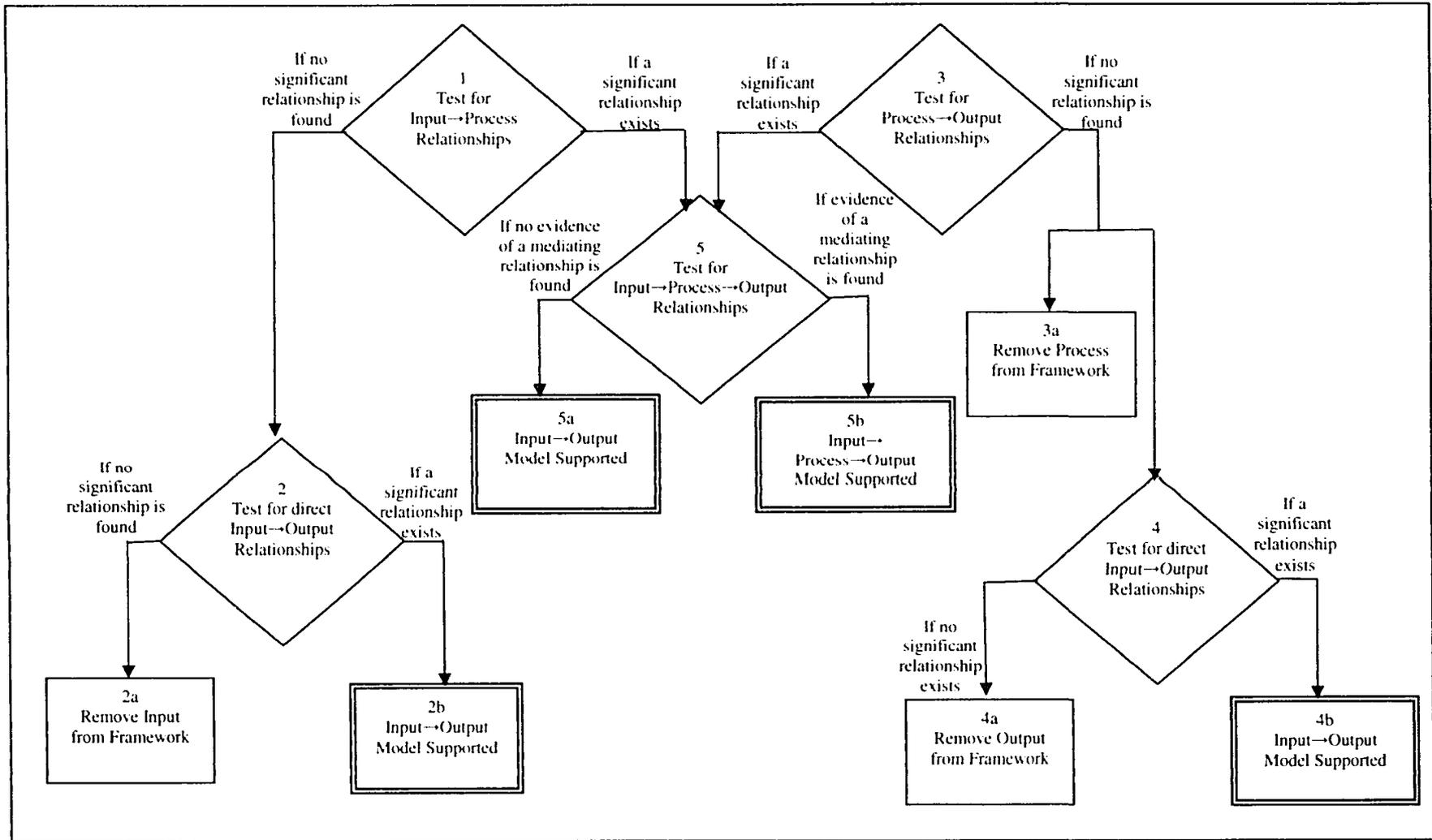
Before exploring the correlations between the different components of the framework (i.e. inputs, process and outputs), the inter-correlations of the variables within each component were examined. This was done to ensure that the variables used to represent each component were not too highly related to one another. Tabachnick and Fidell (1996)

suggested caution when employing variables with a bivariate correlation higher than 0.70 and suggest that variables with that correlations of 0.9 or higher should not be included in analysis. In the interests of parsimony, variables within the same component of the framework were considered redundant if their correlations were greater than 0.80. For example, correlations were performed between all of the team input variables in the framework to ensure that each of them contributed uniquely to the research framework.

The relationships between each of components of the framework were tested using correlation analysis (Pearson 2-tailed correlations). Figure 4 presents the analysis framework for testing the relationships of each variable in this study. For ease of reference, the numbers on the figure correspond to the five steps in the analysis presented below:

- 1) Test for relationships between the input and process variables using correlation analysis;
- 2) Identify those input variables that are not significantly correlated with any of the processes (in Step 1). For each of these input variables, test for a direct relationship with each of the output variables using correlation analysis:
  - a. Remove from the research framework any input variables for which no significant relationship is found with either a process or an output variable;

- b. Identify input variables that were significantly correlated with one or more output variables. In these cases, a direct input→output model form is supported;
- 3) Test for relationships between the process and output variables using correlation analysis:
  - a. Identify those process variables which are not significantly correlated with any of the output variables. Remove these processes from the research framework;
- 4) Identify those output variables which are not significantly correlated with any of the processes (in Step 3). For each of these output variables, test for a direct relationship with each of the input variables using correlation analysis:
  - a. Remove from the research framework any output variables for which no significant relationship was found with either a process or an input variable; and
  - b. Identify input variables which are significantly correlated with one or more output variables. In these cases, a direct input→output model form is supported;



**Figure 4: Procedure for Testing the Relationships in the Research Framework**

- 5) Explore the potential mediating role of the process variables between input and output variables using a combination of correlation and partial correlation analysis. This is done in three steps. First, calculate the direct correlations between each of the input variables and each of the output variables. Second, calculate the pairwise correlations between each of the input variables and each of the output variables again, while controlling for the process variables, using partial correlations. Third, compare the results from the two analyses (direct and indirect):
- a. For any input variables for which no evidence of a mediated relationship was found, a direct input→output model form is supported;

For any input variables for which evidence of a mediated relationship was found, an indirect input→process→output model form is supported.

The tests for each of the steps are discussed in detail in the following sections.

#### 4.8.2.1 Step 1: Relationships between Inputs and Processes

The relationships between the input variables and the process variables were explored using correlation analysis. The goal was to determine the existence (or absence) of significant relationships between the input and process variables. The relationships between each pair of variables were explored by examining the common variance between the two variables (i.e. how much of the variance in one variable is explained by the other). For relationships that were found to be significant, Davis's (1979) criteria were used to categorize the strength of the correlations. According to Davis, correlations

of 0.30 and 0.49 can be considered to be moderate, those between 0.50 to 0.69 as strong, and those 0.70 and greater as very strong.

Due to the small sample size and the exploratory nature of the study, the selection of significance level for the correlations was critical. The level of significance (probability of Type I error), power (determining Type II error) and sample size of a statistical test are all related to one another. For any given sample size, as the level of significance is decreased (i.e. made more rigorous), power is sacrificed. In other words, when determining the power and significance the researcher, must decide which strategy to employ:

- increase significance and reduce the risk of a Type I error (mistakenly retaining variables with no relationship); or
- increase power and reduce the risk of committing a Type II error (mistakenly eliminating variables that do have a relationship).

On the other hand, when a large number of correlations are computed, the number of relationships that are found to be significant by chance also increases (Type II error). For example, if 100 correlations are performed at a significance of  $p < 0.10$ , ten significant correlations are expected to be found by chance. It is possible to compensate for this by selecting a more stringent significance level. This is typically done using a Bonferroni adjustment (i.e. dividing the chosen significance level by the number of correlations performed) (Stevens, 1992). Such a strategy would, however, cause problems of power when the sample size is small (Type I error).

With respect to correlation analysis, the higher the level of significance, the greater the correlation that is required to be considered statistically significant. For example, with a sample size of 30, a significance at  $p < 0.01$  would have a critical value of  $r = 0.46$ . A significance at  $p < 0.05$  would have a critical value of  $r = 0.36$  and a significance at  $p < 0.10$  would have a critical value of  $r = 0.32$ .

Given that the goal of this study was to develop a model (or models) to provide a basis for future study of VTs, it was felt that it was more appropriate to emphasize power and be less stringent with respect to significance. In other words, the objectives of this research indicate that it is better to mistakenly retain variables with no relationship to VT effectiveness, than to erroneously eliminate such variables from future study.

For the purposes of this study, a significance of  $p < 0.05$  was chosen. This was considered appropriate, given that: 1) this was an exploratory study with the goal of minimizing Type II errors; and 2) the unit of analysis was intact VTs, the implication of which was a small sample size.

Finally, it should be noted that correlation analysis, while indicating the strength of relationships between variables, does not determine causality. In this thesis, the directions of the relationships in the framework were determined from available theory. It is also important to note that correlation analysis assumes normality of the variables

and determines linear relationships only. Low correlations may indicate that no linear relationship is present, but do not determine if non-linear relationships exist. The examination of non-linear relationships is beyond the scope of this study.

#### 4.8.2.2 Step 2: Relationships between Inputs and Outputs (for Inputs Having No Relationship with Processes)

All of the input variables for which no significant relationship was found with any of the process variables were subsequently tested for a direct relationship with the output variables (i.e. the alternate input  $\rightarrow$  output relationship). Each input variable was treated separately by determining, pairwise, the correlations between each of the input variables and each of the output variables. For any input variable for which a significant relationship was found with an output variable, the input  $\rightarrow$  output form of the model of VT effectiveness was supported (Step 2b). All of the input variables for which no significant relationship was found with any of the output or process variables were removed from the research framework (Step 2a).

#### 4.8.2.3 Step 3: Relationships between Processes and Outputs

The relationships between the process variables and the output variables were explored using correlation analysis. Again, each output variable was treated separately by determining, pairwise, the correlations between each of the process variables and each of the output variables. All of the process variables for which no significant relationship was found with any of the output variables were removed from the research framework (Step 3a). This was appropriate given that the objective of the research framework was to describe VT effectiveness. Any process that has no evidence of a relationship with any

of the measures of VT effectiveness is not, therefore, of interest and should be excluded from the framework.

#### 4.8.2.4 Step 4: Relationships between Inputs and Outputs (for Outputs having no Relationship with Processes)

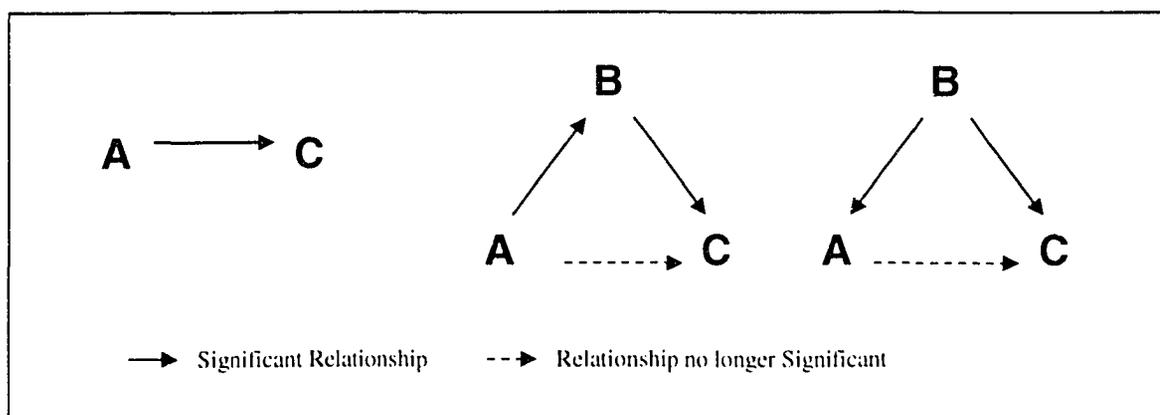
All of the output variables for which no significant relationship was found with any of the process variables were subsequently tested for a direct relationship with the input variables (i.e. the alternate input →output relationship). Each output variable was treated separately by determining, pairwise, the correlations between each of these output variables and each of the input variables. For any output variable in this group for which a significant relationship was found with an input variable, the input →output form of the model of VT effectiveness was supported (Step 4b). All of the input variables for which no significant relationship was found with any of the output or process variables were removed from the research framework (Step 4a).

#### 4.8.2.5 Step 5: Process Mediated Relationships between Inputs and Outputs

The path from input to output has two theoretical routes: 1) the inputs are related to the outputs through an intervening process variable (Steps 1,3 & 5); and/or 2) the inputs are directly related to the outputs (Steps 2 & 4).

The exploration of the correlations between the input and process variables and the process and output variables described in the previous sections, were in keeping with the hypothesized input→process→output form of the research framework. The potential mediating role of the process variables between input and output variables was explored

using a combination of correlation and partial correlation analysis. This was done in three steps. First, the direct correlations between each of the input variables and each of the output variables were calculated. Second, the pairwise correlations between each of the input variables and each of the output variables were calculated again, while controlling for the process variables. This was done using partial correlations. Partial correlation determines the correlation between variables while controlling for another variable. Partial correlations represent the unique correlation between the two variables of interest by factoring out the common variance of the control variable. For example, the partial correlation between two variables, A and B could be tested, while controlling for a third variable C. If A and C are shown to have a significant relationship which subsequently disappears when the analysis controls for B, then A and C have no direct relationship. The interpretation would be that B is either a mediating variable or (because correlation does not determine the direction of the arrows) a common antecedent to both A and C (Ender, 2003). These relationships are presented in Figure 5.



**Figure 5: Example of a Mediating Variable**

Only one of these interpretations is appropriate with respect to this study. It is hypothesized that process plays a mediating role between inputs and outputs. It is this role that is being tested. Theoretically, it would be highly implausible that VT processes would be an antecedent to *both* inputs and outputs. For example, it is highly unlikely that communication effectiveness is an antecedent to adequacy of technology.

The requirement that is inherent in this type of analysis is that there must be a significant direct relationship between A and C (in order for it to disappear when controlling for B). In other words, if A and C do not have a significant direct relationship, one cannot determine how much of that relationship is determined by a mediating variable. As such, partial correlations will only be performed on those input and output variables with a direct significant relationship.

A further requirement is that there must also be a significant relationship between A and B and between B and C in order to establish a mediating relationship (Ender, 2003). Accordingly, only those variables with significant relationships with the other sets of variables will be used in the partial correlations. For example, if an output variable is not significantly correlated with *any* of the process variables, no test for mediating effect will be performed. Similarly, no test for mediating effect will be done if an input variable has no significant relationships with any of the process variables.

Third, the results from the two analyses (direct and indirect) were compared. The comparison of the two results (rather than the individual results themselves) provided insight in two ways:

- 1) If the significant direct relationship between the input and output variables disappeared (were no longer significant) when controlling for the process variables, the hypothesized intervening role of the process variables would be supported (Step 5b); and
- 2) If the direct relationship between the input and output variables remained significant, the direct relationship between those variables would be supported (Step 5a).

#### 4.8.2.6 Role of Degree of Virtuality

Linear regression was used in this thesis to determine if the degree of virtuality variables moderated the relationship between the input and process variables. A moderating variable has a contingent effect on the relationship between two other variables (i.e. the presence of a moderating variable modifies the relationship between the independent and dependent variables) (Cooper and Schindler, 1998). The process variables served as the dependent variables in these regressions and the VT inputs were the independent variables. The moderating role of the degree of virtuality variables was reflected through an interaction term which was included in the regression. The interaction term was calculated as the product of the moderating variable (degree of virtuality) and the independent variable. In each case, the centralized mean was used in the calculation of the interaction terms. The linear regression was performed including the independent

variable, the moderating variable and the interaction term. A significant interaction term in the regression model would indicate that degree of virtuality moderates the relationship between the process variable under consideration and the inputs included in the regression equation.

The moderating relationship of each of the three degree of virtuality variables was tested separately with each pair of input and process variables. Regression was also used to test the potential moderating role of the degree of virtuality between the process and output variables (i.e. with process as independent and output as dependent).

#### **4.8.3 Development of the Models of Virtual Team Effectiveness**

Revised models of VT effectiveness were constructed to reflect the results of the analysis. This was done to satisfy the research objective of developing models of VT effectiveness by describing the relationship between VT effectiveness, VT inputs, contextual inputs, VT processes, and degree of virtuality. As discussed previously, different models of VT effectiveness were developed for the different dimensions of effectiveness (Goodman et al., 1987). The goal was to develop parsimonious models that describe the aspects of VT effectiveness under investigation. As such, the models contained only those variables and those relationships which were found to be significant in the previous analysis.

## **5 RESULTS AND DISCUSSION**

The following sections describe the samples examined in this thesis and outline the results of the data analysis. The chapter is divided into nine sections. The first section describes the sample and the organization from which it was drawn. This is followed by three sections outlining the results obtained for the measures developed in this study: degree of virtuality, VT effectiveness (outputs), managerial support/non-support of VTs, and organizational support/non-support of VTs. The next two sections describe the results for the input and process components of the research framework. The seventh section explores the intercorrelations within each component of the research framework (inputs, process, outputs). The eighth section of this chapter presents the results obtained in the testing of each relationship in the framework. This section is ordered using the steps outlined in Figure 4 (input→process, input→output, process→outputs, input→process→output). The role of degree of virtuality is explored in the final section. Due to the exploratory nature of the study, and an approach (as described above) in which the analysis of each section builds on the results of the previous one, the results and discussion are presented together.

### **5.1 DESCRIPTION OF THE SAMPLE**

This section provides a description of the sample used in this study. The following aspects of the sample are discussed: organization under study, the characteristics of the VT members, and the characteristics of the VTs.

### 5.1.1 The Organization in this Study

Data on the organization which participated in this research was obtained through interviews with human resource personnel and review of corporate documents such as the organization's Corporate Profile, the Citizenship Report, The Workplace Profile, and other internal documents outlining corporate structure, strategies and policies with respect to teams and VTs. Organizational data is presented here to provide context and aid in the interpretation of the results.

Demographic data on the organization's workforce revealed that of those employed in this organization, 47% were women. Women also made up 44% of management. The age of the employees working for the organization was well distributed with:

- 14% of employees under 25 years old;
- 23% of employees aged 25 to 34 years;
- 26% of employees aged 35 to 44 years;
- 27% of employees aged 45 to 54 years; and
- 9% of employees 55 years old and over.

Employees who worked for the organization reported a high level of diversity with respect to levels of formal education. While one in four (24%) of the employees had a high school diploma, 32% had a college degree, 36% a university degree and 8% a graduate degree.

Although VT work was an accepted practice at the organization, there were no formal policies or programs regarding VT work. As such, the organization kept no formal records of its VTs, and was unable to report the number of teams or the number of workers working on VTs. Telework was, however, a recognized program within the organization's flexible work options. Fully 35% of the employees teleworked at least part-time.

### **5.1.2 Sample: Virtual Team Members**

Although the majority of the analysis was performed at the team level, the majority of the data were collected at the individual level from VT members. As such, there are two samples which can be described in this study: the sample of individual team members; and the sample of VTs. Team member data were used in two ways in this thesis: 1) the building blocks for the aggregation to the team level data; and 2) for testing the measures used in this thesis. The individual data was used to test the measures because it provided a sample size of 108 individuals versus a sample size of 30 teams.

Table 7 provides a summary of demographic data collected on the team members. The team member sample consisted of 108 employees: 61 females (56.5%) and 47 males (43.5%). The number of females in the sample (56.5%) is slightly higher than the 47% reported for the overall population, but this difference was not significant ( $p < 0.05$ ).

**Table 7: Description of Team Member Sample**

<b>Demographic</b>	
Gender (Female) (N=108)	56.5%
Age (N=106)	
• under 26	0%
• 26 to 35	22%
• 36 to 45	39%
• 46 to 55	36%
• over 55	3%
Area of Expertise (N=104)	
• IT/IS	33.6%
• Operations	12.2%
• R&D/Engineering	13.5%
• HR	10.6%
• Project Management	8.7%
• Marketing	7.7%
• Communications	6.7%
• Other	6.7%
Education (N=108)	
• High School diploma	7%
• Post-Secondary	18%
• Post-Secondary Degree	41%
• Graduate Degree	34%
Tenure	
• With employer (N=102)	Mean = 14.34 years (s.d. 10.47)
• In current position (N=107)	Mean = 2.44 years (s.d. 2.40)
• With VT (N=105)	Mean = 1.68 years (s.d. 1.71)
Weekly Work Hours	
• Total (N=105)	Mean = 46 hours (s.d. 8.29)
• Spent on VT work activities (N=102)	Mean = 33 hours (s.d. 14.11)
• Spent working virtually on VT activities (N=104)	Mean = 27 hours (s.d. 14.84)
Member Comfort with Technology (N=107)	
• Very Comfortable	52%
• Comfortable	43%
• Somewhat Comfortable	5%
• Not Very Comfortable	0%
• Not at all Comfortable	0%
Member Experience with Technology (N=107)	
• Expert	16%
• Advanced	52%
• Intermediate	31%
• Beginner	0%
• No Experience	0%

As can be seen in Table 7, the respondents were primarily between the ages of 26 and 55. This distribution is very close to that of the organization, although the lower and higher end of the age categories were under represented. Two respondents did not report their ages.

Given the nature of their industry, it was expected that all of the team members would be knowledge workers in fairly technical areas. This expectation was borne out by the data. As can be seen in Table 7, almost half (47%) of the respondents reported that IT/IS, Engineering or R&D was their field of expertise. Four respondents did not report their area of expertise.

As expected with knowledge workers, the great majority (75%) of the respondents had a post-secondary education. Just over a third had a graduate degree as well. The sample contains a higher percentage of respondents with graduate degrees than can be observed in the company as a whole, which reports only 8% of employees having a graduate degree. This would suggest that highly educated knowledge workers may be more likely to be members of VTs.

The team members reported a mean of 14.4 years with their present company and an average of 2.5 years in their current position. They had been members of their current VT for an average of 1.7 years. While six respondents did not report their tenure at the

organization, only one did not provide years in current position, and three did not report their VT tenure.

The respondents reported working an average of 46 hours per week. It was expected that at least some of the team members would have responsibilities other than those associated with the VT (i.e. some would work on the VT part-time). Of their total work hours, the time that the members spent working on tasks associated with VT goals averaged 33 hours. Proportionally, this represents an average of 75% of total work time spent on VT activities. The data also shows that a significant amount of the time spent working on team activities was done virtually. Team members spent, on average, 27 hours per week working virtually on the VT's work. Proportionally, this represents a mean of 82% of the total VT activity time spent working virtually. In other words, 82% of the time that team members spent performing work associated with their VT was performed virtually. Three respondents did not report their total work hours and five did not report the time spent working on their VT. The proportion of time spent working virtually was defined as one of the dimensions of degree of virtuality and will be discussed in greater detail in Section 5.2.

The respondents reported high levels of comfort and experience with information technology. As can be seen in Table 7, almost all of the respondents considered themselves comfortable (52%) or very comfortable (43%) with information technology and two-thirds rated their level of experience as expert or advanced. None of the

respondents reported that they were not comfortable with technology. Similarly, no one described themselves as either a beginner or having no experience with technology. Only one respondent did not answer these two questions.

Data on the location of team members were collected from the team managers. The team members were dispersed through Ontario and Quebec, primarily in Toronto (36% of the sample), Montreal (37% of the sample) and Ottawa (23% of the sample). Eleven percent of the respondents were full-time teleworkers as well as VT members. This number is quite low compared to the organization's population, which has 35% teleworkers.

#### 5.1.2.1 Discussion of Virtual Team Member Sample

In summary, the VT member sample reflected a group that was relatively diverse with respect to age, suggesting that older workers either have adapted to the use of such work arrangements or have accepted the necessity of working this way. Individuals on these VTs had specialised skills and had been with the organization for a substantial period of time. The high level of education indicates that these individuals were likely not engaged in routine work. The VT members were highly educated, worked longer hours, were specialised in technical-related fields, and were comfortable and experienced with information technology. These findings suggest that organizations may place their more highly valued knowledge workers on VTs, perhaps as a way to share their specialised skills and abilities, while minimizing travel and relocation.

VT work seemed to be the norm for these individuals, as three-quarters of their total work time was spent on VT activities and 82% of that time was spent working virtually. The extent of the work time that these teams spend on virtual work indicates the importance of this form of work and underlines the importance of having a high level of comfort and experience with technological tools. These results indicate that within this organization, virtual work is not performed as a “stopgap” when members cannot meet, but rather as the normal way of working. This conclusion is supported by the data showing that overall, VT members spend more than half of their work week (27 out of 44 hours) working virtually. In keeping with the literature, these results suggest that the organization uses VTs as a regular work arrangement, thus ensuring that they have the right person for the right job, regardless of their location.

The membership on the VTs would seem to be fairly stable, given the members' relatively long tenure on the VTs. The VT members' significant experience with a VT work arrangement increases the confidence with in validity of the findings (i.e. respondents are likely to have accurate opinions on the topic under study).

The small number of teleworkers in the sample as compared to the organization's population suggests that perhaps VT workers and teleworkers are from two different groups.

### 5.1.3 Sample: Virtual Teams

Data on the team size, longevity (i.e. years in operation) and meeting history were collected from the team managers. As noted in the previous section, the VT managers were also asked to provide data on the VT member locations. Details and descriptions of the VTs in the sample are presented in Table 8.

**Table 8: VT Descriptions (N=30)**

<b>Demographic</b>	<b>Categories</b>	<b># of Teams</b>	<b>% of Sample</b>	<b>Mean (s.d.)</b>
Team Size	Less than 5	13	43%	5.5 (3.00)
	5 to 9	13	43%	
	10 to 14	4	13%	
# of Locations of Team Members	2	11	37%	3.2 (1.32)
	3	10	33%	
	4 or more	9	30%	
Team Age	Less than 6 months	4	13%	2 years (2.13)
	6 months up to 1 year	8	26%	
	1 year up to 2 years	6	20%	
	2 years up to 3 years	4	13%	
	3 years up to 4 years	4	13%	
	More than 4 years	4	13%	

The 30 teams ranged in size from 2 to 14 members, with a mean of 5.45 members. The members of the VTs were located in an average of 3.2 locations. Roughly one-third (37%) of the teams had members in 2 different locations. A further 33% had members in 3 locations, with the remaining 30% having members in 4 or more locations. Most VTs (80% of the sample) had some co-located members. Finally, it should be noted that the teams had been in existence an average of 2.0 years.

As noted in the previous section, details on team member tenure, work hours, and technological expertise was collected from the team members. Team-level data on these three variables were calculated as the summed average of the individual responses for each VT. A summary of the aggregated data is presented in Table 9.

The teams had an average member tenure of 14.08 years with the company and 2.42 years in their current positions. Average VT tenure (average amount of time the respondents had been members of the VTs) averaged 1.62 years.

**Table 9: Description of VTs: Aggregate Team Member Tenure, Work Hours, and Technological Expertise (N=30)**

<b>Demographic</b>	<b>Mean</b>	<b>s.d.</b>
Tenure at Company	14.08 years	5.87
Tenure in Position	2.42 years	1.56
Tenure on Team	1.62 years	1.09
Comfort with Technology (5 point Scale)	4.50	0.38
Experience with Technology (5 point Scale)	3.86	0.47
Areas of Expertise Represented on the VT	1.93	0.70

The team comfort with information technology (on a five-point scale) ranged from 4 (comfortable) to 5 (very comfortable), with a mean of 4.50. The team experience with information technology (on a five-point scale) ranged from 3 (intermediate) to 5 (expert),

with a mean of 3.86. The VTs were comprised of members from an average of 1.93 different areas of expertise.

The VT members were asked whether or not the team had a leader (defined as any person, internal to the team, who takes a leadership role). Twenty-five of the VTs (83%) reported having a team leader (i.e. all team members or the great majority of team members agreed with this statement). In only one team was there a consensus that no leader existed for their team. There was little or no agreement amongst the remaining five teams as to whether or not they had a team leader.

Questions regarding the VT's meeting history were asked of both team managers and team members. The data reflecting these questions are presented in Table 10.

There was a high level of agreement (agreed in 80% of the cases) between team managers and team members as to whether or not the team had ever had a face-to-face meeting<sup>2</sup>. The members and managers of 21 teams agreed that they had had at least one face to face meeting while the members and managers of 3 teams agreed that they had never had a face-to-face meeting.

For two of the remaining teams, the members agreed that they had had a face-to-face meeting, but the managers answered that question in the negative. These were both small

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<sup>2</sup> It should be recalled that team members were considered to have agreed if the 80% or more of the VT members agreed on a particular question.

teams (2 and 3 members), however, and it is possible that the team members had a meeting without the express knowledge of their managers. In these cases, it was assumed that such a meeting had taken place. For the remaining four teams, the team members were split with respect to this issue (there was no agreement between team members), which meant that agreement with the manager is impossible. As noted in the methodology section of this thesis, the decision rule to be used in cases of within team disagreement is to use the manager response to the particular question.

Those teams which reported having face-to-face meetings were asked a number of additional questions to determine the frequency and timing of these meetings. Of the teams that had met face-to-face, the managers reported meeting an average of 4.7 times over the last year (s.d. 3.59).

With respect to the timing of the face-to-face meetings, teams and managers were asked whether they had had regularly-scheduled face-to-face meetings, an initial kick-off meeting when the team was formed or both. There was considerably less agreement between members and managers in their responses to the questions pertaining to regular face-to-face meetings and kick-off meetings. Again, if there was agreement between team members with respect to a particular response, the team member data were used, otherwise, the team manager data were used to aggregate the data.

**Table 10: VT Meeting History**

Question	Response	
Face-to-Face Meeting (ever) (N=30)	YES 25 Teams NO 5 Teams	83% 17%
Number of Meetings in Last Year (N=25)	Mean = 4.7 s.d. = 3.59	
Face-to-Face Kick-off Meeting (N=25)	YES 17 Teams NO 8 Teams (5 teams did not meet at all)	68% 32%
Regular Face-to-Face Meetings (N=25)	YES 8 Teams NO 17 Teams (5 teams did not meet at all)	32% 68%

Sixty-eight percent of the teams who had met face-to-face did so at an initial kick-off meeting (17 teams had a kick-off meeting). Only 32% of the teams who had met face-to-face did so regularly (i.e. only 8 teams reported regularly scheduled meetings). It should be noted that only 27% of the total sample had met face-to-face regularly. There was virtually no agreement between team members as to the timing of their regular meetings. According to the managers of the eight VTs who met regularly the frequency of those meetings was evenly split between the various categories: weekly (2 teams), bi-weekly (2 teams), monthly (2 teams), and semi-annually (2 teams). The small number of teams reporting regular meetings, however, precludes any analysis on the meeting frequency.

#### 5.1.3.1 Discussion of Virtual Team Sample

Overall, the VTs in the sample were relatively small, had members dispersed over a correspondingly small number of locations (2 to 4) and had members representing less than two different areas of expertise. It should be noted that the size of the VTs in this

sample is consistent with that reported in the VT research, which discusses teams of between 3 and 7 members (see Appendix L). This suggests that small teams in a limited number of locations may be preferred over larger, more dispersed teams, which might face even greater challenges. The organization in this study may have determined that larger, more dispersed teams are not successful, or cost too much (i.e. travel costs, etc.). It is likely that if larger, more dispersed teams did exist, but were not successful, they would be disbanded by the organization.

The VTs in this sample were comprised of experienced individuals with relatively high tenure at the company who had been working together as a team for an average of 2 years. These results suggest that VTs are viable. Otherwise, an organization working in the private sector would have disbanded them. The VTs also had members who worked relatively long hours, suggesting that these highly trained professional can be relied upon to work hard without direct face-to-face supervision or close personal contact.

The VTs had members with a high degree of comfort and expertise with information technology, indicating that the teams were at ease and competent in the virtual environment. These data are interesting and can be interpreted two ways. First, it may be that high comfort levels and experience with technology are necessary to work on VTs and that individuals who do not have such experience/comfort choose not to join or remain on such teams. Alternatively, it may be that working on a VT requires an individual to increase their comfort level and experience with technology. In either case,

it would appear that high comfort/experience with technology is important to VT work. Most VTs reported having a team leader, indicating that function of leadership is important to VTs.

The great majority of VTs in this sample (83%) reported having met face-to-face at least once. This result indicates that face to face-to-face meetings are considered valuable enough by the organization and/or the manager to invest time and money into them. This finding is consistent with the literature which advises VTs to meet face-to-face (Lurey & Raisinghani, 2001). The relatively close proximity of the members (as is seen in the next section on distance virtuality) may also have contributed to the high number of VTs having face-to-face meetings.

While just over half of the VTs in this sample (57%) had an initial kick-off meeting, only one in four had regularly scheduled face-to-face meetings. These results indicate that while VTs may get together when they form, they do not rely heavily on scheduled meetings. When the large proportion of VTs that reported having face-to-face meetings is compared to the low proportion having had regularly scheduled meetings, there is an indication that the VTs perhaps value a traditional connection, but only as they deem necessary (i.e. at time of kick-off or at major crises) rather than on a set schedule. This would suggest that VTs are able to function virtually in most circumstances.

All of the VTs who reported regularly scheduled meetings also reported having a kick-off meeting. This indicates that either a kick-off meeting is viewed as the first instalment in the regular meeting schedule or that upon meeting initially, some of the teams recognized the importance of face-to-face interactions and subsequently scheduled more meetings. Given, however, the fact that these VTs had been functioning for over two years on average in a competitive environment, the low number of VTs reporting regularly scheduled meetings calls into question the necessity of such meetings, despite the findings of the existing literature (Kirkman et al., 2004, Lurey & Raisinghani, 2001).

Finally, the company documents provide insight into these data as the organization being studied had no formal policies with respect to VTs. As such, there were no specific resources or guidelines regarding team meetings and the decision to meet lay at the team manager level. These data would suggest that the majority of the managers of VTs in this study placed a high enough priority on bringing their teams face-to-face that they were willing to take the responsibility for the time and costs of those meetings.

#### **5.1.4 Interdependence of Virtual Teams**

Data on VT interdependence was gathered from two sources: team managers and team members. The results comparing the manager and VT member scores for interdependence are presented in Table 11.

The data on the interdependence of the VTs was interpreted as follows:

- Scores of below 2.49 were deemed to represent low interdependence;

- Scores between 2.50 and 3.49 were deemed to represent a moderate level of interdependence;
- Scores between 3.50 and 4.49 were deemed to represent high interdependence; and
- Scores of 4.50 or greater were deemed to represent a very high interdependence.

Based on VT managers' perceptions, the team interdependencies ranged from 2.75 to 5.00 with a mean of 4.03 (s.d. 0.52), indicating a high level of interdependence overall. The majority of teams (25) were reported to have a high to very high level of interdependence (3.50 or greater). This was very possibly due to the fact that a specific definition of VT (including a requirement for interdependence) was included in the information sent out to all VT managers. Managers of teams with low interdependence likely self-selected themselves out of the study. Only one team had a level of interdependence below 3.0 (2.75). It was decided to retain this team in the sample, pending the interdependence score provided by that team's members.

**Table 11: VT Interdependence Scores**

<b>Interdependence</b>	<b>Manager's Score % of Teams</b>	<b>VT's Score % of Teams</b>
Score (on a 5-point scale):		
• Up to 2.49	0%	0%
• Between 2.50 and 3.49	17%	13%
• Between 3.50 and 4.49	63%	74%
• 4.50 and greater	20%	13%
Mean (s.d.)	4.03 (0.52)	3.99 (0.40)

Based on the team members' perceptions, the team interdependencies ranged from 3.25 to 4.83 with a mean of 3.99 (s.d. 0.40), indicating a high level of interdependence overall.

None of the VT members gave their teams aggregate interdependence scores lower than 3.25.

Overall, there was a high level of agreement between the members and managers of the VTs with respect to their perceptions of interdependence. There was no significant difference between the manager and member ratings of interdependence ( $p > 0.01$ ) and the two ratings were significantly correlated at  $r = 0.362$ ,  $p < 0.05$ ). The team whose manager had reported only a moderate level of interdependence (2.75) had the greatest level of disagreement between the members and manager (the member rating was 4.22). It was decided to retain this team in the sample, based on the member ratings of high interdependence.

#### 5.1.4.1 Discussion of Interdependence of the Virtual Team Sample

In summary, all of the VTs in this sample had moderate to high interdependence and the majority of the VTs had high to very high interdependence according to both the VT managers and the members. These results indicate that virtuality does not preclude a high level of collaboration between team members.

## 5.2 DEGREE OF VIRTUALITY OF THE VIRTUAL TEAM SAMPLE

Theoretically, degree of virtuality contains three dimensions:

- Team time worked virtually: the proportion of team work time that the team members spend working apart (WV);

- Member virtuality: the proportion of the team members who work virtually (MV);  
and
- Distance virtuality: the degree of separation of the team members (distance) (DV).

The means and standard deviations of the three measures of degree of virtuality are presented in Table 12.

**Table 12: Descriptives of the Degree of Virtuality Measures (N=30)**

<b>Dimension</b>	<b>Mean</b>	<b>s.d.</b>
Team Time Worked Virtuality	83.4%	20.00
Member Virtuality	64.9%	22.07
Distance Virtuality	14.2%	6.45

The first dimension of virtuality was calculated from individual team member data: the proportion of total team work time spent working virtually (as opposed to time spent face-to-face with other team members, or the team as a whole). This dimension of virtuality was represented as the proportion of total team work time that the team members spend working virtually on the VT's activities divided by the total time spent working on the VT activities (i.e. time spent working virtually and non-virtually).

The proportion of time that the VTs in this study spent working virtually on team activities averaged 83.4% (i.e. the VT members spent 83.4% of the time spent on the team's activities working apart). The results for this dimension of virtuality indicate that most of the work of the VTs in this study was performed virtually. Conversely, only a

small amount of work was done face-to-face, either through meetings or the co-location of some of the members of the team (as is shown in the next dimension).

The second dimension of degree of virtuality, member virtuality, was calculated using the team manager data. Member virtuality was represented as the proportion of VT members who work in different locations. The mean level of member virtuality of the VTs included in this study was 64.9%. This can be interpreted to mean that the VTs in this sample had 2 locations for every 3 team members. That means that most of the teams had members who were co-located *and* worked virtually with other dispersed team members. Only six teams looked like many of the VTs that are studied in the literature (i.e. 100% dispersed - no two members working in the same location).

The third dimension of degree of virtuality, distance virtuality, was calculated using the team manager data. Distance virtuality was represented as a gauge of the distance between the VT members. Distance virtuality can also be described as the degree to which a VT has a choice of meeting face-to-face (i.e. how much time, effort and money is required to meet). If the costs associated with meeting are low (i.e. VT members work near each other), the VTs can meet whenever they want to. The distance virtuality for the VTs in this study had a mean of only 14.2%. This result indicates that the team members were not dispersed at great distances from one another and could orchestrate face-to-face team meetings without a great deal of trouble and expense. In fact, most of the VTs in this study had members in the major cities of two neighboring provinces. Given this level

of distance virtuality, it is interesting to recall that only eight of the VTs in this sample reported having regular face-to-face meetings.

### **5.2.1 Discussion of the Degree of Virtuality of the Virtual Teams in this Study**

Overall, the VTs in this study were highly virtual with respect to the amount of team time they spend working virtually (84%) but were only moderately to slightly virtual with respect to the dispersion of the team members. Most of the VTs in this sample (80%) had some co-located team members (i.e. only 20% of the teams had 100% member virtuality). In addition, the dispersed members of the VTs in this sample worked within relatively close geographic proximity (i.e. all of the VT members in this sample worked in Ontario or Quebec).

These results would suggest that the type of fully VTs commonly studied in the literature are an extreme form and are not typically found in practice. This interpretation of the data is consistent with the fact that many researchers actually created the VTs they were to study.

Comparing the proportion of work time which was performed virtually, with the proportion of member virtuality, leads to the supposition that some team members may have perceived themselves as working virtually with their co-located team-mates. This is entirely possible if co-located team members work virtually (i.e. phoning or sending and email to a colleague who is just across the hall), despite the fact that they are only metres apart.

Finally, given the relative proximity of team members, it could be interpreted that the great majority of the VT managers have seen no necessity for the VTs to meet regularly and 17% have seen no necessity to meet at all. This interpretation is consistent with the characteristics of the sample (i.e. experienced, highly educated knowledge workers) and their high level of access to technological tools.

### **5.3 EFFECTIVENESS OF THE VIRTUAL TEAM SAMPLE (OUTPUTS)**

For this study, VT effectiveness was defined as a four-dimensional concept, containing one performance outcome (task completion/productivity) and three attitudinal outcomes (satisfaction, professional development, and capacity for future VT work).

The performance dimension was measured in two ways: VT members' perceptions of performance, and VT managers' perceptions of performance. The three attitudinal dimensions were each measured using member perceptions. The five scaled measures of effectiveness are based on a 5 point scale with 5 indicating higher levels of VT effectiveness and 3 representing a neutral response. The scores for the various dimensions of VT effectiveness were broken down into meaningful groups according to the anchors used in the scale and the distribution of the data. Accordingly, the VT effectiveness scores were interpreted as follows:

- Scores below 2.50 were seen to represent an ineffective VT;
- Scores between 2.50 and 3.49 were seen to represent a neutral response (i.e. neither effective nor ineffective);

- Scores between 3.50 and 4.49 were seen to represent an effective VT; and
- Scores of 4.50 or greater were seen to represent a highly effective VT.

The means, standard deviations, and frequencies of the five measures of VT effectiveness are presented in Table 13.

Overall, the VT members perceived their teams to be effective, with a mean of 3.97 on the performance measure. Most of the VTs in this study (70%) perceived their own performance to be effective and 13% considered their team to be highly effective with respect to performance. Five teams (17%) perceived that they were neither effective nor ineffective in terms of their performance.

**Table 13: Descriptives of the Measures of Effectiveness (N=30)**

<b>Effectiveness Component</b>	<b>Mean (s.d.)</b>	<b>Frequencies</b>
VT Members' Perceptions of Performance	3.97 (0.481)	<ul style="list-style-type: none"> <li>• Less than 2.50 0%</li> <li>• Between 2.50 and 3.49 17%</li> <li>• Between 3.50 and 4.49 70%</li> <li>• 4.50 or greater 13%</li> </ul>
VT Member Satisfaction	4.06 (0.378)	<ul style="list-style-type: none"> <li>• Less than 2.50 0%</li> <li>• Between 2.50 and 3.49 7%</li> <li>• Between 3.50 and 4.49 83%</li> <li>• 4.50 or greater 10%</li> </ul>
VT Members' Perceptions of Professional Development	3.84 (0.402)	<ul style="list-style-type: none"> <li>• Less than 2.50 0%</li> <li>• Between 2.50 and 3.49 23%</li> <li>• Between 3.50 and 4.49 77%</li> <li>• 4.50 or greater 0%</li> </ul>
VT Members' Perceptions of Capacity for Future VT Work	3.85 (0.462)	<ul style="list-style-type: none"> <li>• Less than 2.50 0%</li> <li>• Between 2.50 and 3.49 17%</li> <li>• Between 3.50 and 4.49 77%</li> <li>• 4.50 or greater 7%</li> </ul>
VT Managers' Perceptions Performance	4.37 (0.468)	<ul style="list-style-type: none"> <li>• Less than 2.50 0%</li> <li>• Between 2.50 and 3.49 0%</li> <li>• Between 3.50 and 4.49 43%</li> <li>• 4.50 or greater 57%</li> </ul>

The VT members also perceived their VTs to be effective in terms of their satisfaction with the VT experience, with a mean of 4.06. The great majority of the VTs (83%) were perceived to be effective in terms of VT member satisfaction and 10% highly effective. Two of the VTs (7%) perceived that they were neither effective nor ineffective in terms of their satisfaction but none of the teams indicated that they were ineffective (dissatisfied).

The VT members' perceptions of their opportunities for professional development on their VTs were slightly lower than the previous measures of VT effectiveness, with a mean of 3.84. Twenty-three of the VTs in this study (77%) perceived their teams to be effective in terms of the professional development provided by their VT work, but none of the teams perceived themselves to be highly effective. The members of seven teams (23%) had neutral perceptions of their opportunities for professional development on the VTs. None of the VTs perceived their teams to be ineffective on this measure.

As with the results for professional development, the VT members' perceptions of their capacity for future VT work were slightly lower than the other measures of performance, with a mean of 3.85. Twenty-three of the teams in this study (77%) perceived their teams to be effective in terms of the extent that their VT work has improved their capacity to work on VTs in the future. Two of the VTs in this study (7%) perceived their teams to be highly effective with respect to this dimension. The members of five teams (17%) had

neutral perceptions of their capacity for future VT work. Again, none of the VTs perceived their team to be ineffective on this measure of VT effectiveness.

Overall, the VTs in this sample were perceived by their managers to be effective, with a mean on the performance measure of 4.37. All of the managers felt that the VTs they managed were effective. A little more than half (57%) perceived their VTs to be very effective, while 43% rated their team as effective.

As discussed previously in Section 4.4.5, the VT members' and VT managers' perceptions of the performance of the VTs were not significantly correlated. In fact, the VT members gave their teams significantly lower performance ratings than their managers did ( $p < 0.01$ ).

### **5.3.1 Discussion of the Effectiveness of the Virtual Teams in this Study**

Overall, the VTs in this study can be considered to be successful in terms of all of the measured dimensions of effectiveness examined. The success of these teams with respect to their performance is not surprising, as they had been functioning for a relatively long period (an average of 2 years) and it would be expected that teams which were unsuccessful in their task performance would have been disbanded by this time.

The VTs were more effective in the views of the managers than was indicated by the assessments of the members. This was not surprising as Gladstein (1984) reported that team members evaluate their performance using different criteria than others do (i.e.

manager and/or client). Gladstein did not, however, report whether the members rated their performance consistently higher or lower than the other sources of performance data. It should be noted that an extensive review of the literature did not uncover research comparing managers' views of team performance to those held by team members. No comparison of team member and manager data was found in the literature. Gladstein's (1984) comparison, while interesting as a point of reference, compared the views of team members with respect to their performance, to those held by customers and measures of performance using objective sales data. As such, it is unclear why the VT members would rate their performance significantly lower than their managers did, even when the same measure was used for both sources of data. One possible explanation for the result is the outside perspective of the team managers who were likely responsible for other teams (virtual or proximate). This perspective would likely lead them to evaluate the VT's performance based on comparisons to other teams for which they were responsible. The VT members, however, would have only their own teams as a basis for evaluation. Ultimately, however, the responsibility for the teams' performance rests with the managers. Managers could not, therefore, rate their teams negatively without it reflecting on their own performance (i.e. if the team is ineffective, the effectiveness of the manager is called into question). Team members, on the other hand, could blame others on the team or their team managers for poor team performance. As such, the assessments of the team members may, in fact, be more honest.

The slightly lower ratings of the VT members' perceptions of professional development and capacity for future VT work components of VT effectiveness is also not surprising as the organization under study did not indicate that they had any policies or procedures to evaluate or address the expectations of VT members in terms of their expectations for professional development, or their increased capacity for VT work. It does, however, reflect a possible problem associated with the use of VTs. Knowledge workers place a high value on professional development (Caproni, 2000). If VTs do not offer opportunities to learn and grow, employees may be hesitant to accept this kind of work arrangement. This would suggest that organizations who wish to use VTs should ensure that they can effectively provide career development and learning opportunities to members of VTs.

Overall, the different measures of VT effectiveness included in this study seem to be tapping into different aspects of VT effectiveness. While the assessments of performance and satisfaction of the VTs were quite high, the two measures which represented employee development (VT members' perceptions of professional development, VT members' perceptions of capacity for future VT work) were less positive. This supports the contention in the literature that one of the disadvantages of VTs is the "out of sight, out of mind" phenomena experienced by the team members.

## **5.4 MANAGERIAL SUPPORT/NON-SUPPORT AND ORGANIZATIONAL SUPPORT/NON-SUPPORT OF VIRTUAL TEAMS**

The development and testing of the measures of managerial support/non-support of VTs and organizational support/non-support of VTs was one of the major objectives and contributions of this study. The *act frequency approach* was used to develop these measures. The results with respect to the development and testing of these measures are discussed in detail in the sections that follow.

### **5.4.1 Managerial Support/Non-Support of Virtual Teams**

This section, which discusses the development of the measures of managerial support and non-support of VTs, is divided into four sections. The first section presents the development of the measure of managerial support of VTs. The development of the measure of managerial non-support of VTs is presented second. This is followed by a discussion of the measures of managerial support and non-support of VTs. The section concludes with the testing of the two new measures.

#### **5.4.1.1 Results for Managerial Support of Virtual Teams**

This section begins with an examination of the items in the proposed measure of managerial support of VTs. This is followed by the results for the managerial support of the VTs in this study. The refinement of the measure of managerial support of VTs (factor analysis) is then presented.

#### *5.4.1.1.1 Items Comprising Managerial Support of Virtual Teams*

This section examines the list of items in the proposed measure of managerial support of VTs in order to provide insight into the ways in which managers might be able to help their VTs to be successful. The list of the 14 behaviours representing managerial support of VTs was presented in Appendix S.

Eight of the 14 items contained in the list of behaviours representing managerial support of VTs suggest that some of the ways in which managers can support VTs would seem to represent generic team management skills (i.e. important to all teams whether virtual or proximate):

- Empowering VT members;
- Ensuring effective communication;
- Facilitating the team's work;
- Clarifying what is to be done and who is to do it;
- Providing regular opportunities for interaction and information exchange between all team members (i.e. meetings, conference calls, teleconferences, etc.);
- Building team cohesion through non-work focused events;
- Being a role model (i.e. using technology, communicating/managing virtually, being open to new approaches, etc.); and
- Being accessible (virtually and face to face).

It is likely, however, that these eight behaviours become more critical or have different implications in the virtual environment. VTs need their managers to be comfortable with

empowerment, as it would be impractical to take an overseer role with members who are performing their work far from the eyes of their managers. The members of VTs need their managers to play an active role in keeping the lines of communication open, as they cannot rely on informal and chance meetings in the hallways to keep everyone in the loop and identify potential problems. VT managers must also emphasize a facilitating role, as team members are often isolated from their team mates and the organizational resources they require. VTs would also be expected to have a greater need for clear roles and goals, since the team members are not able to meet face-to-face to negotiate roles and resolve conflicts. Although all teams are required to interact in order to collaborate, the interaction of VTs would involve additional coordination and resources, as they would require conference calls, teleconferences, or travel in order to meet as a team. In addition, VT managers would have to recognize that VTs do not have the spontaneous opportunities for “bonding” that proximate teams have (i.e. going to lunch together or staying late working over a tight deadline). VT managers would also be expected to model not only team behaviours, but also, behaviours that are accepting of virtual work, such as interacting virtually with team members and using the available technology. In addition, VT managers must be cognisant of their availability to VT members. Members who are working virtually cannot see when their managers are available or have their doors open.

On the other hand, the results suggest that VTs need some forms of support from their managers that are unique to this type of work arrangement. The six specific forms of support include:

- Ensuring that team members have the communication tools they need to work virtually;
- Supporting the use of flexible work arrangements (i.e. flextime, flexplace, etc.);
- Understanding the difficulties employees can face when engaged in distributed work;
- Recognizing the importance of professional development for VT members;
- Providing opportunities for face-to-face interactions when necessary; and
- Encouraging and promoting training on effective VT work.

Teams whose members rely on virtual communication likely rely on their managers to ensure that they have opportunities to interact regularly with their teammates and that they have the communication tools they need to get the work done. VTs would also be expected to have a greater interest in flexible work arrangements and a need for their manager to be understanding of the unique difficulties faced by virtual workers. To counteract the reduced visibility of the members, VTs require their managers to recognize their need for VT training and professional development. These results are in keeping with the contention in the literature that VTs require specific forms of support, particularly those that counteract the “out-of-sight, out-of-mind” disadvantage of VTs (Furst et al., 1999).

While there is some overlap between virtual and proximate teams in terms of the types of behaviours managers can use to support their work, VTs also require a set of specific types of support because of their unique situation. These unique types of support seem to

be associated with training and development of VT members and proactively providing opportunities to interact. Managers of proximate teams would not be expected to have to go out of their way to provide this type of support to co-located team members, as training in teamwork is much more readily available and opportunities for interaction abound.

#### *5.4.1.1.2 Results for Managerial Support of the Virtual Teams in this Study*

This section discusses the extent to which the supportive managerial behaviours were perceived to be provided to the VTs in this study. The means and standard deviations of the 14 items included in the proposed measure of managerial support of VTs are presented in Table 14. The items are scored on a 5-point scale. The higher the score, the greater the extent to which the VT managers were perceived to have exhibited the supportive behaviour. For the purposes of this study, the scores for the supportive manager items were interpreted as follows:

- Scores below 1.49 indicated that the VT manager did not exhibit the supportive behaviour;
- Scores between 1.50 and 2.49 indicated that the VT manager rarely exhibited the supportive behaviour;
- Scores between 2.50 and 3.49 indicated a neutral response (i.e. the manager sometimes exhibited the supportive behaviour);
- Scores between 3.50 and 4.49 indicated that the VT manager often exhibited the supportive behaviour; and

- Scores of 4.50 or greater indicated that the VT manager regularly exhibited the supportive behaviour.

None of the VTs reported having a manager who regularly exhibited any of the supportive behaviours included in this study. The mean scores for ten of the support items indicate that the managers of the VTs in this study often exhibited a number of behaviours which contributed to the success of the VTs. The VT members agreed that their managers had often helped their VTs to be effective by:

- Providing regular opportunities for interaction (mean of 4.00);
- Empowering VTs (mean of 3.97);
- Ensuring effective communication (mean of 3.95);
- Being a role model for virtual work (mean of 3.83);
- Ensuring that the team members have the communication tools they need (mean of 3.82);
- Facilitating the team's work (mean of 3.80);
- Clarifying what is to be done (mean of 3.77);
- Being accessible (virtually and face to face) (mean of 3.74);
- Supporting the use of flexible work arrangements (mean of 3.70); and
- Understanding the difficulties employees can face when engaged in distributed work (mean of 3.68).

The remaining four behaviours received neutral scores, indicating that the VT managers in this study sometimes exhibited the following supportive behaviours:

- Building team cohesion through non-work focused events (mean of 3.48);

- Recognizing the importance of professional development for VT members (mean of 3.46);
- Providing opportunities for face-to-face interactions when necessary (mean of 3.36); and
- Encouraging and promoting training on effective VT work (mean of 3.05).

**Table 14: Managerial Support of VTs in this Study**

<b>Item</b>	<b>Mean (s.d.)</b>
<b>My VT manager makes it easier for our VT to be effective by:</b>	
Providing regular opportunities for interaction and information exchange between all team members (i.e. meetings, conference calls, teleconferences, etc.)	4.00 (0.438)
Empowering VT members (i.e. trusting, providing autonomy, focusing on objectives rather than process).	3.97 (0.561)
Ensuring effective communication within the team (i.e. encourages interactions, openness, sharing, feedback, and keeps everyone in the loop)	3.95 (0.584)
Being a role model (i.e. using technology, communicating/managing virtually, being open to new approaches, etc.)	3.83 (0.540)
Ensuring that team members have the communication tools they need to work virtually (hardware & software: laptops, high-speed Internet access, Netmeeting, teleconferencing, cell phones, etc.)	3.82 (0.496)
Facilitating the team's work and removes obstacles	3.80 (0.407)
Clarifying what is to be done and who is to do it (i.e. priorities, goals, deliverables, roles, responsibilities and contributions of team and members)	3.77 (0.520)
Being accessible (virtually and face to face)	3.74 (0.573)
Supporting the use of flexible work arrangements (i.e. flextime, flexplace)	3.70 (0.543)
Understanding the difficulties employees can face when engaged in distributed work (non-verbal communication, time zone differences, etc..)	3.68 (0.405)
Building team cohesion through non-work focused events (i.e. meetings, conference calls, teleconferences, etc.)	3.48 (0.571)
Recognizing the importance of professional development for VT members	3.46 (0.610)
Providing opportunities for face-to-face interactions when necessary	3.36 (0.610)
Encouraging and promoting training on effective VT work (i.e. use of tools, time management, etc.)	3.05 (0.588)

## DISCUSSION OF THE RESULTS FOR THE MANAGERIAL SUPPORT OF VTS IN

**THIS STUDY:** Overall, the results indicate that the VT managers in this study often engaged in behaviours that were supportive of VTs. Despite the fact that the organization does not provide any guidance or training for managers of VTs, it would seem that the managers in this study have met with some success with respect to supporting their VTs. The results indicate that the managers of the VTs in this study supported their teams very well using generic team management skills and by adapting some of those skills to the virtual environment.

The managers in this study had lower scores on those supportive behaviours that are specific to VTs. The managers did not seem to be providing the encouragement and resources required to develop the VTs and their members. This result is consistent with the lower results found for the developmental aspects of VT effectiveness (professional development and capacity for future VT work). These results suggest that the VT managers must recognize the need for career development in the virtual setting. It should be noted that as the organization did not have any policies or training that is specific to VTs, managers in this organization would have had to provide these on their own initiative and within their own budgets.

In order to ensure that VT managers are able to effectively support their VTs, the organization would have to support the managers by providing the tools and resources. Although the organization offered extensive leadership and management training, it did not provide any management training specific to VTs.

The moderate success of the VT managers in this study in supporting their VTs is likely due to the application of traditional team management methods to the VT environment. The results are less positive, however, for those behaviours which are specific to support of VTs. Although these results highlight an area of concern, they also provide a possible solution. The support provided by the VT managers would likely be improved through the education and training of the managers in the unique needs of this type of team and the provision of resources for VT member training and development.

#### *5.4.1.1.3 Factor Analysis of the Managerial Support Items*

As the second stage of the act frequency approach was not used to rate and refine the lists of unique nominated behaviours, the set of supportive behaviours was explored for themes and refined through factor analysis.

The factor analysis of the 14 items comprising the measure of managerial support loaded onto two factors. One of the items (ensuring that team members have the communication tools they need to work virtually) had a loading below this study's cut-off of 0.55 (Tabachnick & Fidell, 1996) and was removed from the analysis. Three of the remaining items (being accessible, supporting the use of flexible work arrangements, understanding the difficulties employees can face when engaged in distributed work) did not load exclusively onto one factor (loading difference less than 0.2 between highest and secondary factor (Ferguson & Cox, 1993)). These items were also removed from further analysis.

Table 15 presents the factor loading of the remaining 10 items. Each factor explained a minimum of 27% of the variance. The two factors together were found to explain 63% of the variance and had a combined Cronbach's Alpha of 0.89. The factor loadings were all greater than 0.69. Such loadings were described by Tabachnick and Fidell (1996) as "very good" to "excellent". Each of the factors is discussed below.

#### FACTOR 1: FACILITATING

Six items loaded onto Factor 1. These behaviours indicated that managers could support their team by being a role model, clarifying roles, facilitating the team's work, ensuring effective communication within the team, empowering the VT, and providing opportunities for interaction and information exchange. These behaviours are closely related to traditional team leadership. This factor, which can be thought of as leading or facilitating the work of a VT, explained 36% of the total variance. The reliability of this dimension of managerial support of VTs was tested using Cronbach's Alpha. The high reliability of 0.88 indicates that the items within this factor appear to be measuring the same concept.

The overall score for this factor of managerial support was determined by calculating the summed average of the six items with high factor loadings. Higher scores (on a 5-point scale) indicate greater levels of facilitating behaviours by the VT managers. The overall

mean for this factor was 3.90 (s.d. 0.406), indicating that VT managers often exhibited behaviours which facilitated the work of their VTs.

**Table 15: Factor Loadings for Managerial Support of VTs**

Item	Factor 1 Loadings	Factor 2 Loadings
Being a role model (i.e. using technology, communicating/managing virtually, being open to new approaches, etc.)	0.822	
Clarifying what is to be done and who is to do it (i.e. priorities, goals, deliverables, roles, responsibilities and contributions of team and members)	0.751	
Facilitating the team's work and removing obstacles	0.745	
Ensuring effective communication within the team (i.e. encourages interactions, openness, sharing, feedback, and keeps everyone in the loop)	0.719	
Empowering VT members (i.e. trusting, providing autonomy, focussing on objectives rather than process)	0.705	
Providing regular opportunities for interaction and information exchange between all team members	0.693	
Providing opportunities for face-to-face interactions when necessary		0.766
Recognizing the importance of professional development for VT members		0.762
Encouraging and promoting training on effective VT work (i.e. use of tools, time management, etc.)		0.761
Building team cohesion through non-work focused events (i.e. meetings, conference calls, teleconferences, etc.)		0.724
<b>Variance Explained</b>	<b>36.4%</b>	<b>27.0%</b>

## FACTOR 2: VT DEVELOPMENT

Four items loaded onto Factor 2. All of the behaviours that loaded onto this factor relate to ways in which a manager can support VTs through the development of the team and its

members. This factor includes items such as encouraging VT training and professional development, and building team cohesion through face-to-face interactions and non-work events. This factor explained 27% of total variance. The reliability of the factor of managerial support through VT development was tested using Cronbach's Alpha. The high reliability of 0.82 indicates that the items within this factor appear to be measuring the same concept.

The overall score for this dimension of managerial support was determined by calculating the summed average of the items. Higher scores (on a 5-point scale) indicate that managers are more likely to display behaviours linked to the development of the VT members. The overall mean for this factor was 3.33 (s.d. 0.492), indicating that the VT managers in this study only sometimes exhibited behaviours that encouraged the development of their subordinates serving on VTs.

#### DISCUSSION OF FACTOR ANALYSIS OF MANAGERIAL SUPPORT FOR VTs:

The emergence of two factors of managerial support for VTs indicates that there are two types of behaviours that VT managers can engage in to provide support to their VTs. The results suggest that managers can contribute to the success of their VTs by acting in ways that facilitate the work of the VT and by developing the VTs and their members. The high reliability of the combined factors (0.89) indicates that the two factors combine to describe a single construct of managerial support of VTs.

An examination of the data in Table 15 shows that many of the items comprising the facilitating aspect of managerial support of VTs would seem to be those that are generic team management skills (i.e. apply to both proximate and VTs). The second factor, managerial support of VTs through team development, includes primarily those items that are specific to the support of VTs.

The results indicate that the managers in this study often exhibited the behaviours assorted with facilitation of VT work, suggesting that the VT managers have had some success in supporting their VTs by managing them the way they would their proximate teams. The results also indicate that team development is the area where the VT managers in this study provided the least support.

#### 5.4.1.2 Results for Managerial Non-Support of Virtual Teams

This section discusses the development of a measure of managerial non-support of VTs. The section begins with an examination of the items in the proposed measure, followed by the results for the managerial non-support of the VTs in this study. The results of the refinement of the measure of managerial non-support of VTs are then presented.

##### *5.4.1.2.1 Items Comprising Managerial Non-Support of Virtual Teams*

In this section, the list of items in the proposed measure of managerial non-support of VTs are examined to provide insight into the ways in which managers can behave that may hinder the success of their VTs. The list of behaviours representing managerial non-support of VTs was presented in Appendix S.

Four items in the measure of managerial non-support of VTs might be considered to be generic behaviours that are important to the management of both proximate and VTs:

- Allowing ineffective communication;
- Not being accessible;
- Not clarifying roles and responsibilities; and
- Being uncomfortable with empowerment.

VTs may require their managers to take a more proactive role with respect to these generic behaviours, as the team members cannot rely on face-to-face interactions to highlight and resolve problems. Communication problems, misunderstandings, overlap, and ambiguities may be less evident in virtual collaboration and VTs rely on their managers to oversee these potential problems. Also, VTs cannot rely on casual contact or drop in to see their managers. As such, VT managers may be expected to make themselves available both virtually and face-to-face. Finally, managers cannot expect to exert the same level of control over VTs as they do proximate ones, and some level of empowerment is expected.

The remaining five of the nine items in the proposed measure of managerial non-support of VTs relate specifically to managing the needs of workers who are not always present in the workplace:

- Not being a role model;
- Focusing on presence rather than contribution;
- Making it difficult to get virtual work training;

- Not recognizing need for relationship building; and
- Not treating virtual and proximate team members equally.

It is expected that VTs would be frustrated with managers who continue to operate in traditional ways, such as insisting on face-to-face meetings, shunning technology, giving proximate subordinates preferential treatment, and assuming that individuals have to be present to be performing. In addition, VTs require their managers to recognize the need for resources that are specific to VTs (training, budgets for meetings).

As with managerial support, there appears to be some overlap between the behaviours that may be considered non-supportive of both proximate and VTs. VT managers also may exhibit a set of behaviours that would be particularly troublesome for VTs.

#### *5.4.1.2.2 Results for Managerial Non-Support of the VTs in this Study*

This section discusses the results with respect to the extent to which the managers of the VTs in this study were perceived to exhibit non-supportive behaviours. The means and standard deviations of the nine items in the proposed measure of managerial non-support of VTs are presented in Table 16. The items were scored on a five-point scale. The higher the score, the greater the extent to which the VT managers were perceived to have exhibited the non-supportive behaviour (i.e. the higher the score, the greater the problem).

**Table 16: Managerial Non-Support of the VTs in this Study**

<b>Item</b>	<b>Mean (s.d.)</b>
<b>My VT manager makes it more difficult for our VT to be effective by:</b>	
Modeling unsupportive behaviour (i.e. not using technology effectively, insisting on face-to-face communication, not giving feedback etc.)	1.98 (0.610)
Being uncomfortable with the idea of empowerment (i.e. not encouraging autonomy, relying on/creating hierarchies, focusing on process rather than objectives, unnecessarily intervening, etc.)	2.04 (0.761)
Focusing on presence at work rather than performance or contribution	2.11 (0.682)
Not being accessible to the team	2.20 (0.693)
Treating VT members differently from those who work on proximate teams	2.23 (0.742)
Allowing ineffective communication within the group members (i.e. not resolving conflicts)	2.24 (0.614)
Not clarifying what is to be done (i.e. does not establish priorities, goals, deliverables, roles, responsibilities)	2.37 (0.654)
Making it difficult for team members to get the training they need to work virtually	2.37 (0.635)
Not recognizing and proactively promote relationship building within the VT (i.e. does not provide budget or time for face to face sessions for the team)	2.57 (0.715)

The scores for the supportive manager items were interpreted in this study as follows:

- Scores below 1.49 indicated that the VT manager did not exhibit the non-supportive behaviour;
- Scores between 1.50 and 2.49 indicated that the VT manager rarely exhibited the non-supportive behaviour;
- Scores between 2.50 and 3.49 indicated a neutral response (i.e. the manager sometimes exhibited the non-supportive behaviour);

- Scores between 3.50 and 4.49 indicated that the VT manager often exhibited the non-supportive behaviour; and
- Scores of 4.50 or greater indicated that the VT manager regularly exhibited the non-supportive behaviour.

No item had a mean greater than 2.6, indicating that overall, the VT members did not perceive that their managers often engaged in unsupportive behaviour. The low scores (i.e. scores lower than 2.5) on eight of the nine non-support items suggests that the managers of the VTs in this study avoided, for the most part, the following behaviours which were perceived as possibly hindering the success of VTs:

- Modelling unsupportive behaviour (i.e. not using technology and emphasising face-to-face interactions) (mean of 1.98);
- Being uncomfortable with empowerment (mean of 2.04);
- Focusing on presence rather than contribution (mean of 2.11);
- Not being accessible (mean of 2.20);
- Treating VT members differently than their proximate counterparts (mean of 2.25);
- Allowing ineffective communication (mean of 2.24);
- Not clarifying what is to be done (mean of 2.37); and
- Making it difficult for VT members to get the training they need to work virtually (mean of 2.37).

The mean of 2.57 on the remaining item indicates that the VT managers sometimes did not recognize and proactively promote relationships amongst the VT members.

**DISCUSSION OF THE RESULTS FOR MANAGERIAL NON-SUPPORT OF THE VTS IN THIS STUDY:** Overall, the results indicate that the VT managers in this study only rarely engaged in behaviour that is non-supportive of VTs. This may be due to two factors. First, the organization had a training program for managing proximate teams. It is likely the managers have received this training, much of which is transferable to the VT setting, and this would be expected to prevent managers from exhibiting behaviours that would be non-supportive of all teams (virtual or proximate). Second, these managers have experience managing teleworkers, who also can be considered to work virtually. It would be expected that managers who are familiar with managing the needs of teleworkers would be able to apply this experience and knowledge to VTs. This may explain the relatively positive results with respect to the non-supportive behaviour of the VT managers.

Nevertheless, the results obtained for managerial non-support point to the same area of concern noted previously: a lack of recognition of the specific needs of VTs and resources for face-to-face meetings and training.

#### *5.4.1.2.3 Factor Analysis of the Managerial Non-Support Items*

The factor analysis of the nine items comprising the proposed measure of manager non-support of VTs loaded onto only one factor. Table 17 presents the factor loading of the nine items. The factor loadings were all greater than 0.75 (described by Tabachnick &

Fidell (1996) as “excellent”) and all of the items loaded exclusively onto one factor. The factor explained 70% of the variance. All nine items were retained for further analysis.

**Table 17: Factor Loadings for Managerial Non-Support of VTs**

<b>Item</b>	<b>Factor Loading</b>
Focusing on presence at work rather than performance or contribution	0.878
Being uncomfortable with the idea of empowerment (i.e. not encouraging autonomy, relying on/creating hierarchies, focusing on process rather than objectives, unnecessarily intervening, etc.)	0.853
Not recognizing and promoting relationship building within the VT	0.850
Treating VT members differently from those who work on proximate teams	0.818
Not clarifying what is to be done (i.e. does not establish priorities, goals, deliverables, roles, responsibilities)	0.797
Modeling unsupportive behaviour (i.e. not using technology effectively, insisting on face-to-face communication, not giving feedback etc.)	0.793
Not being accessible to the team	0.792
Making it difficult for team members to get the training they need to work virtually	0.753
Allowing ineffective communication within the group members (i.e. not resolving conflicts)	0.751

Items loading onto this factor all dealt with behaviours that managers engage in that make it more difficult for a VT to be effective. This factor can be described as managerial non-support of VTs. The behaviours exhibited by managers that VT members perceived to contribute negatively to the effectiveness of VTs include such things as discouraging empowerment, relying on traditional hierarchies, valuing presence over contribution, not working to ensure effective communication and role clarity and modeling behaviour that supports traditional rather than VTs (i.e. insisting on face-to-face communication, not using technology effectively). The reliability of this factor was tested using Cronbach’s

Alpha. The high reliability of 0.95 indicates that the items within this factor appear to be measuring the same concept.

An overall score for manager non-support of VTs was determined by calculating the summed average of the items. Higher scores (on a 5-point scale) indicate higher levels of non-supportive behaviours by managers. The mean for this factor was 2.24 (s.d. 0.601), indicating that overall the VT managers in this study rarely exhibited behaviour that was non-supportive of VTs.

#### DISCUSSION OF FACTOR ANALYSIS OF MANAGERIAL NON-SUPPORT FOR

VTs: The emergence of a single factor with high internal reliability suggests that there is a single construct representing managerial non-support for VTs. These results also suggest that VT managers can make it more difficult for VTs to be effective through behaviour that does not support the work of teams in general and VTs in particular.

The managers of the VTs who participated in this study did not exhibit many unsupportive behaviours. This may be due to the application of proximate team and telework management skills in the virtual environment.

##### 5.4.1.3 Discussion of Managerial Support/Non-Support of Virtual Teams

The act nomination interviews (described in Section 4.5.2.2) yielded 14 behaviours that were perceived to be supportive and nine behaviours that were perceived to be non-

supportive of VTs. An examination of these behaviours led to the following observations:

- In seven cases, one set of respondents identified a particular behaviour as reflecting managerial support of VTs, while another set of respondents talked about how the opposite behaviours had made it more difficult for their VT to be successful (i.e., being accessible/not being accessible);
- Some of the supportive behaviours (7) did not have a non-supportive counterpart; and
- Some of the non-supportive behaviours (2) did not have a supportive mate.

The seven supportive managerial behaviours that had corresponding non-supportive behaviours are outlined in Table 18.

**Table 18: Corresponding Supportive Non/Supportive Managerial Behaviours**

<b>Managerial Support of VTs</b>	<b>Managerial Non-Support of VTs</b>
Being a role model	Modeling unsupportive behaviour
Empowering VT members	Being uncomfortable with empowerment
Being accessible	Not being accessible
Ensuring effective communication	Allowing ineffective communication
Clarifying what is to be done	Not clarifying what is to be done
Encouraging and promoting VT training	Making it difficult to get training
Providing opportunities for face-to-face interaction	Not recognizing and promoting relationship building (face-to-face sessions)

Correlations were performed between the pairs of dual managerial behaviours to determine if they were, in fact, measuring the same concept (one with a positive scale and

one with a negative one). Although all of the correlations were significant ( $p < 0.01$ ), the maximum was  $r = -0.58$ , well below the level which Tabachnick and Fidell (1996) indicate is a cause for concern with respect to redundancy ( $r = 0.70$  to  $0.9$ ). In order to gauge both the positive and negative aspects of these behaviours, they were retained as items on the measures of both managerial support and non-support of VTs.

The results suggest that these seven sets of supportive/non-supportive managerial behaviours are key to the success and failure of VTs. Five of these behaviours are ways in which a manager can support the work of all teams (proximate or virtual). Two of these behaviours, however, are specific to managing VTs.

The identification of these dual supportive/non-supportive behaviours is important because education and training pertaining specifically to these behaviours would have the effect of addressing both negative and positive behaviours at the same time. For example, the data indicates that for VTs to be successful, not only is it important for managers to ensure that they do not get in the way of VT training, but they must actively promote it. Similarly, managers should provide opportunities for face-to-face interactions, not just remain neutral on this issue.

Seven of the managerial behaviours were identified as supportive only (providing regular opportunities for interaction, ensuring that team members have the communication they need, facilitating the team's work, supporting the use of flexible work arrangements,

understanding the difficulties of distributed work, building team cohesion through non-work focused events, recognising the importance of professional development). This result indicates that these behaviours were perceived to have a positive association with VT effectiveness. The absence or opposite of these behaviours was not, however, identified as having a negative association.

Finally, two behaviours were identified as negative only (focusing on presence rather than performance, treating VT members differently than proximate ones), indicating that these behaviours were perceived to have a negative association with the effectiveness of VTs, but the opposite or absence of these behaviours was not identified as having a positive association.

The behaviours which were identified as supportive or non-supportive only were identified as important to the success of VTs, but they are likely not as key as the dual behaviours identified above.

#### 5.4.1.4 Testing the Measures of Managerial Support/Non-Support of Virtual Teams

The previous sections dealt with the development of two measures: managerial support and managerial non-support of VTs. The reliabilities of these measures, assessed by Cronbach's Alpha, were presented in the previous sections. The face validity of the proposed measures of managerial support/non-support of VTs was enhanced through the item generation procedure used in the Act Frequency Approach. The predictive validity of these measures was tested by determining if they were correlated to each other and to

other measures that have been previously associated with effectiveness of VTs (Lurey & Raisinghani, 2001; Potter & Balthazard, 2002).

Two measures, members' perceptions of VT performance and VT member satisfaction with their VT experiences were used in this thesis to test the predictive validity of the new measures of managerial support/non-support of VTs. The means and standard deviations for the two outcome measures were discussed previously in Section 5.3.

Pearson 2-tailed correlations were calculated between these two outcome measures and the new measures of managerial support/non-support. These correlations are presented in Table 19 and discussed below.

**Table 19: Correlations of Factors of Managerial Support/Non-Support of VTs and Selected Outcomes**

<b>Measure</b>	<b>Reliability</b>	<b>Managerial Support Factor 1: Facilitating</b>	<b>Managerial Support Factor 2: VT Development</b>	<b>Managerial Non-Support</b>
<b>Managerial Support Factor 1: Facilitating</b>	0.86	-	-	-
<b>Managerial Support Factor 2: VT Development</b>	0.82	0.780**	-	
<b>Managerial Non-Support</b>	0.95	-0.580**	-0.598**	-
<b>VT Members' Perceptions of Performance</b>	0.88	0.548**	0.516**	-0.548**
<b>VT Member Satisfaction</b>	0.80	0.752**	0.600**	-0.463**

\*\*Significant at  $p < 0.01$ ; \*Significant at  $p < 0.05$

The two factors of managerial support and the measure of manager non-support of VTs were all significantly related to one another ( $p < 0.01$ ) in the expected directions. The

correlations between the two positive factors of support (facilitating and VT development) were significantly positively correlated. The correlations between the measure of non-support and the two supportive factors (facilitating, VT development) were significant and negative.

All of the correlations between the factors of managerial support and the outcome measures were significant at  $p < 0.01$  and in the expected direction. Correlations between the outcome measures and two factors of managerial support were positive, indicating that higher levels of facilitating VT work and support through VT development are associated with greater perceived VT member satisfaction and perceived VT performance. Correlations between managerial non-support and the two outcome measures were negative, indicating that as behaviours that represent managerial non-support increase, members' perceptions of team effectiveness and satisfaction decrease.

The significant correlations between the developed measures of managerial support and non-support of VTs and the outcomes that have been previously linked to VT effectiveness, suggest very good construct validity.

#### **5.4.2 Organizational Support/Non-Support of Virtual Teams**

This section discusses the results for organizational support of VTs and organizational non-support of VTs. The results for the organizational support measure are presented first. The results for organizational non-support are presented second. This is followed

by a discussion of the measures of organizational support and non-support of VTs. The section concludes with the testing of the two new measures.

#### 5.4.2.1 Results for Organizational Support of Virtual Teams

This section is divided into three parts. The items in the proposed measure of organizational support of VTs are examined first, followed by the results for the organizational support of the VTs in this study. The section concludes with the refinement of the measure of organizational support of VTs (factor analysis).

##### *5.4.2.1.1 Items Comprising Organizational Support of Virtual Teams*

This section examines the list of items in the proposed measure of organizational support of VTs. The results are used to provide insight into the ways in which organizations can help their VTs to be successful. The list of behaviours representing organizational support of VTs was presented in Appendix T.

Three of the ten items contained in the list of behaviours representing organizational support of VTs suggest that some ways in which organizations can support VTs seem to be generic organizational behaviours that would be important to all teams, whether virtual or proximate:

- Providing effective communication tools and budgets;
- Making sure that technology is compatible; and
- Ensuring effective organizational communication.

It is likely, however, that these behaviours, which might be helpful to proximate teams, become even more critical in the virtual environment. VTs require effective and compatible tools as well as access to organizational information in order to perform their day-to-day work.

Six of the supportive organizational behaviours would appear to be specific to the support of VT work (as opposed to proximate team work):

- Officially supporting the use of flexible work arrangements;
- Basing compensation on performance rather than presence;
- Having a culture that recognizes and accepts that employees don't have to be present to be contributing;
- Having a culture that supports VTs;
- Providing a structure that supports VTs;
- Recognizing the importance of relationship building in VTs by ensuring that there is time and funding for some face-to-face meetings; and
- Providing training on how to work effectively on a VT.

VT members require the training and other resources necessary to collaborate virtually, as this is their primary way of working. VTs also need the resources to build relationships through face-to-face meetings as they cannot be expected to take the responsibility for organizing and funding face-to-face meetings. VTs would also be expected to have a greater interest in flexible work arrangements and a need for their organization to recognize and appreciate their contribution, regardless of their presence in

the workplace. The results indicate that VTs need to be recognized both officially, through the reward system, and unofficially, through the organizational culture. VTs can also be expected to require a more open and less hierarchical structure and culture, as they are reliant on long distance relationships with their organizational contacts and are not as easily able to take advantage of organizational politics.

Overall, the items identified as representing organizational support of VTs are much more specific to VTs than those of managerial support of VTs. This result suggests that although the management of VTs may be closely related to that of proximate teams, at the organizational level, the differences between the needs of proximate and VTs are more profound. The implication of this is that although VT managers can support VTs by adapting their proximate team management skills, organizations must officially address the unique needs of VTs in order to support their success.

#### *5.4.2.1.2 Results for Organizational Support of the Virtual Teams in this Study*

This section discusses the results with respect to the extent to which the supportive organizational behaviours were perceived to be provided to the VTs in this study. The means and standard deviations of the ten items comprising the proposed measure of organizational support of VTs are presented in Table 20. The items are scored on a five-point scale. The higher the score, the greater the extent to which the organization was perceived to have exhibited the supportive behaviour. The scores for the supportive organizational items were interpreted in the same manner as those of managerial support of VTs, described in Section 5.4.1.1.2.

None of the VTs reported that the organization regularly exhibited any of the supportive behaviours included in this study. The moderate scores on eight of the support items indicated that the organization in this study was perceived to exhibit a number of behaviours which contributed to the success of the VTs. The VT members agreed that their organization had often helped their VTs to be effective by:

- Providing effective communication tools and budgets (mean=4.30);
- Making sure that technology is compatible (mean=4.09);
- Officially supporting the use of flexible work arrangements (mean=4.06);
- Basing compensation on performance rather than presence (mean=3.92);
- Having a culture that recognizes contribution over presence (mean= 3.88);
- Having a culture that supports VTs (openness, trust, etc.) (mean= 3.88);
- Ensuring effective organizational communication (mean=3.78); and;
- Providing a structure that supports VTs (mean = 3.71).

The remaining two behaviours received neutral scores, indicating that the organization in this study was perceived to sometimes exhibit the following supportive behaviours:

- Recognizing the importance of relationship building in VTs by ensuring that there is time and funding for some face-to-face meetings (mean=3.04); and
- Providing training on how to work effectively on a VT (mean=2.72).

**Table 20: Organizational Support of VTs in this Study**

Item	Mean s.d.
<b>My organization makes it easier for our VT to be effective by:</b>	
Providing effective communication tools and budgets (hardware & software: laptops, high-speed Internet access, Netmeeting, teleconferencing, cell phones, etc.)	4.30 (0.439)
Making sure that the technology used within the organization is compatible.	4.09 (0.399)
Officially supporting the use of flexible work arrangements such as telework (i.e. training, reward system, funding for tools, etc).	4.06 (0.324)
Basing compensation on performance – rather than presence.	3.92 (0.443)
Having a culture that recognizes and accepts that employees don't have to be present to be contributing.	3.88 (0.498)
Having a culture that supports VTs (i.e. demonstrates trust, less reliance on hierarchies, open communication, less emphasis on presence, etc.)	3.88 (0.526)
Ensuring effective organizational communication (open, timely, centralized, accessible).	3.78 (0.440)
Providing a structure that supports VTs (i.e. less hierarchy, clear team roles, objectives, responsibilities and reporting structures, etc.)	3.71 (0.536)
Recognizing the importance of relationship building in VTs by ensuring that there is time and funding for some face-to-face meetings.	3.04 (0.738)
Providing training on how to work effectively on a VT (i.e. use of tools, time management, long-distance management, etc.).	2.72 (0.510)

#### DISCUSSION OF THE RESULTS FOR ORGANIZATIONAL NON-SUPPORT OF

**VTs IN THIS STUDY:** Overall the results indicate that the organization in this study was perceived to be fairly supportive of VTs. Three of the supportive behaviours which were often exhibited by the organization would seem to be important to all teams whether virtual or proximate (i.e. providing effective communication tools, making sure that the

technology is compatible, ensuring effective organizational communication). Two of these behaviours had the highest scores (providing effective and compatible tools). These results are consistent with the member data regarding the availability of these tools, which were very positive (i.e. almost all of the tools included in this study were reported by the team members to be available) and the characteristics of the industry that the organization is in (telecommunications).

Five of the supportive behaviours which had been perceived to be exhibited often by the organization in this study were those specific to the support of VT work (as opposed to proximate team work): officially supporting alternate work arrangements, performance based compensation, and a trusting and open culture which values performance over presence. These results indicate that the organization's culture and reward system support VT work, as they recognize the contribution of remote workers and support work-time and work-location flexibility. This is an organization that has both formal (compensation system, flexible work arrangements, telework policies) and informal systems (i.e. culture) in place to support virtual work in general. These factors are also perceived to support VT work.

Two of the items of organizational support of VTs scored fairly low. The VT members in this study perceived that the organization only sometimes recognized the importance of relationship building by ensuring funding for face-to-face meetings and providing VT training. These results are consistent with the document review, which indicated that the

organization did not have training or policies in place to support VTs. These results are also consistent with the results with respect to managerial support and non-support of VTs and the evaluations of VT effectiveness with respect to professional development and capacity to work on VTs in the future.

To summarize, the organization in this study was perceived to be relatively supportive of VTs, but these results would seem to be due to the organization's concentration in the high tech industry and its telework policies as opposed to an effort to meet the needs of VTs. It would appear that the specific types of support required by VTs are less likely to be provided, possibly because the organization is not aware of the needs of the VTs in this regard.

#### *5.4.2.1.3 Factor Analysis of Organizational Support of Virtual Teams*

The set of supportive organizational behaviours was explored for themes and refined through factor analysis. The factor analysis of the 10 items comprising the proposed measure of organizational support for VTs loaded onto two factors. All of the factor loadings were greater than 0.60 (described by Tabachnick and Fidell (1996) as "good" to "very good"). One item (ensuring effective organizational communication) did not load exclusively onto one factor (loading difference less than 0.2 between highest and secondary factor). This item was removed from further analysis.

Table 21 presents the factor loading of the remaining nine items. The first factor explained 34.9% of the variance and the second factor explained 25.0%. Together, the

two factors explained 60% of the variance and had a combined Cronbach's Alpha of 0.85. Each of the factors is discussed below.

#### FACTOR 1: SUPPORTIVE CULTURE

Five items loaded onto Factor 1. These items described behaviours associated with the structure and culture of the organization. It would appear from this factor that organizations can support VTs by having a culture that supports VTs, recognizes that employees don't have to be present to be contributing and by having a structure that has fewer hierarchies, clear responsibilities, official policies regarding alternate work arrangements, and performance-based compensation. The reliability of the factor of supportive culture was tested using Cronbach's Alpha. The high reliability of 0.86 indicates that the items within this factor are measuring the same concept.

The overall score for this factor of organizational support was determined by calculating the summed average of the items. Higher scores (on a 5-point scale) indicate greater levels of behaviours that reflect a culture that is supportive of VTs. The overall mean for this factor was 3.89 (s.d. 0.382), indicating that the organization in this study often exhibited this type of behaviour.

**Table 21: Factor Loadings for Organizational Support of VTs**

<b>Item</b>	<b>Factor 1 Loadings</b>	<b>Factor 2 Loadings</b>
Having a culture that supports VTs (i.e. demonstrates trust, less reliance on hierarchies, open communication, less emphasis on presence, etc.)	0.907	
Having a culture that recognizes and accepts that employees don't have to be present to be contributing.	0.875	
Providing a structure that supports VTs (i.e. less hierarchy, clear team roles, objectives, responsibilities and reporting structure, etc.)	0.715	
Officially supporting the use of flexible work arrangements such as telework (i.e. training, reward system, funding for tools, etc).	0.652	
Basing compensation on performance - rather than presence.	0.621	
Providing training on how to work effectively on a VT (i.e. use of tools, time management, long-distance management, etc.).		0.780
Recognizing the importance of relationship building in VTs by ensuring that there is time and funding for some face-to-face meetings.		0.721
Providing effective communication tools and budgets		0.636
Making sure that the technology used within the organization is compatible.		0.603
<b>Variance Explained</b>	<b>34.9%</b>	<b>25.0%</b>

## FACTOR 2: INFRASTRUCTURE

Four items loaded onto Factor 2. These items include behaviours that support VTs through the provision of the infrastructure required for the work of VTs. This factor of organizational support of VTs included the provision of training on VT work, budgets for face-to-face relationship building, and effective and compatible communication tools and technology. The reliability of this factor was tested using Cronbach's Alpha. The

reliability of 0.68 indicates that the items within this factor are measuring the same concept.

The overall score for this factor of organizational support was determined by calculating the summed average of the items. Higher scores (on a 5-point scale) indicate greater levels of organizational behaviours reflecting the provision of infrastructure. The overall mean for this factor was 3.54 (s.d. 0.401), indicating that the organization in this study often provided the infrastructure necessary for the success of VTs.

#### DISCUSSION OF FACTOR ANALYSIS OF ORGANIZATIONAL SUPPORT OF

VTS: The data from this study suggests that VTs need two types of support from their organizations: a supportive culture (e.g. rewards and a culture that values contribution over presence); and support through infrastructure (e.g. training and budgets for VT work). Overall, the data indicates that the majority of the VTs in this study feel that the organization has a culture that is supportive of VT work. It is interesting to note that many of the items in the supportive culture factor might be equally relevant to behaviour that is supportive of telework (i.e. focus on contribution, supportive of flexible work arrangements). Given the highly developed program for teleworkers at this organization (which, similar to VT work, implies that employees need to work remotely from their colleagues), it is interesting that the organization would not be perceived to be more highly supportive of VTs with respect to this factor (the mean score was 3.89). It is possible, that despite the official acceptance of non-traditional work arrangements

(telework), that many of the organization's norms and expectations (i.e. culture) are not supportive. It also suggests a gap between policy and acceptance with respect to the support of such practices.

The VTs in this study also agreed that the organization had the infrastructure in place to support VTs. Although the organization received a moderate score on this factor, (mean of 3.54), the results of the individual items making up this factor were quite varied. As discussed in the previous section, the organization delivered very well on two out of the four items in this factor (communication tools, compatibility). Two of the things in this factor did not appear to be in place, however (recognizing the importance of face-to-face meetings, providing VT training).

#### 5.4.2.2 Results for Organizational Non-Support of Virtual Teams

This section begins with an examination of the items in the proposed measure of organizational non-support of VTs, followed by the results for the organizational non-support of the VTs in this study. This is followed by the refinement of the measure of organizational non-support of VTs.

##### 5.4.2.2.1 *Items Comprising Organizational Non-Support of Virtual Teams*

This section examines the list of items in the measure of organizational non-support of VTs in order to provide insight into the ways in which organizations can behave that may hinder the success of their VTs. The list of behaviours representing organizational non-support of VTs was presented in Appendix T.

Only two of the nine items contained in the list of behaviours representing organizational non-support of VTs seem to be generic behaviours that would be important to all teams, whether virtual or proximate (having unrealistic timelines, not providing the necessary communication tools). Although all teams require some tools for collaboration, VTs use these tools as their primary mode of work. It is also possible that VT members feel increased pressure to work long hours to prove that they are capable of performing without supervision.

The remaining seven of the non-supportive organizational behaviours would appear to be specific to VT work:

- Not supporting the use of flexible work arrangements such as telework or flextime;
- Having a culture that rewards "face time" and presence at work rather than contribution;
- Not providing a structure that supports VTs;
- Putting employees with poor technical skills on VTs;
- Forcing VT members to travel on their own time;
- Not providing VTs with the budget they need to work virtually; and
- Making it difficult for VTs to get together face to face (i.e. limited time or budgets).

Three of the non-supportive organizational behaviours are related to resources (travelling on personal time, not providing budget for virtual work, making it difficult to meet face-to-face). The results indicate that VTs cannot effectively do their jobs without the commitment of the required resources by the organization. Another item (putting employees with poor technical skills on VTs) is also related to organizational resources. This item suggests that organizations must provide technical training to employees before assigning them to VTs, as VTs rely on technology to interact and collaborate. In addition, VT members cannot be expected to provide long distance “on the job” technical training to new teammates.

VTs may also be hindered by a culture that rewards presence rather than contribution and a structure that is not supportive of VTs. VT members who are not present in the workplace can be expected to feel stressed and undervalued in an organization that values “face-time” and has a structure that undermines VT work.

Finally, the non-support of flexible work arrangements was also identified as non-supportive of VTs, indicating that VT members consider themselves to benefit from telework policies. This is consistent with the results for managerial support and non-support of VTs and organizational support of VTs. It is possible, that in the absence of policies specific to VTs, policies which support telework are the next best thing.

As with organizational support of VTs, the items identified as representing organizational non-support of VTs are much more specific to VTs than those of managerial support and non-support of VTs, indicating that while VT managers may be able to employ some methods of proximate team management, organizations must be even more aware of the specific needs of VTs.

#### *5.4.2.2.2 Results for Organizational Non-Support of the Virtual Teams in this Study*

This section discusses the results with respect to the extent to which the non-supportive organizational behaviours were perceived to be exhibited by the organization in this study. The means and standard deviations of the nine items in the measure of organizational non-support of VTs are presented in Table 22. The items were scored on a five-point scale. Higher scores indicate an increased perception that the organization is not behaving in a manner that is supportive of VTs (i.e. higher scores indicate greater problems). The scores for the items for organizational non-support were interpreted in the same manner as those of managerial non-support for VTs, described in Section 5.4.1.2.2.

The organization was not perceived to have exhibited any of the non-supportive behaviours regularly or often. Four of the items had low means (i.e. scores less than 2.50), indicating that the organization rarely exhibited the following non-supportive behaviours:

- Not providing the communication tools VTs need (mean=1.99);
- Not supporting the use of flexible work arrangements (mean=2.20);
- Having a culture that values presence over contribution mean=2.35); and

- Not providing a structure that supports VTs (mean=2.46).

**Table 22: Organizational Non-Support of VTs in this Study**

Item	Mean s.d.
<b>My organization makes it more difficult for our VT to be effective by:</b>	
Not providing to VTs the communication tools they need to work virtually (hardware & software: no laptops, slow network, outdated tools, incompatible software).	1.99 (0.627)
Not supporting the use of flexible work arrangements such as telework or flextime (i.e. no funding for tools, training, reward system, etc)	2.20 (0.684)
Having a culture that rewards "face time" and presence at work rather than contribution.	2.35 (0.780)
Not providing a structure that supports VTs (i.e. does not establish clear priorities, roles, objectives, responsibilities and reporting structures).	2.46 (0.648)
Putting employees with poor technical skills on VTs	2.55 (0.703)
Forcing VT members to travel on their own time.	2.82 (0.870)
Not providing VTs with the budget they need to work virtually (limited teleconferencing budgets, no budgets for face to face meetings, inadequate support, etc.).	2.83 (0.920)
Having unrealistic expectations with respect to timelines	2.96 (0.889)
Making it difficult for VTs to get together face to face (i.e. limited time or budgets)	3.33 (0.873)

The moderate scores (i.e. scores between 2.49 and 3.50) on the remaining four items indicated that the organizations did sometimes exhibit the following non-supportive behaviours:

- Having unrealistic expectations with respect to timelines (mean=2.96);
- Not providing the budget to work virtually (teleconferencing, meetings, support, etc) (mean=2.83);

- Forcing team members to travel on their own time (mean=2.82) and
- Putting employees with poor technical skills on VTs (mean=2.55).

DISCUSSION OF THE RESULTS FOR ORGANIZATIONAL NON-SUPPORT OF VT IN THIS STUDY: The data suggest that, overall, the VTs in this study did not perceive their organization to regularly behave in ways that were non-supportive of VT work. The non-supportive behaviour which was perceived to be exhibited the least often was with respect to the provision of communication tools. This result is consistent with the results for organizational support of VTs, in which it was indicated that the organization does a good job of equipping its VT members. Two of the behaviours which were similarly perceived to be exhibited only rarely were non-support of flexible work arrangements and valuing presence over contribution. These results are also consistent with those of organizational support and are keeping with the organization's provision of an official policy regarding teleworkers.

The results indicate that the organization sometimes exhibited behaviours that are non-supportive of VT work. These behaviours related to the organization not providing the resources necessary for VT work (travel time, budgets, and realistic timelines). These results are consistent with those of organizational support of VTs.

#### 5.4.2.2.3 Factor Analysis of Organizational Non-Support

All of the items included in the proposed measure of organizational non-support of VTs loaded onto only one factor during factor analysis. All of the items had factor loadings greater than 0.65 and loaded exclusively onto one factor.

Table 23 presents the factor loading of the nine items. The factor explained 59% of the variance and had a Cronbach's Alpha of 0.91, indicating that the items within this factor are measuring the same concept.

**Table 23: Factor Loadings for Organizational Non-Support of VTs**

<b>Item</b>	<b>Factor Loading</b>
Not providing a structure that supports VTs (i.e. does not establish clear priorities, roles, objectives, responsibilities and reporting structures).	0.847
Having unrealistic expectations with respect to timelines	0.799
Not providing VTs with the budget they need to work virtually (limited teleconferencing budgets, no budgets for face to face meetings, inadequate support, etc.).	0.791
Making it difficult for VTs to get together face to face	0.786
Having a culture that rewards "face time" and presence at work rather than contribution	0.780
Not supporting the use of flexible work arrangements such as telework or flextime	0.754
Forcing VT members to travel on their own time	0.742
Putting employees with poor technical skills on VTs	0.734
Not providing to VTs the communication tools they need to work virtually	0.651

Items loading onto this factor all relate to ways in which an organization can make it more difficult for VTs to do their work successfully. The results suggest that the

behaviours exhibited by organizations that make it more difficult for VTs to be effective include: not providing the necessary resources (budget for face-to-face meetings, communication tools, adequately skilled members), not supporting the use of flexible work arrangements and rewarding “face time”, not providing a supportive structure (clear priorities, roles, responsibilities), forcing VT members to travel on personal time, and having unrealistic expectations with respect to timelines.

The summed average of the items was calculated to provide an overall score for organizational non-support of VTs. Greater levels of non-support are indicated by higher scores on a 5-point scale. The overall mean for this factor was 2.62 (s.d. 0.633), indicating that VTs in this study perceived that their organization sometimes exhibited behaviour that was non-supportive of VTs.

**DISCUSSION OF FACTOR ANALYSIS OF ORGANIZATIONAL NON-SUPPORT OF VTS:** The existence of a single factor of organizational support of VTs indicates that the respondents perceive a global set of behaviours comprising this concept. The mean score for this measure indicates that the VTs in this sample perceived their organization to be only somewhat unsupportive of VTs. It is possible that the organization’s lack of official recognition of VTs has contributed to the perceptions of non-support. As there are no official policies regarding the resources and structure of VTs, this result is not unexpected and is consistent with the results regarding organizational support of VTs.

### 5.4.2.3 Discussion of Organizational Support/Non-Support of Virtual Teams

Ten organizational behaviours were identified during the act nomination interviews (described in Section 4.5.3.2) that were perceived to be supportive of VTs. Nine behaviours were similarly identified as non-supportive of VTs. Similar to the items for managerial support/non-support of VTs, the following observations were made:

- In five cases, one set of respondents identified a particular behaviour as reflecting organizational support of VTs, while another set identified the opposite behaviour as unsupportive);
- Five of the supportive behaviours did not have a non-supportive counterpart; and
- Four of the non-supportive behaviours did not have a corresponding supportive item.

The five organizational behaviours that had corresponding supportive and non-supportive items are outlined in Table 24.

**Table 24: Corresponding Supportive Non/Supportive Organizational Behaviours**

<b>Managerial Support of VTs</b>	<b>Managerial Non-Support of VTs</b>
Providing effective communication tools	Not providing the tools that VTs need
Officially supporting flexible work arrangements	Not supporting flexible work arrangements
Having a culture that values contribution over presence	Having a culture that values presence over contribution
Providing a structure that supports VTs	Not providing a structure that supports VTs
Recognizing the importance of relationship building (face-to-face)	Making it difficult for VTs to meet face-to-face.

These results suggest that these organizational behaviours are key to the success and failure of VTs. The identification of these dual supportive/non-supportive behaviours is important because organizational attitudes and policies specifically addressing these behaviours would have the effect of addressing both negative and positive behaviours at the same time.

Again, correlations were performed between the pairs of dual behaviours to determine if they were measuring reverse perceptions of the same concept. All of the correlations were significant ( $p < 0.01$ ) but the maximum correlation was  $r = -0.68$ , indicating that these items are not redundant. As such, they were retained as items on the measures of both organizational support and non-support.

Overall, the results suggest that organizations should consider implementing policies including training, reward systems and budgeting, that is specific to the work arrangements of VTs.

Five items were identified as supportive only (ensuring compatible technology, basing compensation on performance, having a culture that supports VTs, ensuring effective communication, providing VT training). These behaviours were perceived to be associated with support of VTs, but the opposite of these behaviours were not perceived to be non-supportive.

Four behaviours were identified as non-supportive only (putting employees with poor technical skills on VTs, forcing VT members to travel on their own time, not providing VTs with adequate budgets for their work, having unrealistic expectations with respect to timelines). These behaviours were perceived to be non-supportive of VTs, but the opposite of the behaviours were not perceived to be supportive.

Although these behaviours, which were identified as supportive or non-supportive only, were perceived as important to the success of VTs, they likely do not play a lesser role than the dual behaviours identified above.

#### 5.4.2.4 Testing the Measures of Organizational Support/Non-Support of Virtual Teams

As a last step in this phase of the analysis, the validity and reliability of the measures of organizational support and non-support, were determined. The reliabilities of these measures, as assessed by Cronbach's Alpha, were high (see Sections 5.4.2.1.3 and 5.4.2.2.3). The item generation procedure used in the Act Frequency Approach enhanced the face validity of these measures. The predictive validity of these two new measures was tested using the method outlined in Section 5.4.1.4.

The correlations between the two outcome measures, the two factors of organizational support and the measure of organizational non-support of VTs are presented in Table 25. These correlations are discussed below.

Table 25: Correlations of Factors of Organizational Support of VTs and Selected Outcomes

Measure	Reliability	Organizational Support Factor 1: Supportive Culture	Organizational Support Factor 2: Supportive Infrastructure	Organizational Non-Support
Organizational Support Factor 1: Supportive Culture	0.86	-	-	-
Organizational Support Factor 2: Supportive Infrastructure	0.68	0.502**	-	-
Organizational Non-Support	0.91	-0.483**	-0.575**	-
VT Members' Perceptions of Performance	0.88	0.324	0.462*	-0.356
VT Member Satisfaction	0.80	0.518**	0.578**	-0.381*

\*\*Significant at  $p < 0.01$ ; \*Significant at  $p < 0.05$

The two factors of organizational support and the measure of organizational non-support of VTs were significantly related to one another ( $p < 0.01$ ) in the expected direction: The two factors of organizational support (culture and infrastructure) were positively correlated with each other. The correlations between the measure of non-support of VTs and the two factors reflecting managerial support of VTs were negative.

VT members' satisfaction had significant positive correlations with both of the factors of organizational support: supportive culture and infrastructure ( $p < 0.01$ ). VT members' satisfaction was also significantly negatively correlated with organizational non-support ( $p < 0.05$ ). VT members' perceptions of performance, on the other hand, was significantly correlated with only one factor: organizational support of VTs through infrastructure

( $p < 0.05$ ). This indicates that while organizational provision of support for VTs can be linked to increased member satisfaction, VT members' perceptions of performance are only related to the provision of the necessary infrastructure.

The fact that VT members' perceptions of performance was only significantly related to infrastructure, but VT member satisfaction was significantly related to both factors of support and the measure of non-support, suggests that the outcomes (performance and satisfaction) may have different antecedents. In addition, this result indicates that organizations must concentrate on different things to achieve different kinds of VT effectiveness. In other words, if the goal of the organization is to improve the performance of its VT, it should focus on infrastructure (which will also improve VT member satisfaction). Conversely, if the goal of the organization is to provide satisfaction to its VT members, it could provide a supportive culture, focus on the necessary infrastructure, or refrain from engaging in behaviours that are non-supportive.

The significant correlations between the developed measures and the outcomes that have been previously linked to VT effectiveness suggest very good construct validity.

## **5.5 INPUTS OF THE TEAM SAMPLE**

This section is divided into 2 parts. The first part outlines key findings with respect to team-level inputs. The second part discusses the results of the inputs at the contextual level.

### **5.5.1 Team-Level Inputs**

Data on nine input components were collected in this thesis: team size, team longevity, meeting history, team composition, motivating task design, goal clarity, adequacy of technology, member skills and leadership effectiveness.

The team demographics, size, longevity and meeting history were discussed in the section describing the sample (Section 5.1.3) and will not be repeated here.

Team composition was operationalized by considering the gender, diversity, the level of experience with information technology and the level of comfort with information technology of the team members. Team gender, level of experience and level of comfort with information technology were discussed in Section 5.1.3 (sample description) and will not be repeated here. The remaining aspect of team composition, team diversity, was operationalized as the diversity of the VT in terms of area of expertise, age, level of education, tenure with the organization tenure, tenure in current position, and tenure with the team. VT diversity with respect to areas of expertise was also discussed in Section 5.1.3 (sample description). The remaining measures of VT diversity were derived from the team member demographics using within-team standard deviation as outlined in Section 4.6.1.2. The summary results for these r aspects of VT diversity are presented in Table 26.

**Table 26: Descriptives of the Team Diversity (N=30)**

<b>Aspect of Diversity</b>	<b>Diversity</b>
Age Diversity	<ul style="list-style-type: none"> <li>• low 14%</li> <li>• medium 55%</li> <li>• high 31%</li> </ul>
Education Diversity	<ul style="list-style-type: none"> <li>• low 17%</li> <li>• medium 33%</li> <li>• high 50%</li> </ul>
Organization Tenure Diversity	<ul style="list-style-type: none"> <li>• low 14%</li> <li>• medium 55%</li> <li>• high 31%</li> </ul>
Position Tenure Diversity	<ul style="list-style-type: none"> <li>• low 73%</li> <li>• medium 17%</li> <li>• high 10%</li> </ul>
Team Tenure Diversity	<ul style="list-style-type: none"> <li>• low 79%</li> <li>• medium 14%</li> <li>• high 7%</li> </ul>

The greatest team diversity was in the level of education (50% of the VTs were highly diverse). Just over half (55%) of the VTs in the sample were moderately diverse with respect to age and organizational tenure. The teams were much less diverse in terms of position (73% with low diversity) and team tenure (79% with low diversity). These results suggest that the organization uses VTs in situations where particular expertises are required, but the employees with those skills are not co-located.

The summary results with respect to motivating task design, goal clarity, adequacy of the technology tools, member skills, and leadership effectiveness are presented in Table 27.

With one exception (the question which determined whether or not the teams had a leader), the measures are all based on a 5-point Likert-type scale with 5 representing higher levels of the team input component. In this study, the scores for the team inputs were interpreted as follows:

- Scores of 2.50 and below reflect low levels of the input under consideration;
- Scores between 2.50 and 3.49 reflect moderate levels of the input under consideration;
- Scores between 3.50 and 4.49 reflect high levels of the input under consideration; and
- Scores of 4.50 and greater reflect very high levels of the input under consideration.

**Table 27: Descriptives of the Team-Level Inputs (N=30)**

<b>Input Component</b>	<b>Mean</b>	<b>s.d.</b>
Motivating Task Design	4.22	0.33
Goal Clarity	3.71	0.47
Adequacy of The Technology Tools	3.93	0.51
Skills	3.96	0.54
Leadership Effectiveness (N=27)	4.02	0.54

The results show that the VTs in this study perceived that they worked on challenging and engaging tasks (i.e. a mean of 4.22 on motivating task design) and that the team goals were clear (mean of 3.71). The aggregate data also indicate that VT members perceived that the technology that they use to collaborate, communicate and access information, was adequate (mean of, 3.93) and that they had the skills required to work on a VT (mean of 3.96).

**LEADERSHIP EFFECTIVENESS:** Eighty-seven percent of the VTs in this study indicated that they had a leader and all of those teams indicated that the leader had been appointed by management. In the event of disagreement between the team members with

respect to whether they had a leader, the opinion of the majority was used. Only one team indicated that the leader role was shared by all of the members of the group. For three of the teams, the members were split with respect to whether they had a leader, so this data was excluded from further analysis. The lack of variance in the data on the existence of a leader rendered this data unsuitable for the proposed analysis (i.e. the existence of a leader was not evaluated as part of the framework). There was, however, sufficient data on perceptions of leader effectiveness (since 26 teams had a leader) to include this measure in the analysis. Those teams who clearly indicated that they had a leader considered their leader effective, with a mean of 4.02.

#### 5.5.1.1 Discussion of the Results for Team-Level Inputs

Overall, VTs in this study had high levels on all but one of the team inputs presented in this section (motivating task design, goal clarity, adequacy of tools, member skills and leadership effectiveness). The only exception was the diversity of the VTs. The VTs in this study had low levels of diversity with respect to position and team tenure, moderate diversity with respect to age and organizational tenure and high diversity with respect to education.

The results with respect to motivating task design and goal clarity suggest that team members can be motivated by their task, despite their physical remoteness from their organizational or departmental base. In addition, it would appear that it is possible to establish a clear understanding of team goals through virtual communication.

The result indicating perceptions of a relatively high adequacy of tools is surprising. It was expected that the perceived adequacy of the tools would have been very high, given the data showing the wide availability of every one of the tools that were included in this study (described in Section 4.6.1.5). Given the high levels of education and skills of the VT member sample and their expertise with the tools they use to collaborate virtually, it is likely that their ratings of adequacy of tools depend on dimensions of the technology such as the age, speed and capacity, rather than access.

The VTs indicated that their leaders were highly effective. While there was no training available specific to leading a VT, the organization provided extensive management and leadership training to its employees. The organization also had a self-learning program on team management. It would appear from these data that the skills that the leaders had acquired through experience or during these general sessions were applicable to the VT environment. This would suggest that at least some virtual leadership skills are no different from those of proximate team leaders. This observation is supported by the findings with respect to managerial support of VTs (i.e. many of the ways in which a manager supports VTs are equally applicable to proximate teams).

### **5.5.2 Contextual Inputs**

Data was collected on six contextual inputs to VT effectiveness: reward structure, training, managerial support and non-support of VTs and organizational support and non-support of VTs. A summary of the results for training and reward structures is presented in Table 28. Given the fact that the measures of organizational support/non-support and

managerial support/non-support were developed for this thesis and provide a key contribution of this research, the findings and discussion regarding these constructs were provided in a separate section (Section 5.4). It should be noted, however, that both of these constructs are theoretically classified as contextual inputs. The measures of reward structure and training were based on a 5-point Likert-type scale, with 5 indicating higher levels of the contextual inputs. The scores for these inputs will be interpreted in the same manner as the team-level inputs (described in Section 5.8.1).

**Table 28: Descriptive of the Contextual Inputs (N=30)**

<b>Input Component</b>	<b>Mean</b>	<b>s.d.</b>
Reward Structures	3.30	0.48
Training	3.07	0.54

The measure of team reward structure had a mean of 3.30, indicating that the VTs perceived that member rewards were only moderately geared towards the team level. The mean for the measure of training was also moderate (3.07). In other words, team members were neutral with respect to their perceptions that the training they received adequately prepared them for the work they do on their VTs.

#### 5.5.2.1 Discussion of the Results for Contextual Inputs

In general, the results indicate that the organization provided the VTs with only moderate levels of the contextual inputs (reward structures and training) examined in this study. One of the implications of these findings is that a significant proportion of the rewards offered by the organization was based on individual performance. This result is borne out by the document analysis which indicated that there were no organizational policies

with respect to team-based rewards. They did, however, have an extensive incentive/recognition program that was available to team managers, department heads, etc. and could be used to reward an entire team. While no documents were available on the use of the incentive/recognition program with respect to its use for team-based rewards, these data would suggest that either these incentives were rarely used for this purpose within the VTs or that the team members were not aware of such use.

The organization in this study provided an extensive professional training and management program to all of its employees. A focus on e-literacy was included as part of this program. Employees' learning plans were part of all performance agreements. The fact that no training specific to VT skills was available, however, is consistent with the neutral evaluation the VT members gave of the training provided by the company (i.e. the fact that the availability of general training is very high is offset by the fact that training for VT work is poor to non-existent). These findings are consistent with those reported in association with organizational support and non-support of VTs (i.e. lack of relevant training).

Overall, the VT members reported higher levels of team-level inputs than contextual (i.e. organizational) inputs. This result leads to two suppositions. First, it is possible that the organization's policies with respect to traditional teams and telework are also appropriate for VTs. Second, it is possible that the VT managers, leaders and members have adapted to VT work much more effectively than the organization as a whole.

## **5.6 PROCESS INDICATORS OF THE VIRTUAL TEAM SAMPLE**

Six indicators of VT processes were included in this thesis: affective trust, cognitive trust, commitment to the task, collaborative climate, potency, and communication effectiveness.

The means and standard deviations of these six indicators are presented in Table 29. The constructs were measured using a 5 point Likert-type scale. In all cases 5 indicates a more positive process. The scores for the process indicators were interpreted as follows:

- Scores of 2.50 and below reflect negative perceptions of the process under consideration;
- Scores between 2.50 and 3.49 reflect neutral perceptions of the process under consideration;
- Scores between 3.50 and 4.49 reflect positive perceptions of the process under consideration; and
- Scores of 4.50 and greater reflect very positive perceptions of the process under consideration.

The results show that the teams reported positive perceptions of all of the processes studied in this thesis. The process which had the highest score was cognitive trust (mean of 4.29). Affective trust, on the other hand, had the lowest score (mean of 3.69). This suggests that the VTs placed more trust in the competence, reliability and professionalism of their members than in the emotional connections within the team.

**Table 29: Descriptives of the Measures of Team Process Indicators (N=30)**

<b>Process Component</b>	<b>Mean</b>	<b>s.d.</b>
Cognitive Trust	4.29	0.46
Affective Trust	3.69	0.59
Team (Task) Commitment	3.85	0.47
Collaborative Climate	3.93	0.38
Potency	3.76	0.50
Communication Effectiveness	3.88	0.47

Perceptions of team task commitment were also positive, with a mean of 3.85, suggesting that the teams considered their task to be fairly attractive. The perceptions of collaborative climate had a mean of 3.93 representing positive interactions between team members. The results for communication effectiveness were also positive, with a mean of 3.88, representing a good level of effectiveness in the teams' communication. The teams reported a positive level of potency with a mean of 3.76, indicating a modest level of confidence that the team would be successful.

### **5.6.1 Discussion of the Results for Virtual Team Process Indicators**

Overall, these results indicate that VTs can have positive processes, despite the reliance on technology for their interactions. Specifically, these results suggest the following:

- VT members can be committed to their task without having to be physically connected to their organizational and departmental base;
- VTs can communicate effectively despite their dependence on virtual communication; and

- Given that most of the VTs in this study did not meet regularly, the reliance of VTs on virtual collaboration does not preclude them from believing in their potential for success.

The scores for affective trust were the lowest of the process indicators and the scores for cognitive trust were the highest. These results suggest that affective trust is less likely to occur in VTs, perhaps because the team members do not see each other often and do not have the opportunity to engage in the type of activities that typically lead to emotional connections (i.e. face-to-face socializing). These results are borne out by the results for meeting history, which indicated that although most of the VTs had met face-to-face, very few of them did so regularly. It is encouraging, however, that the teams perceived such a high level of cognitive trust, indicating that, despite the fact that they do not have close emotional connections to their team members, they still trust them to do their jobs.

## **5.7 INTER-CORRELATIONS OF THE FRAMEWORK COMPONENTS**

Correlations between the variables in the input, process and output components of the research framework were calculated to ensure that the variables used to measure each component were not redundant. Variables that are too highly correlated may be measuring essentially the same construct. Tabachnick and Fidell (1996) noted correlations above 0.9 indicate redundancy and suggested caution when employing variables with correlations higher than 0.70. In this study, variables within the same component of the research framework were considered redundant if their correlations were greater than 0.80. In the event of redundancy, one of the redundant variables was

removed from further analysis. The results for the inter-correlations of the sets of inputs, processes and outputs are presented in the following sections. This is followed by a discussion of the results for the inter-correlations of the framework components.

### **5.7.1 Inter-Correlations of the Inputs**

Due to the large number of variables comprising the input component of the research framework, the inter-correlations of the team-level and contextual inputs were treated separately. For each set of variables, the correlations that were found to be significant were interpreted as follows (Davis 1979):

- Correlations from 0.30 to 0.49 represent a moderate relationship;
- Correlations from 0.50 to 0.69 represent a strong relationship; and
- Correlations of 0.70 and higher represent a very strong relationship.

The following sections present the results of the inter-correlation analyses for each component of the framework.

#### **5.7.1.1 Inter-Correlations of the Team-Level Inputs**

The inter-correlation matrix of the team-level inputs is presented in Appendix X. Many of the team inputs were significantly related to one another. Only three correlations were greater than 0.5, indicating strong relationships:

- Member comfort with technology was strongly correlated with member experience with technology ( $r=0.678$ );
- Member skills was strongly correlated with perceptions of adequacy of technology ( $r=0.547$ ); and

- Leader effectiveness was strongly correlated with goal clarity (0.577).

None of the correlations were higher than the critical value of 0.8, indicating that there were no clear redundancies in the set of team-level inputs. Many of the significant relationships were between demographic variables which were predictable (i.e. older teams had more diversity with respect to member tenure).

#### 5.7.1.2 Inter-Correlations of the Contextual Inputs

The inter-correlation matrix of the contextual inputs is presented in Appendix Y. The majority of the contextual inputs were significantly correlated. Overall, the contextual inputs were more strongly correlated with each other than were the team inputs. Fifteen of the 28 correlations were significant at the  $p < 0.01$  level and a further 11 were significant at  $p < 0.05$ . Two of the correlations indicated very strong relationships ( $r > 0.7$ ). One of these was between the two factors of managerial support of VTs ( $r = 0.780$ ), indicating good internal validity of the new measure of managerial support of VTs. The other very strong correlation was between the two measures of non-support of VTs ( $r = 0.748$ ).

Twelve of the correlations indicated a strong relationship between the contextual variables ( $r > 0.5$ ). Organizational support of VTs through infrastructure was strongly correlated to the following five contextual variables:

- Managerial support of VTs through development ( $r = 0.630$ );
- Training ( $r = 0.574$ );
- Managerial non-support of VTs ( $r = -0.573$ );

- Managerial support of VTs through facilitating ( $r=0.570$ ); and
- Organizational support of VTs through culture ( $0.502$ ).

Managerial non-support of VTs was strongly correlated to three variables:

- Training ( $r=-0.593$ );
- Managerial support of VTs through facilitating ( $r=-0.580$ ); and
- Managerial support of VTs through team development ( $r=-0.570$ ).

Four other correlations were greater than 0.5. This included correlations between:

- Rewards and managerial support of VTs through facilitating ( $r=0.525$ );
- Training and managerial support of VTs through VT development ( $r=0.625$ );
- Organizational support of VTs through culture and managerial support of VTs through VT development ( $r=0.586$ ); and
- Organizational support of VTs through infrastructure and organizational non-support of VTs ( $r=-0.575$ ).

None of the correlations between the contextual inputs were higher than the critical value of 0.8, indicating that there were no clear redundancies in the set of variables.

Theoretically, it was expected that many of these contextual inputs would be associated with each other. The fact that they are not redundant suggests that they are measuring related, but distinct concepts.

### **5.7.2 Inter-Correlations of the Processes**

The inter-correlation matrix of the process indicators are presented in Appendix Z. The manner in which the correlations were interpreted was described in Section 5.7.1. Two of the correlations between the process variables were above the threshold for

redundancy ( $r > 0.8$ ), calling into question the unique contribution of these variables to the VT effectiveness framework. Collaborative climate was very highly correlated with both cognitive trust ( $r = 0.862$ ) and affective trust ( $r = 0.808$ ). Tabachnick and Fidell (1996) noted that an appropriate way to deal with two redundant variables is to remove one of them from the analysis. Collaborative climate represented a more global perspective of VT interactions and the measure for collaborative climate had greater reliability (0.90 for collaborative climate vs 0.85/0.81 for cognitive and affective trust). In the interest of simplicity, collaborative climate was retained and both affective and cognitive trust were eliminated from further analysis.

Three of the remaining four process components were strongly correlated to one another ( $r > 0.50$ ), but the correlations were below the cut-off for redundancy. Collaborative climate was strongly correlated to both potency ( $r = 0.503$ ) and communication effectiveness ( $r = 0.659$ ). Potency and communication effectiveness were also strongly correlated ( $r = 0.680$ ). The fourth process variable, task commitment was only moderately related to one other process variable: potency ( $r = 0.389$ ). All of the correlations were in the expected direction (positive), indicating that all of the process variables increased or decreased with one another. It is not surprising that the majority of the process variables were strongly correlated to one another, as they all represent the VTs' interactions. The fact that they were not redundant, however, suggests that they measure different aspects of the teams' interactions.

### **5.7.3 Inter-Correlations of the Outputs**

VT effectiveness, the output in the research framework, was operational as having four dimensions: task performance, VT member satisfaction, professional development and capacity for future VT work. The data for one of the dimensions, task performance, was collected from two different sources, VT members and VT managers. The inter-correlations of the output variables were discussed in Section 4.4.5. It should be recalled that the four variables for which the data was collected from the VT members were all strongly or very strongly inter-correlated (with the exception of VT members' perceptions of performance and VT members' perceptions of capacity for future teamwork, which were moderately correlated). The VT managers' perceptions of task performance were not significantly correlated with any of the variables which were collected from the team members. None of the correlations indicated redundancy (i.e. all of the correlations were below 0.8).

### **5.7.4 Discussion of the Inter-Correlations of the Framework Components**

Many of the variables within each component of the research framework were significantly correlated, suggesting that some of the variables within each component represent different, but related aspects of these components. Two variables were assumed to be redundant with collaborative climate (affective and cognitive trust). It was assumed that the inclusion of all three of these variables would not significantly contribute more to the analysis than the inclusion of only collaborative climate. Both affective and cognitive trust were removed from the analysis and the research framework. It is also possible that,

rather than being redundant, the two aspects of trust contribute to collaborative climate. This possibility is an avenue for future research.

## **5.8 TESTING THE PATHS IN THE RESEARCH FRAMEWORK**

The following six sections examine the relationships between the components of the research framework. The steps for the analysis of these relationships were described in detail in Section 4.8.2 and summarized in Figure 4. The first section presents the results for the testing of the first part of the input→process →output form of the research framework (i.e. Step 1 in Figure 4 - the correlations between the inputs and the processes). In the second section, the input variables that had no significant relationships with any of the processes were tested for direct relationships with the output variables (i.e. Step 2 in Figure 4 - the alternate input→ output form of the research framework). To test the second part of the input→process →output framework, it was necessary to examine the relationships between the process and the output variables (i.e. Step 3 in Figure 4). These are examined in the third section. In the fourth section, the output variables that had no significant relationships with any of the processes were tested for direct relationships with the input variables (i.e. Step 4 in Figure 4 - the alternate input→ output form of the research framework). Partial correlations were employed in the fifth section to determine if there was an indirect relationship between inputs and outputs, with process acting as a mediator (i.e. Step 5 in Figure 4 – the input→process→output form of the research framework). In the sixth section, the results for the relationships with respect to each of the dimensions of VT effectiveness are summarized. The final section examines the role of degree of virtuality in the research framework.

Davis' (1979) criteria were again used to interpret the strength of the correlations. The statistical methods employed in this analysis do not indicate the direction of the relationships. In the case of some of the inputs (demographic variables), directionality can be assumed (i.e. it is highly unlikely that task commitment can influence the gender profile of the VT). With respect to the other variables however, it was impossible to determine the direction of the relationships. This is due to the cross-sectional nature of this study, which means that the team inputs, processes and outputs were being measured at the same point in time, rather than longitudinally (i.e. allowing time for the inputs and/or processes to influence the outputs). In the interests of developing models of VT effectiveness, it was, however, necessary to make assumptions of directionality (i.e. input→process→output or input→ output). Such assumptions are stated explicitly when relevant.

### **5.8.1 Step 1: Relationships between Inputs and Processes**

This first section examines the relationships between the inputs and the process relationships (i.e. Step 1 in Figure 4). Because of the large number of input variables, this section is broken down into two parts: 1) the correlations between the process indicators and the team inputs; and 2) the correlations between the process indicators and the contextual inputs. In each of the sections, the significant correlations will be presented first with respect to each input variable. The results with respect to each of the processes will then be presented (i.e. which inputs were related to each process). The section will conclude with a discussion of the results of the input-process relationships.

### 5.8.1.1 Relationships between Team Inputs and Processes

The correlations between the team input components and the four process indicators are presented in Table 30.

**Table 30: Correlations between Team Inputs and Process Indicators**

<b>TEAM INPUT/PROCESS</b>	<b>Task Commitment</b>	<b>Collaborative Climate</b>	<b>Potency</b>	<b>Communication Effectiveness</b>
<b>Member Comfort with Technology</b>	-0.413*	0.063	-0.129	-0.158
<b>Member Experience with Technology</b>	-0.349	-0.077	-0.210	-0.363*
<b>Gender</b>	0.289	-0.169	0.223	-0.178
<b>Age Diversity</b>	0.129	0.256	0.085	0.318
<b>Education Diversity</b>	0.337	0.219	0.259	0.239
<b>Organization Tenure Diversity</b>	0.301	0.341	0.400*	0.486**
<b>Position Tenure Diversity</b>	-0.186	-0.011	-0.316	-0.239
<b>Team Tenure Diversity</b>	-0.051	-0.206	-0.281	-0.201
<b>Expertise Diversity</b>	-0.263	-0.018	-0.211	-0.046
<b>Adequacy of Technology</b>	0.023	0.544**	0.522**	0.720**
<b>Skills</b>	0.383*	0.507**	0.614**	0.666**
<b>Motivating Task</b>	0.281	0.555**	0.634**	0.582**
<b>Goal Clarity</b>	0.626**	0.378*	0.565**	0.442*
<b>Leader Effectiveness</b>	0.306	0.292	0.729**	0.542**
<b>Team Size</b>	0.091	0.047	0.123	0.249
<b>Team Longevity</b>	0.311	0.171	0.251	0.250
<b>Face-to-Face Meeting History</b>	0.473**	0.184	0.184	-0.166

\*\* Correlation significant at  $p < 0.01$ ; \*Correlation significant at  $p < 0.05$

Fifteen correlations between the team inputs and the process were significant at the  $p < 0.01$  level:

- Adequacy of technology was correlated with collaborative climate ( $r=0.544$ ), potency ( $r=0.522$ ) and with communication effectiveness ( $r=0.720$ );
- Member skills was correlated with collaborative climate ( $r=0.507$ ), with potency ( $r=0.614$ ) and with communication effectiveness ( $r=0.666$ );
- Motivating task was correlated with collaborative climate ( $r=0.555$ ), with potency ( $r=0.634$ ) and with communication effectiveness ( $r=0.582$ );
- Leader effectiveness was correlated with potency ( $r=0.729$ ) and with communication effectiveness ( $r=0.542$ );
- Goal clarity was correlated with task commitment ( $r= 0.626$ ) and with potency ( $r=0.565$ );
- Member diversity with respect to organizational tenure was correlated with communication effectiveness ( $r=0.486$ ); and
- Face-to-face meeting history was correlated with task commitment ( $r=0.473$ ).

All of these correlations were positive. Another six correlations were significant at the  $p < 0.05$  level:

- Goal clarity was correlated with collaborative climate ( $r=0.378$ ) and with communication effectiveness ( $0.422$ );
- Member comfort with technology was correlated with task commitment ( $r=-0.413$ );

- Member experience with technology was correlated with communication effectiveness ( $r=-0.363$ );
- Member diversity with respect to organizational tenure was correlated with potency ( $r=0.400$ ); and
- Member skills was correlated with task commitment ( $r=0.383$ ).

Two of these correlations were negative: member comfort with technology and task commitment; and member experience with technology and communication effectiveness. The negative correlations indicate that lower levels of these inputs are associated with higher levels of the processes.

Two of the inputs were significantly correlated with all of the processes: member skills and goal clarity. Two inputs (adequacy of technology, motivating task) were significantly correlated with the following three processes: collaborative climate, potency, and communication effectiveness. Another two inputs (member diversity with respect to organizational tenure, leader effectiveness) were correlated with two processes: potency and communication effectiveness. Finally, three inputs, member comfort with technology, member experience with technology and face-to-face meeting history, were each significantly correlated with one process.

Eight of the team level inputs had no significant relationships with any of the process variables: gender, member age diversity, member education diversity, position tenure diversity, team tenure diversity, diversity with respect to member areas of expertise, team

size and team longevity. These eight inputs were later tested in Section 5.8.2 to see if they have a direct relationship with the outputs (Step 2 in Figure 4).

#### TEAM INPUTS CORRELATED WITH COMMUNICATION EFFECTIVENESS:

Communication effectiveness was significantly related to the greatest number of team inputs. Communication effectiveness was correlated to five of the team inputs at the  $p < 0.01$  level (organization tenure diversity, adequacy of technology, skills, motivating task, leader effectiveness) and two team inputs at the  $p < 0.05$  level (member experience with technology and goal clarity). Communication effectiveness had a very strong relationship with adequacy of technology ( $r = 0.720$ ) and a strong relationship with member skills ( $r = 0.666$ ), motivating task design ( $r = 0.582$ ), and leader effectiveness ( $r = 0.542$ ). These results indicate that the VTs in this study which had the technology required to do their work, had members with skills in teamwork and VT work, had a motivating task and/or a leader that was perceived to be effective, also perceived that their communication was more effective. The very high correlation between communication effectiveness and adequacy of technology (0.729) does not suggest redundancy, as these variables are not in the same set (i.e. one is an input and one is a process) and are not being used together to explain the variance in third variable. Rather, this suggests that in a VT setting, having the right technology may improve the ability to communicate within the VT.

Communication effectiveness was moderately related to member diversity with respect to organization tenure ( $r=0.486$ ), goal clarity ( $r=0.442$ ) and member experience with technology ( $r=-0.363$ ). These results indicate that the VTs in this study that had greater diversity with respect to the organizational tenure of their members (i.e. the VTs that were made up of individuals who were relatively new to the organization, individuals who had been with the organization for a longer period of time and individuals with time at the organization between these two extremes) and/or had clear goals, also had greater perceived effectiveness in their communication. Alternately, as VT members' experience with technology increased, perceived communication effectiveness decreased.

**TEAM INPUTS CORRELATED WITH POTENCY:** Potency was significantly correlated with five team inputs at the  $p<0.01$  level (adequacy of technology, skills, motivating task, goal clarity, leader effectiveness) and one team input at the  $p<0.05$  level (organization tenure diversity). Potency was found to have a very strong relationship with leader effectiveness ( $r=0.729$ ) and a strong relationship with motivating task design ( $r=0.634$ ), member skills ( $r=0.614$ ), goal clarity ( $r=0.565$ ) and adequacy of the technology ( $r=0.522$ ). All of the correlations were positive. These results indicate that the VTs in this study that had a leader who was perceived to be effective, had a motivating task, had members who were skilled in VT work, had a clear goal and/or had the required technology, also had a greater belief in their potential for success (potency).

Potency was moderately related to member diversity with respect to organizational tenure ( $r=0.400$ ), indicating that teams with a greater diversity in the organizational tenure of its members also had a greater potency.

**TEAM INPUTS CORRELATED WITH COLLABORATIVE CLIMATE:** Collaborative climate was significantly correlated with three of the team inputs at the  $p<0.01$  level (adequacy of technology, skills, motivating task) and one team input at the  $p<0.05$  level (goal clarity). The input variables which were strongly related to collaborative climate were: motivating task design ( $r=0.555$ ), adequacy of the technology available ( $r=0.544$ ), and member skills in VT work ( $r=0.507$ ). These results indicate that the VTs in this study that had an engaging task, adequate tools, and/or members skilled in VT work, also had more positive interactions (collaborative climate). All of the correlations were positive.

Collaborative climate had a moderate positive correlation with goal clarity ( $r=0.378$ ), indicating that the VTs with a clear goal also perceived that interactions were more positive.

**TEAM INPUTS CORRELATED WITH TASK COMMITMENT:** Task commitment was found to be significantly correlated to two of the team inputs at the  $p<0.01$  level (goal clarity, meeting history) and two at the  $p<0.05$  level (comfort with technology, skills). Task commitment was strongly positively correlated to goal clarity ( $r=0.626$ ). Task commitment was moderately positively correlated to face-to-face meeting history

( $r=0.473$ ), and member skills ( $r=0.383$ ). One input variable, comfort with technology, had a moderate negative correlation with task commitment ( $r=-0.413$ ). These results indicate that the VTs in this study that had clear goals, that had experienced at least one face-to-face meeting in their history, and that included members who were skilled at VT work, also had greater task commitment. On the other hand, as levels of member comfort with technology increased, task commitment declined.

#### *5.8.1.1.1 Discussion of Results for Team Input - Process Relationships*

The results indicate that many of the aspects of VT membership considered in this study (i.e. the proportion of women on the team, the diversity of the team with respect to age, education, expertise, position and team tenure) had no relation to the quality of the processes that occur within the team. These results suggest that these are VT design issues that may not be critical to the quality of the team interactions. Alternately, it may be that the relationships between these variables and the processes in this study are non-linear (i.e. not detectable through correlations) or that these variables have direct relationships with the VT outputs. This second scenario will be explored in Section 5.8.2.

Team member diversity has been linked to both virtual and proximate team effectiveness. Tenure, age and education diversity have been studied primarily in the proximate team research. The fact that no relationship was found between these aspects of diversity and the VT processes, suggests that these types of diversity may have less of an impact on VT interactions than those occurring at a more personal level. It may be that virtuality “blinds” individuals to differences that are more apparent when team members can

actually see one another. Types of diversity that have been studied in the VT literature include: culture, organization and function (Cohen & Gibson, 2003; Maznevski & Chudoba, 2000). Two of these three types of diversity (organization, culture), were not included in this study as the sample was drawn from a single organization within one region of Canada (cultural diversity has been applied to global teams). Diversity in the function of the VT members was included (diversity in areas of expertise). This was the only aspect of diversity that was found to have a significant relationship with any of the process variables in this study.

The longevity and size of the VTs in this study also had no linear relation to the team process indicators. The VT research with respect to these variables has had mixed results (Alge et al., 2003; Leenders et al., 2003). It is important to note that the maximum team size in this sample was 14, so these results suggest that in teams with no more than 14 members, the size of the team may not be related to the quality of its processes. It is possible, however, as the proximate team research suggests, that much larger teams would have more difficulty interacting and this would affect their processes. In contrast, however, the VTs in this sample represented a fairly wide range of team ages (the VTs had been in existence from 6 months to over 8 years). This provides greater confidence in the conclusion that the amount of time that a VT has been in existence may not be related to team processes. The potential direct relationships between team age and team size and the outputs will be explored in Section 5.8.2.

The results for two of the inputs, member experience and comfort with technology were surprising, as the correlation was in the opposite direction than expected. In the VT literature, it was suggested that the abilities of the VT members with respect to their communication and collaboration tools will affect their ability to interact effectively (Warkentin et al., 1997). It was expected that VTs with members who are not comfortable in the virtual environment would be frustrated and would not be able to interact effectively. The result may be explained however, given that the sample in this study is made up of team members who are highly versed with their tools and can be expected to use their tools to their greatest advantage. It is possible that VT members, once they reach a high level of comfort and experience with their technology, may experience frustrations with its limitations (i.e. there may be a non-linear relationship). Alternately, it may be that the types of individuals who are attracted to VT work have unique expectations with respect to their communications.

Overall, the results for the team input-process path suggest that four of the team inputs play the greatest role in the quality of the VT interactions: member skills, goal clarity, adequacy of technology and motivating task. Member skills and goal clarity were significantly correlated to all four of the team processes, suggesting that these two team inputs may require the greatest attention when a VT is being designed. Adequacy of technology and motivating task were significantly correlated to all of the process except task commitment, suggesting that these team inputs may also be key in VT design.

In addition, three of the team inputs were related, to a lesser degree to the set of processes. Leader effectiveness and organization tenure diversity were both significantly correlated to two of the processes, potency and communication effectiveness. Teams which have met face-to-face also reported greater task commitment. The implication of these results is that organizations and managers may be able to contribute to numerous aspects of VT interactions by controlling a very small number of team inputs. For example, VTs may be aided by ensuring that there is some continuity of the VT membership (not changing all of the members at the same time), planning a face-to-face team meeting at the beginning of the VT's mandate, and providing VT leadership training to those who lead VTs.

#### 5.8.1.2 Relationships between Contextual Inputs and Processes

The correlations between the contextual input variables and the four process indicators are presented in Table 31. Thirteen of the correlations between the contextual inputs and the process indicators were significant at the  $p < 0.01$  level:

- Managerial support through facilitating was correlated with task commitment ( $r=0.550$ ), with collaborative climate ( $0.604$ ), with potency ( $r=0.689$ ) and with communication effectiveness ( $r= 0.619$ );
- Managerial support through VT development was correlated with task commitment ( $r=0.585$ ), with collaborative climate ( $r=0.524$ ) and with potency ( $r=0.657$ );
- Managerial non-support was correlated with collaborative climate ( $r=-0.498$ ), and with potency ( $r=-0.670$ );

- Rewards was correlated with potency ( $r=0.593$ );
- Training was correlated with potency ( $r=0.599$ );
- Organizational support through infrastructure was correlated with communication effectiveness ( $r=0.527$ ); and
- Organizational non-support was correlated with collaborative climate ( $r=-0.491$ ).

All the correlations were in the expected directions. With two exceptions, the correlations were positive. Correlations between the processes and the two variables measuring non-support of VTs (organizational non-support and managerial non-support) were, as expected, negative.

Ten of the correlations between the contextual inputs and the processes were significant at the  $p<0.05$  level:

- Training was correlated with task commitment ( $r=0.405$ ) and with communication effectiveness ( $r=0.381$ );
- Organizational support through culture was correlated with task commitment ( $r=0.455$ ) and with collaborative climate ( $r=0.433$ );
- Organizational support through infrastructure was correlated with collaborative climate ( $r=0.423$ ) and with potency ( $r=0.442$ );
- Rewards was correlated with communication effectiveness ( $r=0.431$ );
- Managerial support through VT development was correlated with communication effectiveness ( $r=0.459$ );

- Managerial non-support was correlated with communication effectiveness ( $r=-0.499$ ); and
- Organizational non-support was correlated with potency ( $r=0.429$ ).

Again, all of the correlations were in the expected directions (i.e. all were positive except those between the processes and the two measures of non-support of VTs).

**Table 31: Correlations Between Contextual Inputs and Process Components**

CONTEXTUAL INPUT/PROCESS	Task Commitment	Collaborative Climate	Potency	Communication Effectiveness
Rewards	0.213	0.338	0.593**	0.431*
Training	0.405*	0.170	0.599**	0.381*
Managerial Support - Facilitating	0.550**	0.604**	0.689**	0.619**
Managerial Support - VT Development	0.585**	0.524**	0.567**	0.459*
Managerial Non-Support	-0.199	-0.498**	-0.670**	-0.449*
Organizational Support - Culture	0.455*	0.433*	0.226	0.325
Organizational Support - Infrastructure	0.199	0.423*	0.442*	0.527**
Organizational Non-Support	-0.076	-0.491**	-0.429*	-0.309

\*\*Correlation significant at  $p<0.01$ ; \*Correlation significant at  $p<0.05$

All of the contextual inputs were significantly related to at least two of the process indicators. Two of the contextual input variables (managerial support through facilitating and managerial support through VT development) were significantly correlated to all of the processes. Three of the inputs were significantly correlated with three of the four process indicators. Managerial non-support and organizational support through

infrastructure were both significantly correlated to collaborative climate, potency and communication effectiveness. Training was significantly positively correlated to task commitment, potency and communication effectiveness. Three of the contextual inputs had significant correlations with two processes. Team rewards was correlated to potency and communication effectiveness, while organizational support through culture was significantly correlated to task commitment and collaborative climate, and organizational non-support was correlated to collaborative climate and potency.

**CONTEXTUAL INPUTS CORRELATED WITH POTENCY:** Potency was significantly related to the greatest number of contextual inputs. Potency was correlated to five of the contextual inputs at the  $p < 0.01$  level (rewards, training, managerial support of VTs through facilitating, managerial support of VTs through VT development, managerial non-support) and two contextual inputs at the  $p < 0.05$  level (organizational support through infrastructure, organizational non-support). Potency had a strong positive relationship with rewards ( $r = 0.593$ ), training in VT work ( $r = 0.599$ ), managerial support of VTs through facilitating ( $r = 0.589$ ) and managerial support of VTs through VT development ( $r = 0.567$ ). Potency was found to be strongly negatively correlated with managerial non-support of VTs ( $r = -0.670$ ). These results indicate that the VTs in this study that had team-oriented rewards, members who have been trained in VT work and/or a manager who was supportive of VT work through facilitation and VT development, also had greater belief in their potential to succeed. Conversely the VTs whose manager exhibited behaviours that were non-supportive of VTs also reported less potency.

Another two contextual inputs were moderately correlated to potency. Organizational support through infrastructure was moderately positively correlated with potency ( $r=0.442$ ), indicating that the VTs in this study that perceived their organization to be supportive through infrastructure also had a greater belief in their potential for success (potency). Conversely, organizational non-support was moderately negatively correlated with potency ( $r=-0.429$ ), indicating that the VTs within an organization that was perceived to be unsupportive of VTs also had a lesser belief in their potential for success.

#### CONTEXTUAL INPUTS CORRELATED WITH COLLABORATIVE CLIMATE:

Collaborative climate was significantly correlated with four of the contextual inputs at the  $p<0.01$  level (managerial support of VTs through facilitating, managerial support of VTs through VT development, managerial non-support, organizational non-support) and two contextual inputs at the  $p<0.05$  level (organizational support through culture, organizational support through infrastructure). Collaborative climate was strongly positively correlated with the managerial support through facilitating ( $r=0.604$ ) and VT development ( $r=0.524$ ). Organizational support through culture ( $r=0.433$ ) and infrastructure ( $r=0.423$ ) were both moderately positively correlated with collaborative climate. These results indicate that the VTs in this study that had a manager who was perceived to provide support through facilitating and developing the VT and/or perceived that they work in an organization that supports VTs through its culture and infrastructure, also perceived their climate to be more collaborative. Both managerial and

organizational non-support of VTs ( $r=-0.498$  and  $r=-0.491$ , respectively) were moderately negatively correlated to collaborative climate, suggesting that the VTs who perceived that their manager and/or organization were non-supportive also perceived their climate to be less collaborative.

#### CONTEXTUAL INPUTS CORRELATED WITH COMMUNICATION

**EFFECTIVENESS:** Communication effectiveness was significantly related to two of the contextual inputs at the  $p<0.01$  level (managerial support through facilitating, organizational support through infrastructure) and four contextual inputs at the  $p<0.05$  level (rewards, training, managerial support of VTs through VT development, managerial non-support). Communication effectiveness had a strong relationship with managerial support through facilitating ( $r=0.619$ ) and organizational support through infrastructure ( $r=0.527$ ). Both of the correlations were positive. These results indicate that the VTs in this study that perceived that they had received support from their manager through facilitation and/or from their organization through infrastructure also perceived greater effectiveness in their communications.

Communication effectiveness was moderately positively related to rewards ( $r=0.431$ ), member training ( $r=0.381$ ) and managerial support through VT development ( $r=0.449$ ), indicating that the VTs in this study that perceived greater effectiveness in their communication also perceived their rewards to be more team-oriented, had members who were trained in VT work, and/or perceived their manager to provide support through

facilitation. Managerial non-support was moderately negatively correlated with communication effectiveness ( $r=-0.449$ ), indicating that the VTs whose managers were perceived to have exhibited non-supportive behaviour, also perceived their communication to be less effective.

**CONTEXTUAL INPUTS CORRELATED WITH TASK COMMITMENT:** Task commitment was significantly correlated with two of the contextual inputs at the  $p<0.01$  level (managerial support of VTs through facilitating, managerial support of VTs through VT development) and two contextual inputs at the  $p<0.05$  level (training, organizational support through culture). All of the correlations were positive. Task commitment was strongly correlated with managerial support through facilitating ( $r=0.550$ ) and managerial support through VT development ( $r=0.585$ ). These results indicate that the VTs in this study with greater task commitment also perceived their managers to provide support through facilitation and/or developing the VT.

Member training ( $r=0.405$ ) and organizational support through culture ( $r=0.455$ ) had a moderate positive correlation with task commitment, indicating that the VTs who had members who were trained in VT work and/or who received support from the organization through culture, were also more committed to their task.

#### *5.8.1.2.1 Discussion of Results for Contextual Input - Process Relationships*

Overall, these results suggest that the contextual inputs, as a set, may play an even more important role in the VTs' interactions than do the team inputs. All of the contextual

inputs were significantly correlated with at least two of the processes. The two measures of managerial support of VTs, developed in this thesis, managerial support through facilitating and managerial support through VT development, were correlated with all four of the processes included in this study, suggesting that these two contextual inputs deserve the greatest attention. Managerial non-support is also key as it is correlated to three of the four processes. Given that all of these inputs are based on the VT manager's behaviour, these results suggest that VT managers may have a great influence on the quality of the interactions of the VT. As such, VT managers should be made aware of these supportive behaviours and recognize that VTs have some needs and expectations that are similar to those of proximate teams and some that are unique to VTs.

The two measures of organizational support of VTs as well as organizational non-support of VTs would seem to play an important, but lesser, role in the VT interactions. This suggests that organizations can contribute to the interactions of VTs through supportive behaviour, but that they should also focus on providing the VT managers with the resources they need to support their teams (budgets, policies, training, development) and by rewarding VT managers who are doing a good job of supporting their VTs.

Team member training in VT work was significantly related to all of the process indicators except collaborative climate, suggesting that providing VTs with training in VT work may be key to improving the quality of their interactions. As the interactions of VTs are primarily virtual, it would seem critical that VT members have training that is

specific to collaborating virtually. The importance of training to VTs was also highlighted by the measures of managerial support and organizational support of VTs, both of which contain items related to VT training, indicating that the provision of such training is perceived to contribute to VT success.

Member rewards was related to two of the processes, suggesting that rewards that are oriented towards the team may also contribute to some of the positive team processes. It is possible that team-oriented rewards are perceived to motivate VTs to work harder, which makes them communicate more effectively and instills a greater belief in the potential success of the VT.

Overall, the relationship between the contextual inputs and some of the processes were very similar. Potency and communication effectiveness, and to a lesser degree collaborative climate, were significantly related to many of the same contextual inputs (these three processes were highly inter-correlated). This suggests that organizations and managers may be able to contribute to numerous aspects of VT interactions by controlling a relatively small number of contextual inputs.

### **5.8.2 Step 2: Direct Relationships between Inputs and Outputs (for Inputs Having no Relationship with Processes)**

In the previous section, eight input variables (gender, member diversity in age, member diversity in education, position tenure, team tenure and expertise, team size and team longevity) were shown not to have significant correlations with any of the process

variables. These results indicate that these inputs do not follow the input→process→output form (i.e. if there is no relationship with the processes, then the inputs cannot relate to the outputs through the processes). As per the second step of the analysis (Step 2 in Figure 4), each of these input variables were examined to determine if they had a direct relationship with any of the output variables. It should be noted that all of the contextual variables were significantly correlated to the processes. As such, this section deals exclusively with team-level inputs. This section begins with the presentation of the significant correlations with respect to each input variable, followed by the results for each output variable. This is followed by a discussion of the results of the input-output relationships.

The correlations between the inputs that had no relationship with the processes and the outputs are presented in Table 32. Only one of the correlations between these inputs and the outputs was significant at the  $p < 0.01$  level (team member diversity with respect to age was correlated with VT members' perceptions of their capacity for future VT work ( $r = 0.480$ )).

**Table 32: Direct Correlations between Inputs and Outputs (for Inputs Having no Relationship with Processes)**

<b>INPUT/OUTPUT</b>	<b>VT Members' Perceptions of Performance</b>	<b>VT Member Satisfaction</b>	<b>VT Members' Perceptions of Professional Development</b>	<b>VT Members' Perceptions of Capacity for Future VT work</b>	<b>VT Mangers' Perceptions of Performance</b>
<b>Gender</b>	0.378*	0.114	0.034	0.070	0.223
<b>Age Diversity</b>	0.106	0.345	0.463*	0.480**	-0.089
<b>Education Diversity</b>	0.288	0.303	0.038	0.040	-0.089
<b>Position Tenure Diversity</b>	-0.160	-0.099	0.206	0.317	-0.059
<b>Team Tenure Diversity</b>	0.042	-0.124	0.317	-0.052	0.172
<b>Expertise Diversity</b>	-0.070	-0.083	0.051	0.035	-0.117
<b>Team Size</b>	0.311	0.194	0.190	0.010	-0.024
<b>Team Longevity</b>	0.391*	0.294	0.390*	0.280	0.322

\*\* Correlation significant at  $p < 0.01$ ; \*Correlation significant at  $p < 0.05$

Four correlations were significant at the  $p < 0.05$  level:

- Team longevity was correlated with VT members' perceptions of performance ( $r=0.391$ ) and with VT members' perceptions of professional development ( $r=0.390$ );
- Team member diversity with respect to age was correlated with VT members' perceptions of professional development ( $r=0.463$ ); and
- Gender was correlated with VT members' perceptions of performance ( $r=0.378$ ).

All of these correlations were moderate and positive.

Two of the inputs were significantly correlated with two of the outputs. Member age diversity was correlated to both VT members' perceptions of professional development and VT members' perceptions of capacity for future VT work. Team longevity was significantly correlated to both members' perceptions of performance and VT members' perceptions of professional development. One of the inputs was significantly correlated to only one output (gender was correlated with VT members' perceptions of performance). The five remaining input variables (education diversity, position tenure diversity, team tenure diversity, expertise diversity, team size) were not significantly correlated to any of the outputs. As these variables were also found to have no relationship with any of the processes, they were eliminated from further analysis and from the research framework.

#### **CORRELATIONS WITH VT MEMBERS' PERCEPTIONS OF PERFORMANCE:**

Only two input variables had significant correlations with members' perceptions of performance: gender ( $r=0.378$ ) and team longevity ( $r=0.391$ ). Both correlations were at the  $p<0.05$  level. The relationships were moderate. These results indicate that the VTs in this study that had been in existence longer and/or had a higher percentage of women also had greater perceptions of their VTs' performance.

#### **CORRELATIONS WITH VT MEMBERS' PERCEPTIONS OF PROFESSIONAL**

**DEVELOPMENT:** Two input variables had significant moderate relationships ( $p<0.05$ ) with VT members' perceptions of professional development: member age diversity

( $r=0.463$ ) and team longevity ( $r=0.390$ ), indicating that the VTs that had been in existence longer and/or whose members had greater diversity with respect to age also had greater perceptions of the professional development that they had received through their work on their VTs.

#### CORRELATIONS WITH VT MEMBERS' PERCEPTIONS OF CAPACITY FOR

FUTURE VT WORK: VT members' perceptions of capacity for future VT work was significantly moderately correlated with one input (age diversity,  $r=0.480$ ), indicating that the VTs whose members had greater diversity with respect to age also had greater perceptions of their capacity for future VT work.

The two remaining outputs, VT member satisfaction and VT managers' perceptions of performance had no significant relationships with any of the inputs tested in this section.

##### 5.8.2.1 Discussion of the Results for the Relationships between the Inputs and Outputs (for Inputs Having no Relationship with Processes)

These results suggest that some of the input variables are not related to any of the other components in the framework, and as such, are not related to VT effectiveness. VT size and team member diversity with respect to age, education, position tenure, team tenure and expertise were eliminated from the research framework. It is possible, however, that these variables have non-linear relationships with VT effectiveness. The fact that the diversity inputs were not found to have any relationship to the team processes or outputs, suggests that the aspects of diversity that have been highlighted in the proximate team

literature perhaps do not apply to the virtual environment. It is also likely that the members of VTs do not form the same kinds of relationships as proximate team members do and, as such, their within-group identification (feelings of similarity and belonging) are not critical to their interactions or performance. As was discussed previously, the fact that team size was not found to be related to any of the other components in the framework may be due to the limited size of the VTs in this study.

The results also indicate that some inputs have a direct relationship with the outputs and that the relationship is not mediated by the team processes (i.e. they are significantly correlated to the outputs but not the processes). Gender, member diversity with respect to age, and the amount of time that the team has been operating (longevity), were all found to have direct relationships with some of the outputs. All of these variables were team-level input and were demographic in nature, suggesting that at least some of the design components of the team may be related to its outcomes. The correlations were moderate, however, with only three of the five output variables, suggesting that while these demographic variables play a role in VT effectiveness, their role may be lesser than the VT processes and the inputs correlated to them.

### **5.8.3 Step 3: Relationships between Processes and Outputs**

This section examines the correlations between the processes and the outputs (i.e. Step 3 in Figure 4 - the process→output component of the research framework). In this section, the significant correlations with respect to each process variable are presented first. The

results with respect to each of the outputs are then presented, followed by a discussion of the results of the process-output relationships.

The correlations between the process indicators and the output variables are presented in Table 33. Six correlations between the team processes and the outputs were significant at the  $p < 0.01$  level:

- Collaborative climate was correlated with VT members' perceptions of performance ( $r=0.527$ ) and with VT member satisfaction ( $r=0.787$ );
- Potency was correlated with VT members' perceptions of performance ( $r=0.732$ ) and with VT member satisfaction ( $r=0.620$ ); and
- Communication effectiveness was correlated with VT members' perceptions of performance ( $r=0.704$ ) and with VT member satisfaction ( $r=0.794$ ).

All of these correlations were positive. One correlation was significant at the  $p < 0.05$  level: potency was correlated with VT managers' perceptions of performance.

One of the process variables, potency, was significantly correlated to three of the outputs (VT members' perceptions of performance, VT member satisfaction, VT managers' perceptions of performance). Three of the process variables, collaborative climate, potency, and communication effectiveness, were significantly correlated to the same two outputs (VT members' perceptions of performance, VT member satisfaction). One of the process indicators, task commitment, had no significant relationship with any of the outputs. This indicates that, although task commitment was significantly related to

several of the inputs, it had no significant relationship with the outputs in the framework. As such, task commitment was eliminated from the research framework and from further analysis.

**Table 33: Correlations between Process Indicators and Outputs**

<b>PROCESSES/ OUTPUTS</b>	<b>VT Members' Perceptions of Performance</b>	<b>VT Member Satisfaction</b>	<b>VT Members' Perceptions of Professional Development</b>	<b>VT Members' Perceptions of Capacity for Future VT work</b>	<b>VT Managers' Perceptions of Performance</b>
<b>Task Commitment</b>	0.301	0.360	0.209	0.258	0.081
<b>Collaborative Climate</b>	0.527**	0.787**	0.341	0.310	-0.037
<b>Potency</b>	0.732**	0.620**	0.299	0.179	0.417*
<b>Communication Effectiveness</b>	0.704**	0.794**	0.304	0.255	0.051

\*\*Correlation significant at  $p < 0.01$ ; \*Correlation significant at  $p < 0.05$

**TEAM PROCESSES CORRELATED WITH VT MEMBERS' PERCEPTIONS OF PERFORMANCE:** Members' perceptions of performance was significantly correlated to three of the four processes at the  $p < 0.01$  level (collaborative climate, potency, communication effectiveness). All of the correlations were positive. Members' perceptions of performance had a very strong relationship with potency ( $r = 0.732$ ) and communication effectiveness ( $r = 0.704$ ) and a strong relationship with collaborative climate ( $r = 0.527$ ). These results indicate that the VTs that perceived their climate to be

collaborative, their communication to be effective, and/or their potency to be greater, also had greater perceptions of their performance.

#### TEAM PROCESSES CORRELATED WITH VT MEMBER SATISFACTION: VT

member satisfaction with the VT experience was significantly correlated to three of the process indicators at the  $p < 0.01$  level (collaborative climate, potency, communication effectiveness). All of the correlations were positive. VT member satisfaction was very strongly related to collaborative climate ( $r = 0.787$ ) and communication effectiveness ( $r = 0.794$ ) and strongly related to potency ( $r = 0.620$ ). Similar to the results observed for team members' perceptions of performance, these results suggest that the VTs in this study that perceived their climate to be more collaborative, their communication to be more effective and/or their potential for success to be greater, also had greater member satisfaction.

#### TEAM PROCESSES CORRELATED WITH VT MANAGERS' PERCEPTIONS OF

PERFORMANCE: VT managers' perceptions of performance was only significantly correlated with one of the process variables, potency ( $r = 0.417$ ,  $p < 0.05$ ). This data indicates that VTs that had greater belief in their own potential for success (potency) also were perceived to be more effective by their managers.

Two of the output variables, VT members' perceptions of their professional development and their perceptions of capacity for future VT work were not significantly related to any

of the process indicators. This suggests that the indicators of team interactions measured for this framework do not contribute to these aspects of VT effectiveness. It is possible that these two outputs have a direct relationship with some of the inputs (i.e. Step 4 of Figure 4). This potential relationship will be examined in the next section.

#### 5.8.3.1 Discussion of the Results for the Relationships between Processes and Outputs

These results show that three of the four process indicators examined in this study (collaborative climate, potency, communication effectiveness) are highly associated with two of the VT outputs (VT members' perceptions of performance and VT member satisfaction). The relationship between these processes and VT member satisfaction with the VT experience were very similar to those observed with VT members' perceptions of performance (these two outputs were very highly inter-correlated).

One of the process indicators, task commitment, was not found to be correlated to any of the VT outputs included in this study. There are three possible explanations for this result. First, task commitment may have a non-linear relationship with the VT outputs included in this study (such a relationship can not be determined through correlations). Second, task commitment may be related to other aspects of VT effectiveness, not included in this study. Finally, task commitment may not play a role in VT effectiveness. As no relationship was found between task commitment and the outputs in this study, it was eliminated from the framework. Although many of the input variables were found to have significant relationships with task commitment, if this process plays no role in

VT effectiveness, then these relationships are of limited interest (e.g. does it matter that VT training contributes to task commitment if task commitment does not contribute to VT effectiveness?). Finally, this result calls into question the use of task commitment as a proxy for VT effectiveness as has been done in the literature (Huang et. al., 2002).

Potency was the only process indicator that was significantly correlated with VT managers' perceptions of task performance. This correlation was moderate and not as strong as the correlations between the other outputs and the processes. This suggests that the VT managers' perceptions of VT performance may be linked to things other than the team interactions measured in this study. It is interesting to note that a VT's belief that it will be successful (potency) is the only process that is significantly linked to both member and manager perceptions of performance. As suggested by Guzzo and Shea (1992) and tested by Pearce et al. (2002), it is likely that the relationship between potency and performance is reciprocal (i.e. if a team believes that they can succeed, they are more likely to succeed; if a team succeeds, they are more likely to believe that they will succeed in the future). It is possible that a similar relationship may exist between managers' perceptions of performance and team potency, particularly if the VT has received positive feedback from their manager. In other words, if a VT receives positive feedback from its manager, the VT may have a greater belief in their success and may even have a better idea of the expectations of the managers (i.e. if the manager believes in the team, the team will believe in itself).

Both collaborative climate and communication effectiveness were strongly to very strongly correlated to two of the outputs (VT members' perceptions of performance and VT member satisfaction). This result is in keeping with Gladstein (1984), who found that these self-report measures of proximate team effectiveness were very closely linked to the team processes, indicating that the team members are more satisfied if they have experienced positive interactions and further, that they base their judgments of performance on these processes as well. Although it is understandable that all teams, whether proximate or virtual, require effective communication in order to be effective, the strong associations found for potency and collaborative climate in this study are somewhat surprising, as it was expected that the importance of the team interactions would be lessened in the virtual team environment (Gonzalez et al., 2003).

Two of the output variables (VT members' perceptions of professional development and VT members' perceptions of capacity for future VT work) did not have significant relationships with any of the processes in this study. It could be that these two outputs may be directly related to the inputs (i.e. an input→output relationship). Alternately, it may be that these outputs are related to processes that were not included in this study. It is also possible that these outputs have a non-linear relationship with the processes that could not be observed with correlations. These output variables were tested in the next section to determine if a direct input→output relationship exists (i.e. Step 4 in Figure 4).

Overall, these results suggest that VT interactions in general, and collaborative climate, potency, and communication effectiveness in particular, play a key role in two aspects of VT effectiveness: VT member satisfaction and VT members' perceptions of performance. The nature of these relationships will be explored further in Section 5.8.5 (Step 5 in Figure 4).

Of the five measures of VT effectiveness included in this study, two were strongly related to most of the processes, one was moderately related to only one of the processes and two were not correlated to any of the processes. Together, these results support the contention of this study that the different dimensions of team effectiveness may need to be described by different models.

#### **5.8.4 Step 4: Direct Relationships between Inputs and Outputs (for Outputs Having no Relationship with Processes)**

In the previous section, two output variables (VT members' perceptions of professional development and VT members' perceptions of capacity for future VT work) showed no significant relationship with any of the process variables. This result indicates that these outputs do not seem to follow an input→process→output form (i.e. if there is no relationship with the processes, then the outputs cannot relate to the inputs through the processes). In this section, these output variables are examined for direct relationships with the input variables (i.e. Step 4 in Figure 4). This section is divided into two parts. First the results with respect to the team inputs are presented. This is followed by the results for the contextual inputs.

#### 5.8.4.1 Direct Relationships between Team Inputs and Outputs (for Outputs Having no Relationship with Processes)

This section begins with the presentation of the significant correlations with respect to each team input variable, followed by the results for each of the output variables noted above. This is followed by a discussion of the results of the team input-output relationships.

The correlations between the team-level inputs and the outputs are presented in Table 34. None of the correlations between the team inputs and outputs were significant at the  $p < 0.01$  level. Four of the correlations between the team inputs and outputs were significant at the  $p < 0.05$  level:

- Member comfort with technology was correlated with VT members' perceptions of professional development ( $r = -0.450$ ) and with VT members' perceptions capacity for future VT work ( $r = -0.423$ );
- Member experience with technology was correlated with VT members' perceptions of capacity for VT work ( $r = -0.373$ );
- Goal clarity was correlated with VT members' perceptions of professional development ( $r = 0.379$ )

Three of these correlations were negative: member comfort with technology was negatively correlated with VT members' perceptions of professional development and with their perceptions of their capacity for future VT work, and member experience with

technology was negatively correlated with VT member perceptions of capacity for future VT work.

**Table 34: Direct Correlations between Team Inputs and Outputs (for Outputs Having no Relationship with Processes)**

<b>INPUT/OUTPUT</b>	<b>VT Members' Perceptions of Professional Development</b>	<b>VT Members' Perceptions of Capacity for Future VT work</b>
<b>Member Comfort with Technology</b>	-0.450*	-0.423*
<b>Member Experience with Technology</b>	-0.172	-0.373*
<b>Organization Tenure Diversity</b>	-0.028	0.069
<b>Adequacy of Technology</b>	0.142	-0.018
<b>Skills</b>	0.155	0.176
<b>Motivating Task</b>	0.312	0.223
<b>Goal Clarity</b>	0.379*	0.334
<b>Leader Effectiveness</b>	0.289	0.153
<b>Face-to-Face Meeting</b>	0.215	0.075

\*\*Correlation significant at  $p < 0.01$ ; \*Correlation significant at  $p < 0.05$

Finally, the following six team inputs were not significantly related to either of these two outputs: organization tenure diversity, adequacy of technology, member skills, motivating task, leader effectiveness, and face-to-face meeting history. Their relationships with the other VT outputs (VT members' perceptions of performance, VT member satisfaction, VT managers' perceptions of performance) are presented in Section 5.8.5 (Step 5 in Figure 4).

One team input was significantly correlated to two of the outputs. Member comfort with technology was moderately negatively related to both VT members' perceptions of professional development and their perceptions of their capacity for future VT work. Two team inputs were correlated to only one output. Member experience with technology was moderately negative related to VT members' perceptions of capacity for future VT work. Goal clarity was moderately positively correlated with VT members' perceptions of professional development.

**TEAM INPUTS CORRELATED WITH VT MEMBERS' PERCEPTIONS OF PROFESSIONAL DEVELOPMENT:** VT members' perceptions of professional development was not significantly correlated to any of the team inputs at the  $p < 0.01$  level, but was significantly correlated to two team inputs at the  $p < 0.05$  level (comfort with technology, goal clarity). VT members' perceptions of professional development was moderately positively related to goal clarity ( $r = 0.379$ ) and moderately negatively related to member comfort with technology ( $r = -0.450$ ). This result indicates that the VTs in this study that had clear goals and whose members were less comfortable with technology were more likely to report that they had experienced professional development as a result of their work with the VTs. It should be recalled that in Section 5.8.3, this output had no significant relationships with any of the process variables, suggesting that the relationship between VT members' perceptions of professional

development has a direct relationship with the member comfort with technology and goal clarity.

TEAM INPUTS CORRELATED WITH VT MEMBERS' PERCEPTIONS OF CAPACITY FOR FUTURE VT WORK: VT members' perceptions of capacity for future VT work was not significantly correlated to any of the team inputs at the  $p < 0.01$  level, but was significantly correlated to two team inputs at the  $p < 0.05$  level (comfort with technology, experience with technology). VT members' perceptions of capacity for future VT work was moderately negatively related to member comfort with technology ( $r = -0.423$ ) and member experience with technology ( $r = -0.373$ ). This result indicates that the VTs in this study whose members were less comfortable and/or experienced with technology were more likely to perceive that their work on the VT had increased their capacity for future VT work. This output also had no significant relationships with any of the process variables (tested in Section 5.8.3), suggesting that the relationship between VT members' perceptions of capacity for future VT work has a direct relationship with the VT member comfort with technology and experience with technology.

#### *5.8.4.1.1 Discussion of the Results for the Relationships between the Team Inputs and Outputs (for Outputs Having no Relationship with Processes)*

The results suggest that only three of the team input variables tested in this section are linked to VT members' perceptions of professional development and their perceptions of their capacity for future VT work. The results also indicate that these inputs have a direct relationship with the outputs and that the relationships are not mediated by the

team processes (i.e. they are significantly correlated to the outputs but not the processes). Two of the variables are demographic (member comfort with technology, member experience with technology), suggesting that organizations and managers may be able to affect some VT outcomes through team selection and training. The correlations were negative however, implying that VTs with members who are less comfortable and experienced with technology may have perceptions that their work on the VT has led to greater professional development and capacity for future VT work. It is possible that teams with members who already have high levels of competence with their virtual tools consider this an area of development in which they can no longer improve (i.e. technical competence is possibly an aspect of professional development and capacity for future VT work and it cannot be increased for those who already excel in it). Alternately, it maybe that the members of the VTs with greater technical competence have other reasons for being less attracted to future VT work (i.e. perhaps they are frustrated by the long hours or the isolation).

Goal clarity was also shown to have a significant direct relationship with VT members' perceptions of professional development. The relationship was positive. It is possible that if VT members are provided with clear goals, they are more aware of their accomplishments or are more motivated to excel. As such, they may be more likely to see the link between VT work and professional development.

The following six team input variables were not related to either of the outputs: diversity with respect to organizational tenure, adequacy of technology, member skills, motivating task, leader effectiveness, and face-to-face meeting history. The results suggest that these team inputs may not play any role in these two aspects of VT effectiveness (VT members' perceptions of professional development and their perceptions of their capacity for future VT work). This is interesting, given that these are some of the input variables which have been linked to VT effectiveness in the past. It should be recalled that both VT members' perceptions of professional development and their perceptions of their capacity for future VT work are dimensions of effectiveness developed for this study. As such, it is possible that the inputs which are linked to these two dimensions of effectiveness are not typically found in the proximate and VT literature and were therefore not included in this study. Alternately, the measures developed for these dimensions of effectiveness do not fully capture the concept. It is also possible, however, that these input variables have non-linear relationships with these two aspects of VT effectiveness.

#### 5.8.4.2 Direct Relationships between Contextual Inputs and Outputs (for Outputs Having no Relationship with Processes)

This section examines the direct relationship between the contextual inputs and the two output variables which had no relationship with the processes (VT members' perceptions of professional development and VT members' perceptions of capacity for future VT work). The section begins with the presentation of the significant correlations with respect to each of the contextual input variables, followed by the results for each output

variable. This is followed by a discussion of the results of the contextual input-output relationships.

The correlations between the contextual-level inputs and the two outputs are presented in Table 35. None of the correlations between the contextual inputs and these two outputs were significant at the  $p < 0.01$  level. Two of the correlations between the contextual inputs and the outputs were significant at the  $p < 0.05$  level:

- Rewards was correlated with VT members' perceptions of professional development ( $r = 0.373$ ); and
- Organizational support through culture was correlated with VT members' perceptions of professional development ( $r = 0.419$ ).

Two of the contextual inputs were significantly correlated to one of the outputs. Team rewards was moderately related to VT members' perceptions of professional development. Organizational support through culture was also moderately related to VT members' perceptions of professional development.

Finally, the following six contextual inputs were not significantly related to either of the outputs: member training, managerial support of VTs through facilitation, managerial support of VTs through VT development, managerial non-support of VTs, organizational support of VTs through infrastructure and organizational non-support of VTs. Their relationships with the other VT outputs (VT members' perceptions of performance, VT

member satisfaction, VT managers' perceptions of performance) are presented in Section 5.8.5.

**Table 35: Direct Correlations between Contextual Inputs and Outputs (for Outputs Having no Relationship with Processes)**

<b>INPUT/OUTPUT</b>	<b>VT Members' Perceptions of Professional Development</b>	<b>VT Members' Perceptions of Capacity for Future VT Work</b>
<b>Rewards</b>	0.373*	0.204
<b>Training</b>	0.268	0.083
<b>Managerial Support - Facilitating</b>	0.275	0.264
<b>Managerial Support - VT Development</b>	0.361	0.118
<b>Managerial Non-Support</b>	0.119	0.028
<b>Organizational Support - Culture</b>	0.419*	0.338
<b>Organizational Support - Infrastructure</b>	0.051	0.070
<b>Organizational – Non-support</b>	-0.089	-0.058

\*\*Correlation significant at  $p < 0.01$ ; \*Correlation significant at  $p < 0.05$

CONTEXTUAL INPUTS CORRELATED WITH VT MEMBERS' PERCEPTIONS OF PROFESSIONAL DEVELOPMENT: VT members' perceptions of professional development was not significantly correlated to any of the team inputs at the  $p < 0.01$  level, but was significantly correlated to two team inputs at the  $p < 0.05$  level. VT members' perceptions of professional development was moderately positively related to team rewards ( $r = 0.373$ ) and organizational support through culture ( $r = 0.419$ ). This result indicates that the VTs in this study that had team-oriented rewards and/or perceived their

organization to have a culture that is supportive of VTs, also had greater perceptions of the professional development that they had received as a result of their work with the VTs. As this output had no significant relationships with any of the process variables (tested in Section 5.8.3), this result suggests that the relationship between VT members' perceptions of professional development has a direct relationship with team rewards and organizational support through culture.

CONTEXTUAL INPUTS CORRELATED WITH VT MEMBERS' PERCEPTIONS OF CAPACITY FOR FUTURE VT WORK: VT members' perceptions of capacity for future VT work was not significantly correlated to any of the contextual inputs.

*5.8.4.2.1 Discussion of the Results for the Relationships between the Contextual Inputs and Outputs (for Outputs Having no Relationship with Process)*

The results suggest that only two of the contextual input variables tested in this section are directly linked to VT members' perceptions of professional development (i.e. their relationship is not mediated by the processes): team rewards and organizational support of VTs through culture. The implication of this is that organizations may be able to influence this aspect of VT effectiveness by providing rewards that are oriented to the team level and a culture that is supportive of VTs.

VT members' perceptions of capacity for future VT work was shown not to have a relationship with any of the contextual variables, suggesting that nothing can be done at the organizational or managerial level to influence this aspect of VT effectiveness.

Six of the input variables were not related to these two VT outputs: member training, managerial support of VTs through facilitation, managerial support of VTs through VT development, managerial non-support of VTs, organizational support of VTs through infrastructure and organizational non-support of VTs. These results suggest that these contextual inputs may not play any role in VT members' perceptions of professional development and capacity for future VT work. As with the team-level inputs, it is possible that the contextual inputs which are linked to these two dimensions of effectiveness were not included in this study, or that the measures developed for these dimensions of effectiveness do not fully capture the concept.

Overall, these results have three implications. First, they support the contention of this thesis that the different dimensions of VT effectiveness have different antecedents and should therefore be analyzed separately. Second, it seems that these two dimensions of VT effectiveness are much more closely connected to the team inputs than the team processes. No significant relationships were found between these two outputs and any of the processes, indicating that these two outputs follow the input→ output form of the framework. The inputs can be, for the most part, considered design factors and as such are controllable (by managers or organizations). Third, this result also indicates that further research should be conducted to determine if there are other elements, not included in this study, which may contribute to these two dimensions of VT effectiveness.

It should be noted that both of the VT outputs tested for direct relationships in this section were correlated with at least one input. As such, no variables were eliminated from the framework at this stage of the analysis.

#### **5.8.5 Step 5: Relationships between Inputs and Outputs through Processes**

As discussed previously, the path from input to output has two theoretical routes: 1) the inputs are directly related to the outputs (input→output) (Steps 2 and 3 in Figure 4); and 2) the inputs are related to the outputs through a mediating variable (input→process→output) (Steps 1, 3 and 5 in Figure 4). The goal of this section is to determine which form of the framework is more appropriate for each of the VT outputs (i.e. Step 5 in Figure 4). The analysis was done in three steps. First, the potential direct correlations between the input and output variables were examined through correlation analysis. The indirect relationships between inputs and outputs, with process acting as a mediator (input→process→output) were then calculated using partial correlations. Third, the results from the partial correlations (representing the mediating role of the processes) were compared to the results of the direct correlations (the direct input to output path). The comparison of the two results was done to determine whether a mediating role is played by the process variables. If the significant direct relationship was no longer significant when controlling for process, a mediating effect is supported (Step 5b in Figure 4). If the direct relationship is still significant, when the processes are controlled for, a direct relationship is supported (Step 5a in Figure 4).

As discussed in Section 4.8.2.5, there are three requirements for this type of analysis. First, there must be a significant relationship between each of the inputs and the processes (Step 1 in Figure 4: input→process). Second, there must also be a significant relationship between each of the processes and the outputs being examined (Step 3 in Figure 4: process→output). Finally, there must be a significant direct relationship between each of the inputs and outputs being examined (input→output). The results with respect to Steps 1 through 4 are summarized in Table 36.

The first requirement was tested in Section 5.8.1 (Step 1 in Figure 4). Eight inputs did not satisfy this requirement (gender, education diversity, position tenure diversity, team tenure diversity, expertise diversity, team size, team longevity). These inputs were subsequently tested for direct relationships with the outputs in Section 5.8.2 (Step 2 in Figure 4). Five inputs were not correlated to any of the outputs (education diversity, position tenure diversity, team tenure diversity, expertise diversity, team size). These inputs were eliminated from the research framework and no further analysis was performed on these variables.

Table 36: Summary of Results of Steps 1 Through 4

<b>STEP 1: INPUTS - PROCESSES</b>		
<b>VARIABLES TESTED</b>	<b>Relationship Found TEST IN STEP 5</b>	<b>No Relationships Found TEST IN STEP 2</b>
<p>TEAM-LEVEL INPUTS</p> <ul style="list-style-type: none"> <li>• Member Comfort with Technology</li> <li>• Member Experience with Technology</li> <li>• Gender</li> <li>• Age Diversity</li> <li>• Education Diversity</li> <li>• Organization Tenure Diversity</li> <li>• Position Tenure Diversity</li> <li>• Team Tenure Diversity</li> <li>• Expertise Diversity</li> <li>• Adequacy of Technology</li> <li>• Skills</li> <li>• Motivating Task</li> <li>• Goal Clarity</li> <li>• Leader Effectiveness</li> <li>• Team Size</li> <li>• Team Age</li> <li>• Face-to-Face Meeting</li> </ul> <p>CONTEXTUAL INPUTS</p> <ul style="list-style-type: none"> <li>• Rewards</li> <li>• Training</li> <li>• Managerial Support- Facilitating</li> <li>• Managerial Support - Development</li> <li>• Managerial Non- Support</li> <li>• Organizational Support - Culture</li> <li>• Organizational Support – Infrastructure</li> <li>• Organizational Non-Support</li> </ul>	<p>TEAM-LEVEL INPUTS</p> <ul style="list-style-type: none"> <li>• Member Comfort with Technology</li> <li>• Member Experience with Technology</li> <li>• Organization Tenure Diversity</li> <li>• Adequacy of Technology</li> <li>• Skills</li> <li>• Motivating Task</li> <li>• Goal Clarity</li> <li>• Leader Effectiveness</li> <li>• Face-to-Face Meeting</li> </ul> <p>CONTEXTUAL INPUTS</p> <ul style="list-style-type: none"> <li>• Rewards</li> <li>• Training</li> <li>• Managerial Support- Facilitating</li> <li>• Managerial Support - Development</li> <li>• Managerial Non- Support</li> <li>• Organizational Support - Culture</li> <li>• Organizational Support – Infrastructure</li> <li>• Organizational Non-Support</li> </ul>	<p>TEAM-LEVEL INPUTS</p> <ul style="list-style-type: none"> <li>• Gender</li> <li>• Age Diversity</li> <li>• Education Diversity</li> <li>• Position Tenure Diversity</li> <li>• Team Tenure Diversity</li> <li>• Expertise Diversity</li> <li>• Team Size</li> <li>• Team Longevity</li> </ul>
<b>STEP 2: INPUTS - OUTPUTS</b>		
<b>INPUT VARIABLES TESTED</b>	<b>Relationships found INPUT→OUTPUT form supported</b>	<b>No Relationships Found ELIMINATE INPUT</b>
<p>TEAM-LEVEL INPUTS</p> <ul style="list-style-type: none"> <li>• Gender</li> <li>• Age Diversity</li> <li>• Education Diversity</li> <li>• Position Tenure Diversity</li> <li>• Team Tenure Diversity</li> <li>• Expertise Diversity</li> <li>• Team Size</li> <li>• Team Longevity</li> </ul>	<p>TEAM-LEVEL INPUTS</p> <ul style="list-style-type: none"> <li>• Gender</li> <li>• Age Diversity</li> <li>• Team Longevity</li> </ul>	<p>TEAM-LEVEL INPUTS</p> <ul style="list-style-type: none"> <li>• Education Diversity</li> <li>• Position Tenure Diversity</li> <li>• Team Tenure Diversity</li> <li>• Expertise Diversity</li> <li>• Team Size</li> </ul>

**Table 36: Summary of Results of Steps 1 Through 4 - Continued**

<b>STEP 3: PROCESSES – OUTPUTS</b>			
<b>VARIABLES TESTED</b>	<b>Relationship Found TEST IN STEP 5</b>	<b>No Relationships Found</b>	
		<b>TEST OUTPUT IN STEP 4</b>	<b>ELIMINATE PROCESS</b>
<b>PROCESSES</b> <ul style="list-style-type: none"> <li>• Task Commitment</li> <li>• Collaborative Climate</li> <li>• Potency</li> <li>• Communication Effectiveness</li> </ul> <b>OUTPUTS</b> <ul style="list-style-type: none"> <li>• VT Member's Perceptions of Performance</li> <li>• VT Member Satisfaction</li> <li>• VT Members' Perceptions of Professional Development</li> <li>• VT Members' Perceptions of Capacity for Future VT Work</li> <li>• VT Manager's Perceptions of Performance</li> </ul>	<b>PROCESSES</b> <ul style="list-style-type: none"> <li>• Collaborative Climate</li> <li>• Potency</li> <li>• Communication Effectiveness</li> </ul> <b>OUTPUTS</b> <ul style="list-style-type: none"> <li>• VT Member's Perceptions of Performance</li> <li>• VT Member Satisfaction</li> <li>• VT Manager's Perceptions of Performance</li> </ul>	<b>OUTPUTS</b> <ul style="list-style-type: none"> <li>• VT Members' Perceptions of Professional Development</li> <li>• VT Members' Perceptions of Capacity for Future VT Work</li> </ul>	<b>PROCESSES</b> <ul style="list-style-type: none"> <li>• Task Commitment</li> </ul>
<b>STEP 4: INPUTS - OUTPUTS</b>			
<b>OUTPUT VARIABLES TESTED</b>	<b>Relationships found INPUT→OUTPUT form supported</b>	<b>No Relationships Found ELIMINATE OUTPUT</b>	
<b>OUTPUTS</b> <ul style="list-style-type: none"> <li>• VT Members' Perceptions of Professional Development</li> <li>• VT Members' Perceptions of Capacity for Future VT Work</li> </ul>	<b>OUTPUTS</b> <ul style="list-style-type: none"> <li>• VT Members' Perceptions of Professional Development</li> <li>• VT Members' Perceptions of Capacity for Future VT Work</li> </ul>	NONE	

The second requirement (significant process-output relationship) was tested in Section 5.8.3 (Step 3 in Figure 4). One of the processes, task commitment, was not correlated with any of the outputs and was removed from the research framework. In addition, two of the outputs (VT members' perceptions of professional development, VT members' perceptions of capacity for future VT work) were not related to any of the processes. These outputs were subsequently tested for direct relationships with the inputs in Section 5.8.4 (Step 4 in Figure 4). Both of the outputs were shown to have significant direct relationships with some of the inputs in this study, supporting a direct input→output form of the framework.

The results with respect to the third requirement (significant input-output relationship) are presented in the next section as the first stage of the partial correlation analysis (Step 5 in Figure 4). Each of the stages of the partial correlation analysis are presented in the following sections. As it is not until the third step that the role of the processes in the research framework is determined, the discussion of the last two steps is presented after the results of the third step. Due to the large number of input variables, the results of the three steps in this analysis are presented twice, once for the team inputs and once for the contextual inputs.

#### 5.8.5.1 Relationships between Team Inputs and Outputs through Processes

This section discusses the results of the testing of the indirect relationship between the nine remaining team-level input variables (member comfort with technology, member experience with technology, organization tenure diversity, adequacy of technology, skills, motivating task, goal clarity, leader effectiveness, face-to-face meeting history) and the three remaining outputs (VT members' perceptions of performance, VT member satisfaction, VT managers' perceptions of performance). The section is divided into two parts. The first part presents the results for the direct correlations between the inputs and the outputs listed above. The second part examines the results of the partial correlations and compares them to the direct correlations.

### 5.8.5.1.1 Direct Correlations between Team Inputs and Outputs

This section examines the direct correlations between the team inputs and the output variables listed above. These correlations are presented in Table 37.

**Table 37: Direct Correlations between Team Inputs and Outputs**

<b>INPUT/OUTPUT</b>	<b>VT Members' Perceptions of Performance</b>	<b>VT Member Satisfaction</b>	<b>VT Managers' Perceptions of Performance</b>
<b>Member Comfort with Technology</b>	-0.222	-0.227	-0.075
<b>Member Experience with Technology</b>	-0.205	-0.350	0.060
<b>Organization Tenure Diversity</b>	0.442*	0.449*	-0.398*
<b>Adequacy of Technology</b>	0.474**	0.537**	0.117
<b>Skills</b>	0.603**	0.670**	0.095
<b>Motivating Task</b>	0.506**	0.625**	0.171
<b>Goal Clarity</b>	0.592**	0.503**	0.246
<b>Leader Effectiveness</b>	0.606**	0.493*	0.202
<b>Face-to-Face Meeting</b>	0.222	0.133	0.308

\*\*Correlation significant at  $p < 0.01$ ; \*Correlation significant at  $p < 0.05$

The following nine of the direct correlations between the team inputs and the outputs were significant at the  $p < 0.01$  level:

- Adequacy of technology was correlated with VT members' perceptions of performance ( $r=0.474$ ) and with VT member satisfaction ( $r=0.537$ );
- Member skills was correlated with VT members' perceptions of performance ( $r=0.603$ ) and with VT member satisfaction ( $r=0.670$ );

- Motivating task was correlated with VT members' perceptions of performance ( $r=0.506$ ) and with VT member satisfaction ( $r=0.625$ );
- Goal clarity was correlated with VT members' perceptions of performance ( $r=0.592$ ) and with VT member satisfaction ( $r=0.503$ ); and
- Leader effectiveness was correlated with VT members' perceptions of performance ( $r=0.606$ ).

All of these correlations were positive. Four other direct correlations between the team inputs and outputs were significant at the  $p<0.05$  level:

- Member diversity in organizational tenure was correlated with VT members' perceptions of performance ( $r=0.442$ ), with VT member satisfaction ( $r=0.449$ ) and with VT managers' perceptions of performance ( $r=-0.398$ ); and
- Leader effectiveness was correlated with VT member satisfaction ( $r=0.493$ ).

All of these correlations were positive except organization tenure diversity and VT managers' perceptions of performance.

One of the team inputs (organization tenure diversity) was significantly, albeit moderately, correlated with three of the outputs: VT members' perceptions of performance (positive correlation), VT member satisfaction (positive correlation) and VT managers' perceptions of performance (negative correlation). Five team inputs had significant positive correlations with the same two outputs. Adequacy of technology, member skills motivating task, goal clarity and leader effectiveness were all moderately

to highly related to VT members' perceptions of performance and VT member satisfaction.

Finally, three of the team inputs (member comfort with technology, member expertise with technology, face-to-face meeting history) were not significantly correlated to any of the outputs tested in this section. It should be recalled that in Section 5.8.4, member comfort with technology and member expertise with technology were shown to have direct relationships with two of the outputs in this study (VT members' perceptions of professional development, VT members' perceptions of capacity for future VT work). Face-to-face meeting history, however, was found to have no significant relationships with any of the measures of VT effectiveness. This indicates that face-to-face meeting history has no linear relationship with any of the outputs included in this study. In addition, in Section 5.8.1.1, face-to-face meeting history was found to be significantly related to only one process variable, task commitment. Task commitment was removed from the research framework because it was not correlated to any outputs. In other words, there is no evidence from this research, that team face-to-face meeting is linked (either directly or indirectly through process) to any of the measures of VT effectiveness. Face-to-face meeting history was therefore eliminated from further analysis and from the research framework.

#### TEAM INPUTS CORRELATED WITH VT MEMBERS' PERCEPTIONS OF

PERFORMANCE: VT members' perceptions of performance was significantly related to

six of the team inputs. VT members' perceptions of performance had a strong significant relationship ( $p < 0.01$ ) with member skills ( $r = 0.603$ ), motivating task design ( $r = 0.506$ ), goal clarity ( $r = 0.592$ ), and leader effectiveness ( $r = 0.606$ ). This result indicates that the VTs in this study that had members skilled in VT work, a task that was motivating, clear goals, and/or a leader who was perceived to be effective, also perceived their performance to be greater. VT members' perceptions of performance also had a moderate relationship with member diversity with respect to organizational tenure ( $r = 0.442$ ,  $p < 0.05$ ) and adequacy of technology ( $r = 0.474$ ,  $p < 0.01$ ), indicating that the VTs with greater diversity with respect to organizational tenure and/or perceptions that their technology was adequate to do their work, also had greater perceptions of performance.

**TEAM INPUTS CORRELATED WITH VT MEMBER SATISFACTION:** VT member satisfaction was significantly related to six of the team inputs. VT member satisfaction had a strong significant ( $p < 0.01$ ) relationship with adequacy of technology ( $r = 0.537$ ), member skills ( $r = 0.670$ ), motivating task design ( $r = 0.625$ ), and goal clarity ( $r = 0.503$ ). This result indicates that the VTs in this study that had the technology required to do their work, members skilled in VT work, a task that was motivating, and /or clear goals, also had greater satisfaction. VT member satisfaction also had a moderate significant ( $p < 0.05$ ) relationship with member diversity with respect to organizational tenure ( $r = 0.449$ ) and leader effectiveness ( $r = 0.493$ ), indicating that the VTs with greater diversity with respect to organizational tenure and/or a leader who was perceived to be effective, also had greater satisfaction.

**TEAM INPUTS CORRELATED WITH VT MANAGERS' PERCEPTIONS OF PERFORMANCE:** VT managers' perceptions of performance was not significantly correlated to any of the team inputs at the  $p < 0.01$  level, but was significantly correlated to one team input at the  $p < 0.05$  level. VT managers' perceptions of performance was moderately negatively related to member diversity with respect to organizational tenure ( $r = -0.398$ ). This result indicates that the VTs in this study that had less diversity with respect to the organizational tenure of their members, also had managers who perceived them to have greater performance.

**DISCUSSION OF RESULTS FOR THE DIRECT RELATIONSHIP BETWEEN TEAM INPUTS AND OUTPUTS:** Overall, it seems that six of the team inputs (organization tenure diversity, adequacy of technology, members skills, motivating task, goal clarity, leader effectiveness) have the strongest association with two of the aspects of VT effectiveness included in this study (VT members' perceptions of performance, VT member satisfaction). These six team inputs and two outputs also had the greatest association with the process indicators. This suggests that all of these variables are linked and that they, as a set, may explain at least two of the aspects of VT effectiveness examined in this thesis. The nature of their relationship is explored in the next sections. It would seem that VT literature, which has identified these inputs and outputs as variables of interest, is on the right track with respect to studying VT effectiveness in terms of VT members' perception of performance and VT member satisfaction.

VT managers' perceptions of performance was only directly correlated to one of the team input variables, suggesting two things. First, VT managers may base their perceptions of performance on different criteria than members do. Second, this result suggests that either the characteristics of the team do not contribute to the managers' perceptions of VT performance or that they base such judgments on team-level variables that are not typically associated with proximate or VT effectiveness (i.e. variables which were not included in this study).

#### *5.8.5.1.2 Partial Correlations between Team Inputs and Outputs*

This section explores the potential mediating role of process in the input→process→output form of the framework by examining the partial correlations between the team inputs and outputs, while controlling for the process variables.

It should be recalled that in the previous section, three team inputs (member comfort with technology, member experience with technology, face-to-face meeting history) were shown not to satisfy the third requirement for the partial analysis (i.e. they had no significant direct relationship with the three outputs being tested in this section). As such, these three team inputs were not included in the partial correlation analysis.

The correlation matrix showing the direct correlations and the partial correlations while controlling for the process variables are shown in Table 38. Only one of the partial correlations was significant, suggesting that, with one exception, the processes play a

mediating role in the relationship between the team-level inputs and the outputs tested in this section. VT member diversity with respect to organization tenure, on the other hand, was still significantly correlated ( $r=-0.678$ ) with VT managers' perceptions of performance. This indicates that in this case, the process variables considered in this study do not mediate the relationship between VT member diversity with respect to their organizational tenure and the VT managers' perceptions of performance.

**Table 38: Comparison of Direct and Partial Correlations between Team Inputs and Outputs**

DIRECT CORRELATIONS PARTIAL CORRELATIONS	VT Members' Perceptions of Performance	VT Member Satisfaction	VT Managers' Perceptions of Performance
	<b>Organization Tenure Diversity</b>	0.442*	0.449*
<b>Adequacy of Technology</b>	0.474**	0.537**	-
<b>Skills</b>	0.603**	0.670**	-
<b>Motivating Task</b>	0.506**	0.625**	-
<b>Goal Clarity</b>	0.592**	0.503**	-
<b>Leader Effectiveness</b>	0.606**	0.493*	-

\*\*Correlation significant at  $p<0.01$ ; \*Correlation significant at  $p<0.05$

#### DISCUSSION OF RESULTS FOR PARTIAL CORRELATIONS BETWEEN TEAM

INPUTS AND OUTPUTS: Overall, these results suggest that processes mediate the

relationship between the team-level inputs and two of the VT outputs: VT members'

perceptions of performance and VT member satisfaction. Interestingly, these are the two

outputs that have been studied most frequently in both the proximate and VT literature. Although the literature often employs an input→ output model of VT effectiveness, the input→process→output form is the most common. These results suggest that the research on these variables has accurately described these two aspects of team effectiveness (virtual and proximate).

With respect to VT managers' perceptions of performance, the mediating role of the processes between the team-level inputs and this output was not supported. The significant relationship between VT managers' perceptions of performance and organization tenure diversity was not negated by controlling for the processes. These results are consistent with the previous results obtained for this output and support the contention that VT managers evaluate VT performance differently than do those who serve on the team. It should be noted, however, that the relationship between this output and only one team-level input (organization tenure diversity) was tested in this section. One of the requirements for the partial correlation analysis was that the input and output variables have a significant direct correlation. Given that in the previous section only the one input note above was found to have a significant direct correlation with VT managers' perceptions of performance, only one partial correlation was performed.

This result suggests that the diversity in the organizational tenure of the members of VTs is directly negatively related to the VT managers' perceptions of performance. It should be recalled that the correlation between these two variables was  $r=-0.398$ . Taken

together, these findings suggest VTs with lower diversity with respect to the organizational tenure of their members are perceived by their managers to perform better. One possible explanation for this finding is that VTs with greater diversity with respect to their organizational tenure may have more conflict within the team. Alternately, it may be that greater diversity with respect to organizational tenure affects VT productivity, as new employees have to learn to work within the norms of the organization. These data suggest that VT managers are more aware of such difficulties.

The differing results with respect to the three output variables tested in this section again reinforce the contention in this study that it is appropriate to describe the different dimensions of VT effectiveness using different models.

#### 5.8.5.2 Relationships between Contextual inputs and Outputs through Processes

This section discusses the results of the testing of the indirect relationship between the contextual input variables and the outputs (Step 5 in Figure 4). It is divided into two parts. The first part presents the results for the direct correlations between the contextual inputs and outputs. The second part examines the results of the partial correlations and their comparison with the direct correlations.

##### 5.8.5.2.1 *Direct Correlations between Contextual Inputs and Outputs*

This section examines the direct correlations between the contextual inputs and the output variables (i.e. the first part of the partial correlation analysis). These correlations are presented in Table 39.

**Table 39: Direct Correlations between Contextual Inputs and Outputs**

<b>INPUT/OUTPUT</b>	<b>VT Members' Perceptions of Performance</b>	<b>VT Member Satisfaction</b>	<b>VT Managers' Perceptions of Performance</b>
<b>Rewards</b>	0.587**	0.448*	0.373*
<b>Training</b>	0.518**	0.362*	-0.022
<b>Managerial Support - Facilitation</b>	0.548**	0.752**	0.020
<b>Managerial Support - VT Development</b>	0.516**	0.600**	0.063
<b>Managerial-Non-Support</b>	-0.548**	-0.463**	0.074
<b>Organizational Support - Culture</b>	0.324	0.518**	-0.190
<b>Organizational Support - Infrastructure</b>	0.462*	0.578**	-0.256
<b>Organizational Non-Support</b>	-0.356	-0.381*	0.153

\*\*Correlation significant at  $p<0.01$ ; \*Correlation significant at  $p<0.05$

Ten of the direct correlations between the contextual inputs and the outputs were significant at the  $p<0.01$  level:

- Managerial support through facilitating was correlated with VT members' perceptions of performance ( $r=0.548$ ) and with VT member satisfaction ( $r=0.752$ );
- Managerial support through virtual team development was correlated with VT members' perceptions of performance ( $r=0.516$ ) and with VT member satisfaction ( $r=0.600$ );
- Managerial non-support was correlated with VT members' perceptions of performance ( $r=-0.548$ ) and with VT member satisfaction ( $r=-0.463$ );

- Organizational support through culture was correlated with VT member satisfaction ( $r=0.518$ );
- Organizational support through infrastructure was correlated with VT member satisfaction ( $r=0.578$ );
- Member rewards was correlated with VT members' perceptions of performance ( $r=0.587$ ); and
- Training was correlated with VT members' perceptions of performance ( $r=0.518$ ).

All of the correlations were positive except those with the measures of managerial non-support and organizational non-support. An additional five of the direct correlations between the contextual inputs and outputs were significant at the  $p<0.05$  level:

- Rewards was correlated with VT member satisfaction ( $r=0.448$ ) and with VT managers' perceptions of performance ( $r=0.373$ ); and
- Training was correlated with VT member satisfaction ( $r=0.462$ );
- Organizational support through infrastructure was correlated with VT members' perceptions of performance ( $r=0.462$ ); and
- Organizational non-support was correlated with VT member satisfaction ( $r=-0.381$ ).

With one exception (the correlation between organizational non-support and VT member satisfaction), all of these correlations were positive.

One of the contextual inputs (rewards) was significantly correlated with all three of the outputs. Team rewards was highly correlated with VT member' perceptions of performance and moderately correlated with VT member satisfaction and VT managers'

perceptions of performance. Five contextual inputs were significantly and moderately to strongly correlated to the same two outputs (VT members' perceptions of performance, VT member satisfaction): training, managerial support through facilitating, managerial support through VT development, managerial non-support, and organizational support through infrastructure. Finally, two contextual inputs were each significantly correlated to one output (VT member satisfaction): organizational support through culture and organizational non-support.

**CONTEXTUAL INPUTS CORRELATED WITH VT MEMBERS' PERCEPTIONS OF PERFORMANCE:** Members' perceptions of performance was correlated to five of the contextual inputs (rewards, training, managerial support through culture, managerial support through VT development, managerial non-support) at the  $p < 0.01$  level and one contextual input (organizational support through infrastructure) at the  $p < 0.05$  level. VT members' perceptions of performance had a strong relationship with member rewards ( $r = 0.587$ ), training ( $r = 0.518$ ), managerial support through facilitating ( $r = 0.548$ ), managerial support through VT development ( $r = 0.516$ ) and managerial non-support ( $r = -0.548$ ). This result indicates that the VTs in this study that had team-oriented rewards, training in VT work, and/or a manager who was perceived to engage in behaviours of facilitating and VT member development which supported the work of the VT, also had greater perceptions of their performance. Conversely the VTs whose managers were perceived to exhibit non-supportive behaviours reported lower perceptions of

performance, as did those VTs who felt that the organization did not provide the necessary infrastructure to perform their work ( $r=0.462$ ).

#### CONTEXTUAL INPUTS CORRELATED WITH VT MEMBER SATISFACTION: VT

member satisfaction was significantly related to all of the eight contextual inputs examined in this thesis. VT member satisfaction was correlated to five of the contextual inputs (managerial support through facilitating, managerial support through VT development, managerial non-support, organizational support through culture, organizational support through infrastructure) at the  $p<0.01$  level and the other three contextual inputs (rewards, training, organizational non-support) at the  $p<0.05$  level. VT member satisfaction had a strong relationship with managerial support through facilitating ( $r=0.752$ ), managerial support through VT development ( $r=0.600$ ), organizational support through culture ( $r=0.518$ ) and organizational support through infrastructure ( $r=0.578$ ). This result indicates that the VTs in this study that had a manager who was perceived to be supportive through facilitating and VT development, and/or perceived their organization to be supportive through culture and infrastructure also had greater satisfaction. VT member satisfaction had a moderate relationship with rewards ( $r=0.448$ ), training ( $r=0.362$ ), managerial non-support ( $r=-0.463$ ), and organizational non-support ( $r=-0.381$ ), indicating that the VTs that had team-oriented rewards and training in VT work, also had greater satisfaction. Conversely the VTs whose manager and/or organization were perceived to exhibit non-supportive behaviour reported lower satisfaction.

CONTEXTUAL INPUTS CORRELATED WITH VT MANAGERS' PERCEPTIONS OF PERFORMANCE: VT managers' perceptions of performance was not significantly correlated to any of the team inputs at the  $p < 0.01$  level, but was significantly correlated to one team input at the  $p < 0.05$  level. VT managers' perceptions of performance was moderately related to rewards ( $r = 0.373$ ). This result indicates that the VTs in this study that had team-oriented rewards also had managers who perceived them to have greater performance.

#### DISCUSSION OF RESULTS FOR THE DIRECT RELATIONSHIP BETWEEN

CONTEXTUAL INPUTS AND OUTPUTS: Overall, it seems that the contextual inputs, as a set, have a strong association with two of the aspects of VT effectiveness included in this study, VT members' perceptions of performance and VT member satisfaction. This same set of contextual inputs and two outputs were also significantly correlated with three of the process indicators. This suggests that all of these variables are linked. The nature of their relationship is explored in the next sections.

VT managers' perceptions of performance was only directly correlated to one of the contextual input variable. This is similar to the results obtained with the team-level inputs and supports the contention that VT managers' perceptions of performance are formed using a different set of inputs than are used by the VT members.

All of the contextual variables were significantly related to at least one of the outputs. As such they satisfy the final requirement for the analysis using partial correlations (Step 5 in Figure 4). The results for the partial correlations are presented in the following section.

#### *5.8.5.2.2 Partial Correlations between Contextual Inputs and Outputs*

This section explores the potential mediating role of process in the relationship between the contextual inputs and the outputs. The approach for the analysis was the same as that for the team-level inputs (Section 5.8.5.1.2). All of the eight contextual inputs satisfied the requirements for the analysis. It should be recalled that three of the outputs (VT members' perceptions of performance, VT member satisfaction, VT managers' perceptions of performance) and three of the processes (potency, collaborative climate, communication effectiveness) also satisfied the requirements for the analysis.

The correlation matrix showing the direct correlations and the partial correlations while controlling for the process variables is shown in Table 40.

Only one of the partial correlations examined in this analysis was significant. This indicates that, with one exception, the relationships between the contextual inputs and the measures of VT effectiveness tested in this section are mediated by the VT processes. This is particularly true in the case of VT members perceptions of performance and VT member satisfaction, which were shown to have mediated relationships with the majority

of the contextual variables. This result supports the input→process→output form of the framework for these aspects of VT effectiveness.

**Table 40: Comparison of Direct and Partial Correlations between Contextual Inputs and Outputs**

DIRECT CORRELATIONS PARTIAL CORRELATIONS	VT Members' Perceptions of Performance	VT Member Satisfaction	VT Managers' Perceptions of Performance
<b>Rewards</b>	0.587**	0.448*	0.373*
	0.283	0.128	0.210
<b>Training</b>	0.518**	0.362*	-
	0.153	0.019	-
<b>Managerial Support - Facilitating</b>	0.548**	0.752**	-
	-0.027	0.441*	-
<b>Managerial Support- VT Development</b>	0.516**	0.600**	-
	0.124	0.284	-
<b>Managerial Non-Support</b>	-0.548**	-0.463**	-
	-0.112	0.067	-
<b>Organizational Support - Culture</b>	-	0.518**	-
	-	0.319	-
<b>Organizational Support - Infrastructure</b>	0.462*	0.578**	-
	0.091	0.284	-
<b>Organizational Non-Support</b>	-	-0.381*	-
	-	0.046	-

\*\*Correlation significant at  $p < 0.01$ ; \*Correlation significant at  $p < 0.05$

Managerial support through facilitating, on the other hand, was still significantly correlated with VT member satisfaction ( $r=0.441$ ), indicating that these two variables have a direct (rather than mediated) relationship.

#### DISCUSSION OF RESULTS FOR PARTIAL CORRELATIONS BETWEEN

CONTEXTUAL INPUTS AND OUTPUTS: The results obtained for the contextual

inputs are very similar to those observed for the team-level inputs. Both sets of results

indicate that, with very few exceptions, VT processes mediate the relationship between the inputs and two of the outputs (VT members' perceptions of performance, VT member satisfaction). In addition, the results suggest that managers may contribute directly to VT success by providing support to the VT members through facilitating behaviour.

The results also suggests that there is some support for a mediated relationship between the inputs and the third output, VT managers' perceptions of performance. As with the team-level inputs, only one contextual input was tested for its indirect relationship with this output variable, indicating that there may be other variables that have a direct or indirect relationship with VT managers' perceptions of performance, but were not tested either because of the limitations of the analysis or because they were not included in this study.

### **5.8.6 Frameworks for Each Output**

Based on the results of the previous sections, the relationships between the inputs, the processes and each of the output variables are summarized in the following sections using frameworks.

#### **5.8.6.1 Framework for VT Members' Perceptions of Professional Development**

As discussed previously, VT members' perceptions of professional development was not significantly related to any of the process indicators included in this study. This suggests that what goes on inside the virtual team (i.e. the VT interactions) has no relationship with the VT members' perceptions that they are developing professionally through their

work on the VT. This dimension of VT effectiveness was, however, significantly directly correlated to a number of input variables. This result suggests that VT members' perceptions of professional development follows an input→output model form. The relationships between VT members' perceptions of professional development and the relevant inputs, as indicated by the analysis are summarized in the framework in Figure 6.

This aspect of virtual team effectiveness was found to be significantly correlated with six of the 25 inputs included in this study: member age diversity ( $r=0.463$ ), member comfort with technology ( $r=-0.450$ ), team longevity ( $r=0.390$ ), goal clarity ( $r=0.379$ ), rewards ( $r=0.373$ ) and organizational support through culture ( $r=0.419$ ). With one exception (member comfort with technology), the correlations were positive, indicating that higher levels of the inputs were associated with greater perceptions of professional development. All of the correlations were moderate and significant at the  $p<0.05$  level, suggesting that the relationships described in this framework are not as strong as those for some of the other outputs included in this study (i.e. VT members' perceptions of performance, VT member satisfaction).

Overall, this framework suggests that the extent to which VT members perceive that they have developed professionally may be greater if the VT has members with greater diversity with respect to age, has clear goals, has been in operation for longer, receives rewards that are oriented at the team level, and perceives that the organization has a culture that is supportive of VTs. In virtual teams that have diversity with respect to the

age of their members, it is possible that the younger members benefit from the experience (life and work) of the more senior members. Alternately, the more senior members may have the opportunities for mentoring and feel that they are “kept up to date” if there are younger members on the VT. VTs with members who feel that they have clear goals may be more motivated, more aware of their accomplishments and more likely to perceive a link between their work on the VT and their professional development. VTs that have relatively long-term mandates may provide a certain amount of stability that allows members to pursue professional development. In addition, VTs that are offered rewards at the team-level may be more inclined to share tasks as well as credit for their accomplishments, rather than pursuing individual agendas that may hinder the development of teammates. An organization that has a culture that supports virtual work is likely perceived as having less of an “out-of-sight, of-of-mind” attitude towards employee development. It is interesting, however, that managerial support through VT development was not significantly correlated to this output, as it contains items specific to the professional development of VT members. The reason for this is not clear and should be studied further.

Interestingly, VTs that have members who are more comfortable with information technology would seem to perceive that their VT provides less opportunity for professional development. As discussed previously, it is possible that VT members who are highly comfortable with information technology consider this to be an area in which they will no longer develop.

All of the input variables in this framework are controllable to some extent at the managerial and organizational level. These findings suggest that organizations and VT managers may be able to increase the extent to which members of their virtual teams perceive that their experiences on a VT help their professional development. It should be noted that, as the correlations were all moderate, the manipulation of these inputs may only have a modest effect on VT members' perceptions of professional development.

It should be recalled that the professional development dimension of VT effectiveness was developed for this study, and as such, there is no existing research with which to compare these findings. It is clear however, that this dimension of VT effectiveness does not follow the same form as the more traditionally researched aspects of effectiveness (i.e. VT members' perceptions of performance and satisfaction), as it seemed to be independent of the team processes studied in this thesis (i.e. takes an input→output form). In addition, VT members' perceptions of professional development was found to be significantly related to only a small subset of the substantial number of input variables included in this study. This result suggests that there may be other variables (inputs or processes), which were not included in this study, that contribute to this dimension of VT effectiveness. It is also possible that the relationships between this dimension of VT effectiveness and the processes are not linear, and as such cannot be detected through correlations.

INPUTS		OUTPUT
TEAM INPUTS		
		0.463*
Member Age Diversity	_____	-0.450*
Member Comfort with Technology	_____	0.390*
Team Longevity	_____	0.379*
Goal Clarity	_____	
CONTEXTUAL INPUTS:		
Rewards	_____	0.373*
Organizational Support - Culture	_____	0.419*
		VT Members' Perceptions of Professional Development
**Correlation significant at p<0.01; * Correlation significant at p<0.05		

**Figure 6: Framework Describing VT Members' Perceptions of Professional Development**

#### 5.8.6.2 Framework for Virtual Team Members' Perceptions of Capacity for Future Virtual Team Work

Similar to VT members' perceptions of professional development, VT members' perceptions of capacity for future VT work was not significantly related to any of the process indicators in this study. In other words, the results suggest that this outcome can be best described using an input→output model form and that the interactions of VTs have no relationship to VT members' perceptions of professional development. This dimension of VT effectiveness was, however, significantly directly related to a few of the input variables. The relationships between VT members' perceptions of capacity for future VT work and the relevant inputs are summarized in the framework in Figure 7.

This dimension of virtual team effectiveness significantly correlated with the following three of the 25 inputs included in this study: member diversity with respect to age ( $r=0.480$ ), member comfort with technology ( $r=-0.423$ ) and member experience with technology ( $r=-0.373$ ). All of the correlations were moderate and significant at the  $p<0.05$  level, suggesting that this output is not as strongly related to the variables in this study as the more traditional measures of VT effectiveness are (i.e. VT members' perceptions of performance, VT member satisfaction).

INPUTS		OUTPUT
Member Age Diversity	0.480**	VT Members' Perceptions of Capacity for Future VT Work
Member Comfort with Technology	-0.423*	
Member Experience with Technology	-0.373*	
<p>**Correlation significant at p&lt;0.01;* Correlation significant at p&lt;0.05</p>		

**Figure 7: Framework Describing VT Members' Perceptions of Capacity for Future VT Work**

VT members' perceptions of capacity for future VT work was positively correlated with member age diversity, suggesting that VTs that have greater diversity with respect to member age are more likely to perceive that their experiences on the VT have increased their capacity for future VT work. As with the output discussed previously (VT members' perceptions of professional development), it is possible that in VTs with a wide range of member ages, the younger members are benefiting from the experience of the older members. Conversely, the older members may be appreciating the chance to work with and possibly mentor younger team members.

VT members' perceptions of capacity for future VT work was negatively correlated to both member comfort with technology and member experience with technology, indicating that VTs with members who are more comfortable and experienced with the technology tools they use to do their work are less likely to perceive that their experiences on the VT has increased their capacity for future VT work. As noted previously, it may be that VT members who have a high degree of competence and experience with the technological tools may get frustrated by the limitations of the technology.

The input variables in this framework are all at the team level, indicating that none of the organization-level variables in this study are related to this output. These results suggest that there may be things that can be manipulated at the team-level to perhaps improve this

aspect of virtual team effectiveness. There are only three input variables in this framework, however, and all of the correlations were moderate, suggesting that organizations and managers have very little influence on VT members' perceptions of capacity for future VT work through the manipulation of the inputs included in this study.

As with the VT members' perceptions of professional development, this dimension of VT effectiveness was developed for this study and the results cannot be compared to existing research. VT members' perceptions of future VT work seems to be independent of the team processes included in this study (input→output). This output was found to be significantly related to a very small number of the input variables included in this study, indicating that there may be other, unidentified variables (inputs or processes), that contribute to this dimension of VT effectiveness. Alternately, this output may have non-linear relationships with VT processes and inputs

#### 5.8.6.3 Framework for VT Managers' Perceptions of Performance

VT managers' perceptions of performance was found to be significantly directly correlated to only one of the input variables included in this study: organization tenure diversity. This dimension of VT effectiveness was also correlated to one of the process variables, potency. This result suggests that VT managers' perceptions of performance are very different from the other dimensions of VT effectiveness included in this study in that it can best be described using a combination of an input→process→output and an input→output framework. The relationships between the relevant inputs, processes, and

VT managers' perceptions of performance are summarized in the framework in Figure 8 and are discussed below.

VT managers' perceptions of performance was significantly negatively correlated to organizational tenure diversity ( $r=-.398$ ), suggesting that the VTs whose members had greater diversity with respect to the time they had been working for the organization, were perceived by their managers to have lower levels of performance. As discussed previously, it is possible that VTs with a greater range of experience with the company have greater conflict or that VTs with very new employees have lower productivity while the employee becomes acclimated to the organization. It is interesting to note that VT member diversity with respect to age was positively associated with two of the other outputs (members' perceptions of professional development, members' perceptions of capacity for future virtual teamwork). Although age and tenure are likely to be correlated (i.e. in general older employees have more tenure), the two measures of diversity were not significantly correlated in this study.

Potency was shown to mediate the relationship between this output and rewards, indicating that VTs with rewards that are oriented towards the team level were more likely to have greater belief in their potential for success. It is possible that VTs whose rewards are hinged on team performance are more motivated to work as a team, thus instilling greater belief in their success. VT managers' perceptions of performance moderately positively correlated with potency, indicating that VTs who had greater belief

in their potential for success were likely to be perceived as successful by their managers. Research has suggested that the relationship between potency and members' perceptions of performance is reciprocal (Guzzo & Shea, 1992; Pearce et al., 2002). It is possible that this relationship is also true for VT managers' perceptions of performance (i.e. if the manager believes in the potential of the team and, in particular if the manager provides positive feedback, the team will believe in itself).

It should be noted that the process in this framework (potency) was shown to mediate the relationship between VT managers' perceptions of performance and only one input (rewards). Potency, on the other hand, was significantly correlated with five team-level inputs and seven contextual inputs. There are two interpretations of this result. First, it is possible that rewards are associated with only one aspect of potency and it is that aspect which, in turn is associated with VT managers' perceptions of performance. Alternately, it is possible that other inputs in this study are also associated with this output through potency, but that due to the limitations of the analysis, these associations were not found. It should be recalled that the partial correlation analysis with respect to this output was only performed on two inputs (i.e. partial correlations could only be performed on those inputs having a significant direct relationship with this output).

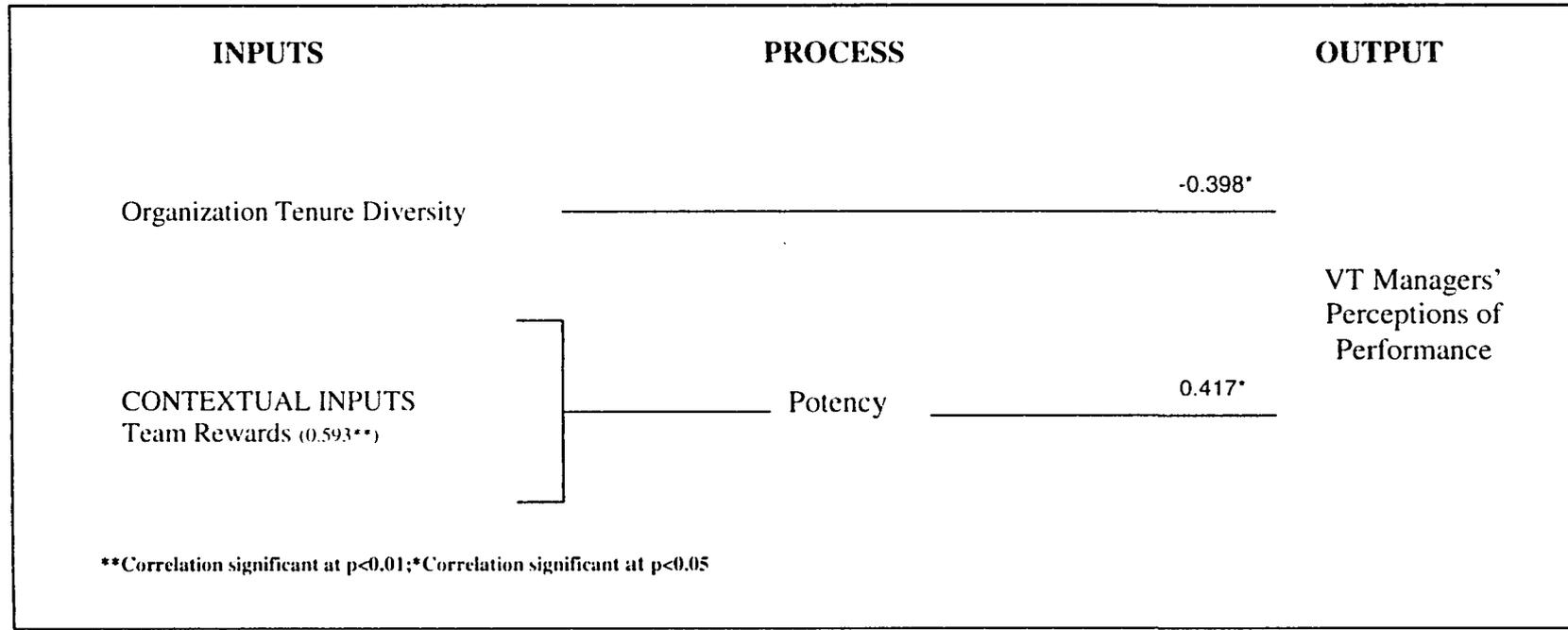


Figure 8: Framework Describing VT Managers' Perceptions of Performance

Although VT managers' perceptions of task performance seems to follow a combination of an input→process→output and input→output form of the framework, it was correlated (moderately) to one process variable and one input variable. This would suggest that it is not as likely to be as affected by the team processes or inputs studied in this thesis as are the two more traditional VT outcomes (VT members' perceptions of performance, VT member satisfaction). This result is very much in keeping with Gladstein's (1984) study of proximate teams in which she reported that team effectiveness is perceived differently by members than it is by more objective evaluators. It is likely, as with the previous two dimensions of effectiveness (VT members' perceptions of professional development, VT members' perceptions of capacity for future VT work) that other, unexplored variables contribute to VT managers' perceptions of task performance.

#### 5.8.6.4 Framework for VT Member Satisfaction

VT member satisfaction had a direct relationship with only one of the input variables (managerial support through facilitating), but was (with the exception of task commitment which was removed from the framework) strongly positively correlated to all of the process indicators included in this study (collaborative climate, potency, communication effectiveness). This result suggests that VT member satisfaction can be best explained using an input→process→output model form, and that, for the most part, the relationship between the inputs and the outputs is mediated by the process variables included in this research. The relationships between VT member satisfaction and the relevant process variables and input variables are summarized in the framework of VT member satisfaction in Figure 9.

The dimension of VT effectiveness was strongly to very strongly positively correlated with potency ( $r=0.620$ ), communication effectiveness ( $r=0.794$ ), and collaborative climate ( $r=0.787$ ). In general, this framework suggests that the VTs in this study that perceived their interactions to be positive were also more likely to be satisfied with their VT experience. Specifically, VT members who were satisfied were more likely to say that the communication on their VT was effective, the climate was open and caring and that they believed in their VT's success. In other words, the satisfaction of VT members would seem to be more closely linked to positive VT interactions than to any of the inputs in this study. The importance of VT interactions and their mediating role in the framework for this dimension of VT effectiveness is in keeping with both the proximate team research (Gladstein, 1984; Hackman, 1983) and the VT literature (Cohen & Gibson, 2003). The strength of their association was expected to be lessened, however, in the virtual environment, where the emphasis is on performance, rather than on in-depth interaction (Gonzalez et al., 2003). The role of virtuality in the relationship between team interactions and satisfaction is explored in a following section.

As the framework indicates, VT member satisfaction was also shown to be indirectly associated with seven team-level inputs and seven contextual inputs. This type of relationship suggests that the processes are conditions through which the inputs are translated into the outputs (Hackman, 1983). In other words, negative VT interactions would limit the effect of even the most ideal inputs. The results of the correlations

indicate that the input components that have the greatest association with the process variables (and, therefore, indirectly with VT member satisfaction) are adequacy of technology, member skills, motivating task design, goal clarity, managerial support through VT development, managerial non-support, and organizational support through infrastructure. With one exception (managerial non-support), all of these inputs were significantly positively correlated (most of them highly) with all three of the process variables in this framework. In other words, higher levels of all of these inputs are associated with greater levels of collaborative climate, potency, and communication effectiveness, which are in turn, associated with increased VT member satisfaction. Manager non-support, on the other hand, was significantly negatively correlated with all three of the process variables. As VTs rely on communication technology to interact, it is expected that VTs working with tools that are considered to be sufficient for their needs would experience more effective communication. Similarly, if the VTs have the tools required to collaborate virtually, they can be expected to have a greater belief in their potential. It is also possible that if the technological needs of the VT are being met, they are able to focus more on the more personal aspects of team interactions and collaborate in a more open and caring manner. Similar to that of their technological needs, VTs with members who have the technical and interpersonal skills required to complete the task virtually, are likely to put greater stock in their likelihood of success. In addition, when the VT members have the requisite skills, it is possible that they are able to invest more time and effort into communicating effectively and building a positive team climate. VTs who are working on a task that is engaging would also be expected to be more motivated

and work harder to collaborate in a positive and effective way. Clear goals would also be expected to motivate VT members to succeed, reduce ambiguity, permitting the VT to communicate more effectively (as they “are on the same page”) and decrease conflict, resulting in a more positive climate. VTs with managers who support their VT by training members, promoting team development, and not exhibiting unsupportive behaviour, would be expected to be more cohesive and better able to collaborate in a positive way. In addition, these VTs might be better able to rely on their manager if conflicts or misunderstandings arise (i.e. if the manager is not perceived to be unsupportive). Similarly, VTs whose organization provides them with the tools, training and other resources that they need to complete their task, would be expected to be able to communicate more effectively, have a more caring climate (budget for team-building), and believe in their potential for success.

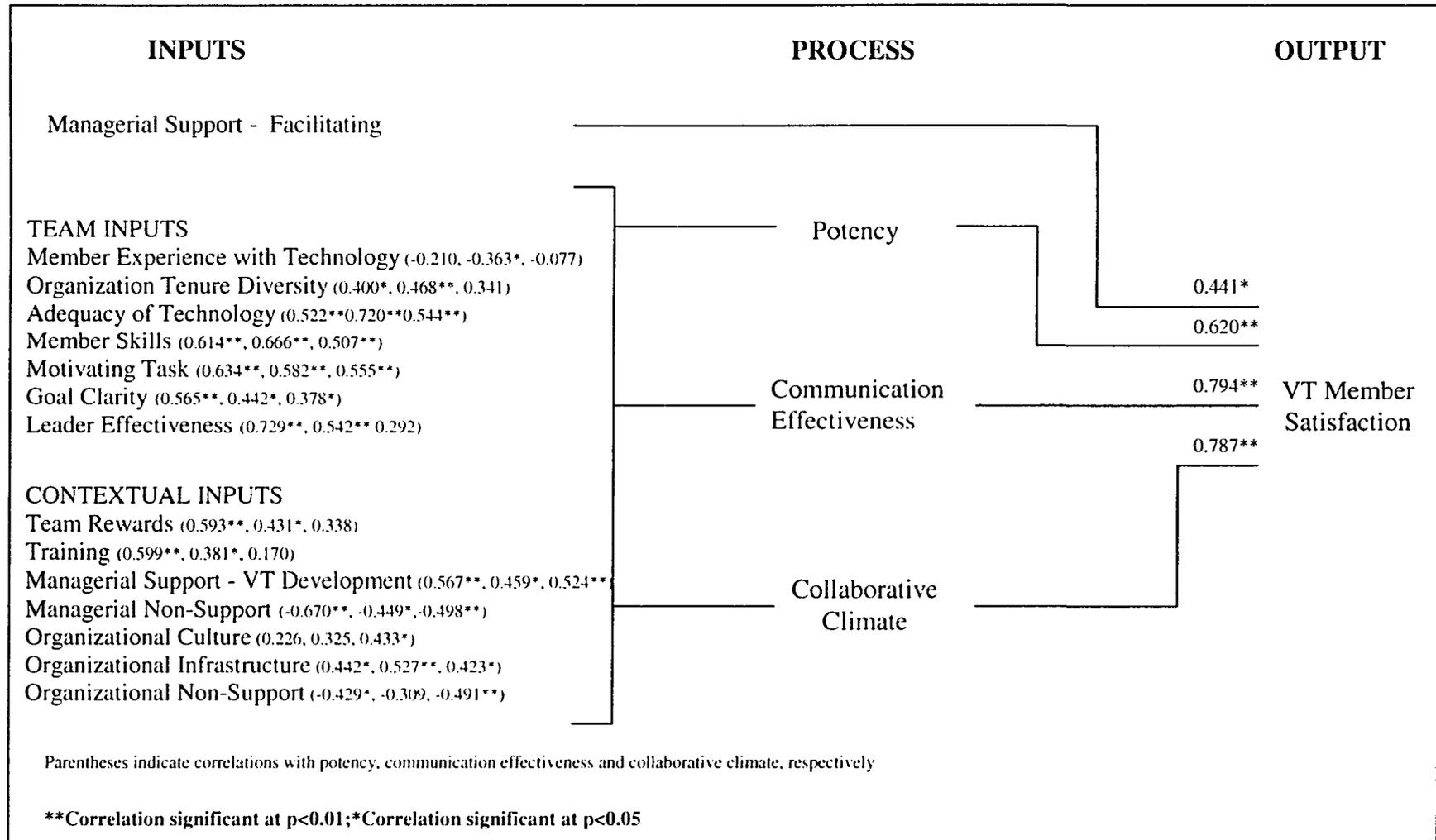
Four of the input components (organization tenure diversity, leader effectiveness, team-oriented rewards, training) were all significantly positively correlated to two of the process variables (potency, communication effectiveness). These components have the second greatest association with the process variables, as higher levels of these variables are associated with higher levels of two-thirds of the process variables. Effective leadership (within the team) would be expected to keep everyone in the loop, and ensure that everyone is contributing. As such, VTs with effective leaders would potentially have more effective communication and greater confidence in their success. Rewards that are geared to the team level would be expected to motivate VT members to focus more on

VT goals (rather than individual agendas) and as such, may lead to greater efforts towards communication and successful outcomes. VTs with members who are trained in VT work (which would include virtual communication) would be expected to be better able to express themselves virtually and be more willing to contribute openly (mistakes are highly visible in the virtual setting). Finally, VTs whose members have been working at the organization for differing periods of time might provide a broader range of input and insight into the VTs task and communications. It is interesting to note that this variable (organization tenure diversity) was shown to be negatively associated with VT managers' perceptions of performance. In other words, this type of diversity may lead to positive interactions and member satisfaction, but it does not translate into performance in the view of the managers. As stated previously, VTs with very new members may be more closely monitored by the manager or may require greater intervention, this leading the manager to perceive that the VT was less successful. .

In addition, organizational non-support was significantly negatively correlated to two process variables (potency, collaborative climate), indicating that higher levels of this input is associated with VT interactions that are less positive. VTs who work in organizations that do not provide the resources they require, possibly feel that they are fighting an up-hill battle to succeed. In addition, if the resources are scarce and the culture does not value VT work, there might be a negative effect on the VT's climate (i.e. within-team conflict over resources or recognition).

Two input variables (member experience with technology, organizational support through culture) were both significantly moderately correlated with only one of the process variables, indicating that they play a lesser role in VT member satisfaction than the other input variables in this framework. The relationship between organizational support through culture and collaborative climate was in a positive direction, suggesting that VT members who feel accepted and valued within the organization may be more secure in their role and able to be open and caring towards their teammates. The relationship between member experience with technology and communication effectiveness was in a negative direction, suggesting that VTs with members who are highly experienced with the tools they use to collaborate might get frustrated and focus its limitations and imperfections.

It is also important to note that the relationships between each of the inputs and the three processes in the framework were in the same direction (e.g. goal clarity was positively correlated with all three processes and managerial non-support was negatively correlated with all of the processes). This is important because it suggests that each input would have either a global positive effect on the VTs' interactions or a global negative one. If some of the correlations with each input and the processes were positive and others negative, increases in a single input would have been associated with increases in some process variables and decreases in others (e.g. goal).



**Figure 9: Framework Describing VT Member Satisfaction**

Finally, one input variable (managerial support through facilitating) was shown to have a direct positive relationship with VT member satisfaction ( $r=0.441$ ). This result suggests that VTs with managers who clarify roles and responsibilities, remove obstacles, and facilitate the team, are more likely to be satisfied by their experiences. It is expected that VTs require proactive facilitation from their managers, as conflicts, misunderstanding, and ambiguities are more difficult to identify and resolve when team members are not meeting regularly.

Overall, the framework for VT member satisfaction with the VT experience is very similar to the models of proximate and virtual team effectiveness developed by Hackman (1983), Gladstein (1984), and Cohen and Gibson (2003). The main differences between the proximate models and this framework are the inputs which were measured specifically for VTs (e.g. adequacy of technology, managerial support and non-support of VTs and organizational support and non-support of VTs). The key findings are essentially the same, however: the right team inputs may lead to positive team processes, which in turn, may lead to VT member satisfaction.

#### 5.8.6.5 Framework for Virtual Team Members' Perceptions of Performance

VT members' perceptions of performance had a significant direct correlation with two of the input variables (gender, team longevity), but was highly positively correlated with all of the process indicators: collaborative climate, potency, and communication effectiveness. This result suggests that team members' perceptions of performance can best be explained using an input → process → output model form. In other words, the

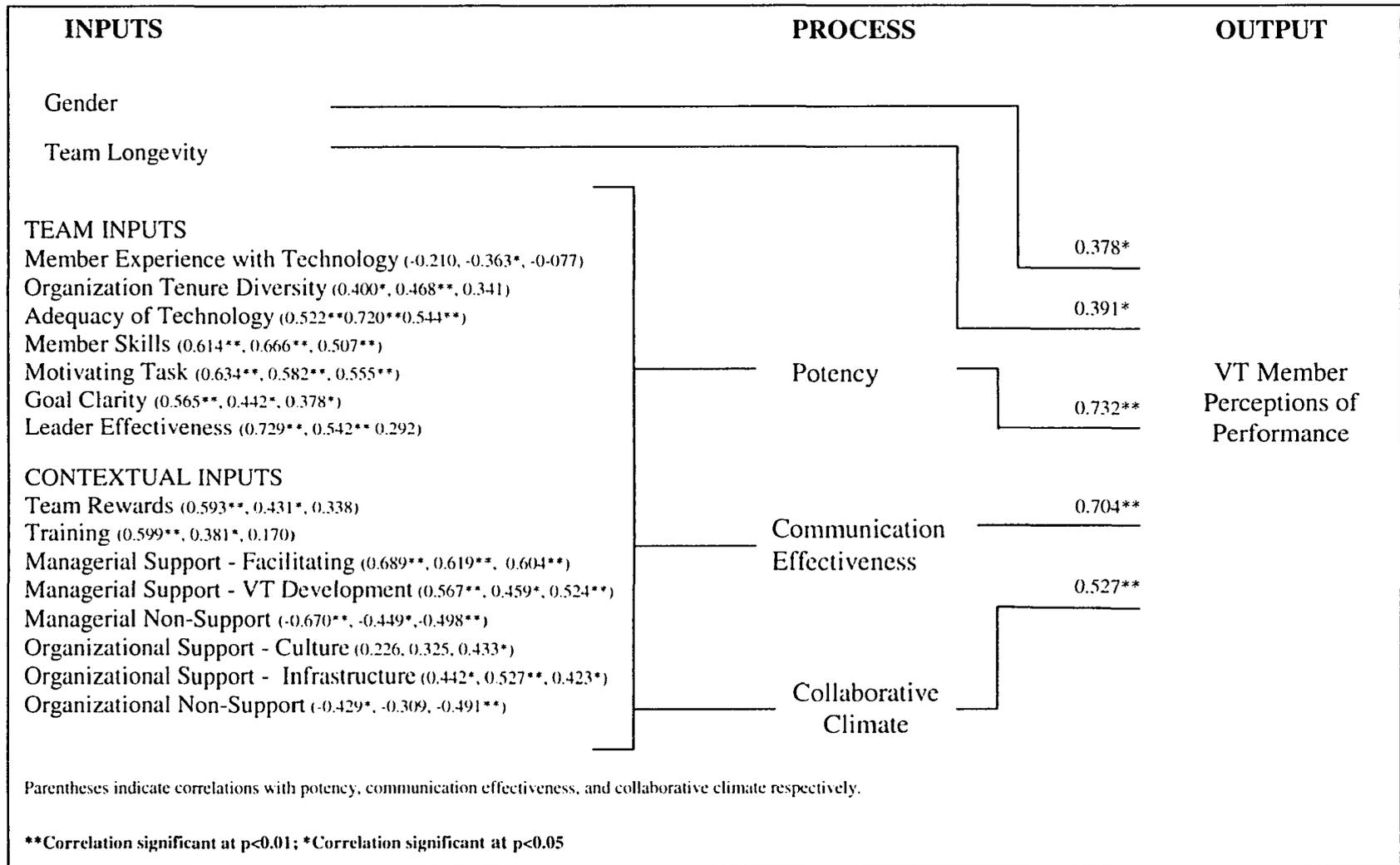
relationship between most of the inputs and this dimension of VT effectiveness are mediated by the team processes. The relationships between VT members' perceptions of performance, the process variables, and the inputs are presented in the framework in Figure 10.

With the exception of the two direct relationships, the framework for VT members' perceptions of performance is identical to that of VT member satisfaction (shown in Figure 9). The correlations between VT members' perceptions of performance and the three processes in the framework were all strong to very strong and positive. This framework suggests that the VT members' perceptions of performance were greater when the communication was also perceived to be effective ( $r=0.704$ ), when the climate was perceived to be open and caring ( $r=0.527$ ), and when the team members believed in their potential for success ( $r=0.732$ ). As the process components that are relevant to team members' perceptions of performance are identical to those for VT member satisfaction, the indirect role of the input components and dimensions of virtuality are similar to those discussed in the previous section.

VT members' perceptions of performance was also moderately directly correlated to gender ( $r=0.378$ ) and team longevity ( $r=0.391$ ), indicating that the VTs that had more females, and/or had been in existence longer were more likely to perceive that their team had performed well. It is possible that female members of VTs have a more optimistic view of their performance. VTs that have been operating for a certain amount of time

may benefit from familiarity (after forming, storming, norming), and perceptions of stability. This is in keeping with research on proximate teams, which indicate that the effectiveness of a team will increase with age. Once the team reaches a certain age, however, the effectiveness is expected to drop off (stagnation). It is not clear whether VTs also exhibit the “U”-shaped relationship between age and effectiveness, as most of the VTs in this sample were well established, but not “old”. In addition, the correlations performed in this study test only linear relationships.

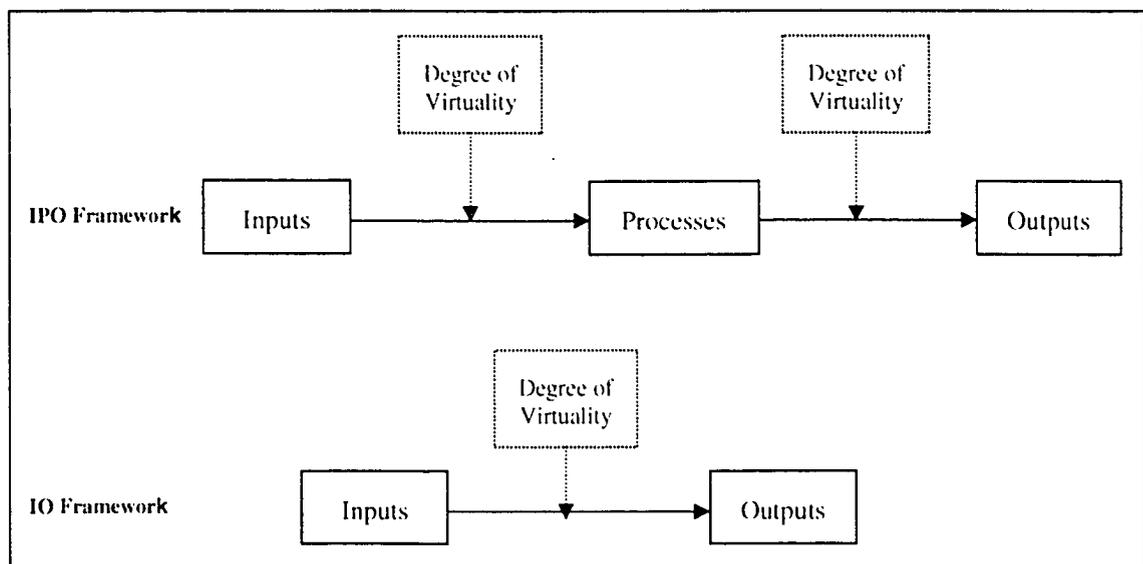
Overall, the framework for VT member perceptions of performance is very similar to that of the previous output discussed (VT member satisfaction) the IPO models of proximate and virtual team effectiveness. It would seem that the two traditional dimensions of VT effectiveness taken from the proximate team literature (VT member satisfaction and VT members’ perceptions of performance) exhibit the same relationships with team processes and inputs as do the proximate teams.



**Figure 10: Framework Describing VT Members' Perceptions of Performance**

### 5.8.7 Role of Degree of Virtuality

The research framework posits that degree of virtuality plays a moderating role in the relationship between the inputs and the processes. It is also possible that degree of virtuality plays a moderating role in the relationship between the processes and the outputs. Figure 11 describes these two potential roles. For these outputs which were shown to have direct relationships with the inputs, the role of degree of virtuality as a moderator of the relationship between the inputs and outputs was tested (also shown in Figure 11).



**Figure 11: Potential Moderating Role of Degree of Virtuality**

In each case, the moderating role of the degree of virtuality was explored using linear regression as described in Section 4.8.2.6. The analysis for each of the potential roles of degree of virtuality is discussed in the following sections.

#### 5.8.7.1 Degree of Virtuality as a Moderator of the Input-Process Relationship

To test the moderating role of degree of virtuality on the relationship between the inputs and the processes, linear regression was performed between each pair of inputs and processes and each of the three dimensions of degree of virtuality (team time worked virtually – WV, member virtuality – MV, distance virtuality – DV). Since the three dimensions of degree of virtuality were not significantly related to one another, it was possible to treat them as separate variables in this analysis.

The analysis was done as follows. The process variables served as the dependent variables in these regressions and the VT inputs were the independent variables. The moderating role of the degree of virtuality variables was reflected through an interaction term which was included in the regression. The interaction term was calculated as the product of the moderating variable (degree of virtuality) and the independent variable (input). A significant interaction term in the regression model would suggest that degree of virtuality moderates the relationship between the process variable under consideration and the input included in the regression equation. The regression between each process and each input was performed three times, once for each variable of degree of virtuality.

The standardized coefficients for the linear regression performed between each input and each process are presented in Table 41.

Table 41: Coefficients of Regression ( $\beta$ ) for Interaction Terms

INPUT/PROCESS	Collaborative Climate			Potency			Communication Effectiveness		
	WV	MV	DV	WV	MV	DV	WV	MV	DV
<b>Organization Tenure Diversity</b>	-0.674	-0.367	0.015	-0.268	-0.338	-0.489	-0.414	-0.437	-0.046
<b>Adequacy of Technology</b>	1.46	3.36	0.728	-1.40	-0.894	1.06	0.775	4.00**	1.92
<b>Skills</b>	2.59	-2.24	0.472	0.869	-1.75	0.031	1.76*	-0.498	1.90
<b>Motivating Task</b>	1.71	5.23*	-0.720	-0.498	0.986	1.796	1.53	3.40	3.34
<b>Goal Clarity</b>	-0.301	1.80	-0.943	0.890	1.18	1.96	0.816	-0.067	0.895
<b>Leader Effectiveness</b>	-0.870	1.18	-1.47	-0.625	0.032	-1.27	-0.485	-1.11	0.161
<b>Rewards</b>	0.124	0.324	0.098	0.441*	0.124	0.132	0.518*	0.003	0.163
<b>Training</b>	-0.016	-0.117	-0.335	-0.151	-0.162	0.024	-0.062	-0.284	-0.144
<b>Managerial Support - Facilitation</b>	-0.121	-0.080	-0.001	-0.219	-0.048	-0.047	-0.127	-0.071	-0.284
<b>Managerial Support - VT Development</b>	-0.347	-0.010	0.158	0.130	0.030	0.066	0.227	0.230	0.362
<b>Managerial-Non-Support</b>	0.017	0.111	0.357	-0.171	0.233	0.305	0.003	0.157	0.443
<b>Organizational Support - Culture</b>	-0.246	0.045	-0.088	-0.024	-0.008	-0.138	-0.116	-0.163	-0.367
<b>Organizational Support - Infrastructure</b>	0.108	0.116	0.007	0.031	-0.010	0.159	0.117	0.177	-0.016
<b>Organizational Non-Support</b>	0.315	0.058	0.179	0.225	0.212	0.232	0.289	0.351	0.411*

\*\*Coefficient significant at  $p < 0.01$ ; \*Coefficient significant at  $p < 0.05$

Only one interaction term was significant at the  $p < 0.01$  level: the interaction term of member virtuality (MV) and adequacy of technology in the regression on communication effectiveness. The following five further interaction terms were significant at the  $p < 0.05$  level:

- the interaction term of team work time virtuality (WV) and skills in the regression on communication effectiveness;

- the interaction term of team work time virtuality (WV) and rewards in the regression on potency;
- the interaction term of team work time virtuality (WV) and rewards in the regression on potency;
- the interaction term of member virtuality (MV) and motivating task in the regression on collaborative climate; and
- the interaction term of distance virtuality (DV) and organizational non-support in the regression on communication effectiveness;

To summarize, three of 42 interaction terms including member virtuality (MV) were significant, two of 42 the interaction terms including team time worked virtually (WV) were significant, and one interaction term including distance virtuality (DV) were significant.

As noted previously, when numerous statistical tests are performed, a certain number of significant relationships are expected by chance. Due to the very small number of significant results in this analysis, the data was examined to determine if any patterns could be observed (i.e. numerous significant interactions were associated with one degree of virtuality, one input variable or one process variable), to determine if the significant interactions which were found were spurious or meaningful. This analysis showed that the significant interaction effects were distributed throughout the input variable set (i.e. six significant terms distributed over five input variables), with no discernable pattern to the significant interactions. Similarly, there was no discernable

pattern to the findings with respect to the degree of virtuality variables. Although there was some limited evidence of the moderating effect of degree of virtuality on communication effectiveness (i.e. four of the six significant interactions), the four significant interactions were with four different input variables. As such, degree of virtuality was not clearly shown to play a moderating role between the inputs and processes in the overall framework.

#### 5.8.7.2 Degree of Virtuality as a Moderator of the Output-Process Relationship

This section explores the moderating role of degree of virtuality on the relationship between the processes and the outputs. The approach for the analysis was the same as for the tests for the moderated input-process relationships described in the previous section (Section 5.8.7.1). The standardized coefficients for the linear regression performed between each process and each output are presented in Table 42.

**Table 42: Coefficients of Regression ( $\beta$ ) for Interaction Terms**

PROCESS/OUTPUT	VT Members' Perceptions of Performance			VT Member Satisfaction			VT Managers' Perceptions of Performance		
	WV	MV	DV	WV	MV	DV	WV	MV	DV
Collaborative Climate	0.066	-0.84	-0.161	-0.034	-0.123	-0.069	-	-	-
Potency	0.079	0.043	0.082	0.018	0.157	-0.107	-0.199	-0.166	-0.152
Communication Effectiveness	-0.098	-0.157	-0.108	0.111	-0.094	-0.177	-	-	-

\*\*Coefficient significant at  $p < 0.01$ ; \*Coefficient significant at  $p < 0.05$

None of the interaction terms were significant at the  $p < 0.01$  or the  $p < 0.05$  level. These results indicate that there is no evidence that degree of virtuality moderates the relationship between the processes and outputs.

#### 5.8.7.3 Degree of Virtuality as a Moderator of the Direct Input-Output Relationship

In the analysis of the paths of the research framework, there was evidence that some of the inputs and outputs in this study have a direct relationship. These relationships were shown in Figures 6, 7, 8, 9 and 10. This section explores the moderating role of degree of virtuality on the direct relationship between these inputs and outputs. The approach for the analysis was the same as described in Section 5.8.7.1. The standardized coefficients for the linear regression performed between each input and each output are presented in Table 43.

None of the interaction terms were significant at the  $p < 0.01$  or the  $p < 0.05$  level. These results indicate that there is no evidence that degree of virtuality moderates the relationship between these inputs and outputs.

Table 43: Coefficients of Regression ( $\beta$ ) for Interaction Terms

INTERACTION TERM INCLUDING:	WV	MV	DV
<b>INPUT/OUTPUT</b>	<b>VT Members' Perception of Professional Development</b>		
Member Age Diversity	0.509	0.303	-1.45
Member Comfort with Technology	0.486	-0.832	0.252
Goal Clarity	0.376	-0.749	-0.197
Rewards	0.326	0.157	0.019
Team Longevity	0.273	0.033	0.273
Organizational Support -Culture	0.187	-0.094	0.144
<b>INPUT/OUTPUT</b>	<b>VT Members' Perception of Capacity for Future VT Work</b>		
Member Age Diversity	1.20	1.36	-1.85
Member Comfort with Technology	-1.15	-0.237	-1.83
Member Expertise with Technology	0.365	0.889	-0.660
<b>INPUT/OUTPUT</b>	<b>VT Managers' Perception of Performance</b>		
Organization Tenure Diversity	-0.291	-0.043	-0.176
<b>INPUT/OUTPUT</b>	<b>VT Member Satisfaction</b>		
Managerial Support - Facilitating	0.087	0.071	0.051
<b>INPUT/OUTPUT</b>	<b>VT Members' Perception of Performance</b>		
Gender	-0.092	-0.023	-0.031
Team Longevity	0.073	0.104	0.257

\*\*Coefficient significant at  $p < 0.01$ ; \*Coefficient significant at  $p < 0.05$

Given the lack of clear evidence of the moderating role of degree of virtuality, alternate roles were explored to determine whether it has a place in the framework. Specifically, data analysis was performed to determine if degree of virtuality should be conceptualized as an input of the framework of VT effectiveness rather than a moderator. If degree of

virtuality is conceptualised as an input in the research framework, there are two possible ways that it can be related to the VT outputs: 1) indirectly through processes (i.e. input→process→output); or 2) directly (input→ output). To test these alternate paths, correlation analysis was performed between the three dimensions of degree of virtuality, the processes and the measures of VT effectiveness (outputs). The approach for this analysis was the same as for the VT inputs (Steps 1, 2, 4 and 5 in Figure 4). The results of these analyses are presented in the following sections.

#### 5.8.7.1 Relationships between Degree of Virtuality and Processes

The correlations between the three dimensions of degree of virtuality and the VT processes (Step 1 in Figure 4) are shown in Table 44. One of the correlations (team time worked virtually and collaborative climate,  $r=-0.506$ ) was significant at the  $p<0.01$  level. The following three correlations were significant at the  $p<0.05$  level:

- Team time worked virtually was correlated with potency ( $r=-0.366$ );
- Member virtuality was correlated with potency ( $r=-0.393$ ); and
- Distance virtuality was correlated with communication effectiveness ( $r=-0.380$ ).

All of the correlations were in the expected direction (i.e. negative). It should also be noted that one of the dimensions of degree of virtuality, team-time worked virtually, was significantly negatively correlated to two of the processes: collaborative climate and potency. The other two dimensions of degree of virtuality, on the other hand, were significantly correlated with only one of the processes each. Member virtuality was significantly correlated to potency while distance virtuality was significantly correlated to communication effectiveness.

**Table 44: Correlations between Process Indicators and Degree of Virtuality**

<b>DEGREE OF VIRTUALITY/PROCESSES</b>	<b>Collaborative Climate</b>	<b>Potency</b>	<b>Communication Effectiveness</b>
<b>Team Time Worked Virtually</b>	-0.506**	-0.366*	-0.331
<b>Member Virtuality</b>	-0.137	-0.393*	-0.357
<b>Distance Virtuality</b>	-0.348	-0.240	-0.380*

\*\*Correlation significant at  $p < 0.01$ ; \*Correlation significant at  $p < 0.05$

**DIMENSIONS OF VIRTUALITY CORRELATED WITH POTENCY:** Potency was negatively correlated to the following two dimensions of virtuality at the  $p < 0.05$  level: team time worked virtually ( $r = -0.366$ ) and member virtuality ( $r = -0.393$ ). This indicates that the VTs in this study who were dispersed over a greater number of locations and/or whose members spent more time working virtually were less likely to believe that they would successfully accomplish their task (potency).

**DIMENSIONS OF VIRTUALITY CORRELATED WITH COLLABORATIVE CLIMATE:** Collaborative climate was significantly correlated to one dimension of virtuality at the  $p < 0.01$  level: team time worked virtually ( $r = -0.506$ ). In this case, the strong negative association indicates that the VTs in this study whose members spent more time working virtually were less likely to perceive that they had a collaborative climate.

## DIMENSIONS OF VIRTUALITY CORRELATED WITH COMMUNICATION

**EFFECTIVENESS:** Communication effectiveness was significantly correlated to one dimension of virtuality: distance virtuality ( $p < 0.05$ ,  $r = -0.380$ ). The correlation was moderate and negative, indicating that the VTs in this study that were dispersed over larger distances perceived their communication to be less effective.

### *5.8.7.1.1 Discussion of Relationships between Degree of Virtuality and Processes*

Overall, these results suggest that the dimensions of virtuality developed for this study may play a role in a VT's interactions. The correlations were all negative, suggesting that VTs with greater virtuality may perceive their interactions to be less positive. The different dimensions of virtuality were significantly related to different processes. This indicates that different kinds of virtuality may affect different aspects of the team's interactions. VT members that are dispersed across great distances may have less effective communication due to the limits of technology, problems associated with asynchronous work, and lack of nonverbal cues. VTs dispersed across numerous locations and/or whose members spend the majority of their time working virtually, may lack confidence in their potential to succeed, as they are less able to assess and bolster each others' morale. Finally, VTs that spend a great deal of time working virtually may perceive their team climate to be less collaborative.

As all three of the dimensions of degree of virtuality were significantly correlated to at least one of the processes, the second step of the analysis (Step 2 in Figure 4 – testing the

direct relationships between inputs and outputs for inputs having no relation to processes) was not necessary.

#### 5.8.7.2 Relationships between Degree of Virtuality and Outputs (For Outputs Having no Relation with Processes)

In Step 3 of the analysis performed in Section 5.8.3, two outputs were shown to have no relationships with the processes in this study: VT members' perceptions of future development and VT members' perceptions of capacity for future virtual teamwork. This section examines the direct relationship between these two aspects of VT effectiveness and the three dimensions of degree of virtuality (Step 4 in Figure 4). The correlations between the two outputs and degree of virtuality are shown in Table 45. None of the correlations were significant at the  $p < 0.01$  level or the  $p < 0.05$ .

**Table 45: Correlations between Degree of Virtuality and Outputs (for Outputs Having no Relation with Processes)**

<b>DEGREE OF VIRTUALITY/OUTPUT</b>	<b>VT Members' Perceptions of Professional Development</b>	<b>VT Members' Perceptions of Capacity for Future VT work</b>
<b>Team Time Worked Virtually</b>	-0.155	-0.248
<b>Member Virtuality</b>	-0.205	0.040
<b>Distance Virtuality</b>	-0.211	-0.299

\*\*Correlation significant at  $p < 0.01$ ; \*Correlation significant at  $p < 0.05$

##### 5.8.7.2.1 Discussion of Relationships between Degree of Virtuality and Outputs

The fact that these two of the dimensions of effectiveness were not shown to be directly related to degree of virtuality suggests that the distance and isolation of VT members is

not associated with VT members' perceptions of the professional development and capacity for future VT work they receive from their VT experiences. This result is interesting, given the results for managerial and organizational support for virtual teams, in which professional development was highlighted as an important form of support. It is possible, however, that these aspects of VT effectiveness are more closely associated with organizational support, rather than the conditions of their virtuality (organizational support through culture was associated with VT members' perceptions of professional development).

Overall, these results underscore the contention that these two outputs are related to a different set of variables (i.e. inputs and processes that are not examined in this study and are not currently popular in the literature).

#### 5.8.7.3 Relationships between Degree of Virtuality and Outputs through Processes

This section examines the potential mediating role of VT processes in the relationship between inputs and outputs (Step 5 in Figure 4). It should be recalled that this analysis has three parts. First the direct correlations between the inputs and outputs are calculated. Second, the correlations are calculated again, while controlling for the processes. Finally, the results of the two types of correlations are compared. The results of these analyses are presented in the following sections.

### 5.8.7.3.1 Direct Correlations between Degree of Virtuality and Outputs

This section tests the direct relationships between the three dimensions of degree of virtuality and the three outputs which were shown to be related to the processes (VT members' perceptions of performance, VT member satisfaction, VT managers' perceptions of performance). The correlations are presented in Table 46. None of the correlations were significant at the  $p < 0.01$  level. The following three correlations were significant at the  $p < 0.05$  level:

- Team time worked virtually was correlated with VT member satisfaction ( $r = -0.411$ ); and
- Distance virtuality was correlated with members' perceptions of performance ( $r = -0.452$ ) and with VT member satisfaction ( $r = -0.363$ ).

**Table 46: Correlations between Degree of Virtuality and Outputs**

<b>DEGREE OF VIRTUALITY/OUTPUT</b>	<b>VT Members' Perceptions of Performance</b>	<b>VT Member Satisfaction</b>	<b>VT Managers' Perceptions of Performance</b>
<b>Team time worked virtually</b>	-0.357	-0.411*	-0.168
<b>Member Virtuality</b>	-0.340	-0.279	-0.268
<b>Distance Virtuality</b>	-0.452*	-0.363*	-0.019

\*\*Correlation significant at  $p < 0.01$ ; \*Correlation significant at  $p < 0.05$

One of the dimensions of degree of virtuality (distance virtuality) was significantly negatively correlated to two of the outputs: VT members' perceptions of performance and VT member satisfaction. One other dimension of virtuality, team time worked virtually,

was significantly negatively correlated to one output: VT member satisfaction. The third dimension of virtuality, member virtuality was not significantly related to any of the outputs. All of the correlations were moderate and negative.

#### DIMENSIONS OF VIRTUALITY CORRELATED WITH MEMBERS'

**PERCEPTIONS OF PERFORMANCE:** VT members' perceptions of performance was moderately negatively related to distance virtuality ( $r=-0.452$ ), indicating that the VTs in this study whose members were dispersed over smaller distances were more likely to perceive that their VT was effective.

#### DIMENSIONS OF VIRTUALITY CORRELATED WITH VT MEMBER

**SATISFACTION:** VT member satisfaction had significant negative correlation to team work time virtuality ( $r=-0.411$ ,  $p<0.05$ ) and distance virtuality ( $r=-0.363$ ,  $p<0.05$ ). This indicates that the VTs in this study that spent more time working virtually were less likely to be satisfied with their VT experiences.

One of the outputs, VT managers' perceptions of performance, had no significant relationships with any of the dimensions of degree of virtuality, suggesting that the extent that the VT members are dispersed is not associated with the VT performance in the eyes of the manager.

#### DISCUSSION OF DIRECT CORRELATIONS BETWEEN DEGREE OF

**VIRTUALITY AND OUTPUTS:** These results suggest that degree of virtuality may

influence two of the dimensions of VT effectiveness examined in this study: VT members' perceptions of performance and VT member satisfaction. These data suggest that VT members' perceptions of performance and VT member satisfaction with their VT experiences may be greatest when the members are dispersed across smaller distances and VT members may derive some satisfaction from working face-to-face.

The relationship between distance virtuality and two of the VT outcomes in this study (VT members' perceptions of performance, VT member satisfaction) was shown to be mediated by one of the processes (communication effectiveness). This result suggests that greater distances between team members may strain the communication of the virtual team. It should be recalled that all of the VTs in this study were located in the same regional of Canada, so in this case, greater distances do not represent varying time zones (identified as one of the a challenge of VTs). VTs with members working in wide-spread locations may have less options for meeting (i.e. greater coordination required, more time spent travelling, and greater costs) when critical issues arise or misunderstandings erupt.

The extent that VT members spend their time working virtually (team time worked virtually) was shown to be negatively associated with collaborative climate and potency. This results suggests that team members who spend a great deal of their time working apart may have greater problems with their interactions in terms of both the openness of the climate and their belief in their success. This result is again in keeping with the literature, which has identified team interactions as one of the major areas of concern in

VTs. (Henry & Hartzler, 1997; Warkentin et al., 1997). This is based on the assumption that team members working virtually will not form the personal bonds that are associated with traditional team effectiveness (i.e. cohesion, commitment, etc.).

One of the dimensions of virtuality, member virtuality, was not significantly correlated to any of the measures of VT effectiveness examined in this research. In other words, the proportion of the team that is working in different locations may not be linked to the VT's effectiveness. Member virtuality, however, was significantly correlated to one of the processes (potency). It is possible that this dimension of virtuality is related to VT effectiveness indirectly, through this process, but that the relationship was not detected due to the limitations of the analysis.

Finally, the fact that one of the outputs, VT managers' perceptions of performance, was not shown to be directly related to any of the measures of degree of virtuality underscores the contention of this thesis that this output is related to a different set of variables (i.e. variables that are not examined in this study and are widely cited in the literature). It is also possible that VT managers' perceptions of performance is indirectly related to degree of virtuality through the process potency, although it is not possible to test this supposition with this set of data. While both VT managers' perceptions of performance and two of the dimensions of degree of virtuality (team time worked virtually, member virtuality) were significantly correlated to potency, partial correlations could not be performed because the necessary requirements to undertake this form of analysis were

not met (i.e. a direct correlation between VT managers' perceptions of performance and degree of virtuality was not shown).

#### 5.8.7.3.2 Partial Correlations between Degree of Virtuality and Outputs

In order to explore the possibility that the processes mediate the relationship between degree of virtuality and the VT outputs, partial correlations were performed on those output variables and degree of virtuality variables having a significant direct correlation, using the methods described in Section 5.8.5.1.2. The partial correlations are presented in Table 47.

**Table 47: Partial Correlations between Degree of Virtuality and Outputs**

<b>DIRECT CORRELATIONS</b>	<b>VT Members' Perceptions of Performance</b>	<b>VT Member Satisfaction</b>
<b>PARTIAL CORRELATIONS</b>		
<b>Team Time Worked Virtually</b>	-	-0.411*
<b>Distance Virtuality</b>	-0.452*	-0.363*
	-0.280	-0.108

\*\*Coefficient significant at  $p < 0.01$ ; \*Coefficient significant at  $p < 0.05$

None of the partial correlations between the dimensions of degree of virtuality and the output variables were significant, suggesting that the processes play a mediating role between degree of virtuality and these outputs.

### 5.8.7.3.3 *Discussion of Partial Correlations between Degree of Virtuality and Outputs*

The results suggest that two of the dimensions of degree of virtuality dimensions play the role of an input for two of the aspects of VT effectiveness: VT members' perceptions of effectiveness and VT member satisfaction. The results also indicate that these relationships can best be described using an input→process→output framework (i.e. as the degree of virtuality increases, the process variables decrease, which in turn, are associated with decreases in VT members' perceptions of effectiveness and VT member satisfaction.

It would seem that of the three dimensions of degree of virtuality, team time worked virtually is most strongly associated with the processes (and subsequently with the outputs). Team time worked virtually was significantly correlated (one of the correlations was high) to two of the three processes (potency, collaborative climate), indicating that the proportion of time that a VT member spends working virtually has the greatest impact on the team processes. The association is negative, so the more time a VT spends working virtually, the less their climate is perceived to be open and caring and the lower their belief in their success.

Member virtuality and distance virtuality were both significantly correlated to only one of the processes, indicating that they, to a lesser extent contribute to team processes (and outputs in turn). The association is negative so the greater the proportion of virtual

members and the greater the distance between them, the lower their belief in their success and the less effective their communication will be, respectively.

## 6 CONCLUSIONS

This research on VTs was undertaken with the primary goal of developing a model (or models) of VT effectiveness that could be used in future research on VTs. Specifically, this research pursued four objectives. The first objective was to operationally define a VT's degree of virtuality and develop a way to empirically measure virtuality. This objective reflects the movement of the existing literature towards the view that virtuality/proximity is not a dichotomy and that virtuality is a continuum. The second objective was to develop an operational definition and a measure of VT effectiveness. This objective addresses the call for research which is designed specifically for VTs and reflects the differences between proximate and virtual teams. The third objective was to develop a better understanding of how managers and organizations can contribute to VT effectiveness through the development of four behaviourally-based measures of support of VTs: organizational support of VTs, organizational non-support of VTs, managerial support of VTs, and managerial non-support of VTs. Such a measure was not found in the current research, but should prove useful to organizations who employ VTs. The fourth objective was to explore the relationship between VT effectiveness, VT inputs, contextual inputs, VT processes, and degree of virtuality. This chapter begins with a discussion of the VTs in this study. The conclusions of this research with respect to each of these objectives are then discussed. This is followed by the limitations and contributions of this research and suggestions for future research.

## 6.1 THE VIRTUAL TEAMS IN THIS STUDY

The VTs in this study were all within a single organization, and as such, the insight they provide into VTs in general should be interpreted with caution. The teams in this research were, however, real teams, functioning over a restively long period of time and performing real work for a private sector organization. As such, the sample in this study provides useful real-word information regarding the functioning of VTs.

The VTs in this study were relatively successful and had been in operation for an average of two years. The teams were also relatively small, suggesting that smaller VTs may be more effective than bigger ones. It is likely that unsuccessful VTs or larger ones, if they did exist, but were not successful, would have been disbanded by the organization.

The VTs in this sample were comprised of highly educated, experienced professionals, who were in specialised areas, and had a high degree of competence in information technology. The fact that they work long hours suggests that they are committed to either their organization and/or their jobs. It also suggests that they might be considered by their organizations to be high performers. The results suggest that VTs are, as the literature indicates, used to pool the resources of specialised individuals who may not be able to collaborate proximately. The data would suggest that people who are selected to work on a VT can be relied upon to work hard without direct face-to-face supervision or close personal contact. Their competence with technological tools, while necessary for

VT functioning, may lead to dissatisfaction or frustrations with the virtual environment for those who are more experienced in this regard.

Most of these VTs had met face-to-face at least once, indicating that VT managers consider traditional meetings valuable enough to invest time and money into them.

Although these VTs were not dispersed over great distances, most did not meet regularly, suggesting that they perhaps value a traditional connection, but only as they deem necessary (i.e. at time of kick-off or at major crises, rather than on a regular set schedule).

Given the fact that these VTs were relatively successful and had been functioning for over two years on average, in a competitive environment, the low number of VTs reporting regularly scheduled meetings calls into question the necessity of such meetings.

Finally, the VTs in this study were operating within an organization that had no official policies or training specific to VTs. The VT managers in this study were perceived to be doing a good job supporting their teams using proximate team methods. These managers were provided with extensive training on how to manage proximate teams. They would also be accustomed to dealing with employees who telework, as policies with respect to teleworkers were well established in the organization. The VT managers were lacking, however, in the resources and the proactive management approach that is unique to VTs.

The results indicate that the organization in this study supported its VTs by providing the tools and technology necessary to do the job. In addition, the organization's telework

policies were perceived to be supportive of VTs as they both deal with virtual work. The organization's lack of policies and training specific to VTs, however, were found to be problematic. The results of this study suggest that while VTs would benefit from the implementation of formal policies on VTs, there is a positive spill-over with respect to the management of proximate teams and the management of teleworkers. As will be observed later, however, the results suggest that VT effectiveness can be enhanced if organizations implement measures at both the managerial and organizational level that encourage and reward supportive behaviour.

## **6.2 DEGREE OF VIRTUALITY**

The first objective was to define and operationalize the construct of degree of virtuality, which has emerged in the recent literature on VTs. Traditionally, a VT has been defined as two or more people, working interdependently for a common goal, whose members do not work at the same place at the same time and must collaborate across space and/or time. More recent literature in the area has begun to reflect the opinion that most teams, whether perceived as proximate or virtual, do not work face to face all of the time and are virtual to some extent. This research study was conceptualized as a continuum rather than a dichotomy. Rather than classifying teams as virtual or not, this research defined teams as having varying degrees of virtuality. A definition of degree of virtuality was developed in this study to reflect the extent that a team's members work apart. Using the literature as a basis, a working definition of degree of virtuality was developed containing three dimensions: the proportion of work time that the VT members spend working apart (team time worked virtually); the proportion of the team's members who work virtually

(member virtuality); and the degree of separation of the team's members (distance virtuality).

The VTs in this study were found to have varying degrees of virtuality, supporting the contention that virtuality is a matter of degree and the wholly VTs studied in laboratory settings do not accurately reflect what is found in practice. This suggests that teams should not be classified as either virtual or not virtual. Rather this study would support the idea that teams have differing degrees of virtuality. The VTs were found to be highly virtual in terms of the amount of time they spend working virtually, but were less virtual if one considered the distance team members were from one another or the number of teams with some co-located members (i.e. member virtuality). Most of the VTs in this study reported having met face-to-face, but despite their relative proximity to each other, most did not meet regularly. This suggests that to a certain degree, the VTs in this study chose to work virtually.

A measure was developed to operationalize each of the proposed dimensions of team virtuality. Degree of virtuality was then included as a component in several frameworks of VT effectiveness. The three dimensions of virtuality were shown to be associated with both VT processes and VT effectiveness. There was little support for the supposition that degree of virtuality moderates the relationship between the VT inputs and VT processes, and no evidence that it moderates the relationship between processes and VT effectiveness. The results suggest that degree of virtuality plays the role of an

input in the frameworks of VT effectiveness and that the VT processes mediate its relationship with VT effectiveness. The fact that each dimension of the measure was linked to different processes and measures of VT effectiveness supports the conceptualization of virtualness as outlined in this thesis.

The extent that VT members are dispersed over different locations (member virtuality) was shown to be negatively associated with one of the VT processes, potency, but was not shown to be related to any of the VT outcomes. This result suggests that although teams with more co-located members may have a greater belief in their potential for success, that belief does not necessarily manifest itself in any of the aspects of VT effectiveness in this study.

The degree to which VT members are geographically dispersed (distance virtuality) was shown to be negatively associated with one of the processes, communication effectiveness. This process was shown to mediate the relationship between distance virtuality and two of the VT outcomes in this study (VT members' perceptions of performance, VT member satisfaction). This result suggests that greater distances between VT members may strain the communication of the VTs, and in turn, reduce their effectiveness. VTs with greater geographical dispersion would be expected to have more difficulty meeting to resolve problems or clarify ambiguities.

The extent that VT members spend their time working virtually (team time worked virtually) was shown to be negatively associated with collaborative climate and potency. This results suggests that team members who spend a great deal of their time working apart may have greater problems with their interactions in terms of both the openness of the climate and their belief in their success. This result is in keeping with the VT literature, which identifies team interactions as one of the major areas of concern in VTs.

These measures of degree of virtuality were developed in this study and were designed for use with teams of varying degrees of virtuality or proximity. The results of this research would suggest that the more teams move away from the proximate form, the more the traditional measures of team effectiveness are negatively impacted.

Conversely, degree of virtuality was not shown to be associated with three of the aspects of VT effectiveness included in this study (VT members' perceptions of future development, VT member's perceptions of capacity for future VT work, VT managers' perceptions of performance). These results indicate that although virtuality seems to impact the quality of the interactions of a VT, it is only associated with those aspects of VT effectiveness that are highly linked to the VT processes (i.e. VT members' perceptions of performance, VT member satisfaction).

Although these results suggest that some of the aspects of the effectiveness of VTs might be improved by reducing the virtuality of the team, in situations where VTs are necessary

or appropriate, organizations and managers may be able to compensate for the negative effects of virtuality by ensuring that other contributors to effectiveness are in place (i.e. highly virtual teams might be given extra training or additional support from their managers).

### **6.3 VIRTUAL TEAM EFFECTIVENESS**

The second objective of this thesis was to investigate the construct of VT effectiveness and develop a measure which could be used to operationalize this construct in future studies in the area. Based on the existing literature on the unique conditions of VTs, a four-dimensional conceptualization of VT effectiveness was proposed. This conceptualization includes both productivity and attitudinal components. VT effectiveness was conceptualized in this thesis as being comprised of the following four components: the degree to which the team has achieved its task successfully; the degree to which the VT members perceive that their VT experience has contributed to their growth and personal well-being; the degree to which being on the virtual team is perceived to have contributed to the VT members' professional development; and the degree to which being on the VT is perceived to have contributed to the VT members' capacity to work on a VT in the future. Furthermore, two points of view on the VT's performance were assessed: the VT managers and the collective view of the VT itself.

The VTs in this study were relatively successful in terms of both member satisfaction and performance. This supports the supposition that VTs can be effective. It also shows that individuals can find the experience of being on a VT satisfying, despite their higher

reliance on communication technology and the reduced opportunities to interact face-to-face.

The VTs were less effective, however, in terms of the extent that the members perceive that they have developed professionally and increased their capacity to work on VTs in the future. This result is borne out by the fact that their organization did not have any policies with respect to equipping, training or rewarding VTs. In addition, the organization did not provide training for VT managers, obliging these managers to rely on their own experiences with both proximate and virtual teams. These findings suggest that organizations that want to make extensive use of VTs need to identify ways to ensure that there are opportunities for career development for individuals working on VTs. This is an important finding as it suggests that ambitious professionals may not want to work on VTs if they do not believe that it will benefit them.

As suggested by Goodman et. al. (1987), the antecedents for each dimension of VT effectiveness were explored separately. All of the four dimensions of VT effectiveness were significantly related to at least one of the team processes or inputs, suggesting that VTs may have measurable outcomes that are different from those of proximate teams. The research also determined that the frameworks describing VT effectiveness were unique, suggesting that organizations need to focus on different inputs and processes to achieve different kinds of results.

As suggested by Gladstein (1984), both manager and members' perceptions of task performance were measured. Despite the fact that the exact same measure of performance was used to collect perceived performance data from both VT managers and VT members, the assessments of performance were not shown to be related to one another. This finding is consistent with that reported by Gladstein (1984) and supports the idea that VT members look at different criteria to assess VT performance than their managers do. These findings suggest that organizations and researchers who wish to evaluate VTs need to consider both the source of the data as well as the aspect of performance that they wish to consider.

The frameworks developed for VT members' perceptions of performance and VT member satisfaction were very similar to each other and to the models of proximate team effectiveness. These findings suggest two things: 1) The same set of inputs and processes are linked to both of these measures of VT effectiveness; and 2) VTs and proximate teams function in a similar manner with respect to these outcomes. The fact that the measures of managerial support/non-support of VTs and organizational support/non-support of VTs were key inputs in both frameworks, suggests that VTs have different needs with respect to support than do proximate teams.

The frameworks developed to describe the final three dimensions of VT effectiveness examined in this study (VT managers' perceptions of performance, VT members' perceptions of professional development, VT members' perceptions of capacity for future

VT work), were very different from those developed for VT performance and VT member satisfaction. This suggests that there may be other variables of interest (not included in this study) that are related to these three outcomes. It also suggests that organizations who are concerned with all of the three outcomes need to consider a different set of inputs and processes than they do for proximate teams.

#### **6.4 ORGANIZATIONAL SUPPORT/NON-SUPPORT OF VIRTUAL TEAMS AND MANAGERIAL SUPPORT/NON-SUPPORT OF VTS**

The third objective of this thesis was to develop measures for organizational support and non-support of VTs and managerial support and non-support of VTs. Measures of these constructs were not found in the current literature, but are important for both researchers who wish to better understand the workings of virtual teams and organizations who wish to maximize their performance. The act frequency approach was used in this thesis to develop behaviourally based measures of these four constructs. The measures of managerial support and non-support of VTs are discussed first, followed by a discussion of the organizational support and non-support of VT measures.

##### **6.4.1 Measures of Managerial Support and Non-Support of Virtual Teams**

Managerial support for VTs was found to be made up of two factors, managerial support through facilitating and managerial support through VT development. The results showed that managers can support their VTs through facilitating behaviour that includes:

- Being a role model for virtual work;
- Clarifying roles and responsibilities;
- Facilitating the team's work and removing obstacles;

- Ensuring effective communication within the team;
- Empowering the VT; and
- Providing opportunities for interaction and information exchange.

Behaviours that were perceived to support VTs through team development included:

- Encouraging training for VT members;
- Recognizing the importance of professional development;
- Providing opportunities for face-to-face interaction; and
- Building team cohesion through non-work events.

The results suggest that a number of the supportive managerial behaviours relate to the sound management of both virtual and proximate teams (i.e. empowering VT members; ensuring effective communication; facilitating the team's work; clarifying what is to be done and who is to do it; providing regular opportunities for interaction and information exchange between all team members; building team cohesion through non-work focused events; being a role model; and being accessible). On the other hand, some of the behaviours relate specifically to the support of virtual teams ( i.e. ensuring that team members have the communication tools they need to work virtually; supporting the use of flexible work arrangements; understanding the difficulties employees can face when engaged in distributed work; recognizing the importance of professional development for VT members; providing opportunities for face-to-face interactions when necessary; and encouraging and promoting training on effective VT work).

The measure of managerial non-support of VTs was found to have one factor. This research shows that managers may hinder the success of their VTs by exhibiting the following non-supportive behaviours:

- Focusing on presence at work rather than performance or contribution;
- Being uncomfortable with empowerment;
- Not proactively promoting relationship building;
- Favouring proximate team members over VT members;
- Not clarifying what is to be done;
- Modeling behaviour that does not recognize VTs (i.e. not using technology effectively, insisting on face-to-face communication, not giving feedback, etc.)
- Not being accessible to the team;
- Making it difficult for VT members to get the training they need to work virtually;  
and
- Allowing ineffective communication within the group members.

Similar to the measure of managerial support, some of the non-supportive managerial behaviours might be considered to be key to the management of both proximate and virtual teams (i.e. allowing ineffective communication, not being accessible, not clarifying roles and responsibilities, and being uncomfortable with empowerment). On the other hand, several of the non-supportive behaviours would seem to be specific to the non-support of VTs (not being a VT role model, focusing on presence rather than contribution, making it difficult to get virtual work training, not recognizing need for relationship building, and not treating virtual and proximate team members equally).

Seven items were identified within each of the two sets of supportive and non-supportive behaviours, where one set of respondents identified the behaviour as reflecting managerial support of VTs, while another set of respondents identified the opposite behaviour as non-supportive. The following managerial behaviours had corresponding supportive/non-supportive behaviours:

- Empowering VT members/Being uncomfortable with empowerment;
- Being accessible/Not being accessible;
- Ensuring effective communication/Allowing ineffective communication;
- Clarifying what is to be done/Not clarifying what is to be done;
- Encouraging and promoting VT training/Making it difficult to get training;
- Providing opportunities for face-to-face interaction/Not recognizing; and promoting relationship building (face-to-face sessions).

The results suggest that these seven sets of supportive/non-supportive managerial behaviours are key to the success and failure of VTs, as education and training pertaining specifically to these behaviours would have the effect of addressing both negative and positive behaviours at the same time.

The measures of managerial support and non-support of VTs had high reliability and the significant correlations between the developed measures of support and outcomes that have been previously linked to VT effectiveness suggest very good validity. These results support their use in future VT research.

The measures of managerial support and non-support of VTs were shown to be related to both VT processes and VT effectiveness. This suggests that VTs that receive higher levels of managerial support from their managers, report a more open and caring climate, more effective communication and a greater belief in their potential for success. Conversely, VTs that receive higher levels of non-support from their managers report lower levels of the same processes. These processes were shown to mediate the relationship between managerial support/non-support and two of the VT outcomes in this study (VT members' perceptions of performance, VT member satisfaction), suggesting that managers who support their VTs can help the team develop positive interactions, which in turn leads to greater effectiveness. In addition, managerial support through facilitating was shown to have a direct association with one of the outputs (VT member satisfaction). No link was found between these two measures and the three remaining aspects of VT effectiveness (VT manager' perceptions of performance, VT members' perceptions of professional development, VT members' perceptions of capacity for future VT work), again confirming that these outputs are associated with variables other than those included in this study.

#### **6.4.2 Measures of Organizational Support and Non-Support of Virtual Teams**

Two factors which were found to represent organizational support for VTs were organizational support through culture, and organizational support through infrastructure. Organizations can help their VTs to be effective through a supportive culture which:

- Demonstrates trust, relies less on hierarchies, practices open communication, emphasizes presence, etc.;
- Recognizes and accepts that employees don't have to be present to be contributing;
- Provides a structure that supports VTs (i.e. less hierarchy, clear team roles, objectives, responsibilities and reporting structure, etc.);
- Officially supports the use of flexible work arrangements such as telework (i.e. training, reward system, funding for tools, etc); and
- Bases compensation on performance rather than presence.

Organizations can support their VTs through their infrastructure by:

- Providing training on how to work effectively on a VT;
- Recognizing the importance of relationship building in VTs by ensuring that there is time and funding for some face-to-face meetings;
- Providing effective communication tools and budgets; and
- Making sure that the technology used within the organization is compatible.

A small number of the supportive organizational behaviours would seem to relate to sound organizational practices for both virtual and proximate teams. The overlap between organizational support of virtual and proximate teams was less than that of managerial support of virtual teams, however, as only three generic behaviours were identified (i.e. providing effective communication tools and budgets, making sure that technology is compatible, and ensuring effective organizational communication). Most of the

supportive organizational behaviours would appear to be specific to the support of VT work (i.e. officially supporting the use of flexible work arrangements; basing compensation on performance rather than presence; having a culture that recognizes and accepts that employees don't have to be present to be contributing; having a culture that supports VTs; providing a structure that supports VTs, recognizing the importance of relationship building in VTs by ensuring that there is time and funding for some face-to-face meetings; and providing training on how to work effectively on a VT).

The measure of organizational non-support was found to have one factor. Organizations can make it more difficult for a VT to be effective by exhibiting the following non-supportive behaviours:

- Not providing a structure that supports VTs (i.e. does not establish clear priorities, roles, objectives, responsibilities and reporting structures);
- Having unrealistic expectations with respect to timelines;
- Not providing VTs with the budget they need to work virtually;
- Making it difficult for VTs to get together face to face;
- Having a culture that rewards "face time" and presence at work rather than contribution;
- Not supporting the use of flexible work arrangements such as telework or flextime;
- Forcing VT members to travel on their own time;
- Putting employees with poor technical skills on VTs; and
- Not providing to VTs the communication tools they need to work virtually.

Only two of the nine items contained in the list of behaviours representing organizational non-support of VTs seem to be generic behaviours that would be non-supportive of both virtual and proximate teams (i.e. having unrealistic timelines, and not providing the necessary communication tools). The majority of the non-supportive organizational behaviours, however, would appear to be specific to VT work (i.e. not supporting the use of flexible work arrangements such as telework or flextime, having a culture that rewards "face time" and presence at work rather than contribution, not providing a structure that supports VTs, putting employees with poor technical skills on VTs, forcing VT members to travel on their own time, not providing VTs with the budget they need to work virtually, and making it difficult for VTs to get together face to face).

As with the measures of managerial support and non-support of VTs, in the case of several of the organizational support and non-support items, respondents identified one particular behaviour as reflecting organizational support of VTs, while others identified the opposite behaviour as unsupportive. The following organizational behaviours had corresponding supportive/non-supportive behaviours:

- Providing effective communication tools/Not providing the tools that VTs need;
- Officially supporting flexible work arrangements/Not supporting flexible work arrangements;
- Having a culture that values contribution over presence/Having a culture that values presence over contribution;
- Providing a structure that supports VTs/Not providing a structure that supports VTs; and

- Recognizing the importance of relationship building (face-to-face)/Making it difficult for VTs to meet face-to-face..

The results suggest that these organizational behaviours are key to the success and failure of VTs because organizational attitudes and policies specifically addressing these behaviours would have the effect of addressing both negative and positive behaviours at the same time.

The measures of managerial support and non-support had high reliability and the significant correlations between the developed measures of support and outcomes that have been previously linked to VT effectiveness suggest very good validity. These results support their use in future VT research.

The measures of organizational support and non-support of VTs were shown to be related to both VT processes and VT effectiveness. Specifically, VTs reporting higher levels of support through infrastructure report a more open and caring climate, more effective communication and a greater belief in their potential for success. VTs reporting higher levels of support through organizational culture were more likely to report a more collaborative climate. Conversely, VTs that perceived higher levels of non-support from their organizations reported lower levels of potency and a less collaborative climate. These processes were shown to mediate the relationship between organizational support/non-support and two of the VT outcomes in this study (VT members' perceptions of performance, VT member satisfaction), suggesting that organizations that provide

support to their VTs, can help the teams develop positive interactions, which in turn lead to greater effectiveness. In addition, organizational support through culture was the only measure of support that was found to be associated with VT manager' perceptions of performance, suggesting that if the culture supports VT work, the VTs are more likely to be successful in the eyes of their manager.

No link was found between these two measures and the two remaining aspects of VT effectiveness (VT members' perceptions of professional development, VT members' perceptions of capacity for future VT work), again confirming that these outputs are associated with variables other than those included in this study.

In summary, the four new measures of managerial support/non-support and organizational support/non-support of VTs developed in this study provide to both organizations and managers concrete advice on how to improve team performance (as viewed by both managers and members) and VT member satisfaction. They identify behaviours that can be measured and improved through organizational policies and systems and management training and provide a set of benchmark data that can be used as part of an accountability framework to track improvement over time. As such, these measures can be expected to contribute to both research and practice in the area of VTs.

## **6.5 MODELING VT EFFECTIVENESS**

The fourth objective of this study was to explore how a number of VT input and process variables, including degree of virtuality, managerial support/nonsupport of VTs and

organizational support/non-support of VTs relate to the five measures of VT effectiveness. In keeping with the suggestions of Goodman et al. (1987), separate frameworks for the different dimensions of VT effectiveness were developed. The results supported this approach.

The overall results of this study supported the input→process→output form of the VT effectiveness framework for the more traditional dimensions of team effectiveness (VT members' perceptions of performance, VT member satisfaction). The results also suggested that some VT inputs, particularly team demographics, also have a direct effect on some of the dimensions of effectiveness, particularly VT members' perceptions of professional development and capacity for future VT work. In this thesis, in keeping with the results of Gladstein (1984), separate frameworks for the different perceptions of performance were also developed. The results supported the contention that different frameworks are appropriate for VT managers' perceptions of performance and VT members' perceptions of performance.

The paucity of variables associated with three of the dimensions of VT effectiveness (VT member's perceptions of professional development and capacity for future VT work, VT managers' perceptions of performance), indicate that either the elements associated with these outputs may not have been included in this research, or that the measures themselves were flawed. Further exploratory research is suggested to determine what contributes to VT members' perceptions of professional development, VT members' perceptions of capacity for future VT work, as well as VT managers' perceptions of performance.

The moderating role of degree of virtuality as hypothesized by Cohen and Gibson (2003) received only limited support. As such, it was posited that degree of virtuality plays the role of an input in the framework of VT effectiveness. The results support this conceptualization and indicate that degree of virtuality has an indirect impact on VT effectiveness, through its impact on VT processes.

The frameworks for the different measures of VT effectiveness outlined earlier were simplified and, in some cases, combined to form three proposed models of VT effectiveness. The proposed models of VT effectiveness are presented in Figures 12, 13 and 14. Not all paths to and from every variable are shown. Instead the most common paths from categories of variables are presented for different sets of VT effectiveness dimensions.

#### **6.5.1 Proposed Model of VT Members' Perceptions of Performance and VT Member Satisfaction**

VT members' perceptions of performance and VT member satisfaction seemed to be closely related in that they were both highly related to the same set of process indicators and they were both found to be best described by an input→process→output type of model. These two dimensions of VT effectiveness were also highly related to one another. As such, the dimension of VT members' perceptions of performance and VT member satisfaction were combined into one model, which is presented in Figure 12.

The model of VT members' perceptions of performance and satisfaction greatly resemble those in the proximate (Hackman, 1983) and VT literature (Cohen & Gibson, 2003; Lurey & Raisinghani, 2001). This resemblance is based on the fact that all of these models take an input→process→output form, as well as on the set of variables contained within the model. This model posits that these two dimensions of VT effectiveness are associated with three VT processes: potency, collaborative climate, and communication effectiveness. It is also hypothesized that the VT inputs are associated with VT effectiveness through the processes (i.e. process mediates the relationship between the inputs and outputs). As the majority of the research on both proximate and virtual teams are based on measures using members' perceptions of performance and satisfaction, it is not surprising that this model closely resembles what is found in the literature.

The two dimensions of VT effectiveness in this model were highly correlated to all of the process indicators. The process indicators were, as a set, related to many of the team inputs and all of the contextual inputs included in the research framework. All but one of the relationships were in the expected directions. These will be discussed in detail below.

As in Gladstein's (1984) study of traditional teams, the process indicators which were found to be related to self-reported performance and satisfaction, "read like a textbook on team building" (Gladstein, 1984: p. 511), suggesting that members base their perceptions of performance, not on outputs, but rather on their evaluations of team interactions or processes. The very strong correlations between the process variables and these two

dimension of VT effectiveness support this contention. The strong correlations with the three VT processes (potency, collaborative climate, communication effectiveness) indicate that positive team interactions (operationalized as a belief in the team's potential for success, an open and caring team climate and effective communication) are associated with these dimensions of VT effectiveness. The high correlations between the process indicators and VT members' perceptions of performance may indicate that the VT members base their perceptions of team performance on the positive processes that they have experienced within the team. Gladstein (1984) found a similar result and posited that the team members, having knowledge of what is supposed to lead to success, permit this knowledge to influence their perceptions of the success. In other words, when deciding whether or not a team has performed successfully, the members perceptions might be influenced by whether or not the team had positive interactions.

As a set, the contextual inputs seemed to be most closely associated with VT members' perceptions of performance and VT member satisfaction (through processes). This suggests that managers and organizations can influence VT member interactions through training and rewards that are geared towards VTs and by ensuring that both the organization and VT managers engage in behaviours shown in this thesis to be supportive of VTs and refrain from those behaviours that were shown to be unsupportive.

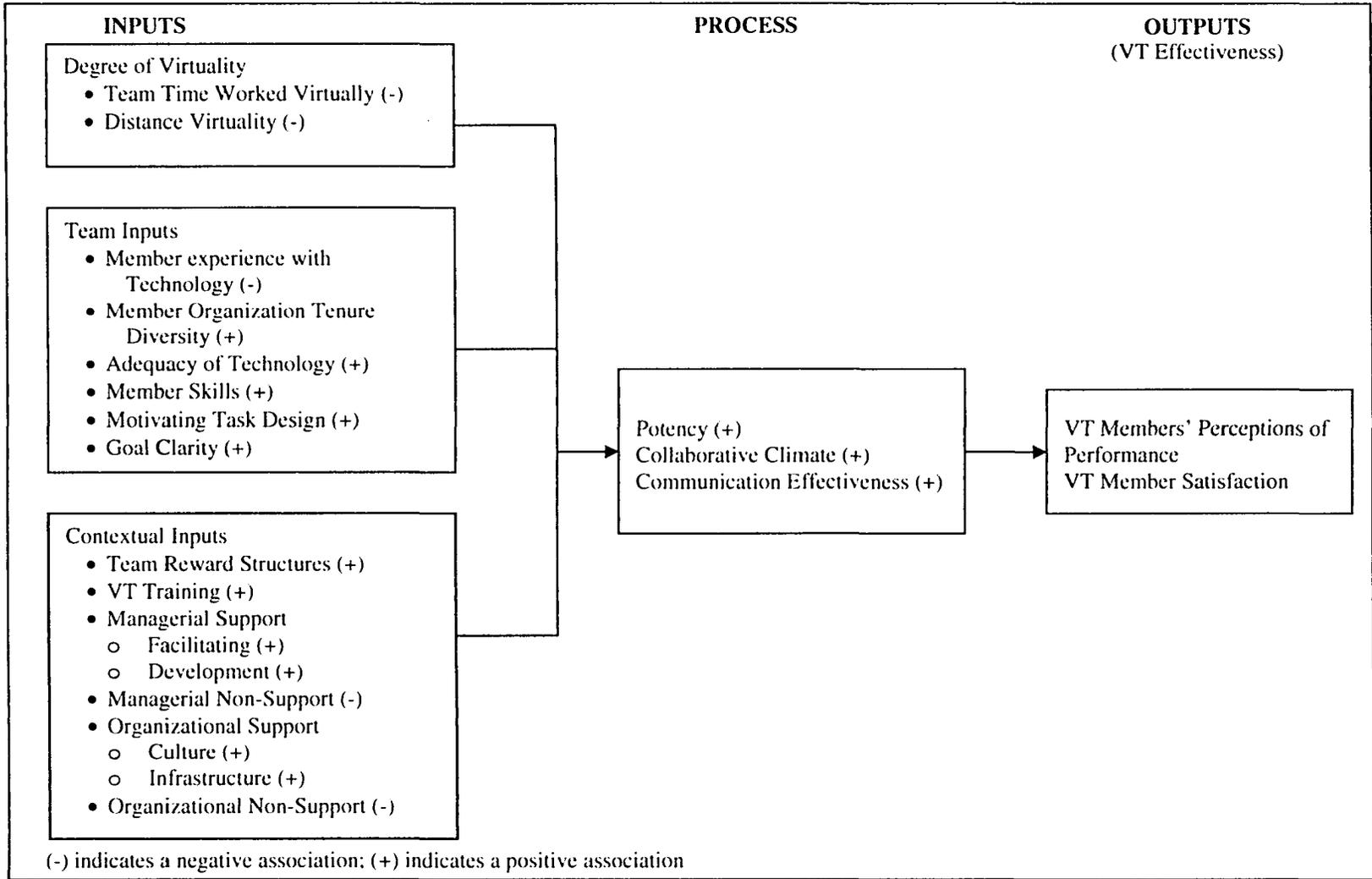


Figure 12: Model for VT Members' Perceptions of Performance and VT Member Satisfaction

Some of the team-level inputs included in this thesis also showed a strong association with these processes, and through the processes, to VT members' perceptions of performance and VT member satisfaction. This suggests that VT managers and organizations can influence VT member interactions through the design of the VTs. A motivating task, clear goals, adequate technology, members who are skilled at VT work, and an effective leader, all appear to contribute to positive perceptions of climate, potency, and communication effectiveness.

Teams with members who reported less experience with their technological tools also had positive team interactions. This was unexpected, as past research has shown that VT members with a better understanding of the technology have better results. It is possible that members who are not comfortable with information technology might have a negative effect on team interactions. Alternately, it may be that members who are highly familiar with the technology might feel frustrated by its limitations. The teams in this study reported very high levels of comfort and expertise with technology. This presents an interesting insight to organizations. On the one hand, they must ensure that the employees who work on VTs receive training so that they are competent with the technological tools used to do their work. At the same time, the organization must ensure that the tools are effective and kept up-to-date. Future research is required in this area to determine the relationship between VT member proficiency with technological tools, the VT interactions and VT effectiveness.

Degree of virtuality is posited in this model to play the role of an input, having an indirect relationship with VT members' perceptions of performance and satisfaction through its direct association with the VT processes. The direction of the relationship was found in this study to be negative, as expected. In other words, as the virtuality of the team increases, the members are hypothesized to perceive less positive interactions, which are in turn, posited to reduce members' perceptions of performance and satisfaction.

### **6.5.2 Proposed Model for VT Members' Perceptions of Professional Development and Capacity for Future Virtual Teamwork**

VT members' perceptions of professional development and VT members' perceptions of capacity for future VT work were highly correlated and both were found to be best described by an input→output type of model. These two dimensions of VT effectiveness were combined in one proposed model which is presented in Figure 13.

The model of VT members' perceptions of professional development and VT members' perceptions of capacity for future VT work also resembles those in the literature (Campion et al., 1993). This resemblance is based on the input→output form of the model. Although these two dimensions of VT work were based on VT members' perceptions (as were VT members' perceptions of performance and VT member satisfaction), there are two main differences between this model and the previous one. First, no process indicators were found to be related to these two dimensions of VT effectiveness. This led to the postulation that the inputs and outputs in this model have a direct relationship. Second, neither of these dimensions of VT effectiveness was found to have a relationship with degree of virtuality.

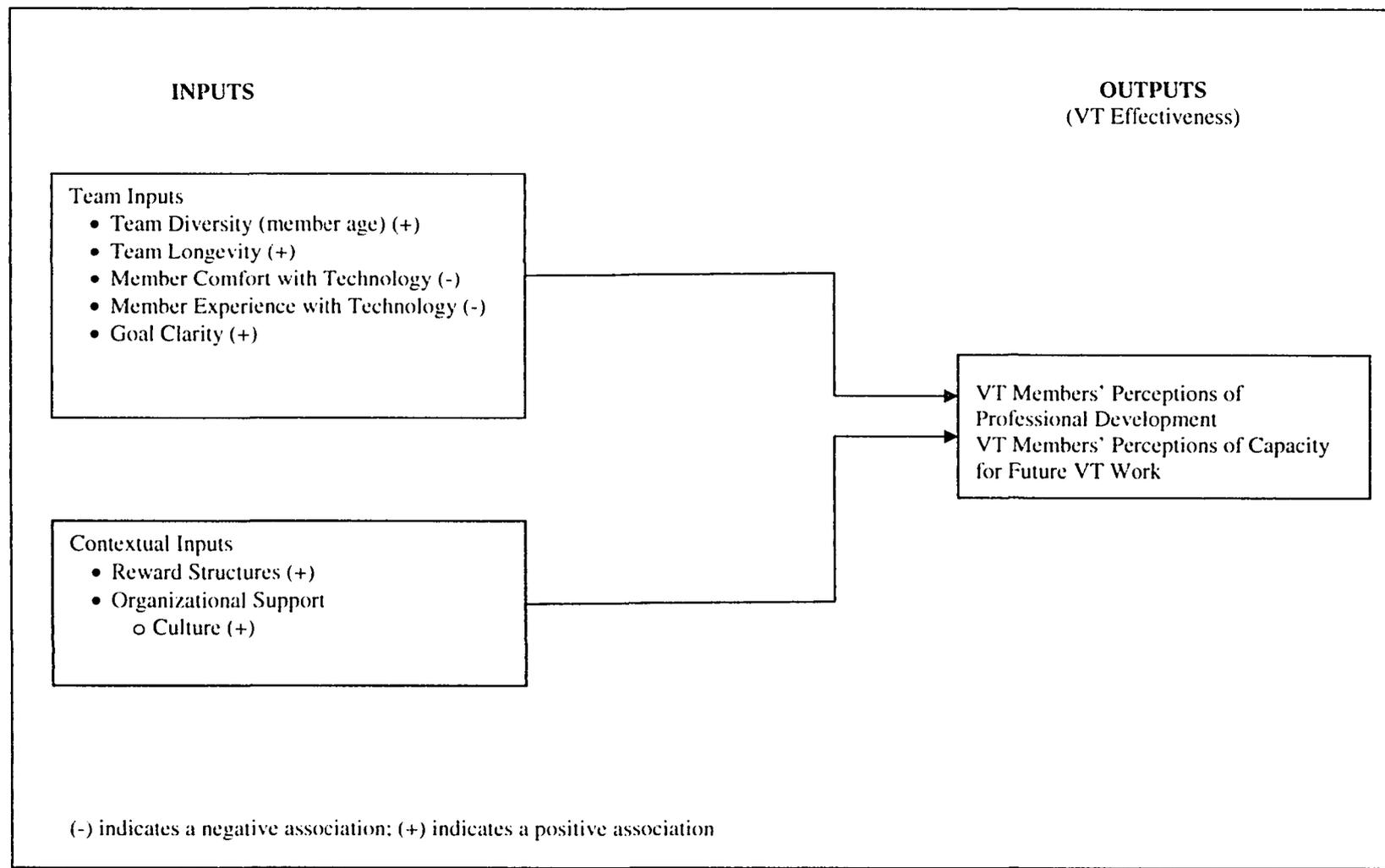


Figure 13: Model for VT Members' perceptions of Professional Development and Capacity for Future VT Work

As such, degree of virtuality is hypothesized to play no role in VT members' perceptions of professional development and VT members' perceptions of capacity for future VT work.

This suggests that these dimensions of VT effectiveness are not influenced by the degree that the team members work apart, but by some of the input components directly. The team input components that are hypothesized to be associated with VT members' perceptions of professional development and capacity for future VT work, suggest that the team's effectiveness will be affected by the member diversity with respect to age, the proficiency the VT members have with their technological tools, the clarity of the team's goals and the length of time that the team has been in operation. With respect to contextual inputs, the extent that the rewards are geared to the team level and the extent that the organization exhibits behaviours that are associated with a supportive culture, are hypothesized to be associated with VT effectiveness.

Overall, this framework suggests that VTs with a mix of younger and older members may benefit from their association, members of VTs with clear goals may be more motivated and aware of their accomplishments with respect to their development, and VTs with relatively long-term mandates may provide a certain amount of stability that allows members to pursue professional development. In addition, VTs that are offered rewards at the team-level may be more inclined to help one another, and organizations that have a supportive culture are likely to offer their VT members more opportunity for development. Interestingly, it is possible that VT members who are highly comfortable and experienced with information technology

consider this to be an area in which they can no longer develop and get frustrated with its limitations.

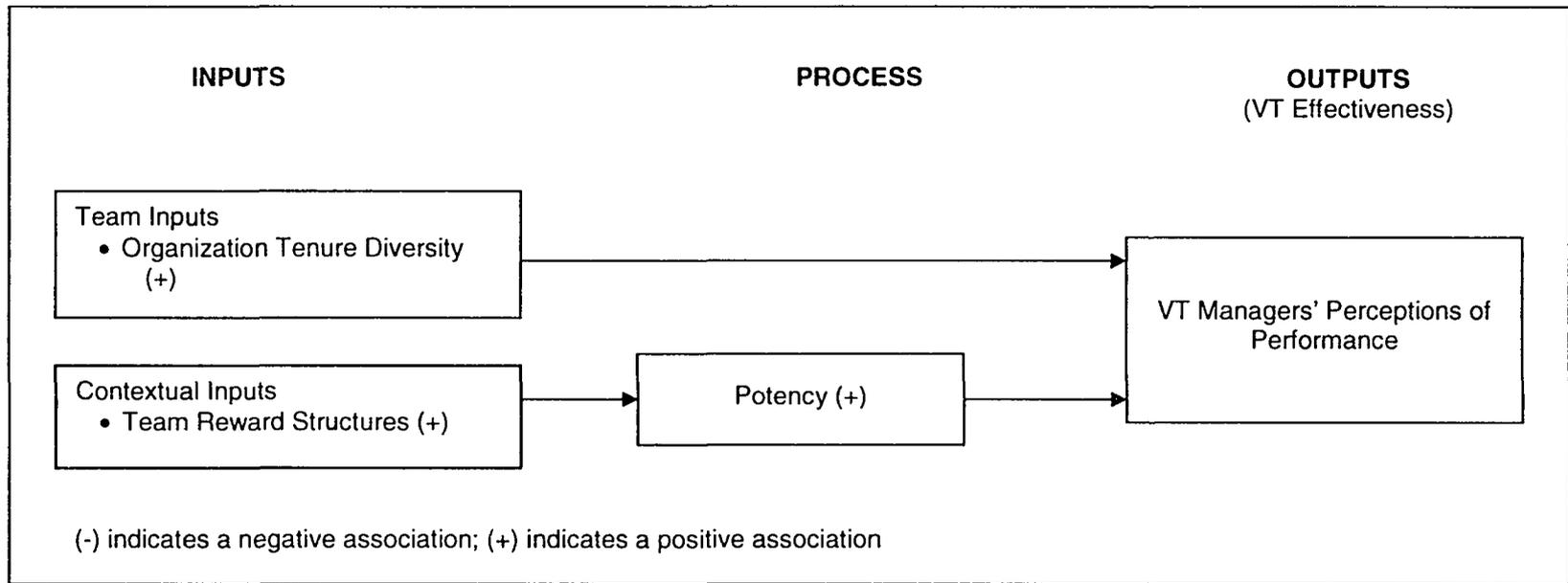
The model does not contain many variables and it is possible that there are other, as yet unidentified, elements which are relevant to these dimensions of VT effectiveness. These two dimensions of VT effectiveness were developed for the purposes of this study. As such there are no indications in the literature as to what these unknown elements might be. There is a need for research to identify these elements (and/or determine if they exist).

### **6.5.3 Proposed Model for VT Managers' Perceptions of Team Performance**

The managers' perceptions of VT effectiveness is presented in its own model, as it seems to be determined differently from the other dimensions of VT effectiveness. The model is presented in Figure 14. This model follows combination of the input→process→output and input→output form. It is similar to the proposed model of VT members' perceptions of performance and VT member satisfaction in that in both models VT processes are posited to play a mediating role in the relationship between the inputs and the outputs. It is different, however, from the model of VT members' perceptions of performance and VT member satisfaction in four important ways. First, only one team process (potency) is included in the model. This decision was based on the fact that in this study, only potency was found to be significantly correlated to VT managers' perceptions of performance. Second, only one input variable was found to be indirectly associated with this output (through the process). Third, only one input was found to have a direct association with this output. Fourth, degree of virtuality is hypothesized to play no role in this model. This reflects the fact that none of the

dimensions of degree of virtuality were significantly correlated to this output in this research. The model posits that VT managers' perceptions of performance are not influenced by the degree that the team members work apart, but rather on other components, such as the members belief in their potential for success.

The inputs that are hypothesized to be associated with this dimension of VT effectiveness are organization tenure diversity (direct association) and team rewards (indirect association through process). No demographic variables were found to have a significant correlation with this output, and as such, they are not posited to play a role in this model. Although some demographic variables were shown to have significant correlations with all of the dimensions of VT effectiveness which are based on members' perceptions, they did not have any significant correlations with the VT managers' perceptions of performance. This suggests that the demographic variables are associated with VT members' perceptions, but not VT managers' perceptions of performance.



**Figure 14: Proposed Model for VT Managers' Perceptions of Performance**

In addition, the relationship between the process variable in this model (potency) and the output was not as strong as those between the processes and outputs in the model for VT members' perceptions of performance and VT member satisfaction. This suggests that there may be other, as yet unidentified, elements which are relevant to this dimensions of VT effectiveness. Although perception of performance is one of the most commonly studied dimensions of team effectiveness, it is generally the members' perceptions, not the manager' which are studied. As such this aspect of effectiveness is relatively undeveloped and there is a need for research to identify the elements which may be associated with VT managers' perceptions of performance.

#### **6.5.4 Summary of Models of Virtual Team Effectiveness**

The results of this study indicate that the different dimensions and perceptions of VT effectiveness should be conceptualized in different ways. The use of a single model to represent and test the differing dimensions of team (and VT) effectiveness was a major criticism of the existing literature. These results support the contention that different models are needed for different dimensions of effectiveness. This result likely holds true for both virtual and proximate teams.

The differing components reflected in these models indicate that the antecedents to VT effectiveness differ according to the type of effectiveness being assessed (i.e. VT members' perceptions of performance, VT members' perceptions of professional development, etc.). In accordance with this conceptualization, managers and organizations wanting to influence the success of VTs must first decide which aspects of

success that they are most interested in and then they can manipulate the inputs which will have the greatest association with that dimension.

This study also indicates that virtuality plays the role of an input in one of the proposed models of VT effectiveness. The effect of degree of virtuality on the outputs (VT members' perceptions of performance and VT member satisfaction) is posited to be mediated by the team processes. In other words, the degree that a team is virtual affects both the team processes directly, and the team outcomes, indirectly.

This research has determined that many of the variables commonly included in team research (virtual and proximate) are not associated with VT effectiveness. This reduction in the set of variables provides focus in future research in this area.

Some of the input variables commonly studied in the research, were not found, in this study, to be associated with VT effectiveness. VT size, face-to-face meeting history, and team member diversity with respect to age, education, position tenure, team tenure, and expertise are not included in the models. The fact that the diversity inputs were not found to have any relationship to the team processes or outputs, suggests that the aspects of diversity that have been highlighted in the proximate team literature perhaps do not apply to the virtual environment. The fact that team size was not found to be related to any of the other components in the framework may be due to the limited size of the VTs in this study. Interestingly, whether or not VTs had met face-to-face was not associated

with VT effectiveness. It is possible that the time spent together at an occasional meeting is not enough to overcome the negative implications of virtual work (i.e. perceptions of less positive interactions).

One of the process variables included in this study (task commitment) was not found to be correlated to any of the VT outputs and was therefore not included in any of the models. Although many of the input variables were found to have significant relationships with this process, these relationships are of limited interest if no connection is made with VT effectiveness. This result calls into question the use of task commitment as a proxy for VT effectiveness as has been done in the literature (Huang et. al., 2002).

These proposed models of VT effectiveness can now be tested in future research. In addition, these models provide researchers, managers and organizations with a better understanding of how to assemble, equip, develop, support and manage VTs.

## **6.6 LIMITATIONS OF THIS RESEARCH AND AREAS OF FUTURE RESEARCH**

The primary limitation in this study is its small sample size. A sample size of thirty teams, while representing a relatively large sample in the area of VT research, is limiting in terms of the analysis that can be employed. As such, only correlations (and partial correlations) could be calculated. A small sample size also increases the critical values for significant correlations, making it very difficult to find significant correlations. As such, the level of significance in this study was relaxed to reduce the probability that a

variable would be erroneously eliminated due to lack of significant correlation. The impact of this is that some of the significant correlations reported in this research may have occurred by chance, and as such non-significant variables may have been included in the models. In addition, because of limitations with respect to the analyses performed (correlations and regressions), only linear relationships were explored. Again, studies including larger sample sizes should be undertaken to permit more sophisticated analysis. As the models developed in this study have provided insight into the nature of the relationships between the components of VT effectiveness and reduced the large body of variables, more focused research will also permit more sophisticated analysis to be performed.

This study is further limited by its generalizability. The sample for this research was collected from a single organization. The organization has some very distinct characteristics, which showed themselves in the data. The VTs in this sample were highly educated and very proficient in the use of the technological tools necessary for VT work. The teams were also very well equipped with respect to the availability of tools. This is because the organization under study is in the telecommunications industry and its employees are primarily knowledge workers. The results of this study may be generalized only to those VTs in this organization, to other organizations in the telecommunications industry or to other VTs populated with knowledge workers. The ability of this organization to provide access to a relatively large number of VTs was, however, a rare opportunity. Future research should make the attempt to collect data

from intact VTs working at different organizations. This opportunity may present itself as more becomes known about VT and they become more popular.

Team activities take place over time, and one of the major criticisms of team and group research has been the reliance on cross-sectional data (Katz, 1982). Many of the variables, most notably the process components and team effectiveness components should be measured longitudinally, "in order to get an accurate picture of the team" (Baker & Salas, p. 337). However, longitudinal data of this type is extremely difficult to come by (it was difficult enough to get 30 busy VTs to agree to participate in a cross-section study) and due to practical considerations, only cross sectional data was collected. This study can serve as a first step, however, by providing the measures and identifying the appropriate variables for future longitudinal studies (Katz, 1982).

Given the small sample and limited variances in this study and the large number of analyses performed, the tests for the moderating effect of degree of virtuality were limited and not conclusive (i.e. no clear evidence of a moderating effect was found). To improve the confidence that degree of virtuality does not play a moderating role in VT effectiveness, future research on degree of virtuality is warranted.

The frameworks and analysis were limited in the following ways. First, the frameworks were presented as a proposed conceptualization of the variables of study. The purpose was not to test a model, but to refine the framework into a model (or models) that can be tested in the future. Second, the research framework did not include all possible

variables, as time and sample constraints prohibit the inclusion of an unlimited number of variables. The large number of variables in the framework, when paired with the small sample size, prohibited complex analysis. Also, due to the cross-sectional nature of this research, the analysis did not test causal relationships. It did, however, provide three models of VT effectiveness that can serve as a basis for future research.

Finally, this study does not address one of the critical issues in the field of VTs: Under what circumstances would it be best to employ VTs and when would it be better to dedicate the time and resources to co-locating? While this question was not the focus of this study, it is acknowledge that the models in this study could be more appropriately applied if such a question could be answered.

This thesis has identified a number of other areas where future research should be directed. First, the relationship between the computer proficiency of the members of a VTs and team processes and outcomes was found in this research to be in the opposite direction than expected. The potentially negative effect of high levels of computer expertise on VT interactions and outcomes should be further explored.

Second, this research indicated that a VT's degree of virtuality has an indirect relationship with VT effectiveness through processes. This research, however, included VTs from within one region of Canada. The role of degree of virtuality should be

investigated further using teams that are dispersed across a greater range of distances to determine the relative importance of the different dimensions of virtuality.

Third, this research concluded that the different dimensions of VT effectiveness have different antecedents and should be represented by different models. The models describing VT members' perceptions of professional development and capacity for future VT work and VT managers' perceptions of performance contain only a few variables. Further research is need to explore the non-traditional dimensions of VT effectiveness and investigate their measures and antecedents.

Finally, this research has provided a model of VT members' perceptions of performance and VT member satisfaction. Further research should be conducted to test and refine this model.

## **6.7 CONTRIBUTIONS OF THIS RESEARCH**

This study makes six contributions. First, it responds to the frequent appeal for research that is specifically designed for VTs, rather than adapted from proximate teams. This is accomplished through the review of both the team and VT research and attempts to make comparisons and distinctions between them with the purpose of identifying components that may be related to VT effectiveness.

Second, it develops four measures which do not currently exist in the literature, organizational support and non-support of VTs and managerial support and non-support

of VTs. These new measures have high reliability and validity and provide researchers and managers with a better understanding of the kinds of support that VTs need to be effective. They provide a mechanism to measure and track the supportiveness of both managers and organizations in order to determine problems areas. These measures are also useful for future research on VTs.

Third, it explores the meaning of VT effectiveness and proposes a construct of VT effectiveness that reflects the unique characteristics of VTs. This allows researchers and managers to better evaluate VT success, rather than basing judgements on proximate team constructs which may disadvantage VTs.

Fourth, it proposes a measure of degree of virtuality, and examines the effect of virtuality on the relationship between components of effectiveness and VT effectiveness. This allows teams of varying virtuality to be better studied and compared. It also provides organizations and managers with an indication of the associations between the three dimensions of degree of virtuality and the VT interactions and effectiveness. This information can be used in the design and management of VTs. Understanding the relationship between degree of virtuality, VT processes and VT effectiveness also helps managers to mitigate the negative effects of virtuality. For example, if we know that the amount of time that team members spend working virtually has a negative association with team potency (and effectiveness, indirectly), we can either schedule regular face-to-face meetings to reduce the team time worked virtually and/or we can provide more managerial support thorough facilitating to counteract the negative effects of working

long-distance. Also, it should be noted that the conceptualization of virtuality as a continuum in this research broadens the definition of VTs. This should make it easier to conduct research on intact VTs.

Fifth, this thesis examines the relationship between the potential antecedents of effectiveness and VT effectiveness and provides proposed models of VT effectiveness. Different models of team effectiveness were developed to reflect the differing dimensions of effectiveness. The different models support the idea that not all aspects of VT effectiveness are associated with the exact same set of variables, in the same way. This research suggests that if we want a VT to be successful in the eyes of the manager, we have to look at different variables than if we want the VT members to be satisfied or perceive themselves to be effective. This also underscores the necessity to collect less subjective data with respect to VT performance, and reveals the danger inherent in relying solely on the perceptions of VT members.

Finally, this thesis provides research conducted with real, ongoing VTs under real conditions, rather than under the simulated conditions that dominate the current research. As such, there is greater confidence that the findings of this research reflect the circumstances of real virtual teams.

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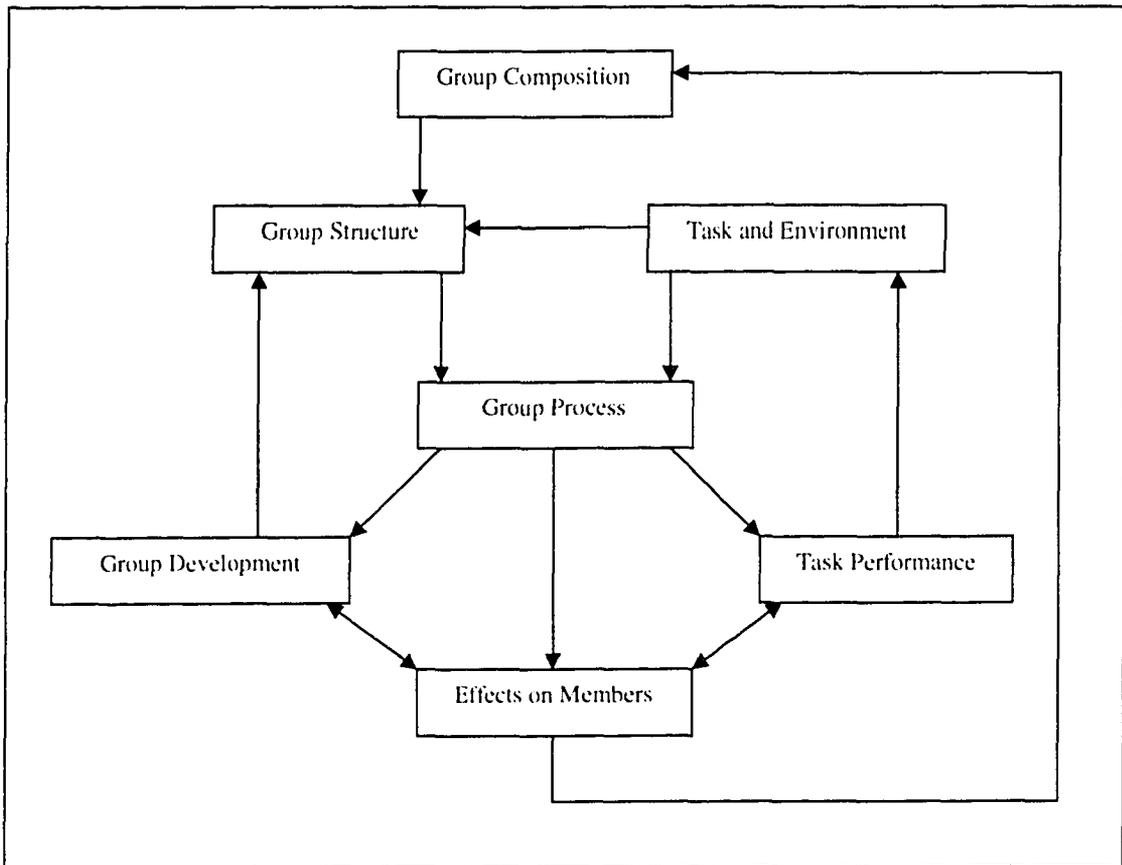
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**APPENDIX A: DIMENSIONS OF AND COMPONENTS ASSOCIATED WITH  
TEAM EFFECTIVENESS**

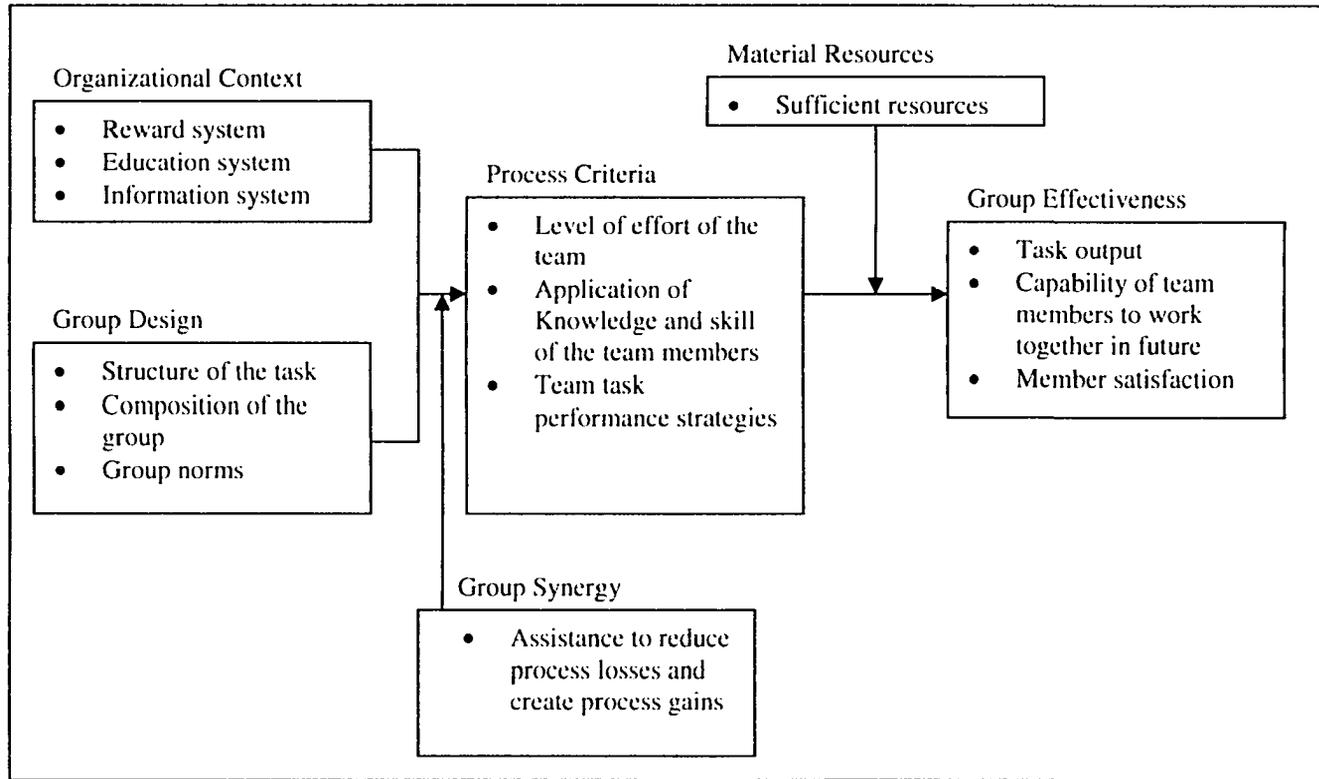
Author	Effectiveness Dimension	Components Associated with Effectiveness	
		INPUTS	PROCESS
Campion et al. (1993)  Empirically tested: Yes	<ul style="list-style-type: none"> <li>• Productivity</li> <li>• Satisfaction</li> <li>• Manager Judgements</li> </ul>	<p>Job Design</p> <ul style="list-style-type: none"> <li>• Self-Management</li> <li>• Participation</li> <li>• Task Variety</li> <li>• Task Significance</li> <li>• Task Identity</li> </ul> <p>Interdependence</p> <ul style="list-style-type: none"> <li>• Task Interdependence</li> <li>• Goal Interdependence</li> <li>• Interdependent Feedback &amp; Rewards</li> </ul> <p>Composition</p> <ul style="list-style-type: none"> <li>• Heterogeneity</li> <li>• Flexibility</li> <li>• Relative Size</li> <li>• Preference for Team Work</li> </ul> <p>Context</p> <ul style="list-style-type: none"> <li>• Training</li> <li>• Managerial Support</li> <li>• Communication/Cooperation between Teams</li> </ul>	<ul style="list-style-type: none"> <li>• Potency</li> <li>• Social Support</li> <li>• Workload Sharing</li> <li>• Communication/ Cooperation within Team</li> </ul>
Cohen & Bailey (1997)  Empirically tested: No	<ul style="list-style-type: none"> <li>• Performance Outcomes (quality)</li> <li>• Attitudinal Outcomes (Satisfaction, trust)</li> <li>• Behavioural Outcomes (turnover, absenteeism)</li> </ul>	<p>Task Design</p> <ul style="list-style-type: none"> <li>• Autonomy</li> <li>• Interdependence</li> </ul> <p>Group Composition</p> <ul style="list-style-type: none"> <li>• Size</li> <li>• Tenure</li> </ul> <p>Organizational Context</p> <ul style="list-style-type: none"> <li>• Rewards</li> <li>• Supervision</li> </ul> <p>Group Psychosocial Traits</p> <ul style="list-style-type: none"> <li>• Norms</li> <li>• Mental Models</li> </ul> <p>Environmental Factors</p> <ul style="list-style-type: none"> <li>• Turbulence</li> <li>• Industry</li> </ul>	<ul style="list-style-type: none"> <li>• Conflict</li> <li>• Communication</li> </ul>
Fry & Slocum (1984)  Empirically tested: Yes	<ul style="list-style-type: none"> <li>• Productivity</li> <li>• Flexibility</li> <li>• Adaptability</li> </ul>	<p>Technology</p> <ul style="list-style-type: none"> <li>• Interdependence</li> <li>• Variety in Work</li> <li>• Ease of Finding Solutions</li> <li>• Structure</li> </ul>	

Author	Effectiveness Dimension	Components Associated with Effectiveness	
		INPUTS	PROCESS
Gladstein (1984)  Empirically tested: Yes	<ul style="list-style-type: none"> <li>• Group Performance</li> <li>• Satisfaction of members</li> <li>• Ability of group to exist over time</li> </ul>	<p>Group Composition</p> <ul style="list-style-type: none"> <li>• Adequate Skills</li> <li>• Heterogeneity</li> <li>• Organizational Tenure</li> </ul> <p>Group Structure</p> <ul style="list-style-type: none"> <li>• Role &amp; Goal Clarity</li> <li>• Specific Work Norms</li> <li>• Task Control</li> <li>• Size</li> <li>• Formal Leadership</li> </ul> <p>Resources Available</p> <ul style="list-style-type: none"> <li>• Training &amp; Technical Consultation</li> <li>• Markets Served</li> </ul> <p>Organizational Structure</p> <ul style="list-style-type: none"> <li>• Rewards for Group Performance</li> <li>• Supervisory Control</li> </ul> <p>Group Task (Moderator)</p> <ul style="list-style-type: none"> <li>• Task Complexity</li> <li>• Environmental Uncertainty</li> <li>• Interdependence</li> </ul>	<ul style="list-style-type: none"> <li>• Open Communication</li> <li>• Supportiveness</li> <li>• Conflict</li> <li>• Discussion of Strategy</li> <li>• Weighing Individual Inputs</li> <li>• Boundary Management</li> </ul>
Goodman et al. (1986)  Empirically tested: No	<ul style="list-style-type: none"> <li>• Group Output</li> <li>• Organizational Commitment</li> </ul>	<p>Group Composition</p> <ul style="list-style-type: none"> <li>• Adequate Skills</li> <li>• Heterogeneity</li> <li>• Organizational Tenure</li> <li>• Job Tenure</li> </ul> <p>Group Structure</p> <ul style="list-style-type: none"> <li>• Role &amp; Goal Clarity</li> <li>• Work Norms</li> <li>• Task Control</li> <li>• Size</li> <li>• Formal Leadership</li> </ul> <p>Resources</p> <ul style="list-style-type: none"> <li>• Training &amp; Technical Consultation</li> <li>• Markets Served</li> </ul> <p>Organizational Structure</p> <ul style="list-style-type: none"> <li>• Rewards for Group Performance</li> <li>• Supervisory Control</li> </ul> <p>Task (moderator)</p> <ul style="list-style-type: none"> <li>• Task Complexity</li> <li>• Environmental Uncertainty</li> <li>• Interdependence</li> </ul>	<ul style="list-style-type: none"> <li>• Open Communication</li> <li>• Supportiveness</li> <li>• Conflict</li> <li>• Discussion of Strategy</li> <li>• Weighing Individual Inputs</li> <li>• Boundary Management</li> </ul>
Katz (1982)  Empirically tested: Yes	<ul style="list-style-type: none"> <li>• Performance (schedule, cost, innovativeness adaptability)</li> </ul>	<ul style="list-style-type: none"> <li>• Communication</li> <li>• Longevity</li> <li>• Size</li> <li>• Task</li> </ul>	

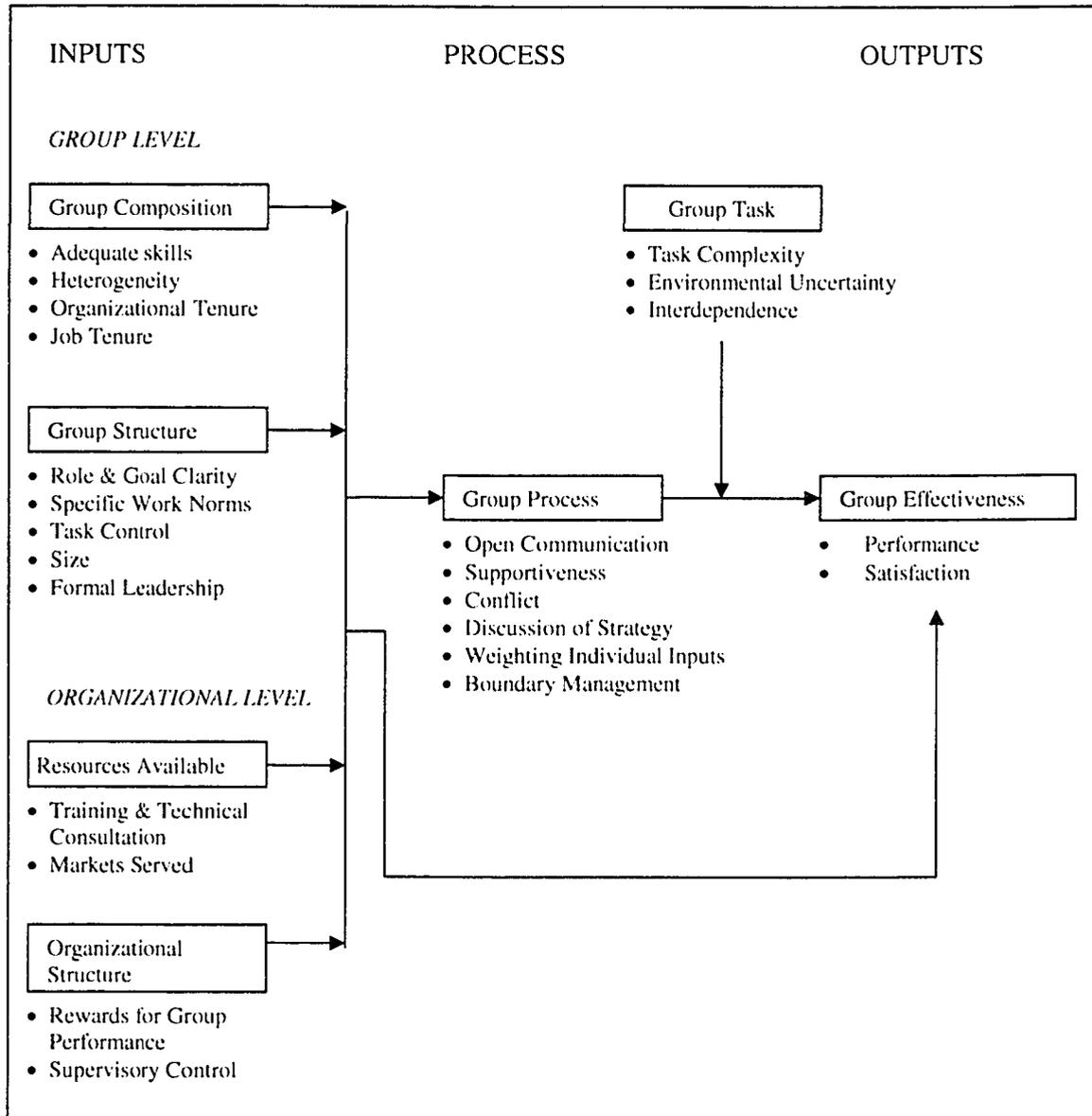
Author	Effectiveness Dimension	Components Associated with Effectiveness	
		INPUTS	PROCESS
Keller (1986)  Empirically tested: Yes	<ul style="list-style-type: none"> <li>• Technical Quality</li> <li>• Budget</li> <li>• Schedule</li> <li>• Value to organization</li> <li>• Overall Performance</li> </ul>	<ul style="list-style-type: none"> <li>• Education</li> <li>• Gender</li> <li>• Age</li> <li>• Cohesiveness</li> <li>• Satisfaction</li> <li>• Self – Esteem</li> <li>• Innovative Orientation</li> <li>• Equipment</li> <li>• PM Influence</li> <li>• Proximity</li> <li>• Size</li> <li>• Task</li> </ul>	
Kolodny & Kiggundu (1980)  Empirically tested: Yes	<ul style="list-style-type: none"> <li>• Productivity (cost, output, loss of skilled labour)</li> <li>• Satisfaction (pay, pride, cohesiveness)</li> </ul>	<ul style="list-style-type: none"> <li>• Task Conditions</li> <li>• Organizational Arrangements <ul style="list-style-type: none"> <li>○ Number of Shifts &amp; Rotation</li> <li>○ Transportation Patterns</li> <li>○ Group Bonus</li> <li>○ Training</li> <li>○ Feedback</li> <li>○ Goal Setting</li> </ul> </li> <li>• Leadership &amp; Supervision</li> <li>• Technical Skills</li> </ul>	(Group Interaction) <ul style="list-style-type: none"> <li>○ Mutual Influence</li> <li>○ Equity</li> <li>○ Problem Solving</li> <li>○ Openness</li> <li>○ Informal Leadership</li> </ul>
Magjuka and Baldwin (1991)  Empirically tested: Yes	<ul style="list-style-type: none"> <li>• Performance</li> </ul>	Composition <ul style="list-style-type: none"> <li>• Size</li> <li>• Heterogeneity</li> <li>• Personality</li> </ul> Resources <ul style="list-style-type: none"> <li>• Information Access</li> <li>• Hours expended</li> </ul> Rewards <ul style="list-style-type: none"> <li>• Financial rewards</li> <li>• Other</li> </ul>	
Rickards et al. (2001)  Empirically tested: Yes	<ul style="list-style-type: none"> <li>• Creativity</li> <li>• Productivity</li> </ul>	<ul style="list-style-type: none"> <li>• Platform of Understanding</li> <li>• Shared Vision</li> <li>• Creative Climate</li> <li>• Idea Owners</li> <li>• Resilience</li> <li>• Network Activators</li> <li>• Learning</li> <li>• Leadership</li> </ul>	

**APPENDIX B: MCGRATH'S (1964) FRAME OF REFERENCE FOR ANALYSIS OF GROUPS**

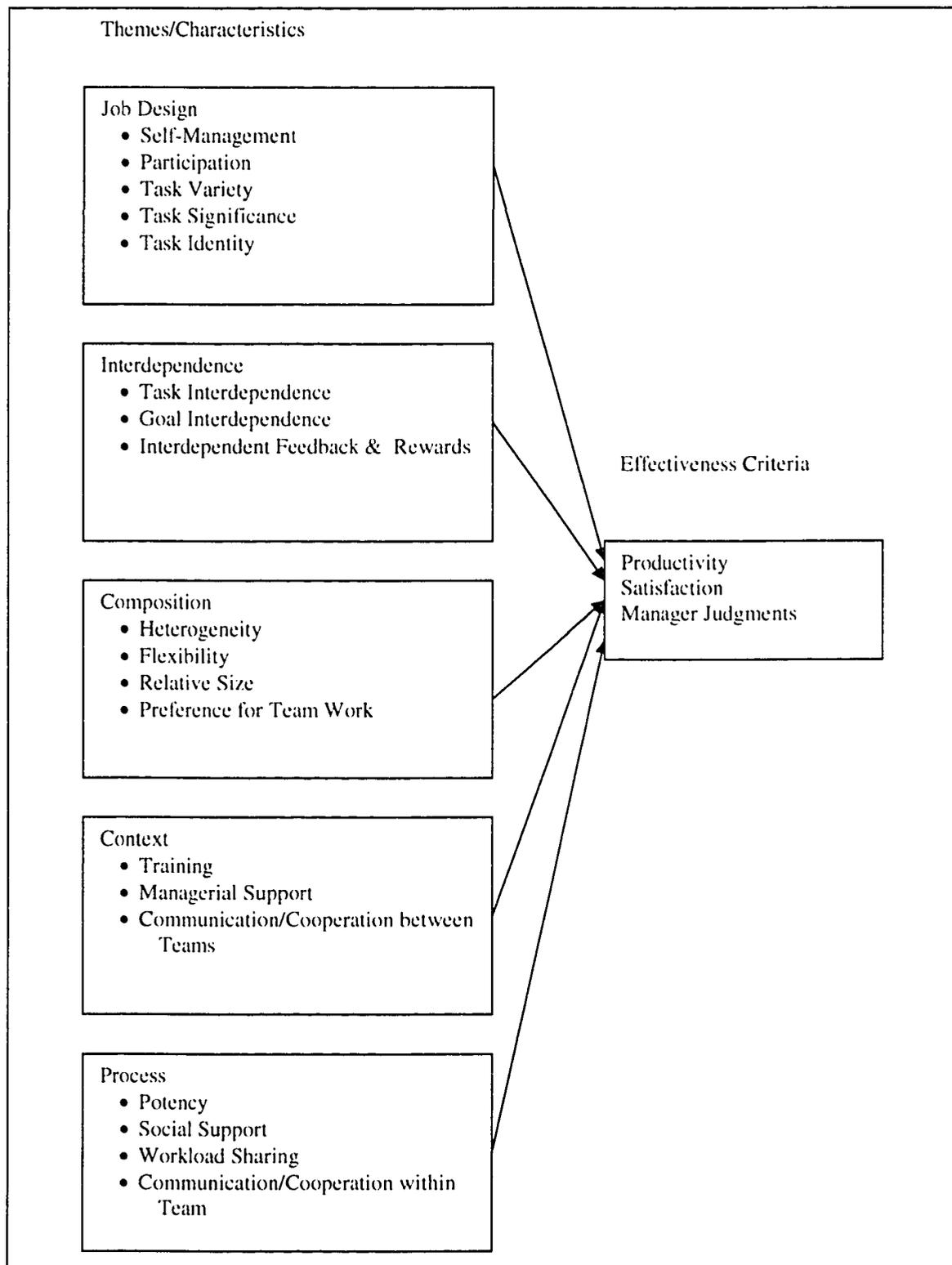
### APPENDIX C: HACKMAN'S (1983) NORMATIVE MODEL OF GROUP EFFECTIVENESS



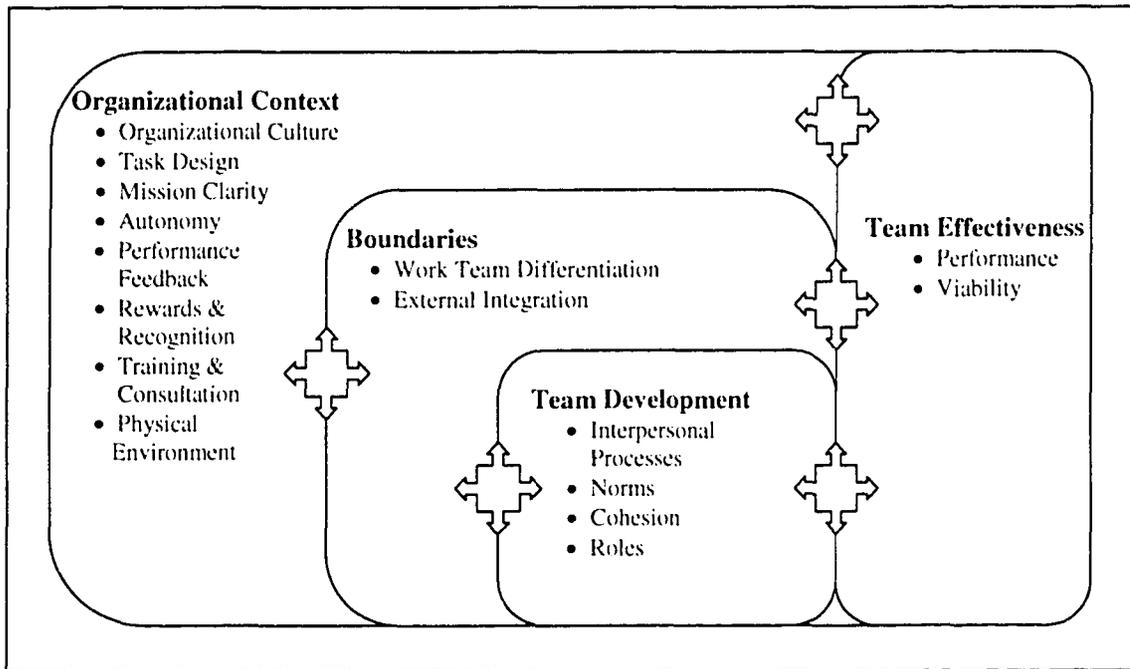
## APPENDIX D: GLADSTEIN'S (1984) GENERAL MODEL OF GROUP BEHAVIOUR



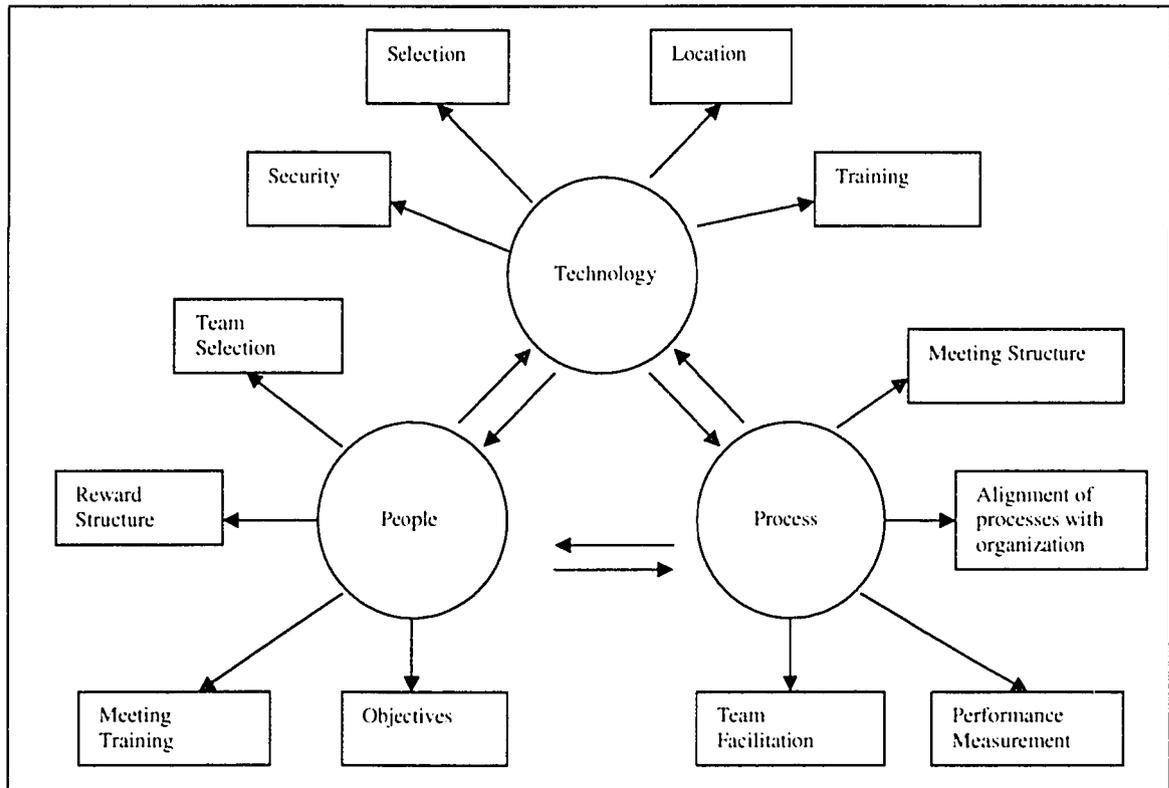
**APPENDIX E: CAMPION ET AL.'S (1993) THEMES AND CHARACTERISTICS  
RELATED TO WORK TEAM EFFECTIVENESS**



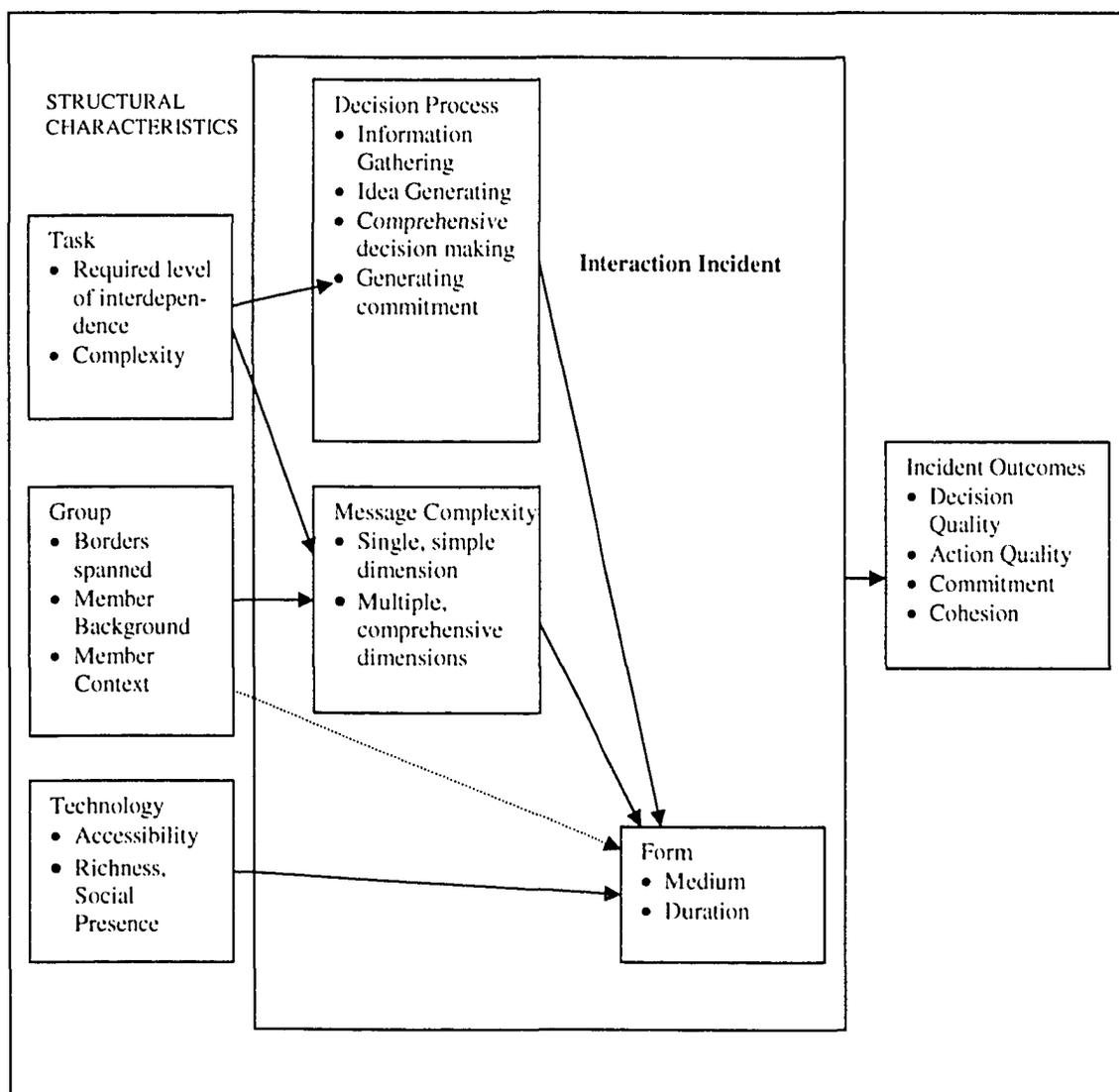
**APPENDIX F: SUNDSTRUM ET AL.'S (1990) ECOLOGICAL FRAMEWORK  
FOR ANALYZING WORK TEAM EFFECTIVENESS**



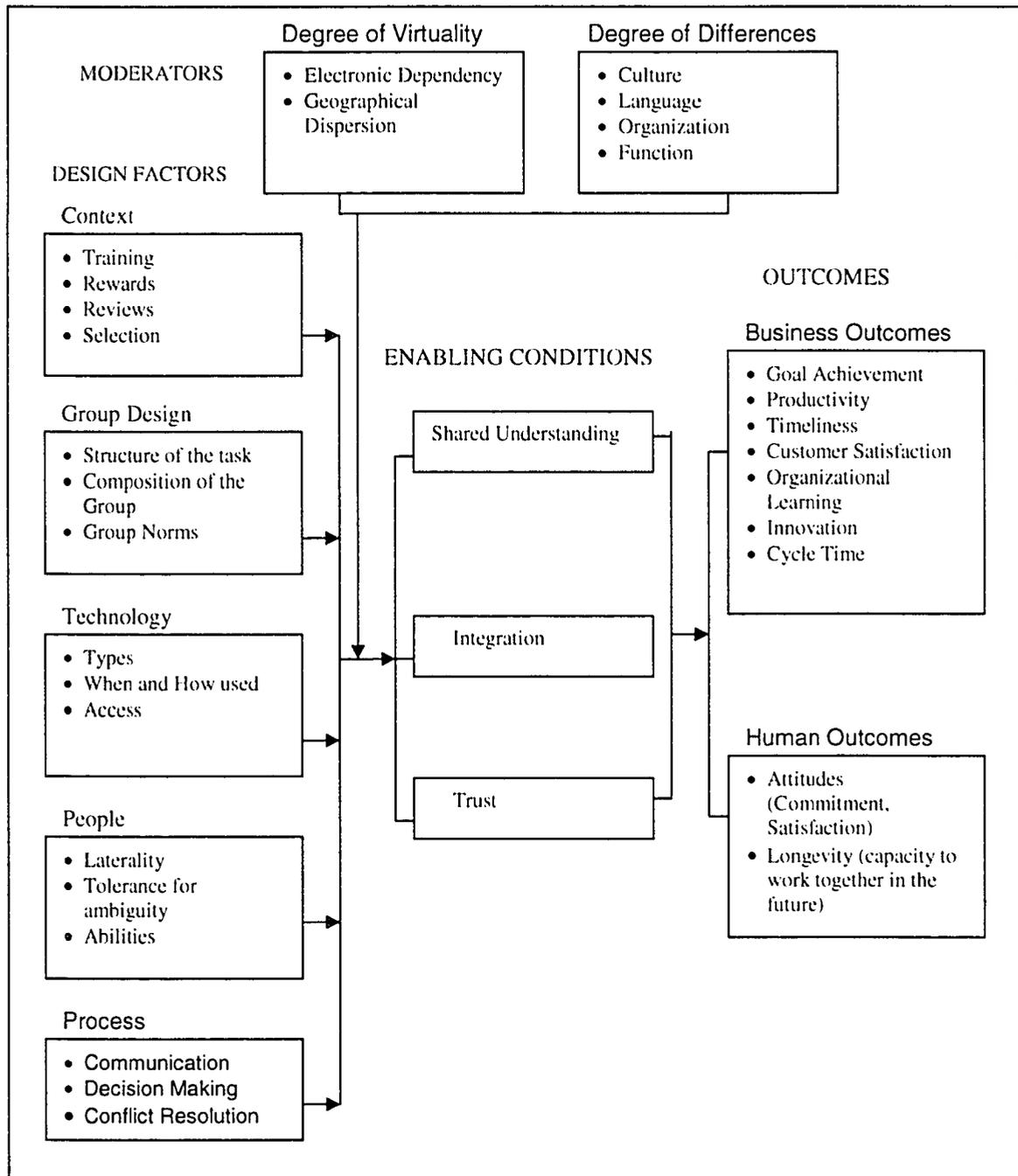
**APPENDIX G: BAL & GUNDRY'S (1999) FRAMEWORK FOR EFFECTIVE VIRTUAL TEAMWORKING**



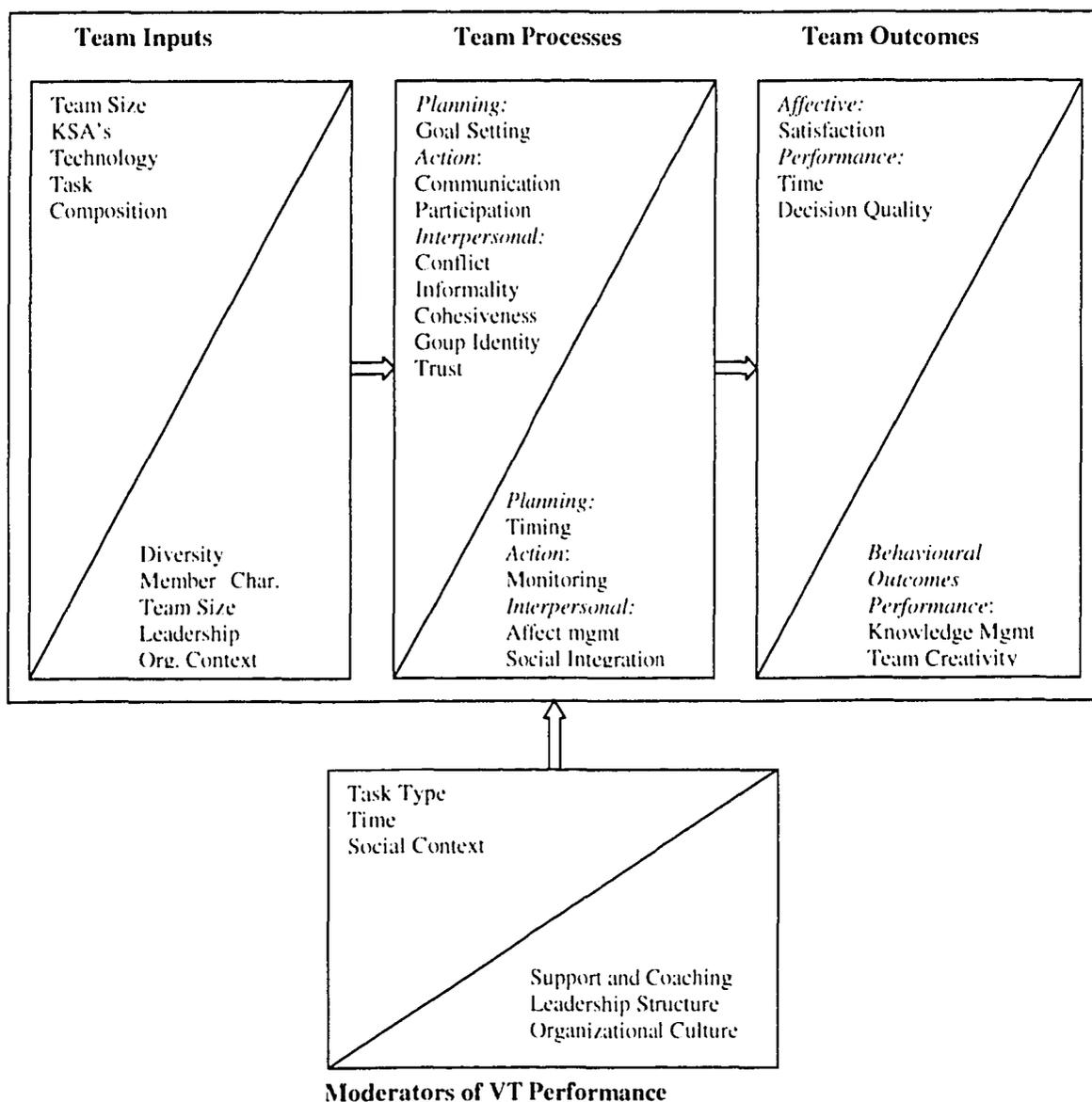
**APPENDIX H: MAZNEVSKI & CHUDOBA'S (2000) MODEL OF  
INTERACTION INCIDENTS IN GLOBAL VTS**



**APPENDIX I: COHEN & GIBSON'S (2003) MODEL OF EFFECTIVE VTS**

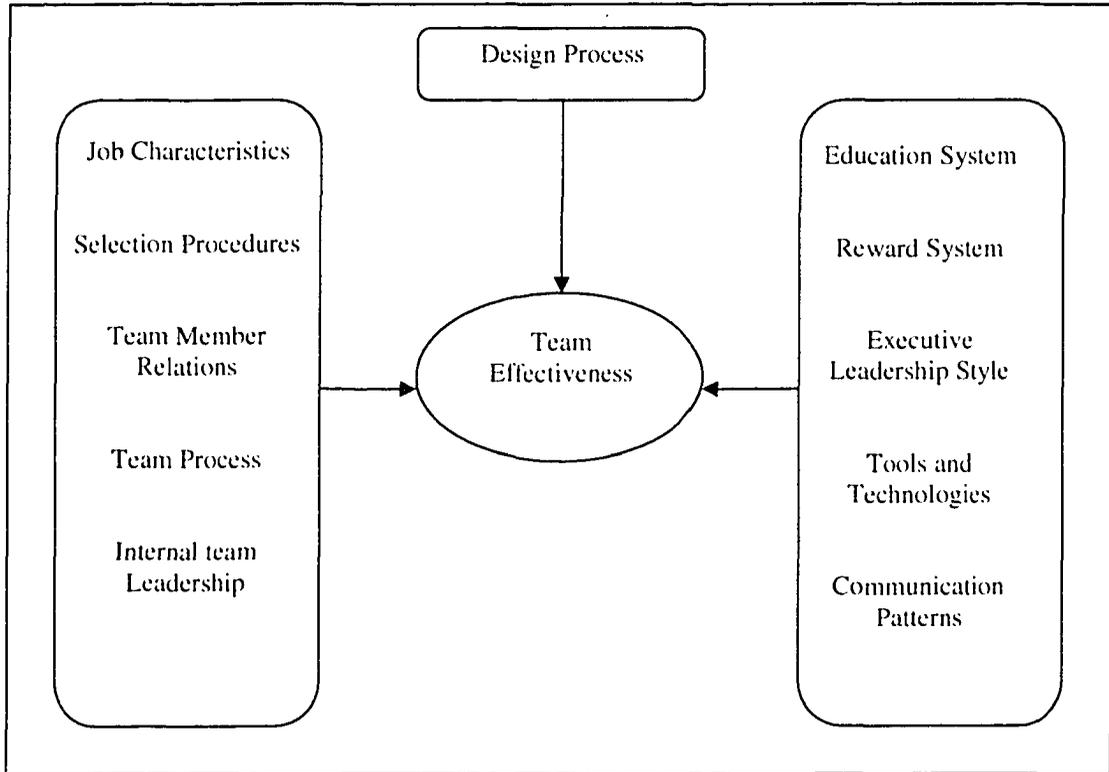


## APPENDIX J: MARTINS ET AL.'S (2003) MODEL OF VIRTUAL FUNCTIONING\*

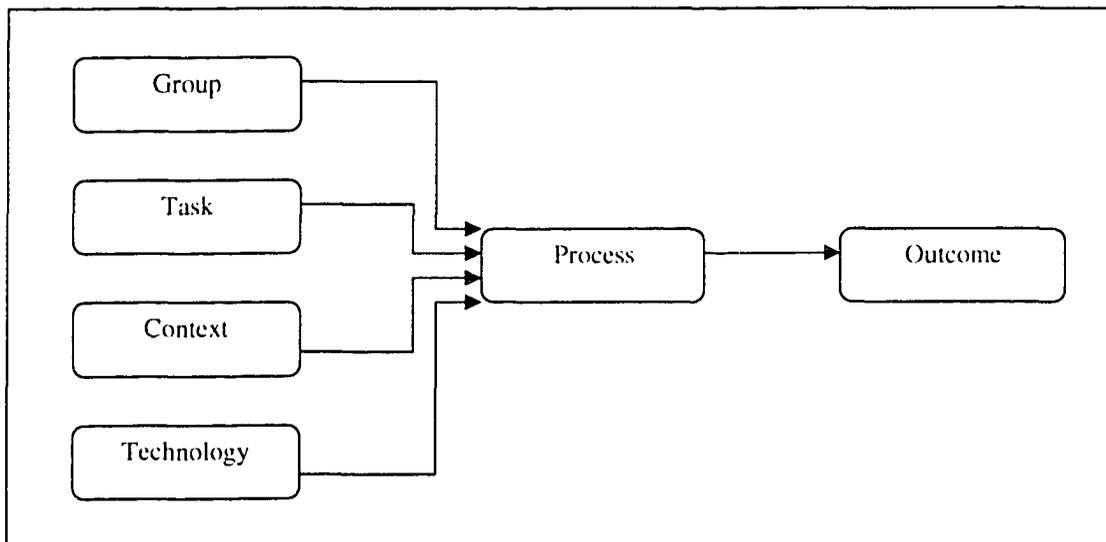


\*Variables that have been examined in the research are listed above the diagonal and those in need of future research are listed below.

### APPENDIX K: LUREY AND RAISINGHANI'S (2001) META-MODEL AND FRAMEWORK



**Framework of Predictor Variables**



**Meta-Level Research Model**

## APPENDIX L: VT EMPIRICAL RESEARCH

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### Andres (2002)

**Title:** A Comparison of Face-to-Face and Virtual Software Development Teams

**Objective:** To compare the impact of face-to-face and videoconferencing collaboration on software development project success.

**Model:** PARTIAL

**Sample:** 48 teams of students (4 members)

**Definition of Virtual Teams:** "Groups of individuals collaborating in the execution of a specific project while located at multiple individual sites or multiple group sites."

**Dependent Variables:** Team productivity (schedule, budget, quality), interaction quality, process satisfaction.

**Intervening Variable:** Group process (participation, negotiation, clarification of efforts, information exchange).

**Independent Variables:** Communication medium (face-to-face, virtual).

**Summary:** It was theorized that group processes would determine the effect that communication medium would have on team outcomes because richer media would support the team development process and provide for more social presence. Based on media richness theory, it was expected that a communication medium's richness would affect team productivity and member satisfaction (lean media inhibit a team's well-being and support functions). The students were randomly assigned to teams and the teams were divided into dyads (sub-teams). The teams performed a single task with a duration of 3 hours. Both types of teams were limited to a single mode of communication (face-to-face or two-way audio-video conferencing). All of the students were restricted to communicating through voice. The intervening variable was not included in the study. Two of the three dimensions of effectiveness were traditional (productivity, satisfaction). The third was defined as interaction quality and was operationalized to measure the negative opinions and frustrations felt about team members' behaviour.

**Major Findings:** Rich communication medium resulted in higher productivity and interaction quality, but had no significant effect on process satisfaction.

**Limitations:** This study presented a partial model with an intervening variable, but the intervening variable was not measured and analyzed. There was no discussion of why the third dimension of effectiveness was included in the model, or for the way in which it was operationalized. It could be argued that interaction quality is a process variable. Although the sample size was relatively large (48), the teams were simulated (made up of students) and limited to a single medium of communication (voice). It is not clear what effect the formation of sub-teams (2 dyads per team) would have on this study. The task was also contrived and lasted only 3 hours.

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**Alge et al. (2003)**

**Title:** When Does the Medium Matter? Knowledge-Building Experiences and Opportunities in Decision-Making Teams

**Objective:** To determine the effect that a team's past and prospects of a future have on the communication effectiveness of face-to-face and computer-mediated teams.

**Model:** PARTIAL

**Sample:** 66 teams of students (3 members per team).

**Definition of Virtual Teams:** "Teams that meet through electronic media."

**Dependent Variable:** Decision making effectiveness (performance).

**Intervening Variable:** Communication effectiveness (openness/trust, team-member exchange, information sharing).

Moderating Variable: Task interdependence

**Independent Variables:** Temporal scope, communication media.

**Summary:** It was theorized that the temporal scope of teams would be related to decision effectiveness. Half of the teams completed their tasks face-to-face in labs. The other half completed their tasks using synchronous chat facilities in different rooms. Three types of teams were identified with respect to temporal scope: ad hoc (temporary) teams, past teams (teams with a history), and future teams (teams that expect to work together in the future). The teams were formed by randomly assigning students. The temporal scope was simulated by managing the students' expectations of future team work. The teams performed two very short tasks each. The tasks were completed during one lab time, after which the students were asked to complete questionnaires. In order to measure the effects of task interdependence, the teams were given one task with low and one task with high interdependence.

**Major Findings:** The results indicated that when newly formed, face-to-face teams have greater levels of openness/trust and information sharing than Virtual Teams. However, for teams with a history, there were no differences in openness/trust and information sharing. This indicates that Virtual Teams may take longer to gear up, but that they eventually would catch up to proximate teams. Although face-to-face teams exhibited higher team-member exchange, the interaction of temporal scope and communication media was not significant. In addition, openness/trust and team-member exchange were positively associated with decision-making effectiveness when task interdependence was high, but were unrelated when task interdependence was low. To summarize, virtuality only affected outcomes when teams were new.

**Limitations:** This study presented a very simple model, but involved a very complicated research design. Two kinds of teams, two kinds of tasks and three types of temporal scope were studied using only 66 teams. The study was also highly simulated. All of the teams were restricted to only one mode of communication. The tasks performed were very short-term (one lasted only 12 minutes). Finally, the assignment of a task with low interdependence is contrary to one of the defining characteristics of teams (high interdependence). Tasks with low need for interaction and collaboration may not be well-suited to teamwork. Although the sample size was relatively large, the complicated design and simulated setting limit the generalizability.

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**Carletta et al. (2000)**

**Title:** The Effects of Multimedia Communication Technology on Non-Collocated Teams: A Case Study.

**Objective:** To explore the effects of introducing multimedia communication technology on non-collocated teams.

**Model:** No.

**Sample:** 2 teams of automotive supply chain teams.

**Definition of Virtual Teams:** "Non-collocated teams."

**Summary:** The researchers began the study by facilitating a discussion with team members about working in non-collocated teams. The discussion was geared towards identifying the strengths, weaknesses, opportunities and threats associated with virtual work. Next, the participants filled out a questionnaire regarding their experiences with non-collocated teams and information technology. The teams were then observed meeting face to face and using multi-media communication technology. Semi-structure interviews were also conducted after the meeting observations.

**Major Findings:** The results showed that one of the greatest challenges of non-collocated teams was overcoming hierarchical differences and learning to share information. Team sociability was reduced, as was team solidarity. Improved communication technology might improve team interaction, but teams were best supported by technology that allows opportunistic rather than scheduled interactions.

**Limitations:** This is a study that used multiple sources of data in a real setting. However, the very small sample size limits its generalizability.

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**Furst et al. (2004)**

**Title:** Managing the Life Cycle of Virtual Teams

**Objective:** To assess how Virtual Teams develop and which factors contribute to effectiveness at each stage of development.

**Model:** NO

**Sample:** 6 virtual project teams

**Definition of Virtual Teams:** "Teams with individuals who are geographically dispersed and interact primarily through telecommunication and information technology to accomplish specific objectives."

**Dependent Variables:** Effectiveness (quality)

**Independent Variables:** Mission clarity, communication, commitment, trust.

**Summary:** Six Virtual Teams were followed and observed for 8 months, through inception to project delivery. Tuckman's 4-stage model of team development was used. Data was collected through observations and repeated member surveys. Effective and ineffective teams were compared and used to make recommendations include timing and type of interventions.

**Major Findings:** The timing and type of interventions required for team effectiveness were determined.

**Limitations:** This field-based study provides insight into the stages of Virtual Team development. However, the sample size was quite small, and even smaller when comparing successful and unsuccessful teams.

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**Gassman & von Zedtwitz (2003)**

**Title:** Trends and Determinants of Managing Virtual R&D Teams

**Objective:** To determine the trends in the use of Virtual Teams.

**Model:** No.

**Sample:** 204 R&D directors and Project Managers.

**Definition of Virtual Teams:** "A group of people guided by a common purpose who work across space, time, and organizational boundaries and are linked by information, communication and transport technology."

**Summary:** This research was conducted through interviews with 204 R&D directors and Project Managers at 37 technology intensive, multinational companies. The respondents were asked how and why Virtual Teams were employed.

**Major Findings:** Four forms of Virtual Teams were identified as well as four determinants for using them.

**Limitations:** This study attempts to answer the question of why and how Virtual Teams are used. This is useful within the specific context within which it was conducted. It does not, however, address the effectiveness of the Virtual Teams.

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**González et al. (2003)**

**Title:** The impact of group process variables on the effectiveness of distance collaboration groups

**Objective:** To test the relationship between cohesion and efficacy and their relationship with effectiveness.

**Model:** PARTIAL

**Sample:** 71 teams of students (2 to 5 members)

**Definition of Virtual Teams:** "Participation of individuals in a group activity without being physically in the same location".

**Dependent Variables:** Group effectiveness (quality)

**Intervening Variables:** Efficacy, behavioural performance, interpersonal attraction, task cohesion.

**Independent Variables:** Efficacy, interpersonal attraction, task cohesion

**Summary:** This study examined competing models of effectiveness and studied the relationship between what have traditionally been two process variables: 1) cohesion as an exogenous variable – theorizing that cohesion causes efficacy and 2) efficacy as an exogenous variable – theorizing that efficacy causes cohesion. In addition, behavioural outcomes were theorized to contribute to performance outcomes rather than being a component of effectiveness. The students in this study were limited to using an asynchronous, test-based communication system.

**Major Findings:** Group effectiveness was predicted by behavioural outcomes (supportiveness & facilitation) and task cohesion mediated the effect of efficacy on performance.

**Limitations:** This study provides insight into the interactions between variables that have largely been ignored. The definition of effectiveness was limited to a performance measure. The teams in this study were artificially constructed, but were given a relatively long-term task (semester). However, by limiting the teams to a very lean medium, the results of this study have limited applicability to the organizational context.

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**Hollingshead et al. (1993).**

**Title:** Group Task Performance and Communication Technology: A Longitudinal Study of Computer-Mediated Versus Face-to-Face Work Groups

**Objective:** To explore the effects of computer-mediated communication and task type on team effectiveness.

**Model:** YES (2 partial models).

**Sample:** 22 teams of students (number of members not given).

**Definition of Virtual Teams:** N/A (the focus was on computer-mediated groups).

**Dependent Variables:** Task performance, process, member satisfaction.

**Moderating Variables:** Task type, change (members, technology, task).

**Independent Variables:** Technology (face-to-face, computer mediated).

**Summary:** This was a longitudinal study of student groups to determine whether task type or changes moderate the relationship between computer use and team effectiveness. The groups were formed at the beginning of the semester and were given numerous tasks to perform (one per week). Also, because the effect of changes was being studied, specific changes were brought to bear on the groups (changes in members, changes in medium). The students were randomly assigned to either face-to-face or computer mediated groups. The tasks varied according to type: generating ideas, intellectual tasks, judgment tasks, or negotiating conflict. Computer mediated groups were required to use a network. After each task, the team members were given a questionnaire to determine their perceptions of performance, process and communication satisfaction. Performance was measured by the degree that the group was successful in each task. At one point, the team members were changed and at another point, the medium was changed (the computer mediated groups became face-to-face groups and vice-versa). It was proposed that task type would have an effect on the relationship between medium and performance (i.e. some tasks are better suited to computer mediated work than others). In an alternate model, it was proposed that changes (to medium or members) would have a mediating effect on the relationship between medium and performance.

**Major Findings:** Experience (with members and technology medium) moderated the relationship between performance and medium. Change was also found to have an effect on the relationship between task type and performance.

**Limitations:** The teams in this study were simulated in that they were made up of students who were assigned the tasks as part of their course work. The sample size of each type of team was quite small (11 of each type). The study was relatively long (1 semester), but it was broken down into very short time spans (1 week) in order to rotate the tasks and study each task type separately. Experience was found to affect performance, but this finding was based on the introduction of changes, rather than the passage of time. In fact, no allowances were made for time (i.e. by the time the teams performed the 11th task, 11 weeks had gone by). The change in computer medium after 6 weeks in order to measure the influence of such changes on the relationship between medium and performance is confusing. Without the use of control groups, (i.e. some groups not changing medium) it is difficult to assess the actual effect of the changes.

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**Holton (2001)**

**Title:** Building Trust and Collaboration in a Virtual Team

**Objective:** To test the effect of team building activities on team development.

**Model:** NO

**Sample:** 1 work (support) team (6 members)

**Definition of Virtual Teams:** None

**Summary:** This was the longitudinal case study of a six member Virtual Team. The team members were given team fitness and personality tests in order to help them assess their composition and their current level of team fitness. The goal was to stimulate conversations within the team about capitalizing on their diversity and building understanding and trust. Reflective feedback was then collected to determine the effect of the interventions. An additional intervention was the introduction of a web-conferencing system.

**Major Findings:** Team development was found to be enhanced through team-building activities.

**Limitations:** This study provides insight into how Virtual Teams might be encouraged to get to know one another. However, in addition to the limitations of the small sample size, the repeated reflective feedback process likely acted as an intervention itself and had an effect on team development.

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**Huang et al. (2002)**

**Title:** Supporting Virtual Team-Building with a GSS: An Empirical Investigation

**Objective:** To test whether a group support system (GSS) embedded with a goal-setting structure can support Virtual Team-building better than one without a goal-setting structure.

**Model:** NO

**Sample:** 48 teams of students (5 members per team)

**Definition of Virtual Teams:** None

**Dependent Variables:** Team-building (team cohesion, team commitment, collaboration climate), perceived decision quality, number of decision alternatives generated.

**Independent Variables:** Communication setting (face-to-face versus virtual), goal-setting structure (presence versus absence of such a structure). The goal-setting structure is a team interaction process which helps members disclose, negotiate and define goals.

**Summary:** The students were assigned to 48 teams. Twenty-four teams were designed to be virtual and 24 were face-to-face. Half of each type of team was assigned a GSS with a goal-setting structure. The Virtual Teams were limited to using a specific groupware. The task was a standard business case. The time allowed was two and a half hours.

**Major Findings:** Virtual Teams using a goal-setting structure had better outcomes than both Virtual Teams and face-to-face teams without the goal setting structure.

**Limitations:** This study used students in simulated virtual settings to complete a simulated task. Communication between team members was limited to one system (groupware). The goal-setting structure was shown to improve the outcomes of both types of teams.

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**Jang et al. (2002)**

**Title:** Virtual Team Awareness and Groupware Support: An Evaluation of the TeamSCOPE System

**Objective:** To test the effect of a web-based collaborative system (TeamSCOPE) on the Virtual Team's member awareness and communication satisfaction.

**Model:** NO

**Sample:** 8 teams of students (4 to 9 members per team).

**Definition of Virtual Teams:** "Teams that are distributed and never meet face-to-face."

**Dependent Variable:** Team awareness, communication satisfaction

**Independent Variables:** TeamSCOPE usage

**Summary:** This study addresses the theorized limitations in information and awareness caused by lack of co-location. An existing web-based collaborative system was enhanced to support the awareness needs of Virtual Teams. The task was an engineering design project with a relatively long time period (4 months). The task was not contrived – the project would have had to be completed regardless. In addition to TeamSCOPE, the students were equipped with email, telephone, fax and Netmeeting. Students filled out questionnaires measuring their awareness of the activities of the teammates as well as their satisfaction with the communication (with TeamSCOPE only).

**Major Findings:** The use of TeamSCOPE was not found to be related to team awareness and communication satisfaction. However, awareness was found to be related to communication satisfaction.

**Limitations:** Although this study used students and had a very small sample size, it used a real task and permitted the use of multiple media. However, the generalizability of a study whose goal was to test a specific system is very limited.

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**Jarvenpaa & Leidner (1999)**

**Title:** Communication and Trust in Global Virtual Teams

**Objective:** To identify the communication behaviours associated with trust in global Virtual Teams.

**Model:** No.

**Sample:** 29 teams of students (4 to 6 members per team).

**Definition of Virtual Teams:** "A temporary, culturally diverse, geographically dispersed, electronically communicating work group."

**Dependent Variable:** Trust

**Independent Variables:** Communication behaviours

**Summary:** This study was populated with students located in different countries. Trust was measured at two different times. The researchers used the archive of member emails to identify behaviours that were attributable to the changes in trust. Trust was measured using questionnaires. The students were asked to perform three tasks. The first two were short term (1 week). The third task was longer term (4 weeks). Trust was measured after the second and third task. The students were restricted to communicating through e-mail. After the project was completed, interviews were conducted to gather insights into the behaviours that may affect trust.

**Major Findings:** Although some teams developed swift trust, it was more likely created through initial communication. Communication regarding the task helps maintain trust. Social communication (when it occurs in conjunction with task communication) can strengthen trust. It was found that it was as important to respond to communications as it was to initiate communication.

**Limitations:** The teams in this study were made up of students. Although the third task was collaborative; the first two tasks had very low interdependence. It is unclear what effect that may have had on the results. Communication was restricted to a single medium.

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**Jarvenpaa et al. (2004)**

**Title:** Toward Contextualized Theories of Trust: The Role of Trust in Global Virtual Teams

**Objective:** To examine the effect of trust on the attitudes and performance of individuals collaborating virtually

**Model:** PARTIAL

**Sample:** 16 and 26 teams of students (6 members per team).

**Definition of Virtual Teams:** "A self-managed knowledge work team, with distributed expertise..."

**Dependent Variable:** Cohesiveness, satisfaction, perceptions of outcomes, quality of outcomes (grades).

**Independent Variables:** Trust (initial), number of emails

**Moderating Variable:** Trust (early)

**Summary:** This study included two phases (one with 16 teams having an unstructured task and one with 26 teams having a structured task). The teams were populated with students located in 11 different universities. There were two tasks (a research project and a business plan). The data was collected at three different times – the participants filled out three questionnaires (at the beginning, before the mid-point, and at the end of the project). The quality of outcome measure was based on the grades that the student teams received for their projects. The students were not encouraged to use any means of communication other than email (a listserv was employed to ensure that emails were sent to all team members). It was hypothesized that trust has a direct effect on outcomes in situations of weak structure (simulated as the point in time before the teams have their initial contact). It was also hypothesized that trust moderates the relationship between communication and outcomes in situations of moderate structure. Finally, it was hypothesized that trust would have a weak effect (direct or moderating) in a situation of strong structure (strong structure was simulated through socialization exercises with the team members). The analysis was done using PLS.

**Major Findings:** The effects of trust do depend on the degree of structure. In the low structure situation, trust was found to have a direct effect of attitudinal outcomes, but not performance. Trust was found to moderate the relationship between the number of emails and outcomes (attitudinal and perceptual performance). The effects of trust were found to be lessened in the situation of strong structure.

**Limitations:** The teams in this study were made up of students. Communication was restricted to a single medium and quantified by the number of emails. Degree of structure simulated and not measured.

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**Johnson et al. (2002)**

**Title:** Team Development and Group Processes of Virtual Learning Teams

**Objective:** To study the team development processes of virtual learning teams.

**Model:** No

**Sample:** 7 teams of students (5 to 6 members per team).

**Definition of Virtual Teams:** "Groups of individuals who interact through various communication technologies to accomplish a common goal."

**Summary:** This study describes the team building process of virtual learning teams as they form, establish roles and group norms, and address conflict. The teams were made up of dispersed students who were attending a virtual course. The teams completed numerous tasks throughout the semester. The students were permitted to use e-mail, a collaborative web forum, synchronous text chat, and Internet pagers. Students completed survey and were interviewed. Logs of the electronic communication were also examined to analyze the content with respect to team development stages.

**Major Findings:** Virtual learning teams effectively accomplished group tasks. Their development process was similar to that of proximate teams and was related to their timeline (deadline). The leadership role was shared in the Virtual Teams.

**Limitations:** This research studied real teams in that the teams were not created for the sole purposes of the study. The sample size was quite small and the subjects were students.

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**Kanawattanachai & Yoo (2002)**

**Title:** Dynamic Nature of Trust in Virtual Teams

**Objective:** To study the effect of trust (cognitive and affective) on the performance of teams over time.

**Model:** No

**Sample:** 36 teams of students (4 members per team).

**Definition of Virtual Teams:** "Teams who work across time and space and organizational boundaries with links strengthened by webs of communication technologies."

**Dependent Variable:** Team Performance (financial value)

**Independent Variables:** Trust (cognitive, affective, disposition to trust)

**Summary:** The teams were made up of students from six universities. The survey was administered three times (at the beginning, middle and end of the study). The task was a simulated business game. Team members used email as well as a web-based interface.

**Major Findings:** High-performing teams established trust quickly and maintained it throughout the project.

**Limitations:** This was a study of constructed teams assigned a simulated task. Team performance feedback was provided each week. Trust was measured 3 times. It is possible that the past success of teams leads to greater trust (i.e. that the opposite causal relationship actually exists).

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**Kayworth & Leidner (2002)**

**Title:** Leadership Effectiveness in Global Virtual Teams

**Objective:** To study the effect of different leadership roles on leadership effectiveness in Virtual Teams.

**Model:** No

**Sample:** 13 teams of students (5 to 7 members per team).

**Definition of Virtual Teams:** "Teams that are composed of coworkers geographically and organizationally linked through telecommunications and information technology attempting to achieve an organizational task."

**Dependent Variable:** Communication effectiveness, communication satisfaction, role clarity, team success.

**Independent Variables:** Leadership effectiveness:

**Summary:** For this study, students from three dispersed universities were assigned to 13 teams. Students with high levels of work experience were assigned as team leaders. The task was a research project to be completed over 5 weeks. The team members were permitted to communicate through any medium. Surveys were administered and open-ended interviews were conducted at the end of the study. Team success was defined as the grade on the paper.

**Major Findings:** Effective leadership was shown to predict communication effectiveness, communication satisfaction, and role clarity. Effective leaders acted in a mentoring role and exhibited a high degree of empathy toward other team members, asserted their authority and provided regular, detailed and prompt communication. Leadership effectiveness related to perceptions of communication effectiveness and communication. Also leadership effectiveness was related to effectiveness (grades).

**Limitations:** This study had a relatively small sample size and was populated by students. The teams were assembled for the purposes of the study. The relationship between effective leadership and team success and dependent variables was investigated. However, the relationship between the dependent variables and team success was not studied.

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**Kayworth & Leidner (2000)**

**Title:** The Global Virtual Manager: A Prescription for Success

**Objective:** To identify the core challenges faced by global Virtual Teams

**Model:** No

**Sample:** 12 teams of students (5 to 7 members per team).

**Definition of Virtual Teams:** "A team whose members are geographically dispersed, linked through telecommunications, working to achieve an organizational task."

**Summary:** For this study, students from three dispersed universities were assigned to 12 teams. Students with high levels of work experience were assigned as team leaders. The task was a research project to be completed over 5 weeks. The team members were permitted to communicate through any medium. Surveys were administered and open-ended interviews were conducted at the end of the study.

**Major Findings:** Four major challenges facing Virtual Teams were identified: communication, culture, technology, and project management (leadership).

**Limitations:** This study had a relatively small sample size and was populated by students. The teams were assembled for the purposes of the study.

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**Kirkman et al. (2004)**

**Title:** The Impact of Team Empowerment on Virtual Team Performance: The Moderating Role of Face-To-Face Interaction

**Objective:** To study the effect of team empowerment on Virtual Team performance.

**Model:** PARTIAL

**Sample:** 35 Virtual Teams (mean of 8 members per team).

**Definition of Virtual Teams:** "Groups of dispersed individuals with unique skills who collaborate across time and space to accomplish a task."

**Dependent Variable:** Performance (improvement, customer satisfaction).

**Independent Variables:** Empowerment.

**Mediating Variable:** Number of face-to-face interactions.

**Summary:** This study included 35 sales and service teams in the high technology travel industry. Data was collected through surveys of the team members and organizational documents. Team interdependence and size were used as control variables.

**Major Findings:** The performance of the Virtual Teams was related to levels of empowerment (high empowerment/high performance).

**Limitations:** The sample size was relatively large and the response rate was 84%. However, the teams were all 100% virtual with respect to location, and as such not representative of all Virtual Teams.

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**Knoll & Jarvenpaa (1998)**

**Title:** Working Together in Global Virtual Teams

**Objective:** To observe how students learn to work in Virtual Teams.

**Model:** No

**Sample:** 19 teams of students (6 to 7 members per team).

**Definition of Virtual Teams:** "Teams without physical interaction."

**Summary:** There are two studies described in this publication. The first was conducted with 12 teams of dispersed students. The teams were assigned 2 tasks of different duration (1 week and 5 weeks). The first task was one designed to break the ice. The second task was a business case. The second study was conducted with 7 teams of dispersed students. The task was to develop a business plan. All teams communicated solely through email. Data was collected through interviews and logs of the students' emails. Success was measured by the delivery of a common product.

**Major Findings:** Issues identified as critical to Virtual Teams included: collaboration, conflict, time zones, teamness (cohesion), norms, participation, language, technology.

**Limitations:** The teams in this study were made up of students. Communication was restricted to a single medium. This study was conducted at a time when students had limited access to email and was subject to the opening hours of the computer labs.

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**Larsen & McInerney (2002)**

**Title:** Preparing to Work in the Virtual Organization

**Objective:** To determine how students can best be taught about working in a virtual environment.

**Model:** No

**Sample:** 29 students (number of members not given).

**Definition of Virtual Teams:** "Teams that meet through electronic means."

**Summary:** Teams were formed of students at 4 different universities. The task was to write a paper. Students used a utility software that included chat functions, email and archiving of information. After the course, students were given surveys to evaluate their Virtual Team and learning experience. The students expressed frustration with their lack of goal and role clarity. The limitations of the communication system used also caused frustration. Also, they had trouble communicating because conflicting schedules created delays in chats and responses.

**Major Findings:** Each team's success was closely related to trust and their management of time, particularly with respect to asynchronous communication.

**Limitations:** This study was not really geared at understanding the effectiveness of Virtual Teams. However, insights were provided with respect to the frustrations of Virtual Teamwork. In terms of its applicability to real Virtual Teams, it is very limited because of the constructed teams and the focus on learning methodology.

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**Leenders et al. (2003)**

**Title:** Virtuality, Communication, and New Product Team Creativity: A Social Network Perspective.

**Objective:** To investigate how structural patterns of communication affect team creativity and how teams of varying degrees of virtuality can be designed to be creative.

**Model:** No.

**Sample:** N = 44 product development teams (mean of 5.4 members per team).

**Dependent Variable:** Creativity

**Independent Variables:** Frequency of communication, centralization of communication, tenure, size.

**Definition of Virtual Teams:** "Groups of individuals collaborating in the execution of a specific project while geographically and often temporally distributed."

**Summary:** This was a study of 44 teams at 11 companies. The members filled out a questionnaire regarding their communication patterns. It studied how team communication patterns may determine creativity. Since communication patterns are related to virtuality, this was also studied.

**Major Findings:** Creativity decreased with team age and size. Both high and low levels of interaction frequency impeded creativity. The centralization of communication also negatively affected creativity.

**Limitations:** This was the only field study with a relatively large sample size. It is determined that increased amount of interaction does not necessarily improve effectiveness.

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**Lurey & Raisinghani (2001)**

**Title:** An Empirical Study of Best Practices in Virtual Teams

**Objective:** To identify the practices which are related to the success of Virtual Teams.

**Model:** YES (meta-level) and framework.

**Sample:** 69 individuals from 12 work teams (number of members not given).

**Definition of Virtual Teams:** "Virtual Teams are teams that can be dispersed across organizational, space, and/or time boundaries and are often cross-functional in nature."

**Dependent Variable:** Effectiveness (completion of assignment, job satisfaction).

**Independent Variables:** Job characteristics, selection procedures, team member relations, processes, leadership, education & reward system, senior leadership, tools, technologies, and communication patterns.

**Summary:** A survey was developed to measure the constructs included in the framework. The survey was mailed to 12 Virtual Teams at 8 companies.

**Major Findings:** The establishment of positive team processes, supportive member relations, appropriate reward systems, skilled members, were related to team effectiveness.

**Limitations:** The major contribution of this study is that it is field based. However, the small sample size limits the analysis and generalizability of the results.

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**May & Carter (2001)**

**Title:** A Case Study of Virtual Team Working in the European Automotive Industry

**Objective:** To determine the potential effect of virtual collaboration on engineering design.

**Model:** No

**Sample:** 1 project (case study with 40 engineers)

**Definition of Virtual Teams:** "Teams with geographically distributed members."

**Summary:** This was a case study of a design project that was run virtually. Effectiveness was measured by the satisfaction of objectives. Efficiency was measured by the resources saved.

**Major Findings:** Reductions in time to market of 20 to 50%

**Limitations:** This study has very limited applicability to most Virtual Team settings. However, it is a rare example of research in a real setting.

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**Massey et al., (2003)**

**Title:** Because Time Matters: Temporal Coordination in Global Virtual Project Teams.

**Objective:** To explore the effects of temporal coordination on the conflict in Virtual Teams.

**Model:** No.

**Sample:** 35 teams of students (5 members per team).

**Definition of Virtual Teams:** "Teams with geographically dispersed members who use technology to accomplish a task."

**Dependent Variables:** Quality of team rationale used to support decision (range, organization & depth).

**Independent Variables:** Interaction behaviours (conveyance, convergence, social/relational, process management), presence or absence of temporal coordination mechanism.

**Summary:** This study was performed on students attending universities in two countries. The teams were restricted to communicating through a single groupware, Lotus Notes. 18 of the teams were provided with a temporal coordination mechanism, which consisted of a process structure which organized communication, sequenced work and facilitated problem solving. Data was collected through surveys and debriefing sessions with the members. The task was a business simulation and its duration was days. The students performed the task both individually and collaboratively.

**Major Findings:** Temporal coordination mechanisms affected the coordination and interaction behaviours, but did not affect performance directly.

**Limitations:** This study has limited generalizability because it was made up of students performing a simulated, short term task. Communication was restricted to a single medium.

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**Maznevski & Chudoba (2000).**

**Title:** Bridging Space Over Time: Global Virtual Team Dynamics and Effectiveness

**Objective:** To explore the functioning of global Virtual Teams with respect to their interaction rhythms and develop a model of Virtual Team effectiveness.

**Model:** YES (developed, not tested)

**Sample:** 3 product development teams (8, 9, & 12 members per team)

**Definition of (Global) Virtual Teams:** “Virtual Teams are identified by their organization and members as a team; are responsible for making and/or implementing decisions; use technology-supported communication substantially more than face-to-face communication; and work and live in different countries.”

**Summary:** The researchers conducted a longitudinal exploratory study, using observations, communication logs and questionnaires to determine how interaction incidents are affected by structural characteristics and how they in turn affect team outcomes. A model of Virtual Team effectiveness was also developed.

**Major Findings:** Effective global Virtual Teams developed patterns of interactions to fit their task.

**Limitations:** One of the few longitudinal studies. However, the study focused on interaction patterns rather than relationships between the model components. It also focused on decision-making groups and the decision-making process and cannot be used for other types of processes. The model represents a single interaction incident and it was not tested.

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**McDonough et al. (2001)**

**Title:** An Investigation of the Use of Global, Virtual, and Colocated New Product Development Teams

**Objective:** The investigation of the use, challenges and performance of global, virtual and co-located new product development teams.

**Model:** No

**Sample:** 103 managers

**Definition of Virtual Teams:** "Comprised of individuals who have a moderate level of physical proximity and are culturally similar. Global teams are defined as a type of Virtual Team, being comprised of members who work and live in different countries and are culturally diverse."

**Summary:** A survey was sent to a random sample of 1,156 managers asking them to indicate usage, challenges, and performance of co-located, virtual, and global teams employed within their organization. One hundred and three surveys were returned. Fifty four companies indicated that they had used Virtual Teams. Performance was defined as: attaining the goals set for the team, bringing products to market rapidly, developing commercially successful products, developing high quality products, meeting customer needs, and overall performance.

**Major Findings:** There are different problems associated with the different types of teams. Global teams were found to face greater behavioral and project management challenges than co-located and Virtual Teams. Global team performance was also found to be lower than the performance of virtual or co-located teams.

**Limitations:** This study provides the manager's view of Virtual Teams, which can provide insight into the use of Virtual Teams. However, it was based on past experiences, not current ones and represents a very low response rate.

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**Montoya-Weiss et al. (2001)**

**Title:** Getting it Together: Temporal Coordination and Conflict Management in Global Virtual Teams.

**Objective:** To explore the effects of temporal coordination on the conflict in Virtual Teams.

**Model:** No.

**Sample:** 35 teams of students (5 members per team).

**Definition of Virtual Teams:** "Members who are dispersed or work asynchronously."

**Dependent Variables:** Quality of team rationale used to support decision

**Independent Variables:** Perceptions of conflict management, presence or absence of temporal coordination mechanism.

**Summary:** This study was performed on students attending universities in two countries at four different sites. The teams were restricted to communicating through a single groupware, Lotus Notes. 18 of the teams were provided with a temporal coordination mechanism, which consisted of a process structure which organized communication, sequenced work and facilitated problem solving. The task was a business simulation and its duration was 15 days. The students performed the task both individually and collaboratively.

**Major Findings:** Temporal coordination mechanisms moderated the effects of some perceived conflict.

**Limitations:** This study has limited generalizability because it was made up of students performing a simulated, short term task. Communication was restricted to a single medium.

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**Pauleen (2003)**

**Title:** An Inductively Derived Model of Leader-Initiated Relationship Building with Virtual Team Members

**Objective:** To investigate how leaders develop relationships with their Virtual Teams.

**Model:** YES (of relationship building)

**Sample:** 7 Virtual Team leaders

**Definition of Virtual Teams:** "Dispersed groups that communicate and work asynchronously or synchronously through telecommunication and information technology."

**Dependent Variable:** Relationships

**Summary:** The study followed 7 Virtual Team leaders through a training program designed to determine the issues that team leaders face and how they can be measured and addressed. This was accomplished through an action learning based program designed to provide the leaders with the knowledge and skills relevant to Virtual Team leadership.

**Major Findings:** Leaders need to build personal relationships within their teams before task-related activities are initiated. A 3-step model for relationship building was developed.

**Limitations:** The major contribution of this study is that it used real Virtual Team leaders in its sample. However, the small sample size limits the analysis and generalizability of the results. Also, it did not measure the performance of the Virtual Teams, only the leaders' perceptions of the relationship-building activities.

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**Pauleen & Yoong (2001)**

**Title:** Facilitating Virtual Team Relationships Via Internet and Conventional Communication Channels

**Objective:** To investigate how facilitators use communication channels to build relationships.

**Model:** NO

**Sample:** 7 facilitators

**Definition of Virtual Teams:** "Temporary, culturally diverse, geographically dispersed, electronically communicating workgroups."

**Dependent Variable:** Relationships

**Independent Variables:** Training vs no training

**Summary:** The study was a test for a specific facilitator training program.

**Major Findings:** Strategies for building relationships included selection and use of appropriate communication channels and message content, member selection, training, organizational and HR policies, required task outcomes, and channel biases.

**Limitations:** The major contribution of this study is that it is field based. However, the small sample size limits the analysis and generalizability of the results. Also, it did not measure the performance of the Virtual Teams, only the facilitators' perceptions of the relationships.

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**Potter & Balthazard (2002)**

**Title:** Virtual Team Interaction Styles: Assessment and Effects

**Objective:** "To determine if Virtual Teams exhibit similar interaction styles as proximate teams and if those styles are related to communication and performance."

**Model:** NO

**Sample:** 42 teams of students (4 to 6 members per team).

**Dependent Variable:** Effectiveness, process performance (satisfaction, solution acceptance, group commitment, perceived efficiency).

**Definition of Virtual Teams:** Virtual Team members have distinct complimentary areas of expertise and are geographically dispersed and often temporally distributed.

**Summary:** This study measured, through individual questionnaires, the interaction styles (constructive, passive, aggressive) of the team members. The task was a desert survival simulation and effectiveness was measured by comparing team scores with the aggregate of the individual scores.

**Major Findings:** As with proximate teams, aggressive and passive interaction styles were negatively associated with performance. Constructive interaction style was positively related to performance.

**Limitations:** This study examined students performing a very short-term, simulated task. Some of the interaction styles seem closely related to outcome measures.

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**Ratcheva & Vyakarnam (2001).**

**Title:** Exploring Team Formation Processes in Virtual Partnerships

**Objective:** To clarify and explore the characteristics and behaviours that define the formation of virtual partnerships.

**Model:** NO

**Sample:** 5 companies (10 partnerships)

**Definition of Virtual Teams:** "Team members are geographically dispersed or belong to different organizations, or work together for different lengths of time."

**Summary:** Five organizations were selected because of their involvement in partnerships. In each company, the owner/manager was asked to identify two project groups (one successful, one unsuccessful). The project partners were interviewed to assess the development of the partnerships. Half of the teams had geographically dispersed members.

**Major Findings:** Three dimensions contributed to the success of virtual partnerships: confidence in financial success; personal satisfaction and enjoyment of working in the team; team development with high learning curves. The development process was cyclical and self-energizing.

**Limitations:** This study was focused on partnerships more than teams. Also, the researchers employed a very broad definition of Virtual Teams (members who are geographically dispersed or belong to different organizations, or work together for different lengths of time). Although these are real partnerships, it is unclear to what extent they are really teams.

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**Rockett et al. (1998)**

**Title:** Technology and Virtual Teams: Using Globally Distributed Groups in MBA Learning

**Objective:** To provide MBA students with experience in a globally distributed setting.

**Model:** NO

**Sample:** 4 teams of students (number of members not given).

**Definition of Virtual Teams:** "Members globally distributed"

**Summary:** This study was conducted using 4 teams of MBA students from 3 countries. The task was the development of a business plan and was 10 weeks in duration. Portions of the task were completed by local "sub-teams" and portions through collaboration with the global teams. The teams were allowed to use any available technology to communicate. Students filled out post-task questionnaires on their experiences and satisfaction with the course.

**Major Findings:** Team building was difficult across time and distance and technology presented limitations (videoconferencing was not available at multiple locations, software was not compatible). Teams needed super-ordinate goals, mutual accountability and evaluation to succeed.

**Limitations:** The study was conducted using a very small sample of students performing a simulated task and has limited generalizability. It was designed to help in the teaching of global team skills rather than providing data on Virtual Teams themselves.

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**Sarker & Sahay (2004)**

**Title:** Implications of Space and Time for Distributed Work: an Interpretive Study of US-Norwegian Systems Development Teams

**Objective:** To identify the problems faced by Virtual Teams and the strategies used to deal with them.

**Model:** NO

**Sample:** N = 8 Virtual Teams of students (8-10 members per team)

**Definition of Virtual Teams:** None

**Summary:** Teams were formed with students from a US and Norwegian university. The task was to analyze a business information systems problem. Each team had 2 hubs of co-located members. The data was collected from the communication records, member perceptions and observer perceptions. The goal was to identify problems associated with place, space and time and to discover the strategies used by team members to deal with them..

**Major Findings:** The problems faced by Virtual Teams can only be addressed through both technical and social efforts.

**Limitations:** The study was conducted using a very small sample of students performing a simulated task and has limited generalizability.

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**Sarker & Sahay (2003)**

**Title:** Understanding Virtual Team Development: An Interpretive Study

**Objective:** To describe how teams develop over time according to their communication patterns.

**Model:** YES (of team development stages)

**Sample:** N = 12 Virtual Teams of students (8-10 members per team)

**Definition of Virtual Teams:** None.

**Summary:** Teams were formed with students from 2 North American University. The task was to analyze a business information systems problem. Each team had 2 hubs of co-located members. The data was collected from the communication records, member perceptions and observer perceptions. The goal was to identify communication patterns that describe the Virtual Team development process.

**Major Findings:** Four stages of Virtual Team development were identified: initiation, exploration, collaboration, and culmination.

**Limitations:** The study was conducted using a very small sample of students performing a simulated task and has limited generalizability.

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**Sharifi & Pawar (2002)**

**Title:** Virtually Co-located Product Design Teams: Sharing Teaming Experiences After the Event?

**Objective:** To highlight paradoxes and dilemmas in setting up physically and virtually co-located teams.

**Model:** NO

**Sample:** N = 38 senior managers

**Definition of Virtual Teams:** "Teams that are not co-located"

**Summary:** Questionnaires were sent out to 351 companies. Thirty eight responses were received.

**Major Findings:** The major benefits of Virtual Teams, as perceived by senior managers, included: improved communication between team members; improved quality of product; shorter time to market; improved delivery time; reduced cost of development and design; improved project management; faster resolution of insignificant queries through immediate access to information; reduced time involved in design reiterations; greater sharing of resources; more effective and efficient monitoring and control of projects; and better generation of new and novel ideas.

**Limitations:** No teams were studied (although a case study is included in the article). This study has limited applicability.

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**Tan et al. (2000)**

**Title:** A Dialogue Technique to Enhance Electronic Communication in Virtual Teams

**Objective:** To study the effect of a dialogue technique on the relational development of Virtual Teams.

**Model:** NO

**Sample:** 15 teams of students (5 members per team).

**Definition of Virtual Teams:** "Members are physically distributed."

**Dependent Variables:** Cohesion, Collaboration, Decision Quality, Decision Satisfaction

**Independent Variables:** Dialogue technique vs no dialogue technique.

**Summary:** In this study the students were randomly assigned to teams of 5 members. Eight teams used the dialogue technique. The team members were limited to communicating anonymously through email (team mates were also classmates). The teams were given four tasks within a simulated business situation. Teams were given one week to perform each task. Team members were asked to complete post-task questionnaires regarding the relational development of the teams.

**Major Findings:** The use of the dialogue technique improved Virtual Team outcomes and Virtual Team outcomes improved over time (effects of time & dialogue technique are additive).

**Limitations:** This study had a small sample size (particularly considering that two groups of teams were being compared) and was populated by students. The teams were assembled for the purposes of the study and communication was restricted to a single medium. This study has limited generalizability.

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**Warkentin et al. (1997)**

**Title:** Virtual Teams Versus Face-to-Face Teams: An Exploratory Study of a Web-based Conference System

**Objective:** To compare the effectiveness of virtual and proximate teams.

**Model:** NO

**Sample:** 24 teams of students (3 members per team).

**Variables:** Effectiveness (relational links & satisfaction), cohesion, group interaction process, computer skills.

**Definition of Virtual Teams:** None

**Summary:** This study compared 13 virtual and 11 proximate teams. Students were randomly assigned to teams. The students were limited to the use of a web-based meeting system. The task was a murder mystery activity.

**Major Findings:** Teams using the computer system did not out-perform those working face-to-face. Relational links between team members were found to be related to effectiveness as were computer skills.

**Limitations:** The study used simulated virtual and proximate teams and the sample size of each team type was small. The task was far from what might be encountered by real teams and the subjects were students who were confined to using only one medium of communication.

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**Workman et al. (2003)**

**Title:** The Effects of Cognitive Style and Media Richness on Commitment to Telework and Virtual Teams

**Objective:** To determine the types of people who are best suited to Virtual Teams.

**Model:** NO

**Sample:** 261 members of Virtual Teams

**Definition of Virtual Teams:** "A group of teleworkers who collaborate through an electronically mediated infrastructure."

**Dependent Variables:** Commitment to the team

**Independent Variables:** Cognitive style, media richness

**Moderating Variable:** Cognitive style

**Summary:** It was hypothesized that an individual's cognitive style (internal/external, liberal/conservative, global/local) is related to their commitment to a Virtual Team. The sample included 261 Virtual Team members who were also teleworkers. The relationship between media richness and commitment was also hypothesized to be moderated by cognitive style.

**Major Findings:** Individuals with external cognitive style are more committed to their Virtual Teams. Richer media also enhanced commitment.

**Limitations:** This study had a large sample size and was field-based. However, the respondents were both teleworkers and Virtual Team members, so the results are neither generalizable nor separable.

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**APPENDIX M: DIMENSIONS OF AND COMPONENTS ASSOCIATED WITH  
VIRTUAL TEAM EFFECTIVENESS**

Author	VT Effectiveness Dimension	Components Associated With VT Effectiveness	
		INPUTS	PROCESS
Andres (2002)	<ul style="list-style-type: none"> <li>• Productivity               <ul style="list-style-type: none"> <li>○ Budget</li> <li>○ Schedule</li> <li>○ Quality</li> </ul> </li> <li>• Interaction Quality</li> <li>• Process Satisfaction</li> </ul>	<ul style="list-style-type: none"> <li>• Communication Medium</li> </ul>	<ul style="list-style-type: none"> <li>• Participation</li> <li>• Negotiation</li> <li>• Clarification</li> <li>• Information Exchange</li> </ul>
Alge et al. (2003)	<ul style="list-style-type: none"> <li>• Performance (Decision Making)</li> </ul>	<ul style="list-style-type: none"> <li>• Temporal Scope</li> <li>• Communication Medium</li> <li>• Task Interdependence (Moderator)</li> </ul>	<ul style="list-style-type: none"> <li>• Communication Effectiveness               <ul style="list-style-type: none"> <li>○ Openness</li> <li>○ Trust</li> <li>○ Team Member Exchange</li> </ul> </li> </ul>
Furst et al. (2004)	<ul style="list-style-type: none"> <li>• Quality</li> </ul>	<ul style="list-style-type: none"> <li>• Mission Clarity</li> </ul>	<ul style="list-style-type: none"> <li>• Communication</li> <li>• Trust</li> <li>• Commitment</li> </ul>
González et al. (2003)	<ul style="list-style-type: none"> <li>• Performance               <ul style="list-style-type: none"> <li>○ Effectiveness</li> <li>○ Quality</li> </ul> </li> <li>• Behavioural Performance               <ul style="list-style-type: none"> <li>○ Effort</li> <li>○ Facilitation</li> </ul> </li> </ul>		<ul style="list-style-type: none"> <li>• Efficacy</li> <li>• Interpersonal Attraction</li> <li>• Task Cohesion</li> </ul>
Hollingshead et al. (1993).	<ul style="list-style-type: none"> <li>• Task Performance</li> <li>• Member Satisfaction</li> </ul>	<ul style="list-style-type: none"> <li>• Task Type</li> <li>• Change</li> <li>• Communication Medium</li> </ul>	<ul style="list-style-type: none"> <li>• Process</li> </ul>
Holton (2001)		<ul style="list-style-type: none"> <li>• Team Building Activities</li> </ul>	<ul style="list-style-type: none"> <li>• Team Development</li> </ul>
Huang et al. (2002)	<ul style="list-style-type: none"> <li>• Decision Quality</li> <li>• Decision Quantity</li> </ul>	<ul style="list-style-type: none"> <li>• Communication Medium</li> <li>• GSS (support system)</li> </ul>	<ul style="list-style-type: none"> <li>• Cohesion</li> <li>• Commitment</li> <li>• Collaboration</li> </ul>
Jang et al. (2002)	<ul style="list-style-type: none"> <li>• Communication Satisfaction</li> <li>• Team Awareness</li> </ul>	<ul style="list-style-type: none"> <li>• Collaborative System</li> </ul>	
Jarvenpaa & Leidner (1999)		<ul style="list-style-type: none"> <li>• Technical Expertise</li> </ul>	<ul style="list-style-type: none"> <li>• Trust</li> <li>• Communication Behaviours</li> </ul>
Kanawattanachai & Yoo (2002)	<ul style="list-style-type: none"> <li>• Financial Performance</li> </ul>		<ul style="list-style-type: none"> <li>• Trust (Affective, Cognitive, Disposition)</li> </ul>

Author	VT Effectiveness Dimension	Components Associated With VT Effectiveness	
		INPUTS	PROCESS
Kayworth & Leidner (2002)	<ul style="list-style-type: none"> <li>• Success (Grades)</li> </ul>	<ul style="list-style-type: none"> <li>• Leadership Effectiveness</li> </ul>	<ul style="list-style-type: none"> <li>• Communication Effectiveness</li> <li>• Communication Satisfaction</li> <li>• Role Clarity</li> </ul>
Kirkman et al. (2004)	<ul style="list-style-type: none"> <li>• Performance <ul style="list-style-type: none"> <li>○ Process Improvement</li> <li>○ Customer Satisfaction</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>• Empowerment</li> </ul>	<ul style="list-style-type: none"> <li>• Communication Behaviour</li> </ul>
Leenders et al. (2003)	<ul style="list-style-type: none"> <li>• Creativity</li> </ul>	<ul style="list-style-type: none"> <li>• Tenure</li> <li>• Size</li> </ul>	<ul style="list-style-type: none"> <li>• Frequency of Communication</li> <li>• Centralization of Communication</li> </ul>
Lurey & Raisinighani (2001)	<ul style="list-style-type: none"> <li>• Completion</li> <li>• Satisfaction</li> </ul>	<ul style="list-style-type: none"> <li>• Job Characteristics</li> <li>• Selection Processes</li> <li>• Leadership</li> <li>• Education</li> <li>• Reward System</li> <li>• Senior Leadership</li> <li>• Tools</li> <li>• Technology</li> </ul>	<ul style="list-style-type: none"> <li>• Team Processes</li> <li>• Member Relations</li> <li>• Communication Patterns</li> </ul>
May & Carter (2001)	<ul style="list-style-type: none"> <li>• Time to Market</li> </ul>	<ul style="list-style-type: none"> <li>• Communication Medium</li> </ul>	<ul style="list-style-type: none"> <li>• Amount of Communication</li> </ul>
Massey et al., (2003)	<ul style="list-style-type: none"> <li>• Decision Quality (Rationale)</li> </ul>	<ul style="list-style-type: none"> <li>• Temporal Coordination Mechanism</li> </ul>	<ul style="list-style-type: none"> <li>• Interaction Behaviours</li> </ul>
Montoya-Weiss et al. (2001)	<ul style="list-style-type: none"> <li>• Decision Quality (Rationale)</li> </ul>	<ul style="list-style-type: none"> <li>• Temporal Coordination Mechanism</li> </ul>	<ul style="list-style-type: none"> <li>• Conflict Management</li> </ul>
Pauleen (2003)		<ul style="list-style-type: none"> <li>• Training</li> <li>• Leadership Effectiveness</li> </ul>	<ul style="list-style-type: none"> <li>• Relationships</li> </ul>
Potter & Balthazard (2002)	<ul style="list-style-type: none"> <li>• Performance</li> <li>• Satisfaction</li> <li>• Solution Acceptance</li> <li>• Efficiency</li> </ul>		<ul style="list-style-type: none"> <li>• Interaction Styles</li> <li>• Communication</li> </ul>
Tan et al. (2000)	<ul style="list-style-type: none"> <li>• Decision Quality</li> <li>• Decision Satisfaction</li> </ul>	<ul style="list-style-type: none"> <li>• Dialogue Technique</li> </ul>	<ul style="list-style-type: none"> <li>• Cohesion</li> <li>• Collaboration</li> </ul>
Warkentin et al. (1997)	<ul style="list-style-type: none"> <li>• Relational Links</li> <li>• Satisfaction</li> </ul>	<ul style="list-style-type: none"> <li>• Communication Medium</li> <li>• Computer Skills</li> </ul>	<ul style="list-style-type: none"> <li>• Cohesion</li> <li>• Interaction Processes</li> </ul>
Workman et al. (2003)		<ul style="list-style-type: none"> <li>• Cognitive Style</li> <li>• Media Richness</li> </ul>	<ul style="list-style-type: none"> <li>• Commitment</li> </ul>

## **APPENDIX N: LETTER SOLICITING PARTICIPATION IN THE STUDY**

My name is Linda Schweitzer. I am doctoral student from the Sprott School of Business at Carleton University, working under the supervision of Dr. Linda Duxbury. As part of my doctoral degree, I am conducting research on VTs. I am writing to you to ask you to consider participating in a research study.

VTs are a growing form of organization that allows teams to be composed according to the qualifications and expertise of their members, without the limitations of time, space, and the costs and disruptions of relocation. Despite their growing popularity, very few organizations employing VTs have addressed their unique conditions and needs. To date, very little research has been conducted to enhance the understanding of VTs, how they function and how they can best be managed. The goal of this research is to provide researchers, managers and organizations with a better understanding of how to assemble, equip, develop, support and manage VTs. Participants of this study will be asked to share their opinions, attitudes and experiences with respect to VTs.

Why should you be interested in participating in this study? The study will provide you with the opportunity to contribute your experience with VTs to research that seeks to improve the general understanding of this unique form of work. Specifically, as a participant in this study, you would be asked to relate your experiences and opinions on various actions, behaviours and practices taking place in your organization with respect to how organizations and managers support VTs. In return for your participation in this study, I will, if you wish, send you a brief summary of the major findings of the study. Also, this study fulfills the requirements for my Ph.D. degree, so your participation would be greatly appreciated.

If you agree to take part in this study, your participation in this stage of the study will involve either an interview or a short survey, requiring approximately 20 minutes of your time. The interview will be conducted in person or by telephone, at your convenience. The survey will be offered online (a paper copy will be provided upon request). I must warn you in advance that the online questionnaire will be hosted on one of Carleton University's servers, which is not secure, so the responses are only as secure as any email you'd send. However, on either the interview or the questionnaire, you will not be required to provide any personal information other than your responses to the questions and a few general demographic details (your age, gender, education, tenure, experience with information technology).

I would like to make it clear that if you agree to participate, you will not be obligated to answer any questions with which you are uncomfortable. You may also withdraw your agreement to participate at any time during the study and have data withdrawn without reprisal. There is no foreseen risk, discomforts and/or inconveniences to the participating organizations or individual respondents involved in this study. Moreover, interviewees and survey respondents may decline answering any questions they feel uncomfortable with.

Although I cannot provide anonymity, I guarantee complete confidentiality. Only the researchers will be aware of your participation in this study. Any data that you provide will be assigned a coded numerical identifier, so at no time will your name be associated with your responses in the database. No individual responses will be disclosed to anyone, at any time, and only aggregate data will be reported. The data set will not be shared with anybody within or outside the organization and all data will be stored at a secure location. The interview notes and survey forms will be destroyed once the study is completed.

Although the term VT can mean many things, for the purposes of this study, a VT is a group of people working with a high degree of interdependency and integration but whose members do not work at the same place at the same time and must collaborate across space and/or time.

Does this sound like the kind of team with which you have experience?

If it does, and you are interested in participating in this study, please respond to this email, or contact me at 445-1627 or [lschweit@business.carleton.ca](mailto:lschweit@business.carleton.ca).

This study has been reviewed and received ethics clearance through the Carleton University Research Ethics Committee. Should you have any questions or concerns about the study or your involvement, please contact Linda Schweitzer at (613) 445-1627, e-mail: [lschweit@business.carleton.ca](mailto:lschweit@business.carleton.ca), Dr. Linda Duxbury at (613) 520-2385, e-mail: [linda\\_duxbury@carleton.ca](mailto:linda_duxbury@carleton.ca), or Klaus Pohle, Professor, Ethics Committee Chair at 520-2600, ext. 7434, e-mail: [klaus\\_pohle@carleton.ca](mailto:klaus_pohle@carleton.ca).

## APPENDIX O: VIRTUAL TEAM MANAGER INTERVIEW QUESTIONS

1. To what extent do you agree or disagree with the following statements about your VT's tasks?

	<b>STRONGLY DISAGREE</b>		<b>NEUTRAL</b>		<b>STRONGLY AGREE</b>
The team members cannot accomplish their tasks without sharing information or materials with the other members of the team.	1	2	3	4	5
Task related activities performed by the team members are related to one another.	1	2	3	4	5
The team members must coordinate their efforts with one another to accomplish their tasks.	1	2	3	4	5
The members of this team must collaborate to produce a common output.	1	2	3	4	5

2. How many members are on the team?

3. How long has the VT been operating? \_\_YEARS \_\_MONTHS

4. Has this team ever met face-to-face?

No ⇒ Go to question 7

Yes ⇒ How often has it met?

5. Does this team have regular, face-to-face meetings?

No ⇒ Go to question 6

Yes ⇒ If so, how often?

A. Weekly

B. Monthly

C. Quarterly

D. Yearly

E. Other \_\_\_\_\_

6. Did this team have a face-to-face meeting when it was initially formed? YES/NO

7. To what extent do you agree or disagree with the following statements describing your experiences with this VT?

	<b>STRONGLY DISAGREE</b>		<b>NEUTRAL</b>		<b>STRONGLY AGREE</b>
In the past, this team has been effective in reaching its goals.	1	2	3	4	5
The team is currently meeting its business objectives.	1	2	3	4	5
When the team completes its work, it is generally on time.	1	2	3	4	5
When the team completes its work, it is generally within the budget.	1	2	3	4	5

8. Can you provide me with some information about your team members?
  - I will require the contact information (email addresses only) of each member so that I can invite them to participate in the study. Can you provide me with their email addresses?
  - One of the variables of interest in my study is "degree of virtuality", so I will also need the location of the team members (not their specific addresses, but the city in which they are based – or, in the event that they are in the same city, whether or not they are in the same building, same floor, etc.). Can you provide me with the locations of each of the members on your team?

## APPENDIX P: EMAIL SOLICITING TEAM MEMBER PARTICIPATION IN THE STUDY

Hi \_\_\_\_\_,

My name is Linda Schweitzer. I am writing to you because your team has been selected to participate in a study of VTs. Your name was provided to me by \_\_\_\_\_ (team manager's name).

I am doctoral student from the Sprott School of Business at Carleton University, working under the supervision of Dr. Linda Duxbury. As part of my doctoral degree, I am conducting this research on VTs. Your participation in this study is entirely voluntary and I am writing to you to ask you to consider participating. More detailed information about the study can be found in the attached letter.

To participate in this stage of the study, I ask that you complete an online survey questionnaire. The instructions for doing so are detailed below. It should take about half an hour.

Please be assured that your responses to the survey questions will be held in complete confidence by me as the principle researcher. Your name will not be linked to your responses. You will be identified only by the team member code number listed below. No individual responses will be disclosed to anyone, at any time, and only aggregate data will be reported. The data set will not be shared with anybody within or outside the organization and all data will be stored at a secure location.

Please be aware that your responses will be submitted to a database via a non-secure server. This means that your responses are subject to the same confidentiality risk as is any email message. Please be assured, however, that every precaution will be taken to avert any risk of the loss of your confidentiality. Should you become uncomfortable at any time with your continued involvement in the online version of the survey, please contact me by email at [lschweit@sprott.carleton.ca](mailto:lschweit@sprott.carleton.ca) or by telephone at (613) 445-1627 to receive a paper copy of the survey via postal mail.

To begin your participation in the online questionnaire:

- 1) Launch your web browser
- 2) Go to <http://www.carleton.ca/~lschweit/survey>
- 3) In the field provided, enter your username and password, which are listed below
- 4) Carefully read the instructions on the main page.
- 5) Begin the survey by clicking on the "Survey" icon located at the bottom of the page
- 6) Enter your team's unique code, which is also provided below
- 7) Complete the survey by following the instructions in each section.
- 8) Submit your responses by clicking the "Submit your Responses" button at the end of the survey.

**USERNAME:**  
**PASSWORD:**  
**YOUR TEAM CODE NUMBER IS:**

If you encounter any difficulties while completing the online questionnaire, please email me at [lschweit@sprott.carleton.ca](mailto:lschweit@sprott.carleton.ca).

Should you have any comments or complaints about the ethical administration of this survey, please address them directly to Professor Klaus Pohle, Chair of the Carleton University Research Ethics Committee, by phone at 613-520-7434, or by e-mail at: [klaus\\_pohle@carleton.ca](mailto:klaus_pohle@carleton.ca).

Thank you once again for your participation.  
Linda Schweitzer,  
Doctoral Candidate,  
Sprott School of Business,  
Carleton University

**APPENDIX Q: VIRTUAL TEAM SIZE AND RESPONSE RATES**

<b>Team #</b>	<b># of Members</b>	<b># of Respondents</b>	<b>% of Team Represented</b>
1	3	2	67%
2	3	2	67%
3	6	4	67%
4	2	2	100%
5	2	0	0%*
6	2	1	50%*
7	2	2	100%
8	5	4	80%
9	7	3	43%
10	5	3	60%
11	7	3	43%
12	8	6	75%
13	6	4	67%
14	6	5	83%
15	2	2	100%
16	14	8	57%
17	11	6	55%
18	3	2	67%
19	4	2	50%
20	7	5	71%
21	4	3	75%
22	10	7	70%
23	9	5	56%
24	5	3	60%
25	10	5	50%
26	7	4	57%

<b>Team #</b>	<b># of Members</b>	<b># of Respondents</b>	<b>% of Team Represented</b>
27	3	2	67%
28	4	2	50%
29	3	2	67%
30	3	3	100%
31	3	2	67%
32	5	4	80%

**\*Note: Excluded from further analysis**

## APPENDIX R: MEASURES OF VIRTUAL TEAM EFFECTIVENESS

**Table R1: Measure of VT Performance (Lurey & Raisinghani, 2001\*)**

Items
In the past, this VT has been effective in reaching its goals.
The VT is currently meeting its business objectives.
When the VT completes its work, it is generally on time.
When the VT completes its work, it is generally within the budget.

**Note: Cronbach's Alpha was 0.82**

**Table R2: Measure of VT Satisfaction**

Items	Source
There is respect for individuals on my team.	(Lurey & Raisinghani, 2001*)
I feel that my input is valued by the members of the team.	(Lurey & Raisinghani, 2001)
Team member morale is high in the team.	(Lurey & Raisinghani, 2001)
In the future, I would be interested in participating in another VT.	(Lurey & Raisinghani, 2001)
I enjoy being a member of this team	(Lurey & Raisinghani, 2001)
All in all, I am satisfied with my experiences with this VT.	Gladstein (1984)

**\*Note: Cronbach's Alpha was 0.82**

**Table R3: Measure of VT Member Perceptions of Professional Development**

Item	Source
I find that I am challenged by my work on this team	Lurey & Raisinghani (2001)
My work on this team gives me the opportunity to develop my knowledge and skills.	Lurey & Raisinghani (2001)
My work on this VT has aided in my progress towards meeting my career goals.	Duxbury, Dyke & Lam (1999)
My work on this VT has aided in my progress towards meeting my goals for advancement.	Duxbury, Dyke & Lam (1999)

**Table R4: Measure of VT Members' Perceptions of Capacity for Future VT Work**

<b>Item</b>
My work on this VT has improved my ability to work on VTs in the future.
My work on this VT has increased my desire to work on VTs in the future.

## APPENDIX S: UNIQUE BEHAVIOURS ASSOCIATED WITH MANAGERIAL SUPPORT/NON-SUPPORT FOR VIRTUAL TEAMS

**Table S1: Behaviours Identified as Representing Managerial Support of VTs**

<b>My VT manager makes it easier for our VT to be effective by:</b>
Being a role model (i.e. using technology, communicating/managing virtually, being open to new approaches, etc.)
Clarifying what is to be done and who is to do it (i.e. priorities, goals, deliverables, roles, responsibilities and contributions of team and members)
Encouraging and promoting training on effective VT work (i.e. use of tools, time management, etc.)
Ensuring that team members have the communication tools they need to work virtually (hardware & software: laptops, high-speed Internet access, Netmeeting, teleconferencing, cell phones, etc.)
Ensuring effective communication within the team (i.e. encourages interactions, openness, sharing, feedback, and keeps everyone in the loop)
Being accessible (virtually and face to face)
Providing regular opportunities for interaction and information exchange between all team members (i.e. meetings, conference calls, teleconferences, etc.)
Providing opportunities for face-to-face interactions when necessary
Empowering VT members (i.e. trusting, providing autonomy, focusing on objectives rather than process).
Building team cohesion through non-work focused events (i.e. meetings, conference calls, teleconferences, etc.)
Supporting the use of flexible work arrangements (i.e. flextime, flexplace)
Understanding the difficulties employees can face when engaged in distributed work (non-verbal communication, time zone differences, etc..)
Recognizing the importance of professional development for VT members
Facilitating the team's work and removing obstacles

**Table S2: Behaviours Identified as Representing Managerial Non-Support of VTs**

<b>My VT manager makes it more difficult for our VT to be effective by:</b>
Modeling unsupportive behaviour (i.e. not using technology effectively, insisting on face-to-face communication, not giving feedback etc.)
Focusing on presence at work rather than performance or contribution
Allowing ineffective communication within the group members (i.e. not resolving conflicts)
Not clarifying what is to be done (i.e. does not establish priorities, goals, deliverables, roles, responsibilities)
Not being accessible to the team
Being uncomfortable with the idea of empowerment (i.e. not encouraging autonomy, relying on/creating hierarchies, focusing on process rather than objectives, unnecessarily intervening, etc.)
Making it difficult for team members to get the training they need to work virtually
Not recognizing and proactively promoting relationship building within the VT (i.e. does not provide budget or time for face to face sessions for the team)
Treating VT members differently from those who work on proximate teams (i.e. favouring proximate team members)

## APPENDIX T: UNIQUE BEHAVIOURS ASSOCIATED WITH ORGANIZATIONAL SUPPORT/NON-SUPPORT OF VIRTUAL TEAMS

**Table T1: Behaviours Identified as Representing Organizational Support of VTs**

<b>My organization makes it easier for a VT to be effective by:</b>
Providing effective communication tools and budgets (hardware & software: laptops, high-speed Internet access, Netmeeting, teleconferencing, cell phones, etc..)
Making sure that the technology used within the organization is compatible.
Officially supporting the use of flexible work arrangements such as telework (i.e. funding for tools, training, reward system, etc).
Having a culture that recognizes and accepts that employees don't have to be present to be contributing.
Having a culture that supports VTs (i.e. demonstrates trust, less reliance on hierarchies, open communication, less emphasis on presence, etc.)
Providing a structure that supports VTs (i.e. less hierarchy, clear team roles, objectives, responsibilities and reporting structures, etc.)
Basing compensation on performance - rather than presence.
Providing training on how to work effectively on a VT (i.e. use of tools, time management, long-distance management, etc.).
Recognizing the importance of relationship building in VTs by ensuring that there is time and funding for some face-to-face meetings.
Ensuring effective communication (open, timely, centralized, accessible).

**Table T2: Behaviours Identified as Representing Organizational Non-Support of VTs**

<b>My organization makes it more difficult for a VT to be effective by:</b>
Not providing to VTs the communication tools they need to work virtually (hardware & software: no laptops, slow network, outdated tools, incompatible software).
Not supporting the use of flexible work arrangements such as telework or flextime (i.e. no funding for tools, training, reward system, etc)
Not providing VTs with the budget they need to work virtually (limited teleconferencing budgets, no budgets for face to face meetings, inadequate support, etc.).
Having a culture that rewards "face time" and presence at work rather than contribution.
Making it difficult for VTs to get together face to face (i.e. limited time or budgets)
Forcing VT members to travel on their own time.
Having unrealistic expectations with respect to timelines
Putting employees with poor technical skills on VTs
Not providing a structure that supports VTs (i.e. does not establish clear priorities, roles, objectives, responsibilities and reporting structures).

## APPENDIX U: TEAM-LEVEL INPUT MEASURES

**Table U1: Measure of Motivating Task (Bushe & Johnson, 1989\*)**

Item
The nature of the VT's task is such that we know whether we are making progress as we work.
The VT's task is achievable.
The VT's task is challenging.
The VT's task is important and relevant

**\*Note: No reliability coefficient is available from the literature as this measure was originally designed as a "yes/no" scale.**

**Table U2: Measure of VT Goal Clarity (Rickards and Chen, 2001\*)**

Item
The team tends to have a shared view of team goals.
The team has strong loyalty to its goals.
There is some confusion amongst team members over the team goals (R ).

**\*Note: Cronbach's Alpha was 0.78**

**Table U3: Measure of the Adequacy of Technology (Lurey and Raisinghani, 2001\*)**

Item
Team members are equipped with the information technology necessary to perform our task.
The electronic means that the team members use to communicate with each other are effective.
Team members have access to all of the necessary information from our team mates to perform team tasks.
Team members have access to all of the necessary information from our clients/manager to perform team tasks.

**\*Note: Cronbach's Alpha was 0.79 (**

**Table U4: Measure of VT Skills**

<b>Item</b>	<b>Source</b>
Team members were selected based on their individual talents and abilities to contribute to the team.	Lurey and Raisinghani (2001*).
The team members have the information technology skills necessary to contribute to the team.	Lurey and Raisinghani (2001).
The team members have the task-related skills necessary to contribute to the team.	
The team members have the interpersonal skills necessary to contribute to the team.	
The team members have the team skills necessary to contribute to the team.	

\*Note: Cronbach's Alpha was 0.71

**Table U6: Measure of VT Leader Effectiveness**

<b>Item</b>	<b>Source</b>
My VT leader has knowledge/experience with respect to the team tasks.	Bushe & Johnson (1989)
My VT leader effectively dealt with team conflict.	Bushe & Johnson (1989)
My VT leader communicated effectively with the team members.	Bushe & Johnson (1989)
My VT leader worked to keep all of the team members "in the loop".	
My VT leader ensured the participation of all members in the team tasks.	
Overall, my VT leader was effective.	Kayworth & Leidner (2002)

## APPENDIX V: CONTEXTUAL INPUT MEASURES

**Table V1: Measure of Team-Based Rewards**

Item	Source
My performance evaluation is strongly influenced by how well the entire VT is performing.	Campion et al. (1993)
Many of my rewards are determined in a large part by my contributions as a VT member	Campion et al. (1993)
All team members are rewarded when the VT reaches its goals.	Lurey & Raisinghani, 2001
If our VT does a good job, we get rewarded or recognized for it.	Gladstein (1984)
When our VT does a good job, we get the recognition and rewards that we should receive.	Spector (1985) from Fields (2002)

**Table V2: Measure of Training for VTs**

Item	Source
I receive sufficient training from the organization to develop my core skills.	(Lurey & Raisinghani, 2001)
The organization provides adequate technical training for my work on a VT.	Campion et al. (1993)
The organization provides adequate team skills training for my work on a VT	Campion et al. (1993)
Team members have received training on becoming more effective in the virtual setting.	(Lurey & Raisinghani, 2001)
Team members have received sufficient training on how to communicate effectively with fellow team members who work in dispersed locations.	Lurey & Raisinghani, 2001)

## APPENDIX W: PROCESS MEASURES

**Table W1: Measures of VT Cognitive Trust (Kanawattanachai & Yoo, 2002\*).**

Item
Most of my teammates approach his/her job with professionalism and dedication.
I see no reason to doubt my teammates' competence and preparation for the job.
I can rely on other teammates not to make my job more difficult by careless work.
Most of my teammates can be relied upon to do as they say they will do.

**\*Note: Cronbach's Alpha was 0.89**

**Table W2: Measures of VT Affective Trust (Kanawattanachai & Yoo, 2002\*).**

Item
I can communicate freely to my team about difficulties I am having at work and know that my team will want to listen/pay attention.
I would feel a sense of loss if one of us left the team.
If I shared my problems with my team, I know they would respond constructively and caringly.
I would have to say that we (my team) have made considerable emotional investments in our working relationship.

**\*Note: Cronbach's Alpha was 0.86**

**Table W3: Measure of VT Task Commitment (Larson and Lafasto, 1989\*)**

Item
Achieving our team goal(s) is a higher priority than any individual objective.
Team members believe that personal success is achieved through the accomplishment of the team goal (s).
Team members are willing to devote the effort necessary to achieve team success.

**\*Note: Cronbach's Alpha was 0.90**

**Table W4: Measure of Collaborative Climate (VanGundy, 1984\*)**

<b>Items</b>
When interacting with one another, the members of our team usually exhibit:
Acceptance of diverse behaviours.
A willingness to listen/pay attention.
Friendliness toward one another.
A spirit of cooperation.
Open confrontation of interpersonal conflicts.
Respect for each other's feelings.
A lack of defensiveness.
Very definite attempts at including all members in group discussions/communications.

**\*Note: Cronbach's Alpha was 0.90**

**Table W5: Measure of VT Potency**

<b>Items</b>	<b>Source</b>
Members of my VT have great confidence that the team can perform effectively.	Campion et al. (1993)*
My team can take on nearly any task and complete it.	Campion et al. (1993)
My team has, or can get, everything it needs to succeed.	

**\*Note: Internal reliability was 0.80**

**Table W6: Measure of Communication Effectiveness (Kayworth & Leidner, 2002\*).**

<b>Item</b>
How would you rate the overall quality of the communication between you and your team? (1=highly insufficient, 3=neutral, 5=highly sufficient)
When you have required important information about your task, how sufficient was the detail with which your teammates communicated this information? (1=highly insufficient, 3=neutral, 5=highly sufficient)
How would you rate the regularity of the communication within your team? (1=highly irregular, 3=somewhat irregular, 5=very regular)
How would you rate the quality of the communication between you and your team? (1=not very good, 3=neutral, 5=extremely good)
When there are important changes/news concerning the project, your teammates communicated these changes: (1=not at all, 3=neutral, 5=very clearly)
When you had important questions about the task your teammates responded: (1=very late, 3=neutral, 5=very promptly)

**\*Note: Internal reliability was 0.78**

### APPENDIX X: TEAM-LEVEL INPUT CORRELATION MATRIX

INPUT COMPONENT	Member Comfort with Technology	Member Comfort with Technology	Gender	Age Diversity	Education Diversity	Organization Tenure Diversity	Position Tenure Diversity	Team Tenure Diversity	Expertise Diversity	Adequacy of Technology	Skills	Motivating Task	Goal Clarity	Leader Effectiveness	Team Size	Team Age
Member Comfort with Technology	-															
Member Experience with Technology	.678**	-														
Gender	-.473**	-.475**	-													
Age Diversity	-.287	-.128	-.075	-												
Education Diversity	.029	.014	.101	-.039	-											
Organization Tenure Diversity	.099	-.135	.047	.248	.439*	-										
Position Tenure Diversity	.125	.159	-.066	.249	.023	-.088	-									
Team Tenure Diversity	-.063	.198	.083	.103	.163	-.195	.152	-								
Expertise Diversity	.014	.022	.160	-.050	.192	-.054	.282	.308	-							
Adequacy of Technology	.238	.090	-.072	.009	.326	.326	-.233	-.080	.028	-						
Skills	-.042	-.327	.409*	.188	.162	-.432*	.365*	-.102	-.063	.547**	-					
Motivating Task	-.158	-.115	.137	.204	.177	.243	-.264	-.186	.040	.462*	.433*	-				
Goal Clarity	-.329	-.221	.363*	.117	.397*	.265	-.171	.124	.030	.334	.455*	.399*	-			
Leader Effectiveness	-.376*	-.292	.241	.213	.328	.442	-.293	-.136	-.244	.308	.302	.355	.577**	-		
Team Size	-.133	-.120	.401*	.028	.051	.265	-.220	.280	.445	.154	.243	-.087	.059	-.001	-	
Team Age	-.140	-.171	.214	.014	.170	.206	.147	.390*	.101	.297	.220	.075	.269	.080	.405*	-
Face-to-Face Meeting	.005	.167	.095	-.127	.112	.02	.152	.242	-.046	-.183	-.005	.216	.356	.061	.096	.319

\*\*Correlation significant at p<0.01; \*Correlation significant at p<0.05

### APPENDIX Y: CONTEXTUAL INPUT CORRELATION MATRIX

INPUT COMPONENT	Rewards	Training	Managerial Support-Facilitating	Managerial Support-Development	Managerial Non-Support	Organizational Support - Culture	Organizational Support - Infrastructure
<b>Rewards</b>	-						
<b>Training</b>	.368*	-					
<b>Managerial Support-Facilitating</b>	.525**	.447*	-				
<b>Managerial Support - Development</b>	.443*	.625**	.780**	-			
<b>Managerial Non-Support</b>	-.416*	-.593**	-.580**	-.598**	-		
<b>Organizational Support - Culture</b>	.459*	.434*	.436*	.586**	-.349	-	
<b>Organizational Support - Infrastructure</b>	.271	.574**	.570**	.630**	-.573**	.502**	-
<b>Organizational Non-Support</b>	-.193	-.465**	-.229	-.407*	.748**	-.483**	-.575**

\*\*Correlation significant at  $p < 0.01$ ; \*Correlation significant at  $p < 0.05$

### APPENDIX Z: PROCESS CORRELATION MATRIX

PROCESSES	Cognitive Trust	Affective Trust	Task Commitment	Collaborative Climate	Potency
<b>Cognitive Trust</b>					
<b>Affective Trust</b>	.740**				
<b>Task Commitment</b>	.078	.090			
<b>Collaborative Climate</b>	.862**	.808**	.180		
<b>Potency</b>	.496**	.492**	.389*	.503**	
<b>Communication Effectiveness</b>	.712**	.542**	.179	.659**	.680**

\*\*Correlation significant at  $p < 0.01$ ; \*Correlation significant at  $p < 0.05$