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**VIRTUAL PROJECT WORK: INVESTIGATING CRITICAL SUCCESS FACTORS  
OF  
VIRTUAL PROJECT PERFORMANCE**

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**A THESIS  
IN  
THE JOHN MOLSON  
SCHOOL OF BUSINESS**

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## **ABSTRACT**

### **VIRTUAL PROJECT WORK: INVESTIGATING CRITICAL SUCCESS FACTORS OF VIRTUAL PROJECT PERFORMANCE**

**BRINDA BISSOONAUTH**

This study is an exploration into the critical success factors of virtual project work to determine the effects on virtual project performance. The challenge of management today is developing strategically flexible organizations in response to high technological pressures and increasingly competitive marketplaces. One of the widely adopted team-based designs by many organizations today is the technology-mediated group, or often referred to as the virtual team. As the shift to virtual environments becomes more prevalent in organizations, it would be extremely valuable to explore some of the factors that contribute to this successful shift. The aim of this research is to investigate some organizational and technological critical success factors of virtual project work and determine their impact on virtual project performance.

The organizations targeted to participate in this study, were located in all provinces across Canada. The results indicate that (1) affective commitment, (2) perceived organizational support, (3) management support, (4) technological support and (5) perceived benefits are established critical success factors of virtual project performance among virtual teams. Managerial as well as theoretical implications are discussed and future avenues for research in this field are also provided based on the results obtained in this study.

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## **1. INTRODUCTION**

The challenge of management today is developing strategically flexible organizations in response to high technological pressures and increasingly competitive marketplaces. The emergence of a new generation of information and communication technologies (ICT) lays the foundation for new organizational forms and structures such as virtual enterprises, imaginary corporations, dynamic networks, and flexible work teams (Lucas and Garud, 2000). These innovative organizational designs are proving to be extremely effective and popular to sustain the increasing competitive, technological and workforce demands of our century. One of the widely adopted team-based designs by many organizations today is the technology-mediated group, or often referred to as the virtual team. Technology-mediated groups offer flexible working environments while making use and reaping the benefits of communication technology.

In recent years we have seen the proliferation of virtual work which has come about more due to economic necessity than strategic planning (Raghuram et al., 2001). Many organizations are adopting this new design to reduce costs and shorten project life cycles, while enhancing innovation, capturing knowledge and sharing best practices (Lipnack and Stamps, 2000) in an effort to become more flexible, customer-oriented and to improve business performance. However, much of the research on technology-mediated groups has emphasized the downside of this new form in comparison to face-to-face interaction. Studies show that virtual teams affect outcome variables negatively when compared to face-to-face teams. For example, virtual teams take longer to complete tasks and to make decisions (Keisler et al., 1985; McGuire et al., 1987; Siegel et al., 1986, Weisband, 1992). As technology-mediated groups gain widespread popularity, the

factors necessary for these groups to work effectively and efficiently still remain undefined.

As the shift to virtual environments becomes more prevalent in organizations, it would be extremely valuable to investigate some of the factors that contribute to this successful shift. The aim of this research is to investigate some organizational and technological critical success factors of virtual project work and their impact on virtual project performance. The objective of this research is to determine if and to what extent the pre-identified organizational and technological factors generate positive project outcomes. If so, then this research will have established some critical success factors of virtual teams to effectively conduct virtual project work. The aim of this research, unlike many of the studies done in this area, is not to perform a comparison study between teams working in virtual and face-to-face settings but to look specifically at how virtual teams can operate in a successful environment. The innovativeness of this research arises from considering teams of people who have already made the transition to virtual work from the traditional face-to-face interaction. In this study, the aim is to determine specific factors that constitute a successful virtual work environment that companies can focus on to implement successful virtual project work. The focus is on examining only virtual projects carried out by external consultants working in dispersed locations or by employees within an organization who are required to work in different locations by virtue of the nature of the project.

The research model measures if pre-determined organizational and technological factors impact virtual project performance. The importance of the critical success factors

will be demonstrated if project performance measures are improved in the virtual context. The five a-priori critical success factors to be examined in this study are the independent variables: (1) Affective commitment, (2) Perceived organizational commitment, (3) Management support, (4) Technological support, and (5) Perceived benefits. These constructs encompass both the organizational and technological realms in which project virtual work takes place. The dependent variable to be measured is virtual project performance and this construct comprises of three distinct measures, which are: (1) virtual project satisfaction, (2) virtual project effectiveness and (3) virtual project efficiency.

The outcome of the proposed research may provide insights to both researchers and practitioners in better understanding the conditions under which virtual teams operate efficiently and effectively. Academics can utilize this research framework to further understand and investigate other factors that are critical in establishing successful virtual teams. As virtual project work is rapidly infiltrating the workplace, this framework will provide practitioners with some critical tools to focus on in order to implement successful virtual project work. Virtual arrangements are gaining widespread popularity as more and more organizations realize the benefits of this new model. However to date, given the limited empirical studies conducted in organizations composed of virtual employees, there is a pressing need to explore what makes virtual teams function successfully.

## **2. LITERATURE REVIEW**

### **RESEARCH OBJECTIVES AND SIGNIFICANCE OF THE STUDY**

## **2.1. VIRTUAL TEAMS**

The literature review for this study has been drawn primarily from two bodies of literature namely from the management information systems and the organizational behavior fields deemed relevant to the aspects examined in this research. Typically, most research on virtual teams to date, distinctly belongs to either the IT or organizational behavior domains. This present research involves an amalgamation of these two sciences as the objective and nature of this research entails examining the technological and psychological dynamics of virtual project work. Establishing critical success factors of virtual project performance requires an exploratory study of the organization, the team and the project within which a virtual project takes place. This triad encompasses both areas of MIS and organizational behavior and is relevant for achieving the objectives of this study.

Throughout the 1980s and 1990s, we saw the personal computer revolutionize the workplace and in this decade, recent developments in information and communication technology are creating the new virtual workplace (Townsend et al., 1998). Contrary to past beliefs, organizations are in fact forming virtual project teams that interact primarily via electronic networks (Lipnack and Stamps, 1997). Virtual teams are groups of geographically and/or organizationally dispersed coworkers who work interdependently using a combination of information and communication technologies to accomplish an organizational task (Lipnack and Stamps, 1997). The concept of virtual workplace means that restrictions due to space, time and organization boundaries disappear (Townsend et al., 1998) as project teams rapidly form, reorganize and dissolve according

to the needs of a dynamic marketplace, and individuals with differing competencies become accessible across time, space and cultures (Mowshowitz, 1997; Kristof et al., 1995).

Virtual teams may be set up as temporary structures to accomplish a set task, or they may be more permanent structures (Townsend et al., 1998) who rarely, if ever meet in a face-to-face setting. Virtual work also involves professionals working remotely from home, hotels, and airports or from satellite centers and other non-headquarter locations using networks and the Internet (Raghuram et al., 2001). Virtual employees typically work with minimal supervision and rely heavily on their own abilities and initiative to perform their tasks. Information technology is the common medium used to communicate with management since face-to-face interaction is rare (Staples et al., 1999).

Information and communication technologies (ICT) act as a powerful enabler in the transition to virtual organizing (Knoll and Jarvenpaa, 1995) and in carrying out virtual project work. Such technologies support synchronous communication (e.g. videoconferencing) or asynchronous communication (e.g. e-mail). This type of technology offers the flexibility within the virtual teams; team members can communicate and collaborate while at diverse locations and while 'meeting' at different times (Hollingshead et al., 1993). These technologies can be classified in three broad-based categories: desktop videoconferencing systems (DVCS), collaborative software systems, and Internet/Intranet systems (Townsend et al., 1998).



## **2.2. VIRTUAL PROJECT PERFORMANCE**

The emphasis on work teams in organizations has grown significantly in recent years as companies realize the added value of this design in the execution of project tasks. Using teams to perform tasks and make decisions is a significant component of total quality management (Blackburn and Rosen, 1993; Juran, 1989). The processes and outcomes involved in project related tasks are of great interest to both theoretical and applied researchers (Hackman 1976; McGrath 1984). This interest has grown with the creation of a wide range of computer-based technologies developed to improve group performance by allowing various types of group interaction that would be difficult in a face-to-face group, thus giving rise to virtual teams or computer-supported teams (Connolly et al. 1990). As communication technology evolves from more of a “support” role to a driver of business strategy, little research has been conducted on how communicating electronically affects many aspects of project work (Straus and McGrath, 1994). Despite many benefits of this new technology-based design, it still exhibits many drawbacks. Research is required for organizations to feel confident that virtual teams can be “effective, value-based, swiftly reconfiguring, high-performing, cost-sensitive, and decentralized” (Linack and Stamps, 2000, p.22). Virtual teams face many unique challenges due to their use of communication technologies, consequently it becomes extremely important to understand how such teams can perform efficiently and effectively.

Virtual teams offer flexibility, responsiveness, lower costs, and better resource utilization necessary to survive in highly, competitive and turbulent business environment

(Mowshowitz, 1997; Snow et al., 1996). Many benefits of electronic communication have been highlighted in research studies, for example, speed of information transfer (Kiesler et al., 1984), convenience, increased accessibility of coworkers (Nyce and Groppa, 1983), and increased accessibility of information (Huber, 1990). Although using technology to communicate cuts down time and costs of travel, virtual teams take longer to complete tasks than face-to-face groups (Kiesler et al., 1985; McGuire et al., 1987; Siegel et al., 1986, Weisband, 1992). Much of the research done in this area has emphasized significant drawbacks of this new form such as low individual commitment, role overload, role ambiguity, absenteeism and social loafing (O'Hara-Devereaux and Johansen, 1994). In their review of studies on technology-supported distributed teams, Maznevski et al. (2000) reported some technology-mediated groups performed worse than face-to-face groups (e.g., Hightower and Sayeed, 1996; Smith and Vanecek, 1990); in others they performed better (e.g., Ocker et al., 1995; Straus, 1996); in others there was no difference on outcomes relating to quality of outcome (e.g., Farmer and Hyatt, 1994; Valacich et al., 1993). Furthermore it was suggested from meta-analysis research that computer-mediated communication leads to decreases in group effectiveness, increases in time required to complete tasks, and decreases in member satisfaction compared to face-to-face groups (Baltes et al., 2001). Due to the nature and conflicting characteristics of virtual teams relative to their effectiveness and performance, it becomes extremely valuable to investigate some of the factors that may affect the success of these groups.

### **2.3. IT ADOPTION**

An explanation of the two theories used to support the present conceptual model of this study is provided in this section. The next section delves into how each construct in the model is derived based on the theories highlighted. Finally after identifying the constructs, the following section provides an in-depth definition of each construct identified in the model.

The theoretical basis for the conceptual model of this study is derived from (1) the theory of planned behavior (TPB) (Ajzen, 1991) and (2) from the adoption of Electronic Data Interchange (EDI) model (Iacovou, Benbasat and Dexter's, 1995). Virtual project work is made feasible with the adoption of information and communication technology since the latter acts as a critical enabler in the execution of virtual project work. Hence the conceptual model for this research is constructed based on previous IT adoption studies, where the theory of planned behavior (TPB) has also been used extensively as the theoretical foundation for explaining the factors affecting the successful use of technology. TPB is a popular model widely used by MIS researchers as the theoretical basis for investigating factors regarding the adoption of communication technologies (Igbaria, Guimaraes and Davis, 1995). The Electronic Data Interchange (EDI) Adoption Model (Iacovou, Benbasat and Dexter, 1995) is the additional conceptual model guiding this research. Iacovou et al.'s (1995) study was used since it also demonstrates the benefits regarding the understanding for the adoption and impact of technology in organizations. Taken together, the two models namely TPB and the EDI Adoption Model

(Iacovou et al. 1995) are used in this study to explain the theoretical basis of the current model.

TPB is a well-researched intention model containing integrated concepts and principles, significant in describing a decision process relevant in the study of strategic adoption of IT. Information systems (IS) research has shown that intention models and behavioral decision theories from social psychology may provide the framework for theory building on IT adoption by firms and individuals (Swanson, 1982; Cristie, 1981). TPB has been used in a number of IT related studies, for example, Mathieson (1991) used the TPB to predict a person's intention to use a specific information system; Harrison et al. (1997) used the theory to explain and predict small business executives' decisions to adopt IT; and Igbaria et al. (1997) used it to explain key factors affecting personal computing acceptance in small firms. Hence this theory is used as the basis in the present research to identify the critical success factors of using information and communication technology for teams to work on virtual projects.

The central factor in the TPB is the individual's intention to perform a given behavior (Ajzen, 1991). This theory suggests that the stronger the intention to engage in a behavior, the greater will be the performance on the outcome of that particular behavior. Consequently in the present study, the TPB model is used to derive the critical success factors of conducting virtual project work including using information technology to carry out projects in a virtual mode, which are posited to bring about a greater level of performance.

The model for the adoption and impact of EDI (Iacovou et al. 1995) also offers a strong basis for the investigation of virtual project performance due to their technological similarities. EDI allows computer systems of buyers and sellers to be linked through a standard communication protocol, to enable the transmission of structured data (Boudreau et al., 1998). Electronic commerce provides the capability of buying and selling products and exchanging information using information and communication technology. Virtual teams conduct virtual project work using similar communication technology like telephone lines, computer networks, the Internet, and other electronic means to capture, share and communicate similar information. All three IT based structures, use similar technologies to transmit information and data. On that basis, it can be assumed that factors affecting the adoption of EDI and electronic commerce are comparable to those involved in using information and communication technology for virtual project work.

#### **2.4. IDENTIFICATION OF CONSTRUCTS**

Ajzen (1991) explains that a fundamental element in TPB is the individual's intention to behave in a certain manner to achieve a certain goal. This decision or intention is a function of three independent determinants; (1) *attitude toward the behavior* which refers to what extent an individual believes the behavior in question will lead to a positive outcome, (2) *perceived behavioral control* which deals with the resources and opportunities available to perform the behavior, (3) *subjective norm* which gives an indication of the perceived social pressure of enacting the behavior. For the purposes of the present study, two measures from the TPB model have been identified as relevant and

have been integrated as part of the current model: (1) attitude toward the behavior and (2) perceived behavioral control. The third measure *subjective norm* is a social factor and not relevant in this study as it refers to the perceived social pressure to perform or not to perform the behavior. In this case the choice of executing the behavior is not applicable since the model tests teams who are already working in virtual mode.

“Attitude toward a particular behavior” used in the context of this study can be explained as the extent to which virtual team members believe virtual project work will lead to greater levels of performance. In the present study, the construct *perceived benefits* is used to depict the concept of “attitude toward a particular behavior”. Perceived benefits refers to the extent to which users understand and realize the relative advantage, that working in a virtual mode versus face-to-face can bring to themselves, the team and ultimately the organization. Iacovou et al. (2000) also used the construct perceived benefits as one of the main explanatory factors for the adoption of Electronic Data Interchange.

“Perceived behavioral control” is the second construct taken from the TPB model, and can be defined as the resources and opportunities (e.g., time, money, support, skills) made available for a course of action or behavior to be executed (Ajzen, 1991). The constructs *management support* and *technological support* were identified, in present research model, as constructs illustrating the available resources and opportunities necessary for greater virtual project performance. Management support and technological support are both constructs comparable to the construct ‘perceived behavioral control’ since conceptually these constructs share similar characteristics. In Iacovou et al.’s EDI

adoption model (2000), the construct organizational readiness defined as the availability of the needed organizational resources to adopt EDI, is used to illustrate the concept of 'perceived behavioral control'. The subconstructs of organizational readiness include management support and technological support (Iacovou et al., 2000).

The constructs of interest to this study, taken from the model on the adoption of EDI by Iacovou et al. (1995) are (1) perceived benefits and (2) management support and (3) technological support. In a prior research by Mackay et al. (2001) on the adoption of electronic commerce, both the TPB model and the EDI Adoption Model (1995) were used as the theoretical basis for the conceptual model in their study. The justification for using the TPB model in the study by Mackay et al. (2001) is that TPB has been used in previous IT adoption studies resulting in a strong support for a decision process. The constructs perceived benefits, management support and IT resources used by Mackay et al. (2001) in their model were taken from the EDI Adoption Model (Iacovou et al., 1995). The reasoning for using the same constructs is due to the similarities of EDI technology and electronic commerce in that both technologies are inherently inter-organizational base.

*Affective commitment* and *perceived organizational support* are the organizational behavior related constructs identified for the research model in the current study. These socio-psychological factors are of increasing importance due to the distance between the organization and virtual workers or amongst virtual team members that virtual work inherently brings about (Raghuram et al., 2001). Stronger and more lasting relationships between virtual workers and their organizational members are essential for the general

and long-term association with the organization and for project success (Wiesenfeld et al., 2001). During virtual projects, virtual team members need to feel connected with their home organization in order to be successful in virtual projects. Raghuram et al. (2001) use the construct 'organizational connectedness' to illustrate this psychological bond between virtual employees and their home base company. These connections provide remote employees with the confidence that there is a community they can rely upon for support and information. Furthermore, the connectedness with the organization makes virtual employees more visible and they can thus show their capabilities thereby increasing their job performance (Chao et al., 1992). Hence the two constructs affective commitment and perceived organizational support were identified in this model as depicting similar characteristics of organizational connectedness.

## **2.5. CRITICAL SUCCESS FACTORS**

Based on the theoretical perspectives discussed above and a review of the literature on use or adoption of information technology models, the following constructs have been identified as the critical success factors of virtual project performance: (1) Affective commitment, (2) Perceived organizational support, (3) Management support, (4) Technological support, and (5) Perceived benefits.

### **2.5.1. Affective Commitment**

A number of empirical studies confirm the important role of organizational commitment in promoting dedication and loyalty among employees (Roades et al., 2001). Organizational commitment was found to comprise three distinct dimensions: affective,



continuance and normative commitment (Meyer and Allen, 1997). Affective commitment refers to employees' personal attachment and identification to the organization leading to the adoption of a strong belief in accepting the organization's goals and values (Meyer and Allen, 1991; 1997). Studies have shown that affective commitment plays a significant role in increasing employees' involvement in the organization's activities, their willingness to pursue the organization's goals as well as their desire to remain with the organization (Meyer and Allen, 1991; Mowday, Porter and Steers, 1982).

Recent advances in information and communication technologies have paved the way for increased freedom and flexibilities in the workplace enabling employees to work from any place and at any time (Lucas and Baroudi, 1994). Such temporal, spatial and organizational dispersion however may adversely affect the ties between the organization and the employee. The dispersion and dislocation of employees working virtually strains the psychological ties between organizations and their members (Wiesenfeld et al., 1999). Often the virtual employee works in a location with few or no-coworkers, hence the potential for isolation is high and availability of advice from colleagues is low. Therefore it becomes important to create and maintain a strong connection between virtual employees and the organization. Raghuram et al. (2001) refer to the bond between virtual team members and their interaction partners as organizational connectedness defined as the "extent to which individuals perceive that they are central to, visible in and involved with the organizational community" (Raghuram et al. 2001, pp387). In this study, it is suggested that affective commitment may be a critical component in establishing the link between virtual project team members and their home base organization, which may ultimately impact project performance positively.

When virtual team members are seldom physically in their home base office, they have limited association with their home organization. Virtual team members may spend a significant portion of their time on the road or at the client site and therefore may not have as much access to their organization's support structure, such as the company's information databases, the knowledge base, as well as encouragement and support of their colleagues, which are all factors that may influence project performance. For example if virtual team members feel a tie to their home organization, they may seek socioemotional, or professional support from their company. The emphasis is on the fact that these team members are working virtually and may have little or no contact with their home company so the aim is to find out how important it is to maintain this connection with their organization and if this emotional tie may affect how they perform on projects.

Developing and maintaining connections with the home organization may be particularly challenging in a virtual setting where informal contact with supervisors and peers may be rare (Cascio, 2000). A frequent cause of concern for virtual workers is the possibility that their infrequent presence in the organization may make them "out of sight, out of mind", and this will affect their career advancement (Watad and DiSanzo, 2000) and possibly their performance. Consequently, it may be argued that if virtual employees feel a sense of commitment to their home organization, they will have easier access to their company's support structure to carry out projects more successfully. The objective of measuring organizational commitment is to find out whether the employees' affective commitment to their home organization may affect project performance.

### **2.5.2. Perceived Organizational Support**

Perceived organizational support can be viewed as the general beliefs formed by employees regarding the extent to which the organization values their contribution towards its goal, and cares about their well being (Eisenberger, Huntington, Hutchinson and Sowa, 1986). Organizational support theory (Eisenberger et al., 1986) may help explain how, in order to meet socioemotional needs and to determine the willingness of the organization to reward their efforts, employees form perceptions of the organization's commitment and support towards them. This type of perception is known as perceived organizational support. As a result, employees have a tendency to attribute humanlike characteristics to the organization and view favorable or unfavorable treatment as indicative of the organization's orientation towards them (Levinson, 1965).

High perceived organizational support helps employees meet their needs for approval, esteem and social identity and reward their efforts of job performance in the organization (Eisenberger et al., 1997). When employees perceive that the support and care given to them by their employees or supervisors is high, they may be encouraged and motivated to work harder and perform better. Through the literature, it has been shown that perceived organizational support is linked to many work-related outcomes such as job performance and job satisfaction (Eisengerger et al., 1990), therefore perceived organizational support has been identified as a factor in the present model and it will be tested to establish its influence on virtual project performance.

### **2.5.3. Management Support**

Management support refers to the perceived level of general support given by top management. Previous studies have shown that management support is one of the key factors affecting system success (Igbaria, 1994; Kwon and Zmud, 1987). Management support is required for ensuring sufficient resources are allocated and for acting as an agent for change to create a more conducive environment for using information technology. Therefore management support is associated with greater system success and a lack of it is considered an obstacle to the effective utilization of IT (Igbaria et al., 1997).

Organizational support has been emphasized in many studies as a potential determinant of system success (Igbaria et al., 1990). The higher management support is in the implementation of information technology, the more likely managers will be to invest and monitor the policies and practices in ensuring the right IT implementation environment (Klein et al., 2001). “With top management behind the change effort, the necessary resources and commitment to conduct transformation will be available” (Kilmann and Covin, 1988, pp. 6-7). Using the case study design, Nutt (1986) found that “implementation by intervention” where upper management took the reins for guiding action and change, was a more effective implementation approach. The more committed and the greater support offered by management in technology implementation, the more they are willing to invest and monitor this innovation (Klein et al., 2001). Similarly, it can be argued that top management is also vital in the success of virtual projects where the effective use of IT acts as a key influence to project performance. A parallel can be drawn between an IT implementation project and a virtual team project, as both require

management and allocation of resources for the usage of information technologies. Therefore, greater management support has been identified as a critical success factor yielding greater effectiveness in project performance.

For this particular study it can be argued that since team members are geographically and/or organizationally dispersed, there is limited contact between management and team members. Management support may be significantly affected in the case of virtual teams. The role of managers in managing virtual work is a prime area for inquiry (Wiesenfeld et al., 1999). The physical distance between managers and team members may suggest that management support become an important factor for ensuring greater project performance. The model put forth in this study will test to see if management support does significantly affect virtual project performance.

#### **2.5.4. Technological Support**

Organizational readiness takes into account the level of technological and financial resources accessible to the organization (Iacovou et al., 1995). The justification for including this factor in the research framework is that information and communication technologies require a significant level of, IT sophistication, technological skills and financial support. In this study, the focus is on the technological readiness or technological support.

Technological support refers to the level of sophistication of IT usage and IT resources available in an organization to carry out virtual projects. Information and communication technologies require (1) a high level of integration between all contact

points, (2) a solid IT Infrastructure, (3) information and communication technologies (ICT) and applications, and (4) sufficient training and willingness to use technology on the part of team members. IT sophistication (Paré and Raymond, 1991) captures not only the level of technological expertise within the organization, but also assesses the level of management understanding of and support for using IT to achieve organizational objectives.

Some ICTs that may be used in a virtual project are telephone, e-mail, internet, groupware, audio/video conferencing. The Internet, the largest of computer networks, is an extremely friendly and cost-effective medium for communication. The intranet allows organizations to use internet technology to disseminate organizational information and enhance internal communication. Groupware technology typically integrates electronic messaging with screen sharing, group scheduling, meeting support, group writing and other applications – IBM's Lotus Notes is an example of a groupware product. Video conferencing systems may be costly as it involves dedicated meeting rooms with sophisticated technology.

It can be argued that technological support is critical in virtual project work by virtue of the nature of this type of work. Without information and communication technology, virtual project work would not be possible. Therefore this study aims at determining whether technological support will contribute to greater project performance.

#### **2.5.5. Perceived Benefits**

Perceived benefits is the extent to which managers or team members recognize the relative advantage that communication and information technology can bring to the organization. Past literature from a technology adoption perspective has identified two major categories of perceived benefits: direct benefits and indirect benefits. Direct benefits are mostly defined as the operational savings due to the improved internal efficiency of the organization. Indirect benefits are mostly defined as the tactical, opportunistic, and competitive advantages due to the impact of communication technologies (Iacovou et al., 1995).

Perceived benefits or relative advantage has been identified as one of the most critical adoption factors for information technology (IT) growth in companies (Cragg and King, 1993). For example Cragg and King (1993) identified the perceived benefits of implementing a new technology as resulting in a set of consequences such as “savings in time and effort”, “economic benefits”, and “decreases in discomfort”. Consequently, this construct has been included in the framework as one of the critical success factors of adopting information and communication technology for virtual projects. Perceived benefits of virtual projects refer to the level of recognition of the relative advantage that working in a virtual mode on projects using technology can provide to the team members and organization.

## **2.6. PROJECT PERFORMANCE**

Project outcome reflects the group task performance and effectiveness of the project process. Several studies in this area have explored and measured the different components of project outcome. Most of the studies on performance in a virtual setting aim at comparing various aspects of performance in a computer-supported group versus face-to-face groups. Straus and McGrath (1994) measured group task performance by looking at overall task effectiveness, productivity and average quality. In this study project performance will be measured in terms of project outcomes and project satisfaction (Baker et al., 1988). Project outcome include measures such as the project being completed on time and within budget and met the project's objectives (Kerzner, 1997).

The dependent variable, in its entirety can be referred to as virtual project performance and it includes performance measures such as (1) Project satisfaction and (2) Project effectiveness and (3) Project efficiency. Project satisfaction is further broken down to (1a) Satisfaction with project team, (1b) Satisfaction with project process and (1c) Satisfaction with project outcome. In order to measure project performance in a virtual setting, we have combined measures from information systems (IS) project team performance and performance measures from studies on virtual teams.

The importance of project teams to the success of innovative projects has been highlighted and well documented in the theoretical literature. Popular approaches to new project development such as project management (Pinto et al., 1993), speed and cycle time management (Eisenhardt and Tabrizi, 1995), as well as total quality management



and continuous improvement (Griffin and Hauser, 1992) consider project teamwork as a critical success factor. The focus of project performance in this study is two-dimensional; it is based on performance-relevant measures due to people-related outcomes such as team member satisfaction and task-related outcomes such as quality of project, adherence to budget and schedule (Hoegl and Gemuenden, 2001). Thus, virtual project performance in this study encompasses the quality of the team's collaborative work, project satisfaction as well the quality of the project, project effectiveness and project efficiency in a virtual setting.

The conceptualization of project success is widely regarded in the literature as a multivariable construct (Gemuenden, 1990; Pinto et al., 1990). For the purposes of this study two relevant definitions of project performance have been adopted. Firstly, project performance can be defined as the ability of a team to meet established quality, cost and time objectives of the project (Gemuenden, 1990). Secondly, according to Hackman (1987), project performance can also be defined as the satisfaction that team members express with the team experience and the achievement.

#### **2.6.1. Project Effectiveness and Efficiency**

Project effectiveness is the extent to which the team meets expectations regarding the quality of the outcome (Hoegl and Gemuenden, 2001) or in simpler terms, project effectiveness measures the quality of work produced (Jones and Harrison, 1996). Project efficiency is the extent to which schedules and budgets are adhered to (Hoegl and Gemuenden, 2001) or in mathematical terms, it is the ratio of outputs to inputs. Project

effectiveness illustrates a comparison of actual versus intended outcomes and efficiency provides a comparison of actual versus intended inputs.

### **2.6.2. Project satisfaction with team, process and outcome**

In addition to achieving performance objectives, team members must also be motivated and desire engagements in future teamwork (Hackman, 1987). Project satisfaction takes into account the personal satisfaction of team members and satisfaction to work in teams in the future. Measuring various forms of user satisfaction has been the focus of numerous studies in the IS field (Bailey and Pearson, 1983; Chidambaram, 1996). For this study, project satisfaction has been broken further into three sub-constructs dealing with (1) the dynamics of the team; satisfaction with project team, (2) the process and communication media used during the project; satisfaction with the process and (3) the results of the project; satisfaction with project outcomes. This is in accordance with the various literatures found on project or team performance in virtual teams using computer mediated communication (Galagher and Kraut, 1997; Straus and McGrath, 1994).

Satisfaction with team can be viewed as the team satisfaction reflecting the morale within the team, how well the team satisfies members' needs, and the willingness to work together again on future projects (Galagher and Kraut, 1997; Hackman, 1987). The outcomes of collaborative work are not only dependent on the group's performance and the efficiency of the project processes, but also on the affective experiences of the team members (Galagher and Kraut, 1997).

Satisfaction with the process measures the team members' reactions of using a particular technology and provides an indication of their assessment of the standards of procedure during the projects (Straus and McGrath, 1994). The use of information and communication technology in this study makes it particularly important to measure the satisfaction of the team members with the communication medium used. Straus and McGrath (1994) reported that satisfaction with the medium depended on the type of tasks performed by the team. Studies comparing communication media show that users are less satisfied with the process when using information-poor media for tasks requiring group coordination (Straus, 1996).

Satisfaction with outcome reflects the level of satisfaction of the team members in relation to the final deliverable and results of the project. Hiltz and Johnson's (1990) study explaining user satisfaction for computer-supported groups, found that the best predictors of the socioemotional dimension of satisfaction, which is comparable to team satisfaction with outcomes in this study, are the frequency of previous communication among team members and their attitudes toward the task.

## **2.7. RELATIONSHIPS BETWEEN INDEPENDENT AND DEPENDENT CONSTRUCTS**

### ***2.7.1. Affective Commitment and Performance***

Affective commitment and various types of work performance measures have been measured in previous studies and evidence shows that the two constructs are positively correlated. In Allen and Meyer's (1996) review and evaluation of the body of evidence regarding the construct validity of organizational commitment, it was concluded that significant positive relations existed between employees' affective commitment and

their supervisors' ratings of their overall performance (Konovsky and Cropanzano, 1991; Meyer et al., 1989; Moorman et al., 1993). Commitment is also linked to employee satisfaction at work; Meyer et al. (1993) showed that affective commitment is negatively related to passive withdrawal resulting from dissatisfying work situations. In the meta-analyses conducted by Stanley et al. (1999), they examined the relations between affective commitment and measures of several hypothesized outcomes of commitment. The result showed that affective commitment is positively correlated with job performance. Follow-up interviews conducted by Meyer and Allen (1996) revealed that in organizations where commitment was related to performance, more emphasis was placed on customer satisfaction and continuous performance improvement. Therefore, it can be posited that employees with greater affective commitment will contribute to more effective project performance.

#### **2.7.2. Perceived Organizational Support and Performance**

Previous research studies have confirmed the positive relationship that exists between perceived organizational support and several job performance measures. Perceived organizational support was found to be positively related to a variety of work-related outcomes such as evaluative and objective measures of in-role job performance (Eisenberger et al., 1990; 1986), effort-reward expectancies, constructive suggestions for improving the operations of the organization (Eisenberger et al., 1990), and influence tactics by employees to make their supervisors aware of their accomplishments and dedication (Shore and Wayne, 1993). A strong correlation also exists between perceived organizational support and overall job satisfaction (Eisenberger et al., 1990; Shore and

Tetrick, 1991). Job performance and overall job satisfaction are comparable to project performance and project satisfaction respectively as the focus of this study is not on the entire job but on a particular project. Based on these previous studies, it can be proposed that perceived organizational support is positively linked to virtual project performance.

### **2.7.3. Management Support and Performance**

In the study by Igbaria (1990) investigating the determinant of end-user computing effectiveness, three success indicators were used: end-user satisfaction which measured the overall satisfaction of the user, system usage and perceived effectiveness of end-user's jobs which measured how the system had increased the effectiveness of their jobs at the personal, departmental and organizational level. End-user satisfaction and perceived effectiveness are the two outcome variables of particular interest since they are replicated in the present model as project satisfaction and project effectiveness. Management support was found to be strongly correlated to user satisfaction and effectiveness confirming that management support is influential in the successful implementation of building a computing infrastructure for users and applying IT to support a wide range of business tasks (Igbaria, 1990). Furthermore, management support was reported to have a direct impact on perceived usefulness which is the degree that a person believes a system can enhance his or her job performance (Igbaria et al., 1997). Consequently it can be posited that management support is positively linked to project satisfaction and effectiveness.

#### **2.7.4. Technology Support and Performance**

Virtual teams are possible because of the recent advances in computer and telecommunications technology. These technologies define the operational environment of virtual projects; therefore it is important to examine how these technologies come together to form the infrastructure of virtual teamwork (Townsend and DeMarie, 1998). Without a strong technological support, it would be quite difficult to perform virtual projects. Organizations with greater IT sophistication and technological skills are more likely to achieve actual benefits of working in virtual teams (Iacovou et al., 1995). Therefore it can be hypothesized that greater technology support is positively linked to virtual project performance.

#### **2.7.5. Perceived Benefits and Performance**

Higher managerial recognition of the benefits of virtual projects increases the likelihood that virtual team members will understand the various advantages brought about by working virtually. Operating in virtual teams may lead to reduced costs such as travel, accommodation thereby increasing profitability. The use of information and communication may help shorten project's life cycle and may improve productivity on the project. Perceived benefits are proven determinant factors in the adoption of Electronic commerce (Mackay et al., 2001) and electronic data interchange (Iacovou et al., 1995). Consequently, it can be proposed that higher levels of perceived benefits is positively linked to virtual project performance.

## **2.8. SUMMARY**

In summary, the critical success factors predicted to generate positive project performance in virtual project work are derived from Ajzen's (1991) theory of planned behavior, from Iacovou's (1995) EDI Adoption Model and from organizational behavior theories. A close parallel is drawn between both Ajzen and Iacovou's models and the present model while the relevance of using the two former models is emphasized to explain how the critical success factors of this study is derived based on above conceptual theories. Each critical success factor of virtual project work is defined, explained and analyzed in turn and finally the relationship between each of these constructs and the performance measures is highlighted. After laying the theoretical framework for this study, the following section outlines the research model and hypotheses for this study.

### **3. RESEARCH MODEL AND HYPOTHESES**



The proposed research model, illustrated below, is a schematic representation of the following research question: What are the organizational and technological critical success factors of virtual teams which will enhance project performance? In this research project, the proposed framework is to measure the relationship between the critical success factors of virtual project work and project performance.

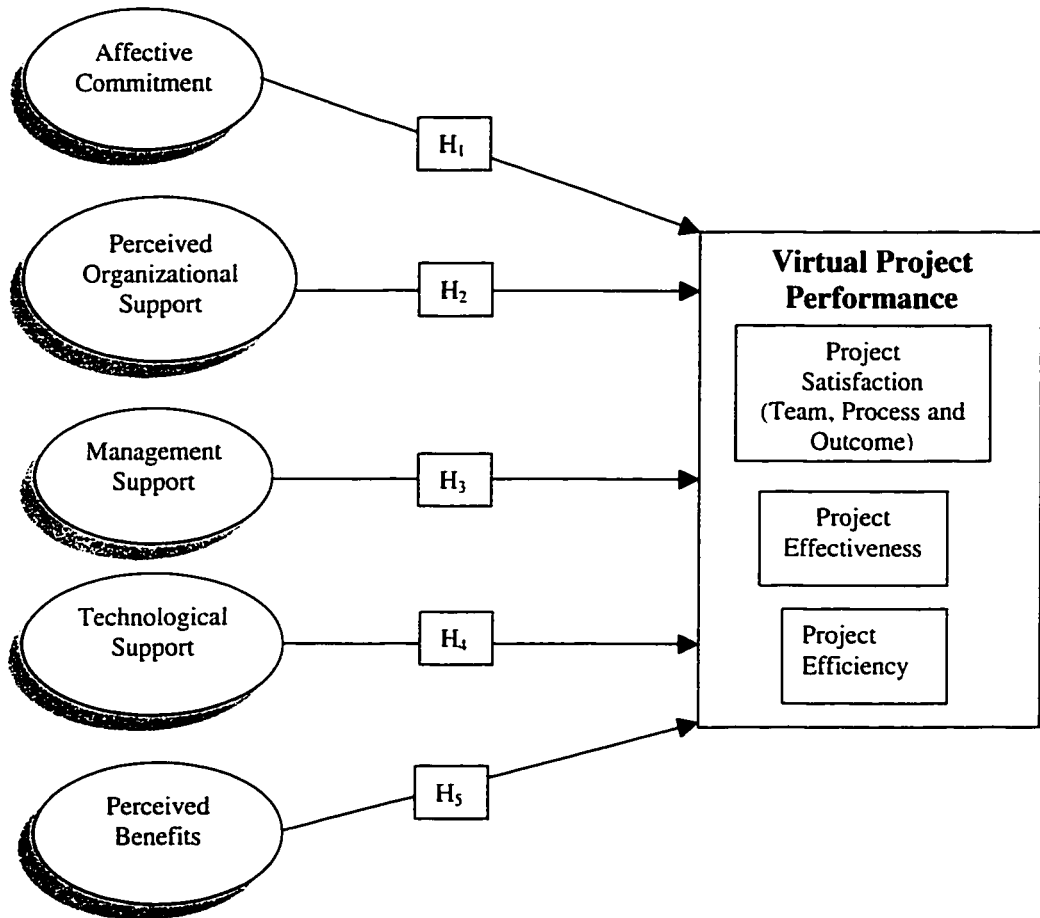
The independent variables consist of the measures identified as the five a priori critical success factors of virtual project performance: (1) Organizational Commitment, (2) Perceived Organization Support, (3) Management Support, (4) Technological support and (5) Perceived Benefits.

The dependent variable is virtual project performance and the variables to be measured are (1) project satisfaction which comprises of (a) satisfaction with project team, (b) satisfaction with project process and (c) satisfaction with project outcomes; and (2) project effectiveness and (3) project efficiency

### 3.1 Research Model and Hypotheses

The research model developed for this research study is depicted in the diagram below:

**Figure 1. Research Model**



### 3.1. HYPOTHESES

**H1:** *Higher level of affective commitment in virtual teams is positively linked to virtual project performance and each of its components (project satisfaction with team, project satisfaction with process, project satisfaction with outcome; project effectiveness and project efficiency)*

Meyer and Allen's (1991) three-component model of organizational commitment examines the three components of commitment and measures the relations of the antecedents and consequences of these variables. Based on Meyer and Allen's model, affective commitment was found to correlate positively with job performance and job satisfaction, classified as two of the consequences of affective commitment. In the meta-analysis carried out by Stanley et al. (1999) to measure the relative strength of the relations between the different components of commitment and several hypothesized outcomes of commitment (for example, turnover, absenteeism, job performance, withdrawal cognition and so on), affective commitment was found to correlate positively with job performance. Similarly, affective commitment was shown to have a positive correlation with individual or group-level indices of performance (Blau, 1988; Mowday, Porter and Dubin, 1974; Steers, 1977).

**H2:** *Greater degree of perceived organizational support in virtual teams is positively related to virtual project performance and each of its components (project satisfaction with team, project satisfaction with process, project satisfaction with outcome; project effectiveness and project efficiency)*

A strong positive correlation was found to exist between perceived organizational support and work-related outcomes such as job performance and overall job satisfaction (Eisenberger et al., 1990; Shore and Tetrick, 1991). One of the purposes of the study conducted by Eisenberger et al. (1997) was to provide empirical evidence for the distinction between perceived organizational support and overall job satisfaction. It was argued that overall job satisfaction was dependent on job conditions rather than on the perceived favorable or unfavorable attitudes of the employer. However in that study, confirmatory factor analysis revealed strong evidence that perceived organization support and overall job satisfaction are positively related. In a study carried out by Shore and Tetrick (1991), a confirmatory analysis also demonstrated a strong positive correlation that exists between perceived organizational support and job satisfaction. Thus it can be hypothesized in our model that perceived organizational support is positively linked to virtual project performance.

**H3:** *Greater management support in virtual teams is positively linked to virtual project performance and each of its components (project satisfaction with team, project satisfaction with process, project satisfaction with outcome; project effectiveness and project efficiency)*

Working in virtual teams implies the use of communication and information technologies, implementing specific strategies to manage the project virtually and keeping all team members informed every step of the way. Management support can play a significant role in ensuring that these steps are achieved thus directly impacting the

outcome of the project. Management support is significantly positively related to the implementation as well as the implementation effectiveness of a project (Klein et al., 2001). Therefore it is hypothesized that management support will positively affect virtual project performance.

**H4:** *Higher level of technological support in virtual teams results in a positive relationship with virtual project performance and with each of its components (project satisfaction with team, project satisfaction with process, project satisfaction with outcome; project effectiveness and project efficiency)*

Technological support is a determinant factor in the adoption of electronic data interchange (EDI) (Iacovou et al., 1995; Chwelos et al., 2001). It can be argued that since virtual projects intrinsically require the use of technology, technological support will positively affect virtual project performance.

**H5:** *Greater degree of perceived benefits in virtual teams is positively linked to virtual project performance and each of its components (project satisfaction with team, project satisfaction with process, project satisfaction with outcome; project effectiveness and project efficiency)*

Perceived benefits are significant factors in the adoption of electronic commerce and electronic data interchange (EDI) (Mackay et al., 2001; Iacovou et al., 1995). Working in virtual projects is rendered possible only by the adoption of information and

communication technology. Thus it is posited that recognizing and understanding the relative advantages of having virtual teams is a determinant factor for the enhanced performance of virtual projects.

## **4. RESEARCH METHODOLOGY**

This section provides a description of the main aspects of the methodological approach adopted in this study. The different phases of the methodology used are (1) Data collection and (2) Operationalization of the research model constructs.

#### **4.1. DATA COLLECTION**

The sample population targeted for this study comprised of project managers from selected industries and occupations which, by virtue of the industry they belonged to, were considered to possibly be involved in virtual projects. The names and company addresses of the sample population of project managers were compiled from a database obtained from the Project Management Institute (PMI), Newtown Square, Pennsylvania, USA in June 2002. The companies targeted were located in all provinces across Canada spanning from the west to the east coast. Several industries were selected from a list of industry and occupation codes obtained by the Project Management Institute and these were (1) Business Management Services/Management Consulting (2) Computers/Software (3) Consulting (4) Information Technology (5) Telecommunications and the occupation targeted was Project/Program Manager as per the codification of PMI's listings. For the purposes of this study, the targeted group was made up of either project managers or project team members working on current or past virtual projects. Using the database of certified project managers from the Project Management Institute ensured that the sample population would consist of project managers but the information provided failed to indicate whether they were working on virtual projects. The only way to ensure that an adequate response rate from virtual project workers would be obtained was to send out a higher number of questionnaires.



A structured, self-administered mail survey, consisting of a five-page questionnaire, was the selected measurement instrument used to test the formulated hypotheses and proposed research model. A package containing four questionnaires and a cover letter was sent directly to 600 project managers across Canada (as shown in Appendix 1 and Appendix 2). The cover letter was addressed to the project manager explaining the objective of the study and requesting their participation if they had or were working on a specific virtual project as well as that of three of their team members. The target population comprised of 600 project managers who received the questionnaire package containing four questionnaires per package, one for themselves and the remaining three to be distributed to their team members. Consequently a total of 2400 questionnaires were sent out to 600 project managers.

#### **4.1.1. Layout of the questionnaire**

Section I of the questionnaire is comprised of a brief description of 'Virtual Project work' for respondents to understand the subject matter at hand. The two organizational constructs, affective commitment, appears as organizational commitment in the questionnaire for simplicity and perceived organizational support is referred simply in the measurement tool as organizational support.

Section II of the questionnaire introduces the theme of the research and asks respondents to answer the questions based on one specific virtual project identified by the project manager (or themselves if they are the project manager). This section of the questionnaire aims at capturing pertinent information regarding the type of virtual project

in question. The construct technological support, management support and perceived benefits were measured in this section.

Section III of the questionnaire deals with the outcome variables of the specific virtual project identified, the objective in this section is to measure the virtual project performance measures identified. Respondents were asked to rate the virtual project performance through the use of a 5-point Likert-type scale ranging from (1) Strongly Disagree to (5) Strongly Agree, they were also given the choice of using N/A for any items that was not applicable to the respondents' situation.

Section IV of the questionnaire deals with demographics and is intended to collect background information from each respondent as well as the organization they work for.

#### **4.1.2. Pre-testing of the questionnaire**

Prior to the mail out of the actual survey to the respondents, the content validity of the questionnaire was assessed in a pre-testing procedure. A pre-test study was conducted whereby the contents and significance of the survey instrument was validated and pre-tested by seven professionals who had considerable experience working in virtual mode using information and communication technology from an industrial design company based in Montreal, Quebec. These professionals were selected as they had proven experience working on projects where either their clients or team members were geographically or organizationally dispersed. The questionnaire was also pre-tested by four academics involved in this current research. The objective of this exercise was to ensure that the measurement tool was clear, concise, easily understood and that the

measurement items depicted their intended meaning. The participants were asked to read the questionnaire, complete it and provide any feedback towards the improvement of the layout of the questionnaire and clarity of the measurement items. They were also asked to provide an overall assessment of the questionnaire based on their expertise with using ICT in virtual projects.

Each participant was contacted personally by phone to request his or her participation in the process and to explain the purpose of the pre-testing of the questionnaire. The pre-test questionnaires along with the cover letters were distributed by one of the group leaders of the company (May 2002) with whom contact had already been established and participants were asked to return the pre-test survey 10 days later.

On receipt of the pre-tested survey questionnaires, the comments and suggestions of each participant was carefully analyzed and incorporated in the survey. Some of the participants were also contacted by phone to obtain first-hand information on certain aspects of the questionnaire and to validate the study considering that they had several years of experience working in virtual mode.

After reviewing the feedback from the pre-testers, many of the items were rephrased due to ambiguity of the choice of words. None of the items were deleted, but were modified to make sure the exact meaning was being conveyed. For example, in Section II, changes were made to remind respondents that the questions were to be answered based on the specific virtual project identified. Other modifications included the addition of items 5, 6 and 7 in Section II to obtain more significant information regarding the virtual project identified and more options were added to the list of ICT to

make it all-inclusive. The layout of the questionnaire was redefined categorizing the different sections, as explained above, to make them more distinct and meaningful. The questionnaire was re-formatted to make it more respondent-friendly.

The final version of the questionnaire comprising of the operationalized constructs discussed in this chapter is found in Appendix 1.

#### **4.1.3. Mail Survey**

The questionnaire package consisted each of a personalized cover letter addressed to the project manager and 4 questionnaires with 4 self-addressed reply envelopes. Each package was mailed out to a random sample of 600 project managers from the PMI database on Monday, June 3<sup>rd</sup>, 2002. Each project manager was requested to complete the questionnaire and asked to distribute the remaining three questionnaires to their project team members. One week later, 600 follow-up letters were sent out (as shown in Appendix 2) to the same target population. Participation to this study was voluntary and each respondent was assured, in the cover letter, that the results would remain strictly confidential and anonymous.

Of the 600 questionnaire packages sent out to project managers, 15 were returned due to wrong addresses which drops the initial mail-out count to 585. 600 project managers were targeted directly and potentially 1800 additional respondents were targeted indirectly which makes the response rate a little more complicated to calculate. Some project managers contacted me through e-mail or telephone to confirm their participation in the study, and others apologized for not participating either because they were not

working on any virtual projects or due to lack of time. Some participants requested an electronic format of the questionnaire via e-mail either for themselves or to send out to their team members who were geographically dispersed. Approximately three weeks after the initial mail-out, much time was spent responding to respondents thanking them for their participation or sending out electronic copies of the questionnaire.

A total of 140 questionnaires was returned within 8 weeks of the initial mail-out. This represents an initial response rate of 24% if only the 585 project managers who were contacted directly is considered. None of the responses were discarded; they were all completed and were usable. If the total of 2400 questionnaires (600 directly to project managers and 1800 indirectly to team is considered then the response rate is only 6%. However it would be inappropriate to consider this response rate as not all 2400 respondents were directly contacted. The response rate of the 1800 team members was dependent on the project manager giving them the questionnaire and requesting their participation. In some cases, project managers reported that they were alone working on the project.

The fairly low response rate may be attributed to firstly the somewhat innovative nature of virtual project work. Many companies either do not possess the technology necessary to work virtually or have not yet made the transition to this level of co-working. Secondly, it was impossible to locate companies which were definitely working on virtual project work.

## **4.2. OPERATIONALIZATION OF THE CONSTRUCTS**

The development of a reliable and valid measurement instrument was crucial for the successful outcome of the research. Since a validated survey instrument testing the critical success factors of virtual project performance did not exist, the questionnaire was composed of validated measures which have all individually been used in previous research.

Given the innovative nature of the theme of this research, all variables measured were adapted from previous academic measurement approaches based on other IT adoption models, which were identified to be related to virtual project work. The reliabilities of each construct, in previous studies, were carefully looked at and measures with acceptable reliabilities were used in this study. Items of the corresponding constructs were reworded and the reliabilities for each measure recalculated from this study. Wherever applicable, pre-tested measurement scales from prior empirical research literature were adapted and used in the questionnaire. All the items corresponding to the constructs were measured on a 5-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). In some cases, the option Not Applicable was also provided as an option. Table 1 shows the measurement constructs, number of items used, as well as the section they appear in the questionnaire, and their corresponding sources in the literature.

**Table 1. Matrix of constructs and corresponding measurement references**

<b>Constructs</b>	<b>Definition</b>	<b>Section in the Questionnaire</b>	<b>Number of items</b>	<b>Measurement References</b>
Affective Commitment	Employees' attachment and identification to the organization	Section I Organizational Commitment	8	Allen and Meyer (1990) and the Organizational Commitment Questionnaire (Porter et al., 1974)
Perceived Organizational Support	General beliefs formed by employees regarding how much the organization values their contribution and cares about their well being	Section II Organizational Support	8	Items from the short form of the Survey of Perceived Organizational Support (Eisenberger et al., 1997; Lynch et al., 1999)
Management Support	Perceived level of general support given by top management	Section II Organizational Support	8	Igbaria (1990)
IT Support	Level of sophistication of IT usage and IT resources available	Section II Organizational Support	6	Iacovou et al., (1995)
Perceived Benefits	Extent to which managers and team members recognize the relative advantage of virtual project work	Section II Potential Benefits	8	Igbaria et al., (1997); Iacovou, et al., (1995)
Satisfaction with Team	Reflects the dynamics of the team	Section III Virtual Project Performance	6	Galagher and Kraut (1994); Hackman (1987)
Satisfaction with Process	Measures team members' reactions of the process and communication media used during the project	Section III Virtual Project Performance	5	Staus, S.G., and McGrath, J.E. (1994)
Satisfaction with Outcomes	Reflects the level of satisfaction with the results of the project	Section III Virtual Project Performance	4	Chidambaram, L. (19960
Project Effectiveness	Measures the quality of the work produced	Section III Virtual Project Performance	4	Hoegl M., Gemuenden H.G., (2001)
Project Efficiency	Extent to which schedules and budgets are adhered	Section III Virtual Project Performance	5	Hoegl M., Gemuenden H.G., (2001)

#### **4.2.1. Affective Commitment**

The items from the affective commitment construct were adapted from the Affective Commitment Scale (Meyer and Allen, 1997) and the Organizational Commitment Questionnaire (Mowday et al., 1979). Items that were identified as relevant in this study were selected and re-worded to fit the model proposed. Affective commitment has never been used, in my knowledge, in any of the IT adoption model but due to the nature of virtual project work it was identified as contributing to the success factors of virtual teams.

#### **4.2.2. Perceived Organizational Support**

The perceived organizational support construct was adapted from the study by from the Survey of Perceived Organizational Support (Eisengerger et al., 1986). Eight of the 36 items were selected that had been found to load highly on the main factor in a previous related study on perceived organizational support and job satisfaction (Eisenberger et al., 1990) and seemed applicable to a wide array of organizations and applicable to this research. Again to my knowledge, perceived organizational support has not been measured in any IT adoption models but has been measured in conjunction with job satisfaction which in this case is analogous to project satisfaction in a virtual setting.



#### **4.2.3. Management Support**

The management support construct was derived from Igbaria's model (1997) analyzing factors affecting personal computing acceptance in small firms. The present model aims at finding out if and to what extent management support affects project performance in virtual teams. The items from Igbaria's model (1997) were modified and re-worded for the purposes of this research study.

#### **4.2.4. Technological Support**

The technological support construct was derived from the construct organizational readiness in Iacovou *et al.*'s (1995) EDI Adoption model which is made up of the financial and technological resources available to the firm. Technological support was identified as the appropriate construct in the present proposed research model to measure virtual project performance. The measurement items were adapted to fit the information and communication technology used in virtual project work and re-worded in six questionnaire items.

#### **4.2.5. Perceived Benefits**

The perceived benefits construct renamed potential benefits in the questionnaire to avoid the ambiguity in the word 'perceived' was adapted from Iacovou *et al.*'s (1995) EDI Adoption and Integration model. EDI adoption and the use of information and communication technologies to perform virtual project work are not related per se, but both involve the use of technology to carry out the objective. Therefore the measurement

items are appropriate for virtual project work. They were adapted and reworded into six questionnaire items.

#### **4.2.6. Virtual Project Performance**

The project performance measures for this research model is divided up (1) Project satisfaction and (2) Project effectiveness and efficiency. After consulting various literatures on project satisfaction (Galagher and Kraut, 1994; Straus and McGrath, 1994), it seemed reasonable to further break down the project satisfaction into (1) satisfaction with team (2) satisfaction with process and (3) satisfaction with outcome. Satisfaction with team was adapted from Galagher and Kraut (1994) and Hackman (1987). The measurement items of satisfaction with team were modified to virtual teams working on virtual project work and re-worded into six items in the questionnaire.

The construct satisfaction with process was adapted from Straus and McGrath (1994) where satisfaction of team members with the medium and the process were also measured. The measurement items were adapted and reworked to fit the present measurement model into five items in the questionnaire.

The construct satisfaction with outcome was adapted from Chidambaram (1996) who measured this construct in computer-supported groups. The construct measured items such as satisfaction with results, perceived effectiveness of the results, and agreement with the outcome. The measurement items were re-worded into four items and used in the questionnaire.

The constructs project effectiveness and efficiency were adapted from the Hoegl and Gemuenden (2001) study on teamwork study and success of innovative projects. The measurement scales for effectiveness and efficiency were originally based partly on the scales used by Gemuender and Lechler (1997) in their large-scale study of project management in Germany. These two constructs were not based on virtual project work but on innovative projects, however the items were relevant to this research study. The project effectiveness construct was re-worded and constituted four items in the questionnaire and the construct project efficiency was made up of five items in the questionnaire as shown on Table 1 above.

## **5. DATA ANALYSIS AND RESULTS**

## **5.1. DATA ANALYSIS PROCESS**

The data analysis was performed using the SPSS statistical program. For the qualitative data, the coding was done by categorizing all answers obtained and assigning a number to each category of replies. For example, for the “specific project identified”, every project was classified in corresponding groups relating to software development, systems requirements, website development, e-commerce, telecommunication/networking, billing systems, HR, finance, customer profiling and so on. The open-ended questions were assigned a numerical value. Some of the items in the questionnaire used reversed scaling and needed to be reversed accordingly before entering the data.

Finally data reduction, reliability and correlations and a regression analysis were the analyses performed on the data to test the research model and its associated hypotheses.

## **5.2. DEMOGRAPHIC CHARACTERISTICS**

### ***5.2.1. Profile of respondents***

Out of the total 140 respondents who participated in this survey, approximately 60% of the respondents were male ( $n = 84$ ) while 30% of women ( $n = 42$ ) also participated in the study, and the remaining opted not to disclose their gender. Over 80% of the respondents are in the age range between 26 and 55 while there is slight majority (37%) who are between 36 and 45.

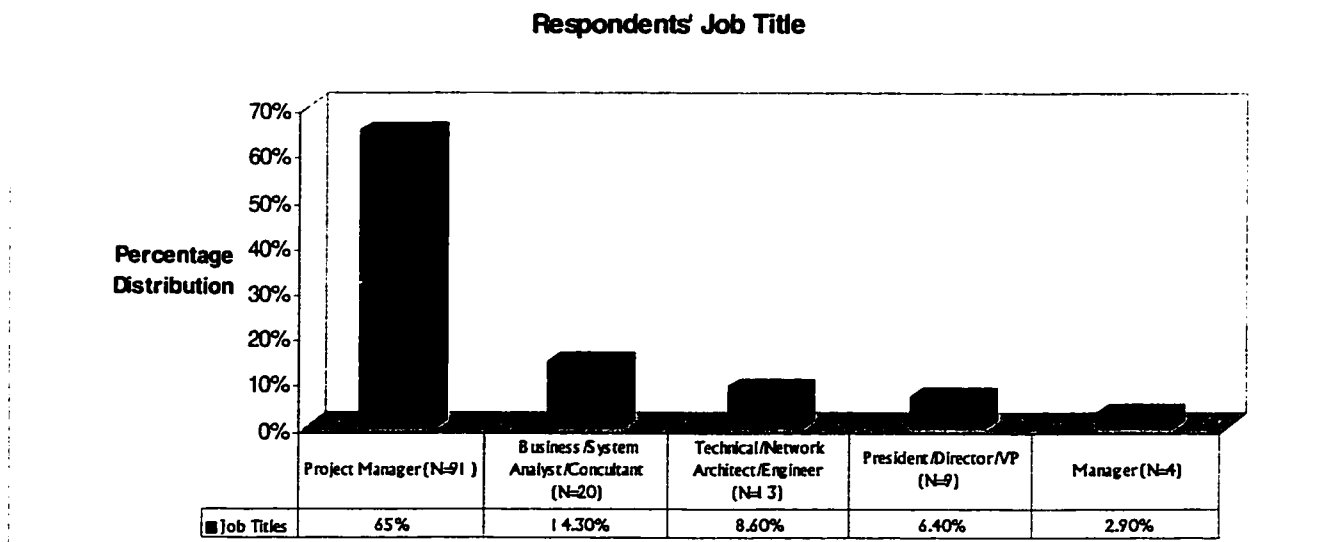
Part of the study is aimed at gaining feedback from teams of people working on virtual projects in an attempt to validate the hypotheses set forth. In order to obtain a

comprehensive view of the team dynamics in virtual project work, it was important to obtain the input of both team members as well as project managers. The package of questionnaires as pointed out earlier, was sent out to project managers who were requested to forward the questionnaires to the team members as well. Out of the 140 total respondents, there were 81 project managers and 59 team members who responded which means that a significant number of project managers were able to obtain the participation of their team members in the study.

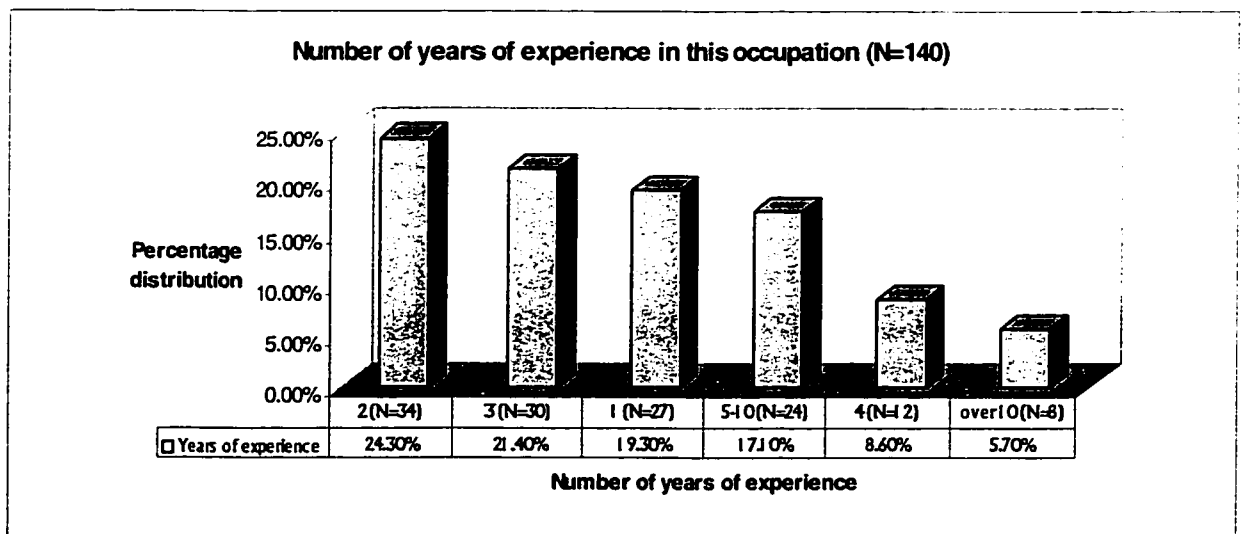
The title of most of the respondents turned out to be project managers (65%) as shown in Figure 2. Although the survey was targeted primarily to project managers, it was surprising to find that a small percentage of respondents (6.4%) were from upper management, their titles were President, CEO's or Director of companies. The other categories of job titles belonged to the team members, however it is interesting to note that some of the team members also had Project Manager as their job title. Figure 3. is a graphical illustration of the number of years of employment experience the current position. Over 75% of the respondents had between one to three years of experience in their current occupation.

Figure 4. illustrates the total number of years the respondents spent with their current organization. Over slightly 50% of the respondents spent between one to five years with the organization and since over 75% of the survey participants have only one to three years of experience in their current position, this explains that most of the respondents were fairly new to the organization.

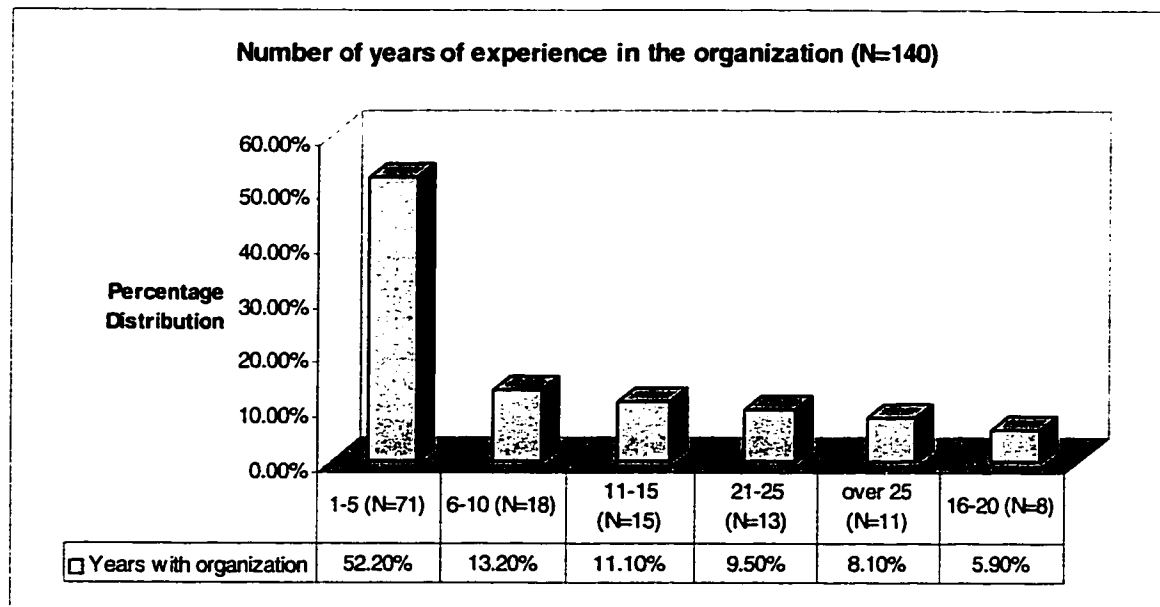
**Figure 2. Respondents' job title and employment experience (n=140)**



**Figure 3. Number of years of experience**



**Figure 4. Years of experience in the organization**

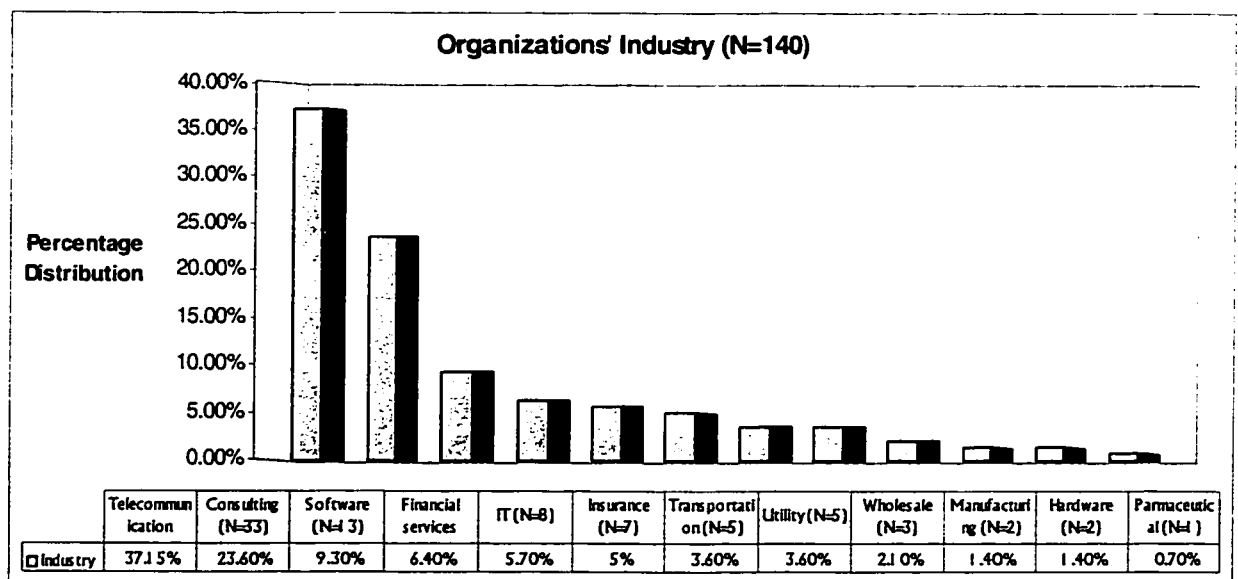




### 5.2.1.1. Organizations' Profile

Figure 5 shows the distribution of the industry categories, which the organizations fall under. Over 60% of the organizations belonged to the telecommunication and consulting sector which leads us to believe that a significant amount of virtual project is conducted in these two industries. Fifteen different industry categories were identified in the survey instrument, it is interesting to note that while most industries were represented, the dot.com category was the only sector that did not register any respondent.

**Figure 5. Industry distribution**



The size of the companies varied considerably from one employee to 150,000 employees. The majority of companies reported a total of 2500 to 40,000 employees with an average of 21,000 employees. Similarly the annual revenue of each organization varied on a wide scale from \$140,000 (CAN) to \$150 billion (CAN). The average annual revenue reported was approximately \$2.6 billion (CAN).

### **5.3. CHARACTERISTICS OF SPECIFIC VIRTUAL PROJECT**

The objective of section II of the questionnaire was to obtain certain specific details of the nature of each project identified by the project managers. The description obtained regarding each virtual project did not directly measure any relationship of the research model but gave an insight into the type and different ways virtual projects are conducted.

Table 2. below shows a categorization of the nature of the different types of virtual projects identified by project managers as well as the frequency of respondents who worked in each category of virtual projects. The various types of virtual work were classified in nine broad categories covering areas in IT, e-business, finance, strategic management, HR, telecommunication and marketing. The majority of virtual projects (approximately 44%) were in the field of IT, software development and website construction. Reasoning for this occurrence may be that people involved in these IT related virtual projects have greater access to the already existing information and communication technology infrastructure necessary to operate in a virtual mode.

**Table 2. Summary of classification of virtual projects with frequency of respondents**

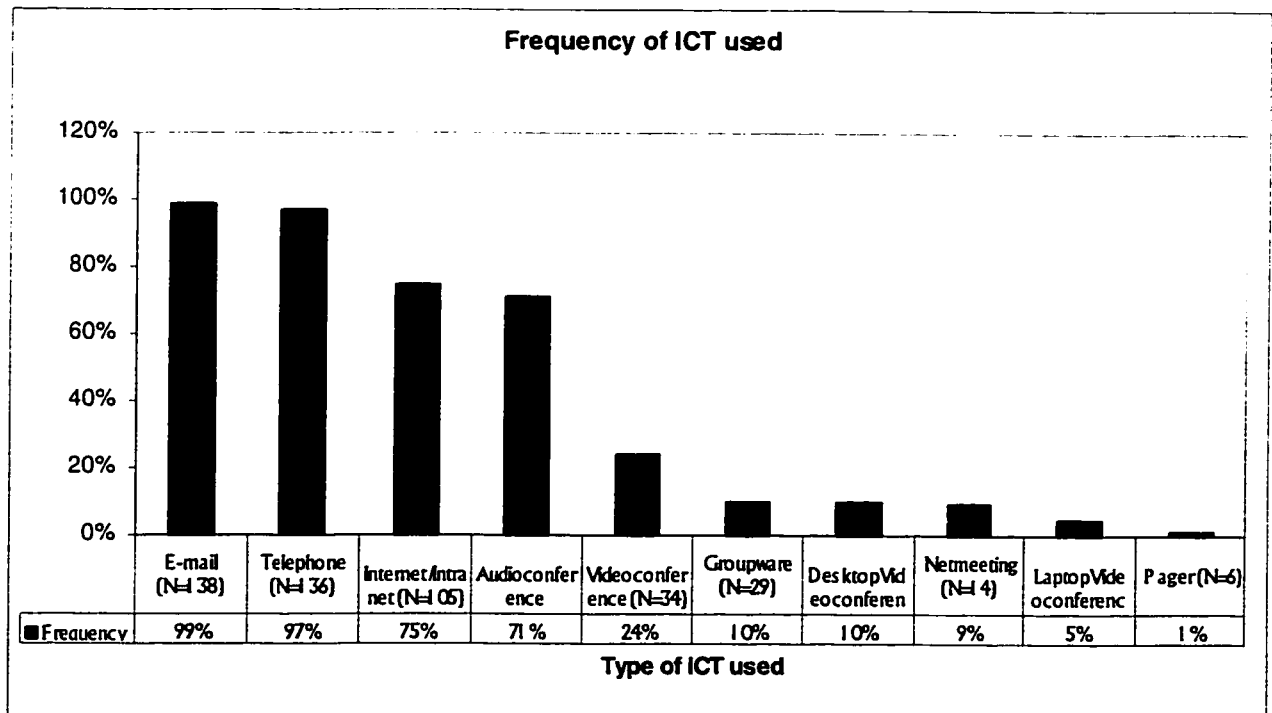
<b>CLASSIFICATION OF TYPES OF VIRTUAL PROJECTS</b>	<b>FREQUENCY OF RESPONDENTS (N=140)</b>	<b>PERCENTAGE OF RESPONDENTS (%)</b>
1. New Technology/Network/Software Development/IT systems/Website construction	62	44.3
2. Business Strategy/E-business	31	22.1
3. Telecommunication/Network	12	8.6
4. Customer Profiling/Product Catalogue/Marketing/Customer Database	11	7.9
5. Finance/Assessment of financial operations	9	6.4
6. Customer Billing/Billing Systems	6	4.3
7. HR Integration/Training/Payroll	5	3.6
8. Infrastructure Optimization/Closing down of offices/Setting up of new offices	3	2.1
9. Change management/Transition to virtual team	1	0.7

The average duration of all the projects identified was 13 months, the entire period of time ranging from 1 to 48 months. 65% of these had a project lifetime between one to twelve months and less than 10% lasted for over than two years. The average number of people on each team was 38, with the smallest team having 2 members while the largest having a total 400 team members. The teams who participated in this study were from organizations across Canada and not from around the world. Issues facing global virtual teams such as language and cultural barriers and working in different time zones were not factors encountered by teams in this study.

Figure 6 below provides valuable information regarding the type of information and communication technology used and the extent to which each technology identified is used during the virtual project. Respondents were asked to check all the various types of information and communication technologies that were used during the entire duration

of the projects. The findings show that e-mail and telephone were the preferred media of communication with 99% and 97% of respondents respectively using these technologies to work in virtual mode. The internet/intranet (with a usage of 75% of respondents) and audio conferencing (with a usage of 71% of respondents) were also popular information and communication technologies used. This suggests that many organizations embarking on virtual projects have access to the internet and have the appropriate infrastructure. 24% of respondents reported using videoconferencing in virtual projects. Such major investments in information and communication technologies may suggest that organizations are embracing the virtual mode for conducting projects.

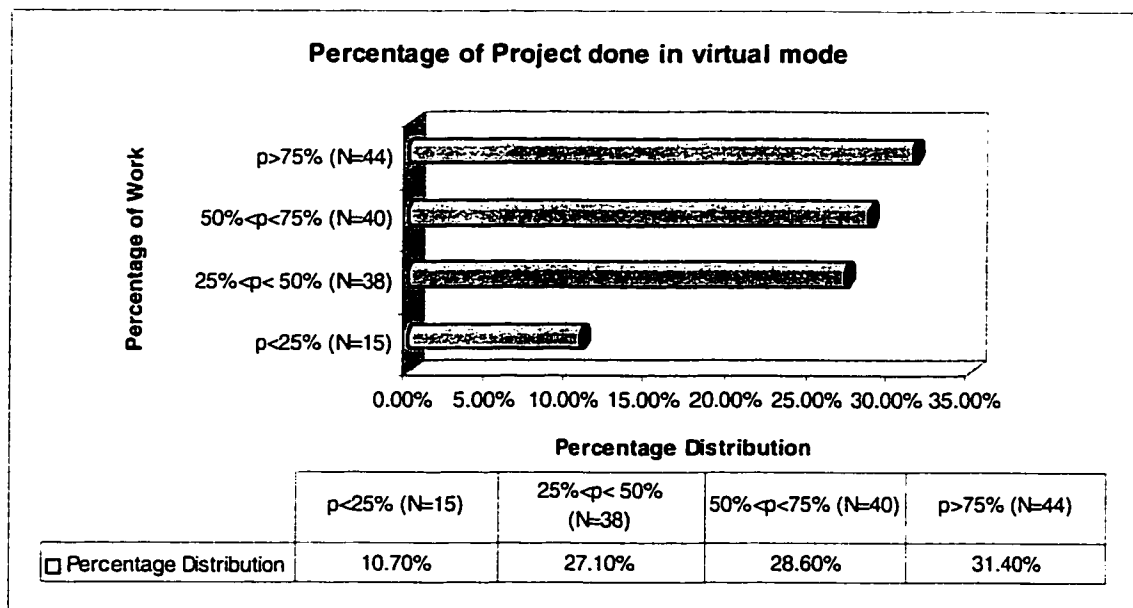
**Figure 6. Type of ICT used and frequency of respondents**



The graph in Figure 6 above illustrates the frequency of usage of each information and communication technology outlined. Most companies reported using a multitude of ICT for the particular project identified with the most used technology being the e-mail and telephone (99% and 97% respectively). It is interesting to note that the internet/intranet and audioconference are also widely used technological tools in virtual projects.

Another aspect of virtual project work worth investigating is the percentage of the project actually done in a virtual mode. This obviously is only an approximate estimation and the answers were one of the four different categories provided as shown in Figure 7. Over 30% of the respondents reported to be in a virtual environment for more than 75% of the entire project.

**Figure 7. Percentage of project done in virtual mode**



**Figure 8. Location of virtual workers**

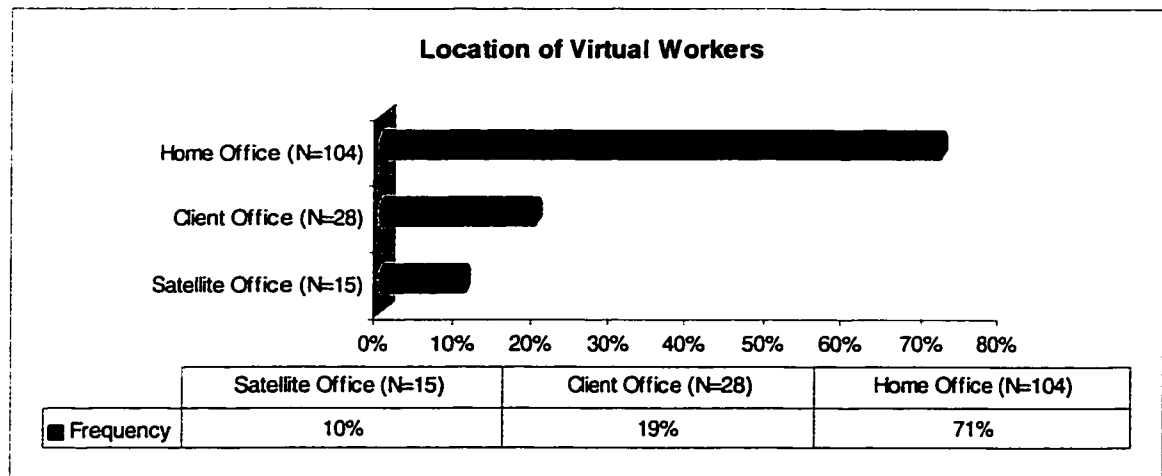
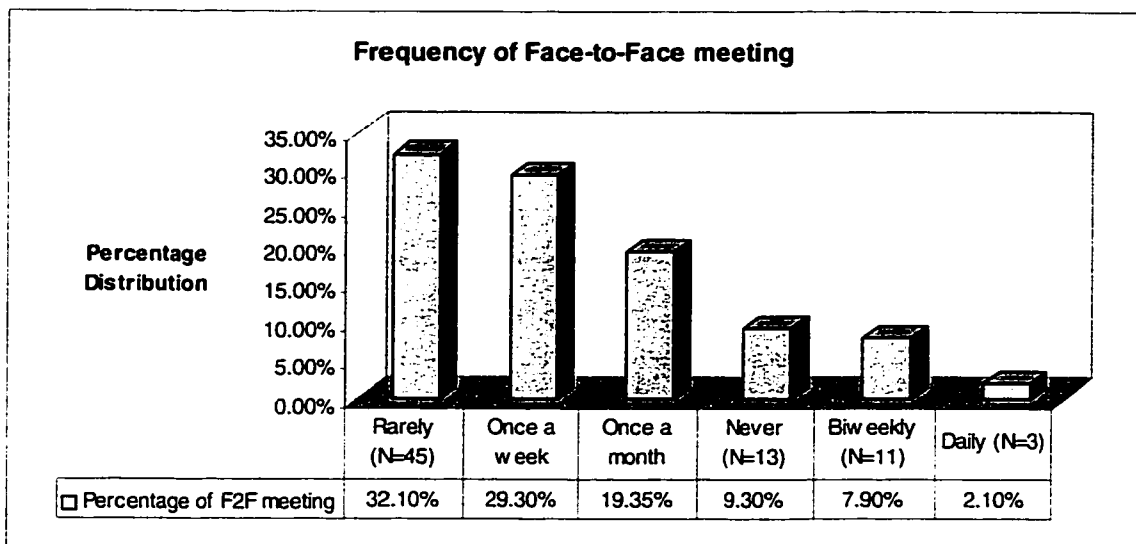


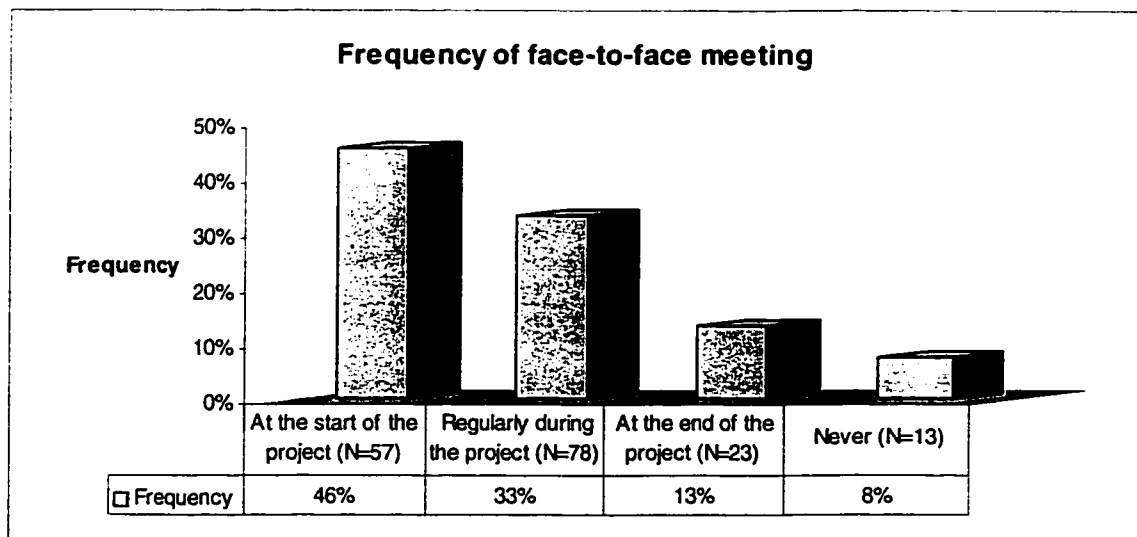
Figure 8 above shows the primary location where most of the time was spent during the virtual project. It is not surprising to note that approximately 70% of respondents spent most of their time at the home office. Another characteristic of virtual project work that is of interest was to find out how often and at what stage of the project there was a face-to-face meeting with other members of the team. As shown in Figure 9, slightly over 30% of respondents claimed to rarely have a face-to-face meeting and less than 30% said they met only once a week.

Figure 10. shows at what stage of the project the team members had a face-to-face meeting. 46% of respondents reported to have had a face-to-face meeting at the beginning of the project or at the project kick-off. A significant percentage (33%) reported meeting face-to-face regularly throughout the project.

**Figure 9. Frequency of face-to-face meeting**



**Figure 10. Frequency of face-to-face meeting during the virtual project**



#### 5.4. DESCRIPTIVE STATISTICS

Table 3. below displays the descriptive statistics of the nine main constructs of the research model. The maximum value is 5.0 conforming to the 5-point Likert scale used in the questionnaire for each item.

**Table 3. Descriptive statistics per construct**

<b>Constructs</b>	<b>N</b>	<b>Min</b>	<b>Max</b>	<b>Mean</b>	<b>Std. Deviation</b>
Organization Commitment	140	1.57	5.00	3.81	.64
Perceived Organizational Support	140	1.33	5.00	3.56	.68
Technological Support	140	2.17	5.00	3.95	.70
Management Support	140	1.75	5.00	3.69	.63
Potential Benefits	140	1.13	5.00	3.75	.77
Satisfaction with Project Team	140	1.67	5.00	4.00	.61
Satisfaction with Project Process	140	1.00	5.00	4.13	.65
Satisfaction with Project Outcomes	140	1.00	5.00	3.89	.68
Quality of Project	140	2.00	5.00	4.09	.62

#### 5.5. INDEPENDENT SAMPLE T-TEST BETWEEN PROJECT MANAGERS AND TEAM MEMBERS

The independent sample t-test is conducted at the construct level on the data set to determine whether the five proposed critical success factors and performance measures may behave differently for project managers and team members for the particular model being tested. In the event that the above statistical test reveals significant differences between the two samples, then two separate sets of analyses have to be performed on the (1) the project manager sample and (2) the team member sample. In the event that no statistical significant differences are noted between the two samples, then all the data will be considered as one homogeneous sample.



An independent sample t-test using SPSS was used to assess the homogeneity of variance based on Levene's Test for Equality of variances for the independent variables (organizational commitment, perceived organizational support, technological support, management support, perceived benefits) as well as the dependent variables between the two sample populations. An independent sample t-test was conducted on the sample of project managers (n=81) and on the sample of project team members (n=59) for each construct. The detailed results of the independent sample t-test are listed in Appendix 3. The results indicate no significant differences (Sig. 2-tailed) between the two samples for none of the constructs at the 95% Confidence Interval. Thus it can be concluded that the two sample populations are homogeneous and can be treated as one common sample.

Also, the reasoning for considering project managers and team members as one sample was to increase the overall sample size. Conclusive analyses would not be obtained with a sample size of  $n = 81$  for project managers or with a sample of 59 team members. Therefore both categories were combined and considered as one sample.

#### **5.5.1. Analysis on the frequency of face-to-face meeting**

A correlation analysis was performed to determine the effects on performance measures between teams who met face-to-face and those who rarely or never met in person during the project. The correlation coefficients for these two groups with respect to (1) virtual project performance and (2) satisfaction with team; (3) satisfaction with process; (4) satisfaction with outcome; (5) project effectiveness and (6) project efficiency were ( $r = .06, .02, .05, .08, .08, .03, R > .05$ ). Since none of the correlation coefficients were significant, it can be concluded that no significant differences exist regarding

performance measures between team who met face-to-face and those who rarely or never had a face-to-face interaction with the members.

## **5.6. RELIABILITY ANALYSIS**

The independent variables set forth in the model are constructs that have been measured in previous research studies but in a different context. Most items for these constructs were borrowed from the literature and modified to fit the current model to be tested. Items corresponding to the dependent variables were a little more challenging to find from past literature. They were identified from other performance measures used in previous studies and regrouped accordingly in the four dependent variables used in this study.

The assessment of the measurement model is conducted using construct reliability to ensure that the measurement scales used in the survey instrument produces a set of reliable constructs. The Cronbach's alpha,  $\alpha$  (also known as coefficient alpha) is a frequently used reliability index that assesses the homogeneity of the constructs in the measurement tool. Coefficient alpha is used in this study to determine and assess the reliability, dependability, and accuracy of the questionnaire. A comprehensive table of all items, with corresponding factor loadings and Cronbach's alpha is found in Appendix 5.

SPSS was used as the statistical tool to conduct the construct reliability on the entire sample. The results of all  $\alpha$  coefficients are summarized in Table 4 below.

**Table 4. Coefficient á of items selected for each construct**

CONSTRUCTS	SECTION OF THE QUESTIONNAIRE	ITEMS REMAINING AFTER ANALYSIS	COEFFICIENT ALPHA - á
Organizational Commitment ( <i>1 item deleted</i> )	Section I – Organizational Commitment and Support	OC1, OC2, OC3, OC4, OC5, OC6, OC7	<b>.83</b>
Perceived Organizational Support ( <i>2 items deleted</i> )	Section I - Organizational Commitment and Support	OS1, OS2, OS3, OS4, OS5, OS7	<b>.85</b>
Technological Support ( <i>none deleted</i> )	Section II – Specific Virtual Project	TS1, TS2, TS3, TS4, TS5, TS6	<b>.86</b>
Management Support ( <i>none deleted</i> )	Section II - Specific Virtual Project	MS1, MS2, MS3, MS4, MS5, MS6, MS7, MS8	<b>.93</b>
Potential Benefits ( <i>none deleted</i> )	Section II - Specific Virtual Project	PB1, PB2, PB3, PB4, PB5, PB6, PB7, PB8	<b>.87</b>
Satisfaction with Project Team ( <i>2 items deleted</i> )	Section III – Virtual Project Performance	PT2, PT3, PT4, PT5	<b>.86</b>
Satisfaction with Project Process ( <i>2 items deleted</i> )	Section III - Virtual Project Performance	PP1, PP2, PP3	<b>.78</b>
Satisfaction with Project Outcome ( <i>1 item deleted</i> )	Section III – Virtual Project Performance	PO1, PO2, PO3	<b>.88</b>
Quality of Project [Project effectiveness and efficiency] ( <i>none deleted</i> )	Section III – Virtual Project Performance	QP1, QP2, QP3, QP4, QP5, QP6, QP7, QP8, QP9	<b>.93</b>

Items giving rise to a coefficient alpha of less than .5, were deleted for every corresponding construct. As per Table 4, the  $\alpha$  coefficients of almost all the constructs are above .80, ranging from .83 to .93 except for the *satisfaction with process* construct which has a slightly lower coefficient of .78. For the independent variable *organizational commitment*, only the last item OC8 was deleted. This may be due to the ambiguity of the statement. Two items from *perceived organizational support* were removed and for the three remaining independent variables, the  $\alpha$  coefficient of the original items were high, confirming their reliability. A possible explanation for items being deleted may be that respondents did not view those items as a homogeneous item.

## **5.7. CORRELATIONS AND REGRESSION ANALYSIS**

The model and hypotheses were tested using (1) bivariate correlation to compute Pearson's correlation coefficient, 2-tailed test as well as (2) regression analysis. First the correlation results will be reported followed by the regression analysis.

### **5.7.1. Correlations**

Pearson correlation coefficient provides an indication as to how variables are related and it is a measure of linear association between variables. The five main hypotheses test the critical success factors or independent variables (affective commitment, perceived organizational support, technological support, management support and perceived benefits) with virtual project performance. A detailed table of the correlation matrix between all the constructs can be found in Appendix 4. Table 5. below provides a comprehensive summary of the correlations coefficients of each of the five

critical success factors with the corresponding five measures of the virtual project performance.

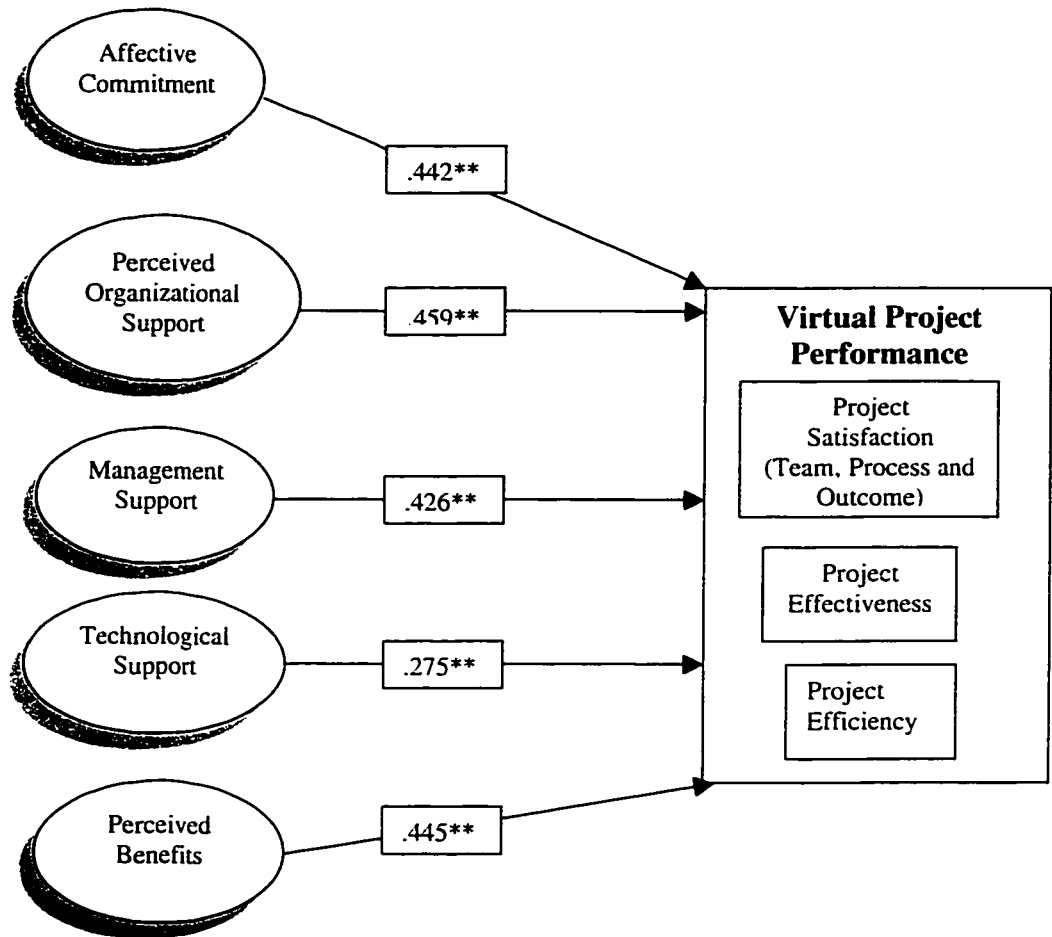
**Table 5. Summary of correlations coefficients of all constructs**

<b>CRITICAL SUCCESS FACTORS</b>	<b>PROJECT SATISFACTION WITH TEAM</b>	<b>PROJECT SATISFACTION WITH OUTCOME</b>	<b>PROJECT SATISFACTION WITH PROCESS</b>	<b>PROJECT EFFECTIVENESS</b>	<b>PROJECT EFFICIENCY</b>
Affective Commitment	.290**	.436**	.334**	.452*	.348*
Perceived Organizational Support	.355**	.382**	.404**	.417*	.388*
Management Support	.330**	.299**	.491**	.300*	.309*
Technological Support	.172**	.213**	.357**	.191*	.180*
Perceived Benefits	.369**	.404**	.375**	.362*	.333*

Note: Pearson 2-tailed test, \*\* Correlation is significant at the 0.01 level; \* Correlation is significant at the 0.05 level

The correlation coefficient for each independent construct with the dependent construct virtual project performance is shown in Figure 15. below.

**Figure 11. Virtual project performance correlations coefficients**



Note: Pearson 2-tailed test, \*\* Correlation is significant at the 0.01 level; \* Correlation is significant at the 0.05 level

Hypothesis 1 which states that higher level of affective commitment in virtual teams is positively linked to virtual project performance is supported, as the Pearson coefficient (.442) is significant at the 0.01 level confirming Hypothesis 1.

Hypothesis 2 tests the relationship between perceived organizational support and virtual project performance. The corresponding Pearson coefficient (.459) is also significant at the 0.01 level confirming that greater degree of perceived organizational support in virtual teams yields positive virtual project performance.

Hypothesis 3 is also supported with a significant Pearson coefficient (.426) at the 0.01 level confirming that greater management support does lead to higher levels of virtual project performance in virtual teams.

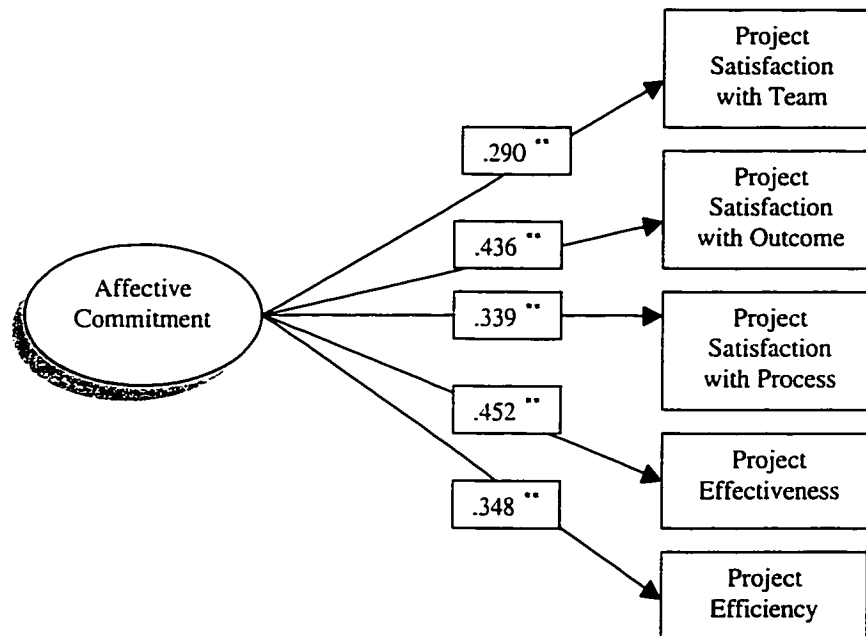
Hypothesis 4 aims at testing the relationship between technological support and virtual project performance. The correlation coefficient is significant (.275) at the 0.01 level confirming that hypothesis is supported.

Hypothesis 5 is also supported confirming that a greater degree of perceived benefits leads to higher virtual project performance. The correlation coefficient (.445) is significant at the 0.01 level proving the causal relationship between perceived benefits and virtual project performance.

Each main hypothesis has five sub hypotheses which test the independent variables with each component of the virtual project performance (satisfaction with project team, satisfaction with project process, satisfaction with project outcome, efficiency and effectiveness of project). The five following figures show the relationship of each independent construct with each performance measure as well as the corresponding Pearson correlation coefficients.

A positive relationship exists between affective commitment and project satisfaction with team, outcome and process as the corresponding three coefficient correlations are all significant at the 0.01 level. Hypotheses *H1d* and *H1e* are also supported at the 0.01 level of significance (see Figure 16 below), confirming the causal relationship between affective commitment and project effectiveness and efficiency. Hence from these results, it can be confirmed that affective commitment is a critical success factor of virtual project performance in virtual teams.

**Figure 12. Correlations of affective commitment and performance measures**



Note: Pearson 2-tailed test, \*\* Correlation is significant at the 0.01 level;

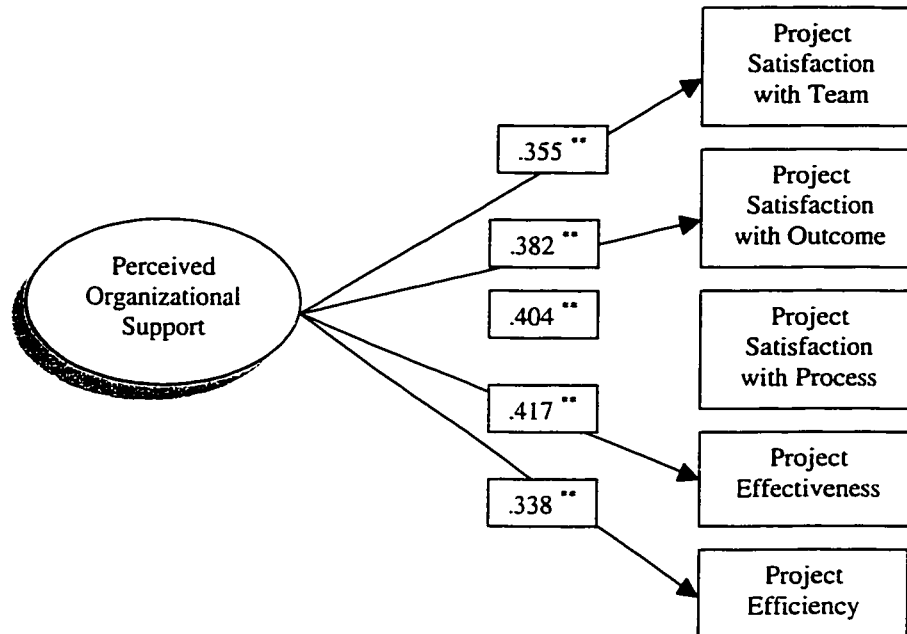
\* Correlation is significant at the 0.05 level

Perceived organizational support is strongly and positively significant with respect to project satisfaction with project team, process and outcome (with coefficients = .355; .382; .404 respectively) at the level \*\*  $p < 0.01$ . A positive causal relationship also



exists between perceived organizational support and project effectiveness and efficiency at the 0.01 level of significance as shown in Figure 17 below.

**Figure 13. Correlations of perceived organizational support and performance measures**

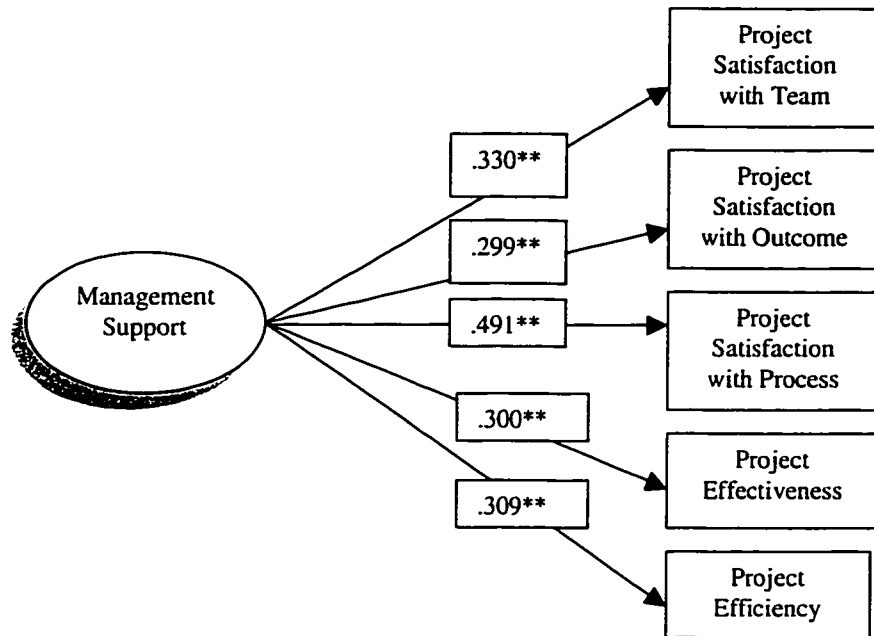


Note: Pearson 2-tailed test, \*\* Correlation is significant at the 0.01 level;

\* Correlation is significant at the 0.05 level

Management support is strongly and positively significant with respect to satisfaction with project team, process and outcome (Pearson Coefficient = .330, .299, .491 at  $p < .01$  level of significance). At the 0.01 level, management support is also positively related to project efficiency and effectiveness. This confirms that management support is a critical success factor of virtual project performance.

**Figure 14. Correlations of management support and performance measures**

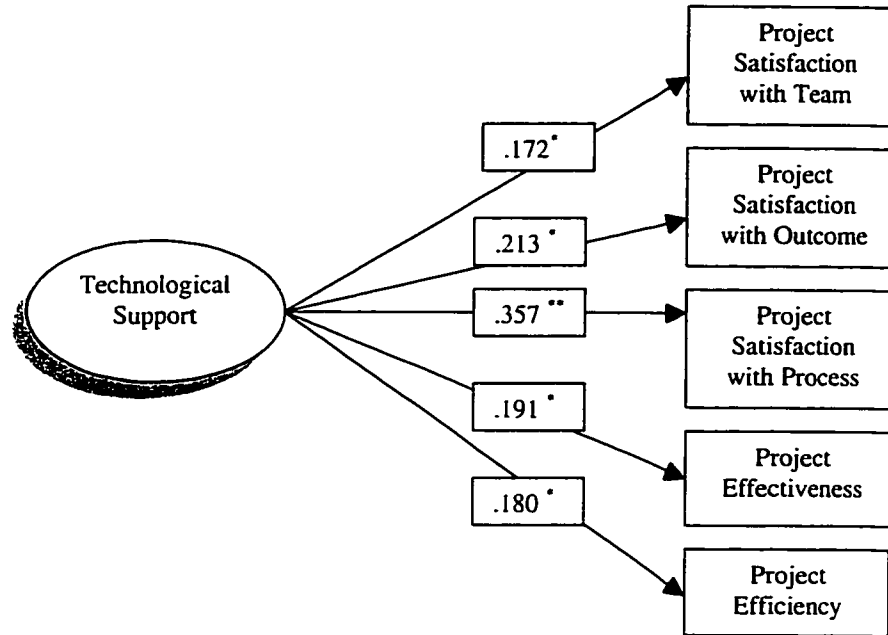


*Note: Pearson 2-tailed test, \*\* Correlation is significant at the 0.01 level;*

*\* Correlation is significant at the 0.05 level*

Technological support is positively correlated with the three variables of project satisfaction namely project satisfaction with team, outcome and process, with correlation coefficient of .172, .213 and .357 respectively, as shown in Figure 19 below. Technological support is also positively significant with regard to project effectiveness and efficiency (Person coefficient = .191 and .181 respectively at  $p < .05$ ), thus showing that greater levels of technological support is positively linked to virtual project performance. This also confirms that technological support is a critical success factor of virtual project performance in virtual teams.

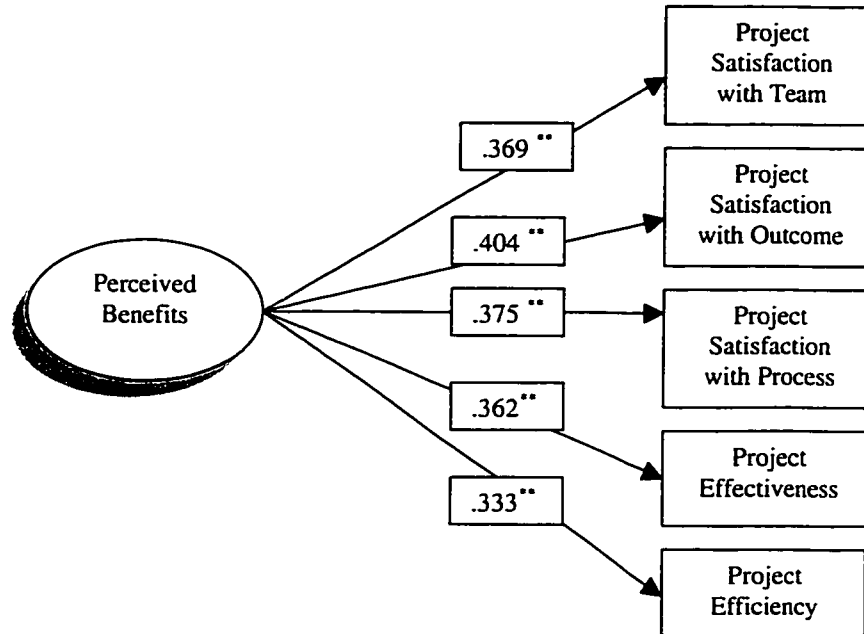
**Figure 15. Correlations of technological support and performance measures**



*Note: Pearson 2-tailed test, \*\* Correlation is significant at the 0.01 level; \* Correlation is significant at the 0.05 level*

Similarly perceived benefits was found to be positively and strongly linked to project satisfaction with team, process and outcome (coefficient = .369, .404, .375 at  $p < .01$  level of significance). Perceived benefits is also positively significant in relation to project effectiveness and efficiency, at the 0.01 level of significance. Consequently perceived benefits can be considered as a critical success factor of virtual project performance in virtual project teams.

**Figure 16. Correlations of perceived benefits and performance measures**



Note: Pearson 2-tailed test, \*\* Correlation is significant at the 0.01 level; \* Correlation is significant at the 0.05 level

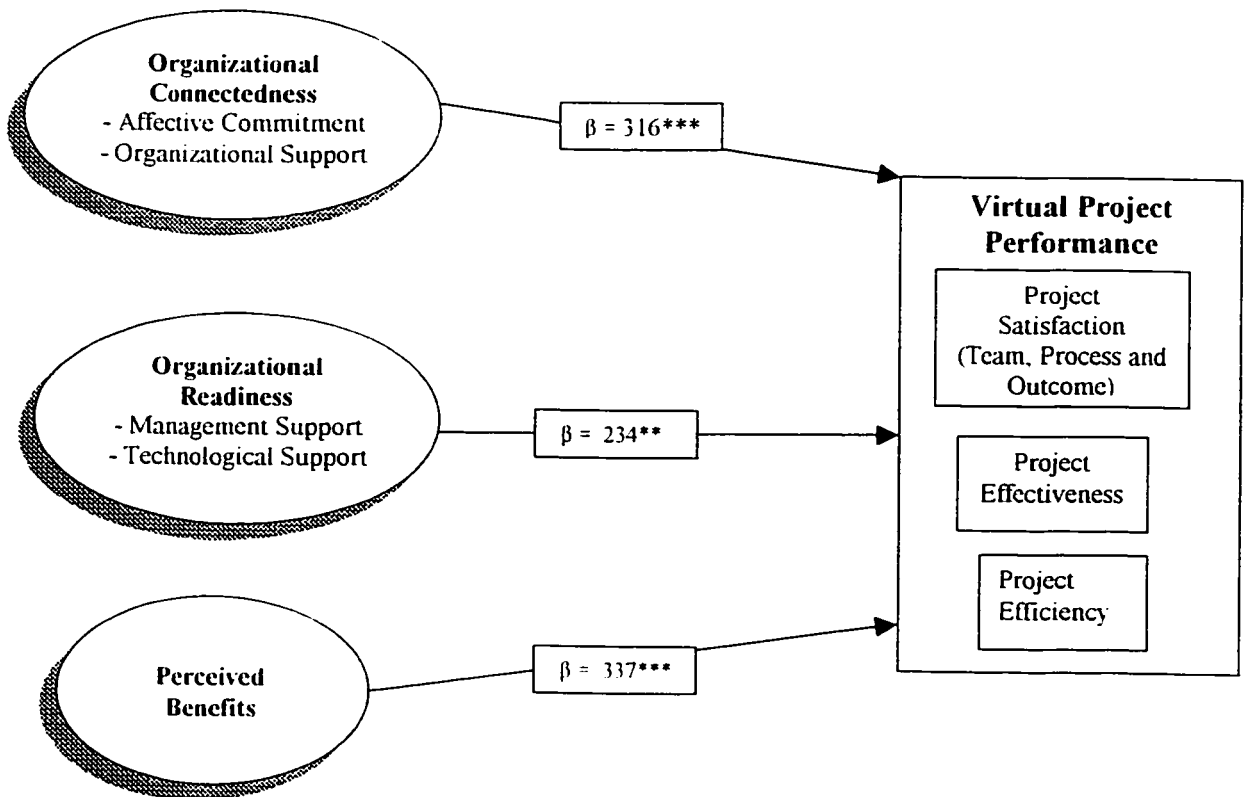
#### **5.7.2. Regression Analysis**

Regression analyses were performed to examine the overall and unique impact of the independent variables on virtual project performance as well as on each component of performance (i.e. project satisfaction with team, project satisfaction with outcome, project satisfaction with process, project effectiveness and project efficiency). As high intercorrelations among some independent variables were obtained (as shown in Appendix 4), the highly correlated variables were grouped together to account for multicollinearity and its effects. Due to a high intercorrelation between affective commitment and organizational support ( $r = .737$ ,  $p < .01$ , as shown in the correlation matrix in Appendix 4), these two constructs were combined into an overall variable termed “*organizational connectedness*” (Raghuram et al., 2001). Similarly, due to a high

intercorrelation between management support and technological support ( $r = .665$ ,  $p < .01$ , as shown in the correlation matrix in Appendix 4), these two constructs were combined into an overall variable termed “*organizational readiness*” (Iacovou et al., 1995). The third construct perceived benefits was included, as such, in the model.

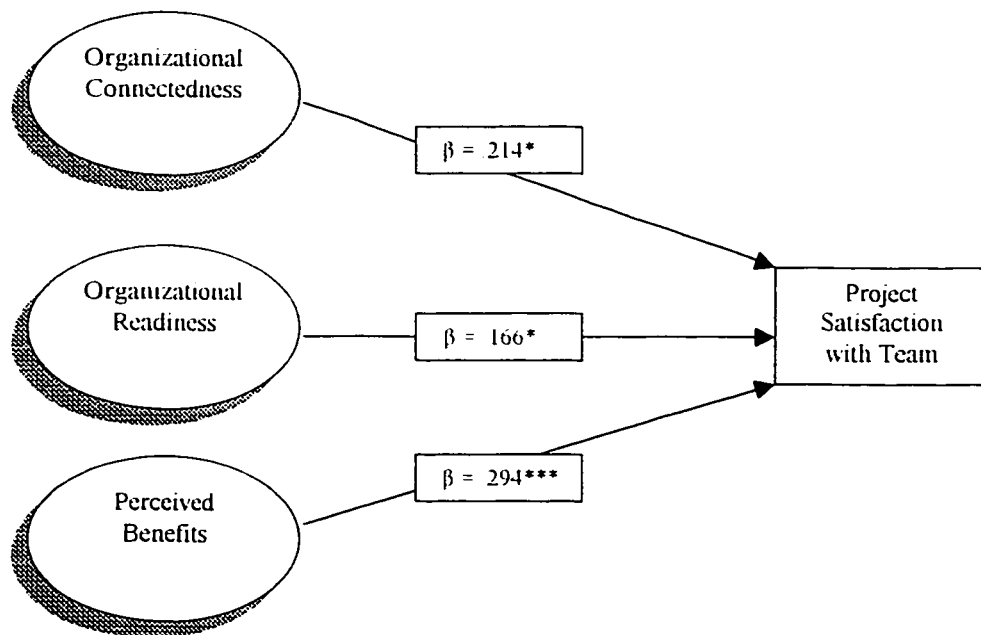
Therefore in the regression analyses, to account for the intercorrelation effects of some of the variables, the impact of organizational connectedness, organizational readiness and perceived benefits on virtual project performance and on each of its corresponding components (project satisfaction with team, process and outcome; project effectiveness and efficiency), were examined.

**Figure 17. Overall regression model**



The results of the regression analysis demonstrate that the constructs organizational connectedness, organizational readiness and perceived benefits overall account for 39.3 % of the variance (i.e.,  $R^2 = .393$ ) in virtual project performance. Individually organizational connectedness is significantly related to virtual project performance ( $\beta = .316^{***}$ ,  $p < .001$ ). Organizational readiness is also found to be positively related to virtual project performance ( $\beta = .234^{**}$ ,  $p < .01$ ) and similarly, perceived is significantly related to virtual project performance ( $\beta = .337^{***}$ ,  $p < .001$ ) as shown in Figure 17 above.

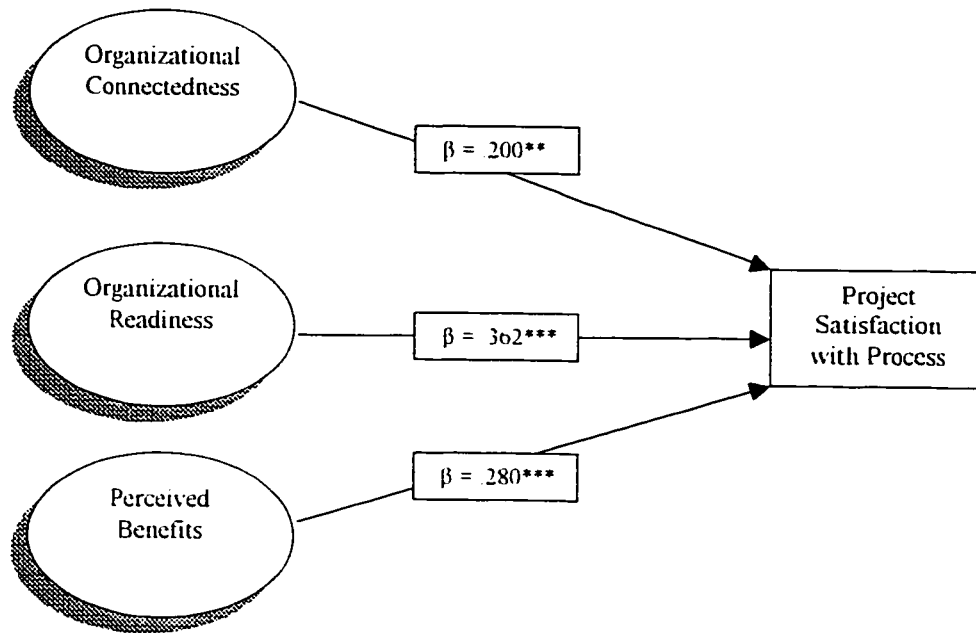
**Figure 18. Regression model (project satisfaction with team)**



Regression analysis was performed to examine how the three new independent variables (organizational connectedness, organizational readiness and perceived benefits) affect the subconstruct *project satisfaction with team*. The results of the regression reveal that organizational connectedness, organizational readiness and perceived benefits overall account for 23.0 % (i.e.,  $R^2 = .299$ ) of the variance in project satisfaction with team. As

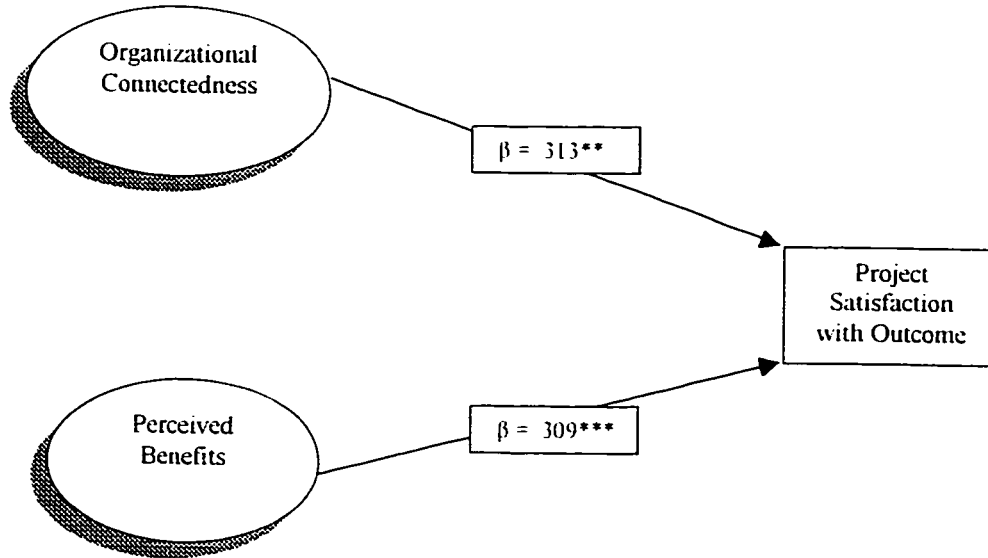
illustrated in Figure 18 above, individually organizational connectedness is significantly related to project satisfaction with team ( $\beta = .214^*$ ,  $p < .05$ ). Similarly, there is a significant relationship between organizational readiness and project satisfaction with team ( $\beta = .166^*$ ,  $p < .05$ ) and a strong relationship exists between perceived benefits and project satisfaction with team ( $\beta = .294^{***}$ ,  $p < .001$ ).

**Figure 19. Regression model (project satisfaction with process)**



Regression analysis results demonstrate that 35.4 % (i.e.,  $R^2 = .354$ ) of the total variance in the dependent variable project satisfaction with process can be accounted for by the independent variables organizational connectedness, organizational readiness and perceived benefits. Each of the independent variables organizational connectedness ( $\beta = .200^{**}$ ,  $p < .01$ ), organizational readiness ( $\beta = .362^{***}$ ,  $p < .001$ ) and perceived benefits ( $\beta = .280^{***}$ ,  $p < .001$ ), was also found to be significantly related to project satisfaction with process respectively as shown in Figure 19 above.

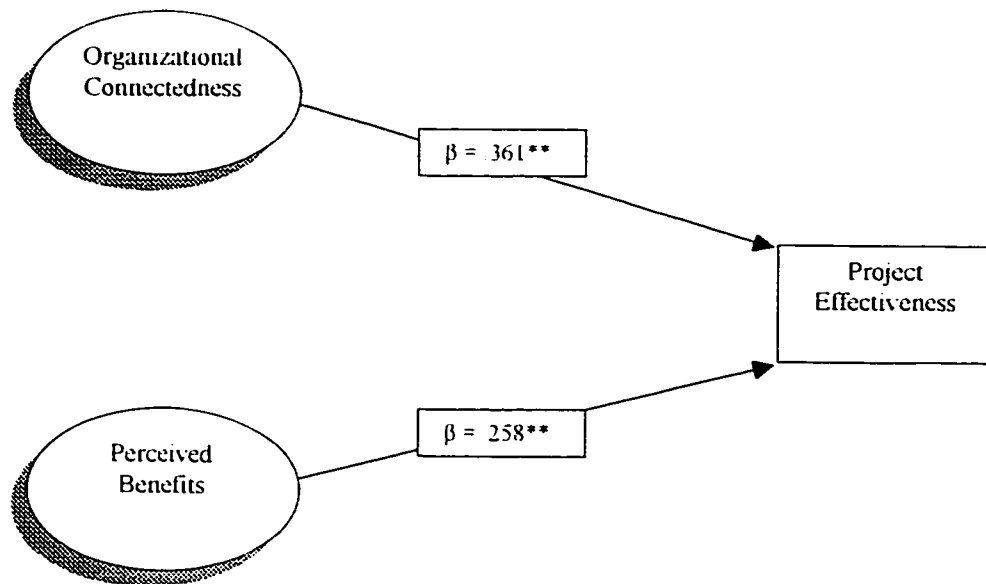
**Figure 20. Regression model (project satisfaction with outcome)**



The results of the regression analysis show that 30.0% ( $R^2 = .299$ ) of the total variation in the dependent variable project satisfaction with outcome can be explained by the independent variables organizational connectedness, organizational readiness and perceived benefits. As shown in Figure 20 above, the regression analysis revealed that organizational connectedness, and perceived benefits (each with coefficients  $\beta = .313^{***}$ ,  $p < .001$  and  $\beta = .309^{***}$ ,  $p < .001$  respectively) are individually all significantly related the dependent variable project satisfaction with outcome. However from the results it can be deduced that organizational readiness is not related to satisfaction with outcome ( $\beta = .131$ ,  $p = .087$ ).

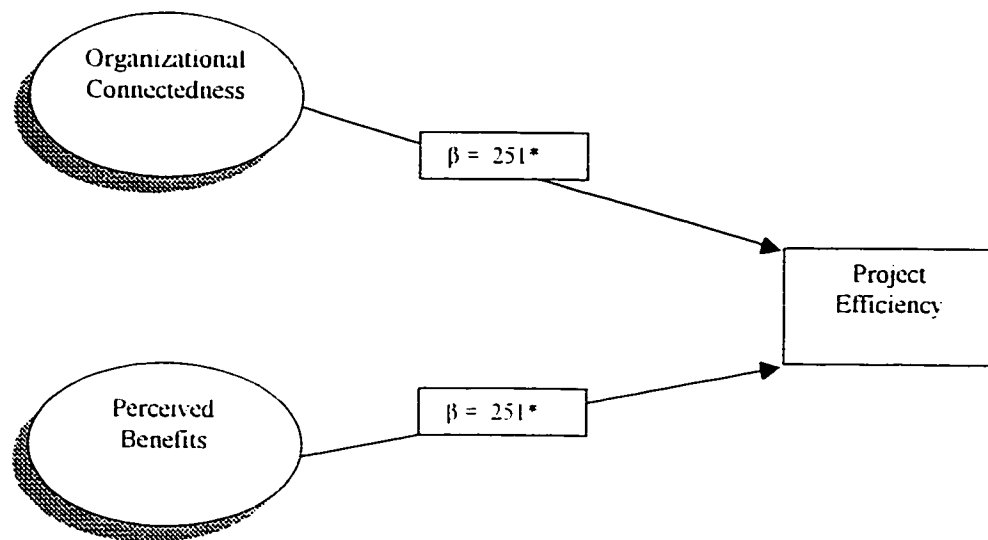


**Figure 21. Regression model (Project Effectiveness)**



The regression model in Figure 21 above reveal that 29.2 % (i.e.,  $R^2 = .292$ ) of the total variation of the dependent variable project effectiveness can be explained by organizational connectedness, organizational readiness and perceived benefits. It can also be deduced from the regression coefficients that organizational connectedness ( $\beta = .361^{***}, p < .001$ ) and perceived benefits ( $\beta = .258^{**}, p < .01$ ) are each significantly related to project effectiveness. However it can be deduced from the results that organizational readiness is not significantly related to project effectiveness ( $\beta = .111, p = .154$ ).

**Figure 22. Regression model (Project Efficiency)**



The results of the regression analysis demonstrate that organizational connectedness, organizational readiness and perceived benefits overall account for 21.7% (i.e.,  $R^2 = .217$ ) of the variance in project efficiency. Individually, organizational connectedness is significantly related to project efficiency ( $\beta = .251^{**}$ ,  $p < .01$ ). Similarly perceived benefits ( $\beta = .251^{**}$ ,  $p < .01$ ) is individually significantly related to project efficiency as depicted in Figure 26 above. However organizational readiness was not found to be significantly related to project efficiency ( $\beta = .151$ ,  $p = .066$ ).

## **6. DISCUSSION & CONCLUSION**

## **6.1. DISCUSSION**

The aim of the proposed research framework was to provide insights into the critical success factors of virtual project work. The focus of the study was to investigate the organizational and technological factors contributing to enhancing virtual project performance among virtual teams. The conceptual model was evaluated with the participation of 140 virtual team workers from organizations across Canada and belonging to few selected industries. The findings from this study have a number of significant implications for academics as well as practitioners. The outcomes of this study provide managers and team members with some factors that need to be emphasized on while working in a virtual mode. It also provides some critical features of what constitutes a typical virtual project.

The general profile of the typical virtual employee is male ranging in age between 36 and 55 working as project manager with one to three years of experience in this position and working between one and five years for their current organization. Most of the companies engaging in virtual project work seem to belong to the telecommunication and consulting sectors. This trend may be explained by the fact that telecommunication companies may already possess the technological infrastructure needed to conduct virtual project while consulting companies by virtue of the nature of their business need to have the flexibility of being geographically and organizationally dispersed while carrying out projects.

The type of virtual project under assessment for this research was mostly IT related projects dealing with software development, IT systems, website construction, e-

business and business strategy. Virtual projects typically lasted between 1 to 12 months and more than 75% of the project was conducted in a virtual mode using mostly information and communication technology such as e-mail and telephone. Virtual projects were done predominantly at the home office where team members never or rarely met face-to-face (once a week) and this in-person contact primarily took place at the start of the project. These were the most common specifications of virtual projects adopted by most companies which participated in this study. Organizations may use these aspects of virtual projects, as a guideline to follow while engaging in virtual work for example meeting face-to-face at the beginning of a project might be required step virtual projects.

The information on the specifications of the virtual worker and virtual projects may help many organizations identify whether they are currently engaging in virtual project work and give companies insights into what is needed to shift to virtual teamwork. Many companies have transitioned to virtual modes of working but fail to realize this shift and understand that it requires the implementation of critical change management objectives. Managing remote workers in virtual environments is significant and needs to be better understood (Staples et al., 1999). With the rapid growth of virtual work, research is needed to inform organizations and managers on what can be done to make remote employees more effective (Lucas, 1996).

All five independent constructs that were tested showed significant positive correlations with all the virtual project performance constructs. This suggests that (1) affective commitment, (2) perceived organizational support, (3) management support, (4)

technological support and (5) perceived benefits are established critical success factors of virtual project performance amongst virtual teams. In accordance with the model and propositions set forward in the beginning of research study, the results indicated that all hypotheses made were supported.

Affective commitment was found to be a strong significant determinant of virtual project performance as well as its subconstructs. This confirms the proposition suggesting that affective commitment is particularly important among virtual employees for maintaining significant ties with the organization. Virtual team members may be geographically or organizationally dispersed, but maintaining a connection to the home-based company still remains a key factor on how they perform on projects. This socio-psychological characteristic leads to enhance project performance and can be established as a critical success factor for virtual project performance.

Perceived organizational support showed a significant positive correlation with virtual project performance and all the subconstructs of performance. This suggests that the general beliefs formed by employees regarding the extent to which the organization values their contributions and cares about their well-being plays a determining role in how employees perform on virtual projects. Even if virtual employees are not physically located at the home-based company, they still place enough emphasis on the perceived organizational support of their employees, which in turn impacts the outcome of the project.

Management support was found to have a strong positive correlation with the performance outcome measures. This result confirms that it is necessary to obtain the

approval, understanding and buy-in of top management to carry out virtual projects successfully. The results of this study show that managing virtual workers is critical in virtual work for positive project performance. Remote workers work with minimal supervision and have to rely heavily on their own skills and abilities to perform various tasks. Information technology is the typical medium of communication since face-to-face interaction is rare. As shown in the study, management plays an important role in the success of virtual project work thus confirming the hypothesis stating that management support is a critical success factor in virtual project performance.

Technological support was found to be highly significant for ensuring positive virtual project performance. This finding supports the theoretical background that a solid infrastructure of information and communication technologies is a key prerequisite for team members to operate in a virtual setting. This finding also suggest that in order to improve virtual project performance, companies may need to invest to acquire the right information and communication technologies needed for virtual project work. These technologies provide the foundation for linking virtual team members thus making it possible to carry out virtual projects. Technological support not only makes virtual projects possible but also this study shows it is a significant contributing factor leading to increased project performance.

Perceived benefits are positively associated with virtual project performance as well as the components of performance. This implies that it is important for virtual team members to understand and recognize the advantages of virtual project work. Virtual project work is still at its infancy but gaining rapid popularity as companies and

employees realize the economic and strategic benefits of adopting this alternative work mode. Based on this result, it may be important for companies to educate and create an awareness of the potential benefits of virtual project work among virtual employees. Based on this research, perceived benefits can be considered as a critical success factor for virtual project performance.

Due to a high intercorrelation between some independent variables, the highly intercorrelated constructs were grouped together and the new model was analyzed using regression analyses. Since a high intercorrelation existed between affective commitment and perceived organizational support, these two constructs were combined into an overall variable termed "*organizational connectedness*". Similarly management support and technological support were combined into one overall variable termed "*organizational readiness*" and perceived benefits remained as one single variable. A regression analysis was performed on the new model and the results indicated that in almost all cases, the three independent variables were significantly related to the virtual project performance as well as each to the components of performance (satisfaction with team, process and outcome; project effectiveness and project efficiency).

The high intercorrelation between affective commitment and perceived organizational support can be explained from several previous studies reporting that these two constructs are strongly associated yet empirically distinct (Eisengerger et al., 1990; Shore and Wayne, 1993). From the literature review, it is found that affective commitment and perceived organizational support have similar antecedents and consequences. Although much of the research done in this area suggests that perceived



organizational support leads to affective commitment (Eisengerger et al., 1986), the two constructs have been measured simultaneously so that the direction of causality is uncertain (Rhoades et al., 2001). Consequently, the model set forth in the present study considered affective commitment and perceived organizational support as two distinct constructs. The high intercorrelation between the two variables and the regression analysis suggest that affective commitment and perceived organizational commitment be combined.

The high intercorrelation between management support and technological support suggested that these two constructs be combined together and be considered as one overall variable termed as "*organizational readiness*". The construct organizational readiness has been used in many previous research studies as a determining element in the adoption of EDI (Iacovou et al., 1995), in the adoption of electronic commerce (Mackay et al., 2001) as well as a significant factor contributing to the acceptance of personal computing. Organizational readiness used in the above stated studies comprised of technological resources and management support. Consequently it is acceptable, based on previous research, to use organizational readiness as an overall construct to depict the availability of the needed organizational resources for successful virtual project performance. The results of the regression analysis in the present study demonstrated that organizational readiness is significantly related to virtual project performance and the components of performance (satisfaction with team, process and outcome; project effectiveness and project efficiency).

## **6.2. CONCLUSION**

There are clear trends for the widespread use of virtual work along with the increased popularity of information and communication technologies to carry out projects. The direction is definitely more towards virtual organization forms where traditional business is being challenged by a wide array of strategic alternatives made possible by the information revolution. However, limited research has been done in the areas of virtual teams and virtual organizing. This objective of this study was to establish critical success factors of virtual project work in an effort to provide practical approaches for managing virtual work initiatives. The findings suggest that it is not enough to simply provide virtual team members with laptops and let them work freely in a virtual mode. The study confirms that significant factors are to be considered in the implementation of successful virtual project work.

This study provides practical insight and some significant tools of virtual project work to organizations currently or intending to operate in a virtual mode, to virtual project managers, as well as virtual team members striving to successfully transition to this innovative way of conducting business. Research done in this area so far has emphasized on comparing face-to-face interaction with working virtually. Many studies have reported considerable drawbacks of virtual teams relating to trust, lack of communication cues, and slower rate of transfer (Jarvenpaa and Leidner, 1999). Despite these negative features of virtual teams, the reality of today's revolutionary ways of conducting business where globalization, e-commerce and the Internet have become the driving forces of success, many organizations are rapidly adopting the virtual mode of

work in an attempt to gain a strategic and competitive advantage. Gaining a strong understanding of what constitutes successful virtual work is vital.

Much of the research on virtual work is in the area of collaborative support systems like the group decision support systems (GDSS). It is interesting to note that although sophisticated GDSS and collaborative support systems exist, the most common type of ICT used on virtual project work, based on this study, is e-mail and telephone. This suggests that working in virtual mode requires access to the internet, company intranet and telephones. Since the internet and telephone are the most widely used ICT, it can be suggested that it is not requires for companies to invest heavily in groupware technology to carry out virtual project work.

Information technology is a key enabler of virtual project work suggesting that organizations need to carefully respond to their remote employees' IT needs. Consequently proper training and on-going access to IT support/help staff should be available to virtual workers. Companies should also carefully select the type of ICT required depending on the nature of the virtual project work undertaken for appropriateness and cost effective reasons. As discussed above, investing in sophisticated groupware systems may not necessarily result in improved virtual performance.

This study suggests that strong management support is critical in ensuring successful virtual project work. For practitioners, this implies that managers can play a significant role in designing the boundaryless, flexible enterprise. Therefore companies involved in virtual projects may need to train managers on how to implement effective remote management practices. Managers can also encourage the productive and healthy

communication processes among virtual team members as well as with the home organization. Career management initiatives such as formal mentoring programs may be useful in ensuring that virtual team members feel connected with their organization (Ragins, 1997). Organizations may wish to select the appropriate time for employees to embark in virtual project work during their careers. For example, it may be more suitable for employees who have been with the organization for an appropriate period of time and are accustomed to the organizational culture to work in virtual mode.

Most of the studies conducted on computer-mediated communication and virtual teams focus around the social and psychological aspects of the group dynamics. The results of this study offers practitioners with efficient ways of conducting project tasks using communication technology, which is especially important for projects in the management consulting and telecommunication fields. This research offers some key success factors for management to take into consideration before and while implementing virtual projects.

### **6.3. LIMITATIONS**

The method of data collection used in this self-reporting study engenders possible sources of errors like variability and bias errors (Joliffe, 1986). Respondents' perceptual differences, the lack of control over the respondents, and the variability in the respondents' level of competence and familiarity with the research topic are some of the sources of variability errors in survey data (Kerlinger 1986; Zahra and Govin 1993). More specifically for this particular survey, the single source bias was encountered as the methodological approach adopted to gather data was a questionnaire targeted to an

individual respondent. Since single respondents answered all the questions, stronger relationships between the independent and dependent constructs, than what actually exists, may have been captured.

Other limitations lie in the fact that no information was obtained pertaining to the length of time these companies have been working on virtual projects, the type of IT infrastructure that is available to them or the type and length of experience of virtual work the respondents have in this field.

The database obtained from the PMI included only the mailing addresses of project managers. E-mail addresses of project managers were not available and this constituted a limitation in this study. Given the nature of this study, sending the questionnaires electronically to the project managers who would and in turn send it to their team members would have been more appropriate.

The questionnaires were sent out to random project managers who were registered with the Project Management Institute of companies from selected industries in Canada. The low rate of response of 24% was due to the fact that it was not possible to identify specific companies involved in virtual project work. Questionnaires were sent out to companies within industries that were thought to be likely working on virtual projects. The inability to exactly identify companies undertaking virtual project was a critical limitation, thus contributing to the low response rate.

#### **6.4. FUTURE RESEARCH DIRECTIONS**

This study adds to the growing body of research on computer-mediated communication. Research on the effects of technology on groups is still at its infancy and more and more studies are being done in this area as communication technology is being used as an enabler in organizations to achieve work group effectiveness and project success.

Future research can be undertaken to provide management with some essential management approaches to adopt in regards to coordinating and managing project tasks as well as effectively communicating with their remote employees. The role of managers in managing virtual work is a prime area for research (Wiesenfeld et al., 1999). Given the critical success factors identified in this study, how can project managers implement these tools in managing virtual teams? How can project managers obtain the support and understanding of upper level management to cooperate in the successful management of virtual teams? Innovative project management tools for virtual teams need to be identified and tested, as virtual teams cannot be managed in similar ways as conventional teams. These are some of concerns that need to be addressed for future exploration as a better understanding of virtual work is gained.

It will be interesting to replicate this study with two groups of team members, virtual workers and face-to-face workers. A comparison study using the same framework model can be used to identify for which group of workers (i.e., virtual teams and face-to-face teams) the correlation between each independent measure and the project performance constructs is greater. This would help us understand whether the critical

success factors identified in this study are more significant in virtual teams versus face-to-face ones. The objective of such a study would provide us with an indication of the degree of dissimilarity between virtual and non-virtual projects. It would also give management insights into the different management approaches to adopt for virtual teams.

During the pretest exercise, participants were asked what they considered to be some critical success factors of working on virtual projects, they unanimously confirmed that access to the technological tools to enable team members to work virtually, strong management support and frequent face-to-face meetings amongst virtual teams especially at the project kick-off were key aspects of working in virtual teams. For future research, it would be extremely interesting to further explore whether frequent face-to-face interactions during the virtual project or at the beginning of the project affect virtual project performance. Information and knowledge sharing as well as frequent communication flow among virtual team members may other critical success factors of virtual project performance that may be explored in the future.

Future research can make use of the current research framework as a starting point to further establish some critical success factors of computer-mediated communication and extend the current findings. This research has only captured a snapshot of the critical success factors of virtual project work; there are other avenues that need to be explored to obtain a comprehensive model of what constitutes successful virtual project work.

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## **8. APPENDICES**

## **Appendix 1. Questionnaires**

**Note:** *To comply with the standards of formatting of the current thesis, the formatting of the original questionnaire was lost. Therefore, the author apologizes for the non-esthetic features of the questionnaire in Appendix 1.*

## VIRTUAL PROJECT WORK

Virtual project work takes place when coworkers in a team are geographically and/or organizationally dispersed while working on a project and work interdependently using a combination of information and communication technologies (ICT) such as the internet, telephone, videoconferencing or collaborative software systems.

### ORGANIZATIONAL COMMITMENT AND SUPPORT

**Instructions:** Using the following scale, please indicate how you would judge your commitment to and support offered by the organization. Please circle the number that best represents your opinion.

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1	2	3	4	5

#### Organizational Commitment

- |   |   |   |   |   |   |
|---|---|---|---|---|---|
| 1. I feel a strong sense of belonging to my organization                                      | 1 | 2 | 3 | 4 | 5 |
| 2. Working at my organization has a great deal of personal meaning to me                      | 1 | 2 | 3 | 4 | 5 |
| 3. I would be happy to work at my organization until I retire                                 | 1 | 2 | 3 | 4 | 5 |
| 4. I feel personally attached to my work organization   | 1 | 2 | 3 | 4 | 5 |
| 5. I do not feel like "part of the family" at my organization                                 | 1 | 2 | 3 | 4 | 5 |
| 6. I really feel that problems faced by my organization are also my problems                  | 1 | 2 | 3 | 4 | 5 |
| 7. I am proud to tell others I work for my organization                                       | 1 | 2 | 3 | 4 | 5 |
| 8. I think that I could easily become as attached to another organization as I am to this one | 1 | 2 | 3 | 4 | 5 |

#### Organizational Support

- |   |   |   |   |   |   |
|---|---|---|---|---|---|
| 1. My organization really cares about my well-being                     | 1 | 2 | 3 | 4 | 5 |
| 2. My organization strongly considers my goals and values               | 1 | 2 | 3 | 4 | 5 |
| 3. My organization shows little concern for me                          | 1 | 2 | 3 | 4 | 5 |
| 4. My organization cares about my opinions                              | 1 | 2 | 3 | 4 | 5 |
| 5. My organization is willing to help me if I need a special favor      | 1 | 2 | 3 | 4 | 5 |
| 6. Help is available from my organization when I have a problem         | 1 | 2 | 3 | 4 | 5 |
| 7. My organization would forgive an honest mistake from my part         | 1 | 2 | 3 | 4 | 5 |
| 8. If given the opportunity, my organization would take advantage of me | 1 | 2 | 3 | 4 | 5 |

## SPECIFIC VIRTUAL PROJECT

**Instructions:** Please answer the following questions while thinking of a **specific virtual project** as identified by the project manager (or yourself if you are the project manager). You may have completed the virtual project or if you are currently working on it, then please answer the questions based on the level of work completed.

1. Please briefly describe the nature of the **specific virtual project identified**:

2. State the approximate duration of this project: \_\_\_\_\_ months

3. What type of information and communication technology (ICT) was used during the project?

☐ Telephone    ☐ E-mail    ☐ Internet/intranet    ☐ Audioconference    ☐ Groupware  
☐ Desktop Videoconference    ☐ Laptop Videoconference    ☐ Videoconference Room    Other \_\_\_\_\_

4. Approximately what percentage of this project is (was) done in a virtual mode that is using information and communication technology (ICT)?

☐ < 25%    ☐ Between 25% and 50%    ☐ Between 50% and 75%    ☐ > 75%

5. While working on this virtual project, where do (did) you spend **most** of your time?

☐ Home Office    ☐ Client Office    ☐ Satellite Office    Other \_\_\_\_\_

6. How often during this virtual project, (do) did you have a face-to-face meeting with members of the team?

☐ Once a week    ☐ Biweekly    ☐ Once a month    ☐ Rarely    ☐ Never    Other \_\_\_\_\_

7. At what stage of the project, do (did) you have this face-to-face meeting with team members?

☐ At the start of the project    ☐ Regularly during the project    ☐ At the end of the project    ☐ Never    Other \_\_\_\_\_

## TECHNOLOGICAL SUPPORT

**Instructions:** Using the following scale, please indicate what you believe is your level of satisfaction with regards to the actual IT resources available in your organization for using information and communication technology in the **specific virtual project identified**. Please circle the number that best represents your opinion.

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Not Applicable
1	2	3	4	5	N/A

- |  |   |   |   |   |   |     |
|--|---|---|---|---|---|-----|
| 1. The organization possesses a good telecommunications infrastructure                     | 1 | 2 | 3 | 4 | 5 | N/A |
| 2. The organization possesses a good information systems infrastructure                    | 1 | 2 | 3 | 4 | 5 | N/A |
| 3. The organization possesses the necessary infrastructure to support remote communication | 1 | 2 | 3 | 4 | 5 | N/A |
| 4. The organization possesses rapid internet/intranet access                               | 1 | 2 | 3 | 4 | 5 | N/A |
| 5. The organization possesses adequate videoconferencing systems                           | 1 | 2 | 3 | 4 | 5 | N/A |
| 6. The organization possesses adequate collaborative software systems                      | 1 | 2 | 3 | 4 | 5 | N/A |

## MANAGEMENT SUPPORT

**Instructions:** Using the following scale, please indicate how you would evaluate the general support offered by top management in your organization while working in a virtual mode on the **specific virtual project identified**. Please circle the number that best represents your opinion.

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Not Applicable
1	2	3	4	5	N/A

- |  |   |   |   |   |   |     |
|--|---|---|---|---|---|-----|
| 1. Management is aware of the benefits that can be achieved with the use of information communication technology for virtual project work          | 1 | 2 | 3 | 4 | 5 | N/A |
| 2. Management always supports and encourages the use of information communication technology for virtual project work                              | 1 | 2 | 3 | 4 | 5 | N/A |
| 3. Management provides most of the necessary help and resources to enable people to use information communication technology in virtual project    | 1 | 2 | 3 | 4 | 5 | N/A |
| 4. Management is really keen to see that people are satisfied with using information communication technology in virtual project                   | 1 | 2 | 3 | 4 | 5 | N/A |
| 5. Management provides good access to hardware resources for virtual project work  | 1 | 2 | 3 | 4 | 5 | N/A |
| 6. Management provides good access to various types of software for virtual project  | 1 | 2 | 3 | 4 | 5 | N/A |
| 7. Use of information and communication technology in virtual project work is regarded as a high priority by top management                        | 1 | 2 | 3 | 4 | 5 | N/A |
| 8. Top management perceives the use of information and communication technology for virtual project work to be a part of the organization's vision | 1 | 2 | 3 | 4 | 5 | N/A |

## POTENTIAL BENEFITS

**Instructions:** Using the same scale as above, please indicate how you would have rated the following benefits of working in virtual mode, **at the time prior to starting the specific virtual project identified**. Please circle the number that best represents your judgment.

**At the beginning of the specific virtual project identified, I felt that working in virtual mode would:**

- |  |   |   |   |   |   |     |
|--|---|---|---|---|---|-----|
| 1. ... increase the organization's profitability     | 1 | 2 | 3 | 4 | 5 | N/A |
| 2. ... help the organization gain a competitive edge | 1 | 2 | 3 | 4 | 5 | N/A |
| 3. ... help decrease operational costs               | 1 | 2 | 3 | 4 | 5 | N/A |
| 4. ... shorten the project's life cycle              | 1 | 2 | 3 | 4 | 5 | N/A |
| 5. ... improve my job performance                    | 1 | 2 | 3 | 4 | 5 | N/A |
| 6. ... increase my productivity on the project       | 1 | 2 | 3 | 4 | 5 | N/A |
| 7. ... be useful in my job                           | 1 | 2 | 3 | 4 | 5 | N/A |
| 8. ... enhance my effectiveness on the project       | 1 | 2 | 3 | 4 | 5 | N/A |

## VIRTUAL PROJECT PERFORMANCE

**Instructions:** Basing yourself on the **specific virtual project identified** and using the following scale, please indicate how you would rate the quality of the project, the satisfaction of working with your team members, project process and project outcome. Please circle the number that best represents your judgment.

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Not Applicable
1	2	3	4	5	N/A

### Satisfaction with Project Team

- |   |   |   |   |   |   |     |
|---|---|---|---|---|---|-----|
| 1. I enjoy(ed) working with members on my project team  | 1 | 2 | 3 | 4 | 5 | N/A |
| 2. I really feel (felt) that I am a part of this project team                                   | 1 | 2 | 3 | 4 | 5 | N/A |
| 3. I learn(ed) a lot from the other members of this group                                       | 1 | 2 | 3 | 4 | 5 | N/A |
| 4. I would like to work with this group again   | 1 | 2 | 3 | 4 | 5 | N/A |
| 5. The team member(s) would like to do this collaborative work again                            | 1 | 2 | 3 | 4 | 5 | N/A |
| 6. Generally, the team served to satisfy, rather than frustrate, personal needs of team members | 1 | 2 | 3 | 4 | 5 | N/A |

### Satisfaction with Project Process

- |   |   |   |   |   |   |     |
|---|---|---|---|---|---|-----|
| 1. This communication media use(d) in this virtual project is (was) effective | 1 | 2 | 3 | 4 | 5 | N/A |
| 2. I enjoy(ed) working on this project  | 1 | 2 | 3 | 4 | 5 | N/A |
| 3. This method of working together is (was) effective                         | 1 | 2 | 3 | 4 | 5 | N/A |
| 4. Working on this project is (was) frustrating                               | 1 | 2 | 3 | 4 | 5 | N/A |
| 5. I feel (felt) pressured trying to complete the task in the allotted time   | 1 | 2 | 3 | 4 | 5 | N/A |

### Satisfaction with Project Outcomes

- |   |   |   |   |   |   |     |
|---|---|---|---|---|---|-----|
| 1. Overall, I am (was) personally satisfied with this project               | 1 | 2 | 3 | 4 | 5 | N/A |
| 2. This group produce(d) effective and valuable results during this project | 1 | 2 | 3 | 4 | 5 | N/A |
| 3. I agree(d) with the outcome of the project                               | 1 | 2 | 3 | 4 | 5 | N/A |
| 4. Overall, the quality team interaction during the project is (was) high   | 1 | 2 | 3 | 4 | 5 | N/A |

### Quality of Project

- |  |   |   |   |   |   |     |
|--|---|---|---|---|---|-----|
| 1. According to the results, this project is (was) regarded as successful  | 1 | 2 | 3 | 4 | 5 | N/A |
| 2. From the company's perspective, all project goals are (were) satisfied  | 1 | 2 | 3 | 4 | 5 | N/A |
| 3. The project result is (was) highly satisfactory                         | 1 | 2 | 3 | 4 | 5 | N/A |
| 4. The team is (was) satisfied with the project result                     | 1 | 2 | 3 | 4 | 5 | N/A |
| 5. From the company's perspective, the project progress(ed) satisfactorily | 1 | 2 | 3 | 4 | 5 | N/A |
| 6. Overall, the project is (was) done in a cost effective manner           | 1 | 2 | 3 | 4 | 5 | N/A |
| 7. Overall, the project is (was) done in a time efficient manner           | 1 | 2 | 3 | 4 | 5 | N/A |
| 8. The project is (was) within schedule                                    | 1 | 2 | 3 | 4 | 5 | N/A |
| 9. The project is (was) within budget                                      | 1 | 2 | 3 | 4 | 5 | N/A |

## BACKGROUND INFORMATION

**Instruction:** Please provide some background information for our analysis.

1. Are (were) you a ☐ Project Leader ☐ Team member in this specific virtual project?
2. How many employees are (were) involved in this specific virtual project? \_\_\_\_\_
3. What is your job title? \_\_\_\_\_
4. How long have you held this position? \_\_\_\_\_
5. How long have you been working for this organization? \_\_\_\_\_
6. How many employees work in your entire organization? \_\_\_\_\_
7. What is your organization's estimated annual revenue? \_\_\_\_\_ (CDN\$)
8. What is your organization's primary business activity?

<input type="checkbox"/> Transportation	<input type="checkbox"/> Banking or financial services
<input type="checkbox"/> Insurance or Brokerage	<input type="checkbox"/> .com
<input type="checkbox"/> Telecommunication	<input type="checkbox"/> Hardware
<input type="checkbox"/> Software	<input type="checkbox"/> Retail
<input type="checkbox"/> Entertainment	<input type="checkbox"/> Wholesale
<input type="checkbox"/> Manufacturing	<input type="checkbox"/> Services or Consulting
<input type="checkbox"/> Pharmaceutical	<input type="checkbox"/> Other (please specify) _____

5. Age: ☐ 18-25 ☐ 26-35 ☐ 36-45 ☐ 46-55 ☐ over 55
6. Gender: ☐ Male ☐ Female

**Please return this questionnaire by using the attached envelope.  
Thank you for your precious cooperation!**

**If you wish to obtain a summary of the results of this survey,  
simply enclose your business card in the return envelope.**

**If you have any comments or questions, please feel free to contact me.**

Brinda Bissoonauth  
M.Sc. Administration Student  
John Molson School of Business  
Concordia University  
Department of Decision Sciences and MIS  
1455 de Maisonneuve Blvd. West, GM 209-13  
Montreal, PQ, H3G 1M8  
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Email: bbissoonauth@jmsb.concordia.ca

\_\_\_\_\_ This confidential number is only used for our reference.

## **Appendix 2. Cover Letter & Reminder Letter**



Date

*Name*

*Title*

*Company*

*City (Province)*

*Postal Code*

**Subject: Critical Success Factors of Virtual Team Projects**

Dear \_\_\_\_\_,

I am a student at Concordia University, Montreal, in the final phase of completing a Master ès Sciences in Administration, specialized in Management/MIS. I am currently conducting a research study, supervised by Dr. Anne-Marie Croteau, to investigate the critical success factors of virtual project work in Canadian organizations.

Virtual Project Work takes place when team members on a project are geographically and/or organizationally dispersed while working on a project and they work interdependently using a combination of information and communication technologies (ICT) such as e-mail, internet, telephone, videoconferencing, collaborative software systems, etc. Team members working on the virtual team may be from the service organization, another organization or the client's site.

I strongly value your views on this topic and believe that responding to this questionnaire should not take more than 15 minutes of your valuable time. Of course your participation is voluntary. Please be assured that all information given will be kept confidential and the results will not disclose your identification.

**Instructions:** Enclosed please find four questionnaires (along with four return envelopes): one to be filled out by the project manager and three by the project team members. I would kindly ask you, as a project manager, to identify a specific virtual project and answer the questions based on this particular project. I would also really appreciate if you could ask your project team members to each fill out a questionnaire basing the answers on the specific project you identified. Everybody's input is extremely important for this study.

I would ask you to return your duly filled questionnaire by **date** using the enclosed envelope. I would like to thank you for your time and support. If you have any questions or comments, please feel free to contact me.

Yours truly,

Brinda Bissoonauth

M.Sc.A. Student

Phone : (514) 848-2781 Fax : (514) 848-xxxx

E-mail: bbissoonauth@jmsb.concordia.ca

p.s. Your coordinates have been obtained from the Project Management Institute

June 12, 2002

*Name*  
*Title*  
*Company*  
*City (Province)*  
*Postal Code*

**Subject: Follow-up regarding the questionnaire to investigate the “Critical Success Factors of Virtual Team Projects”**

Dear \_\_\_\_\_,

Last week, a questionnaire to investigate the Critical Success Factors of Virtual Team Projects was mailed to you. Your participation is crucial to the success of this research study and I seize this opportunity to thank you if have already filled it out. If you have not had a chance to do so yet, I would appreciate your participation and encourage you to complete the questionnaire and return it to me by **June 28, 2002**.

Please be assured that all information given to us will be kept confidential and the results will not disclose your identification. If you have not received the questionnaire, I welcome you to contact me and I will ensure that a questionnaire be sent to you as soon as possible, either my courier or e-mail. Also, should you need an electronic format of the questionnaire, please e-mail me your request.

I would like to thank you for your valuable time and cooperation.

Best regards,

Brinda Bissoonauth  
M.Sc.A Student  
John Molson School of Business  
Concordia University  
1455 de Maisonneuve Blvd. West, GM 209-13  
Montreal QC, H3G 1M8  
Phone : (514) 848-2781 Fax : (514) 848-2824  
E-mail: bbissoonauth@jmsb.concordia.ca

### Appendix 3. Detailed independent sample t-test (95% confidence interval)

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
OC_MEAN	Equal variances assumed	.086	.769	.050	138	.960	5.456E-03	.1091	-.2104	.2213
	Equal variances not assumed			.050	129.118	.960	5.456E-03	.1081	-.2085	.2194
OS_MEAN	Equal variances assumed	.217	.642	.479	138	.633	5.559E-02	.1161	-.1740	.2852
	Equal variances not assumed			.480	126.562	.632	5.559E-02	.1158	-.1735	.2846
TS_MEAN	Equal variances assumed	.001	.971	.116	138	.908	1.391E-02	.1200	-.2233	.2511
	Equal variances not assumed			.116	125.178	.908	1.391E-02	.1199	-.2235	.2513
PB_MEAN	Equal variances assumed	2.185	.142	-.659	138	.511	7.147E-02	.1085	-.2860	.1431
	Equal variances not assumed			-.679	135.934	.498	7.147E-02	.1052	-.2796	.1366
MS_MEAN	Equal variances assumed	3.972	.048	-.656	138	.513	8.614E-02	.1313	-.3458	.1735
	Equal variances not assumed			-.682	137.426	.496	8.614E-02	.1263	-.3358	.1635
PP_MEAN	Equal variances assumed	1.894	.171	-.105	138	.917	1.106E-02	.1054	-.2194	.1973
	Equal variances not assumed			-.108	134.672	.914	1.106E-02	.1027	-.2142	.1921
PO_MEAN	Equal variances assumed	4.762	.031	1.488	138	.139	.1652	.1110	5.43E-02	.3846
	Equal variances not assumed			1.563	138.000	.120	.1652	.1057	4.38E-02	.3742
QP_MEAN	Equal variances assumed	2.329	.129	1.668	138	.097	.1928	.1155	3.57E-02	.4212
	Equal variances not assumed			1.738	137.576	.084	.1928	.1109	2.66E-02	.4121
PT_MEAN	Equal variances assumed	.151	.698	1.399	138	.164	.1487	.1063	6.14E-02	.3589
	Equal variances not assumed			1.412	129.018	.160	.1487	.1053	5.97E-02	.3571

**Appendix 4. Correlation matrix between constructs**

	Affective commitment	Perceived organizational support	Management support	Technological support	Perceived benefits	Satisfaction with project team	Satisfaction with project process	Satisfaction with project outcome	Project effectiveness	Project efficiency
Affective commitment	1.000									
Perceived organizational support	.737**	1.000								
Management support	.377**	.427**	1.000							
Technological support	.224**	.169*	.665**	1.000						
Perceived benefits	.228**	.239**	.146	.076	1.000					
Satisfaction with project team	.290**	.355**	.330**	.172**	.369**	1.000				
Satisfaction with project process	.436**	.382**	.299**	.213**	.404**	.597**	1.000			
Satisfaction with project outcome	.339**	.404**	.491**	.357**	.375**	.564**	.649**	1.000		
Project effectiveness	.452*	.417*	.300*	.191*	.362*	.559**	.595**	.942**	1.000	
Project efficiency	.348*	.388*	.309*	.180*	.333*	.437**	.460**	.644**	.731**	1.000

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

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

## Appendix 5. Questionnaire coding and Reliability Analysis

Coding	Factor structure	Factor loading	Cr.'s á
<i>Affective Commitment</i>			
OC1	I feel a strong sense of belonging to my organization	.780	.819
OC2	Working at my organization has a great deal of personal meaning to me	.778	
OC3	I would be happy to work at my organization until I retire	.798	
OC4	I feel personally attached to my work organization	.775	
OC5R	I do not feel like “part of the family” at my organization	.810	
OC6	I really feel that problems faced by my organization are also my problems	.820	
OC7	I am proud to tell others I work for my organization	.789	
<i>Perceived organization support</i>			
OS1	My organization really cares about my well-being	.8176	.832
OS2	My organization strongly considers my goals and values	.819	
OS3R	My organization shows little concern for me	.826	
OS4	My organization cares about my opinions	.830	
OS5	My organization is willing to help me if I need a special favor	.829	
OS7	My organization would forgive an honest mistake from my part	.856	
<i>Technological Support</i>			
TS1	The organization possesses a good telecommunications Infrastructure	.842	.864
TS2	The organization possesses a good information systems infrastructure	.834	
TS3	The organization possesses the necessary infrastructure to support remote communication	.828	
TS4	The organization possesses rapid internet/intranet access	.839	
TS5	The organization possesses adequate videoconferencing systems	.859	
TS6	The organization possesses adequate collaborative software systems	.846	

	<b><i>Management Support</i></b>		.932
MS1	Management is aware of the benefits that can be achieved with the use of information communication technology for virtual project work	.923	
MS2	Management always supports and encourages the use of information communication technology for virtual project work	.922	
MS3	Management provides most of the necessary help and resources to enable people to use information communication technology in virtual project	.921	
MS4	Management is really keen to see that people are satisfied with using information communication technology in virtual project	.925	
MS5	Management provides good access to hardware resources for virtual project work	.925	
MS6	Management provides good access to various types of software for virtual project	.927	
MS7	Use of information and communication technology in virtual project work is regarded as a high priority by top management	.917	
MS8	Top management perceives the use of information and communication technology for virtual project work to be a part of the organization's vision	.924	
	<b><i>Perceived Benefits</i></b>		.866
PB1	... increase the organization's profitability	.863	
PB2	... help the organization gain a competitive edge	.853	
PB3	... help decrease operational costs	.872	
PB4	... shorten the project's life cycle	.855	
PB5	... improve my job performance	.842	
PB6	... increase my productivity on the project	.832	
PB7	... be useful in my job	.836	
PB8	... enhance my effectiveness on the project	.837	

PT2 PT3 PT4 PT5	<b><i>Satisfaction with project team</i></b>		.859
	I really feel (felt) that I am a part of this project team	.844	
	I learn(ed) a lot from the other members of this group	.831	
	I would like to work with this group again	.790	
PP1 PP2 PP3	<b><i>Satisfaction with process</i></b>		.776
	This communication media use(d) in this virtual project is (was) effective	.689	
	I enjoy(ed) working on this project	.727	
	This method of working together is (was) effective	.689	
PO1 PO2 PO3	<b><i>Satisfaction with outcome</i></b>		.878
	Overall, I am (was) personally satisfied with this project	.807	
	This group produce(d) effective and valuable results during this project	.846	
	I agree(d) with the outcome of the project	.828	
QP1 QP2 QP3 QP4	<b><i>Project effectiveness</i></b>		.930
	According to the results, this project is (was) regarded as successful	.916	
	From the company's perspective, all project goals are (were) satisfied	.916	
	The project result is (was) highly satisfactory	.914	
QP5 QP6 QP7 QP8 QP9	<b><i>Project efficiency</i></b>		.930
	From the company's perspective, the project progress(ed) satisfactorily	.911	
	Overall, the project is (was) done in a cost effective manner	.919	
	Overall, the project is (was) done in a time efficient manner	.915	
	The project is (was) within schedule	.924	
	The project is (was) within budget	.921	