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An Extended Adaptive Structuration Theory Framework for Determinants of Virtual Team Success

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Abstract
Virtual team represents an organizational form which can revolutionize the workplace and provide organizations with unprecedented levels of flexibility and responsiveness. Since nineties, virtual teams have been subjected to exhaustive research, mostly focused on the causal relationship between single or multiple constructs and the success variables of virtual teams, such as performance and satisfaction. There have been quite a few reviews on virtual teams which have provided a good overview of the state of virtual team research. These reviews have identified significant constructs in virtual team research, summarized and assessed their findings, proposed frameworks demonstrating the state of present research and posed some challenges and research questions which should be answered by future research on virtual teams. However, existing reviews are too general in terms of portraying relationships, such that their frameworks delineate links among categories of constructs as against among individual constructs themselves. None of the extant reviews identify explicit relationships among the most significant constructs of virtual teams and the research on virtual team performance is still equivocal. An understanding of such explicit relationships between the most significant constructs of virtual teams can get us a deeper insight into how virtual teams achieve effectiveness. Thus, there is a need to structure the current empirical research in order to understand the key direct and indirect drivers of virtual team performance. This study, based on a qualitative review of existing literature on virtual teams, identifies key drivers of virtual team effectiveness and develops a conceptual research framework with 9 propositions linking the identified drivers. It goes beyond the generalized models, such as, AST and Input-Process-Output models and develops a new model EAST (extended adaptive structuration theory) by extending the tenets of AST. This study uses adaptive structuration theory to organize the literature on virtual teams into three broad categories; viz. structural dimensions, social interaction and outcomes, and comes up with hypotheses and research questions linking the above categories.

Keywords: Virtual Teams, Adaptive Structuration Theory, Computer-Mediated Communication

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conceptual research framework with 9 propositions linking the identified drivers. It goes beyond the generalized models, such as, AST and Input-Process-Output models and develops a new model EAST (extended adaptive structuration theory) by extending the tenets of AST.

This study uses adaptive structuration theory to organize the literature on virtual teams into three broad categories; viz. structural dimensions, social interaction and outcomes, and comes up with hypotheses and research questions linking the above categories.

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1. Introduction

A virtual team is group of people who interact through interdependent tasks guided by common purpose and work across space, time and organizational boundaries (Lipnack & Stamps, 1997). The role of virtual teams in organizations is becoming increasingly important and has gained more significance due to the increased globalization of business organizations in the last two decades. Organizations frequently rely on virtual teams for key operations, such as product development, strategic analysis and customer service. In this era of globally expanding organizations, virtual teams possess the potential to provide flexibility, responsiveness, reduced costs and improved resource utilization demanded by the ever changing task requirements in dynamic and turbulent global business organizations. Members of a virtual team often transcend geographical, cultural and even organizational borders and interact to achieve organizational tasks and goals. Members of virtual teams are experts in differing field of knowledge and work in different functional areas (Duarte & Snyder, 1999; Jarvenppa & Leidner, 1999; Lipnack & Stamps, 1997). These teams are most often constructed because organizations require skills, local knowledge, experience, resources and expertise to be captured where it is located and speeding up team processes (Guinea, Webster, & Staples, 2005) and also to save costs. There are quite a few impressive examples of virtual team deployment. May and Carter carried out a study, where they collaborated electronically instead of face to face. They estimated that the team saved between 10 to 23 days using information technology tools. The IBM's Academy of Technology has always been on the forefront of exploring technology research and innovation. In late 2008, IBM organized a virtual world conference and then hosted their annual meeting in the new virtual world Second Life. IBM estimates that the annual meeting was hosted at one-fifth of the usual cost (Second-Life, 2008).

Since last decade, the research on virtual teams is focused on number of challenges affecting virtual teams such as communication (Jarvenppa & Leidner, 1999; Steinfeld, Jang, Huysman, & David, 2002), collaboration (Donker & Blumberg, 2008; Geyer, Richter, & Fuchs, 2001; Steinfeld et al., 2002), trust (Jarvenppa & Leidner, 1999; MacDonough, Kahn, & Barczak, 2001; Sarkar & Sahay, 2002), technology, design and so forth. However, the results of virtual team research have been inconsistent and there is no consensus among researchers regarding virtual team effectiveness.

This study views the effectiveness of virtual teams as a dichotomy of group processes and virtual teams (explanation of this dichotomy is provided in section 4). Gidden's (Giddens, 1986) proposed a theory of structuration to explain the dichotomies of sociology. Structuration is posited as a social process that involves the reciprocal interaction of human actors and structural features of an organization (Orlikowski, 1992). Desanctis and Poole (Gerardine DeSanctis & Poole, 1994) adapted this theory to study the changing structure of organizations by use of advanced information technology. The theory states how a technology's inherent structural characteristics shape interaction patterns without determining the interaction in a definitive manner (Maznevski & Chudoba, 2000). Similar to the premise of structuration theory and later of AST, virtual team effectiveness involves the emergence or shaping of social interaction (group processes) under the structures provided by virtual teams. Thus, AST provides an ideal base for study of virtual teams. However, due to the fact that the purpose of AST is fundamentally different from that of virtual teams, we feel that AST can't be used as it is in the context of virtual teams. Thus, we adopt AST for the purposes of virtual teams and propose an extended AST in this study.

This study presents a qualitative review of extant research on virtual teams. By means of a large scale review, this study identifies determinants of virtual team success and

categorizes them as: Structural Dimensions, Social Interaction and Effectiveness. These determinants are then integrated into a conceptual framework based on adaptive structuration theory (AST). Based on our discussion of extant literature organized in the conceptual framework we explain how the existing literature issues gel with each other and how they explain virtual team effectiveness.

2. Motivation, Scope and Contribution

In multi-national organizations, global virtual teams make important and strategic decisions. Technology allows distributed people to collaborate on issues and challenges facing a company on global level. Big names such as HP, Microsoft have been using virtual teams for quite a while now. Hewlett Packard formed a 200 people cross-functional team which developed and launched a medical health care system, which became successful commercially and reduced the R&D costs to half. Verifone, a multi-national company is reported to rely on teams which interact electronically to carry out their everyday business. Microsoft uses virtual teams for global corporate sales and post-sales services (Jarvenppa & Leidner, 1999).

Reviews of virtual team literature till date are quite rich and comprehensive, and provide a good overview of the virtual team research (Alain Pinsonneault & Caya, 2005; Martin, Gilson, & Maynard, 2004; Powell, Piccoli, & Ives, 2004). Powell et. al (2004) developed an input-process-output model for organizing literature on virtual teams between the years 1991 and 2002 and proposed future research themes. Martin et.al (Martin et al., 2004) reviewed empirical articles on virtual teams and identified constructs such as team inputs, team processes, team outcomes and moderators of performance. Pinsonneault and Caya (Alain Pinsonneault & Caya, 2005) reviewed empirical papers on virtual team research and synthesized the extant literature on virtual teams in an input-process-

output model and proposed future research agendas. The extant literature reviews, qualitatively analyze the present literature and list the general findings of each construct in their framework.

For example, Pinsonnault and Caya (Alain Pinsonneault & Caya, 2005) observe that trust is one of the most important process variables in virtual team research and that initial reactions seems critical for establishing trust in virtual teams. They state that moderate use of process structure mechanisms (such as dialogue techniques, training) helps develop and maintain trust in virtual teams. Further, they notice that antecedents of trust in virtual teams are dynamic and point out to the study by Jarvenappa et.al (Sirkka L. Jarvenpaa, Kathleen Knoll, & Leidner., 1998) which found that perceptions of other members' ability and integrity initially act as important determinant of trust over time. So, what does this tell us? If we look at their framework, we can make out that trust is a part of "group dynamics" and electronic communication they mention refers to the sub-field of "technological factors". Similarly, the process structure is represented by their framework by the "technology support" category which includes sub field "training" and that the dynamic antecedents of trust are related to the "personal factors" category in their framework. Thus, this study enlightens us with the most prominent research issues present in virtual team research, important independent and dependent variables and emphasizes the implicit links present between them. However, this review does not enlighten us regarding the specific relationships among key drivers which make up the virtual teams and the key drivers which make up the group processes.

As a consequence, we are still in the dark regarding what makes virtual teams work. Thus, clearly there is a need to develop a unifying theory which will explain the patterns leading to virtual team effectiveness. Thus, the growing importance of virtual teams plus the huge prospects in organizations in coming years, the shortcomings of the previous

literature reviews and new developments in technology and theory on virtual teams motivates us to review the present literature on virtual teams to develop a conceptual analytical model which will provide a better understanding of virtual teams dynamics and will identify the patterns leading to virtual team effectiveness.

This study includes studies from the early eighties when communication using technology first started being researched. We searched various keywords such as virtual teams, virtual groups, virtual communities, distributed groups, computer mediated groups, global virtual teams, and computer mediated communication in databases such as ACM, JSTOR, Science Direct, and Springer Link and so on. After that, a search was also made on databases such as JAIS, Information Systems Journal, Database of Information systems, Organization Science, Academic Management Review and so on. Once we had the extant reviews of literature on virtual teams, we also went through their reference list to check whether we missed or overlooked any papers. The only criterion to include a study into the review was that it must have studied a group of spatially dispersed people collaborating using computer-mediated communication.

This research makes a following contribution to existing body of literature on virtual teams.

1. It compiles and synthesizes and develops new conceptual framework with supporting propositions based on theoretical perspectives to explain the dysfunctions of virtual team effectiveness
2. It combines two existing theories to develop a new theory
3. It provides the practitioners with a clear idea of the absolute key drivers of virtual team effectiveness such that they will know which factor to manipulate to make virtual teams behave in a certain manner.

3. Literature Review

Taking a cue from the adaptive structuration theory, we categorized the literature on virtual teams into three categories, viz. *Structural Characteristics, Social Interaction and Outcomes.*

Structural Dimensions

Task dimension: Task has been an important factor in the study of most work groups. The group processes and performance cannot be explained without taking into account the nature of tasks being performed (Susan Strauss, 1999). Numerous scholars have advanced our understanding of groups by proposing theoretical frameworks that classify tasks on the basis of critical features (Susan Strauss, 1999). For example, Hackman et.al (Hackman, Jones, & McGrath, 1967) proposed that there are three types of tasks: production (i.e. idea generation), discussion and problem solving tasks. Steiner (Steiner, 1972) classified tasks as unitary or dividable. He further classified unitary tasks as disjunctive, conjunctive, additive or discretionary; these categories reflect how members' efforts are combined to yield group product. Shaw (Shaw, 1981) identified the following six dimensions of tasks: difficulty, solution multiplicity, intrinsic interest, population familiarity, co-operative requirements and intellective versus manipulative environments. In 1984, McGrath (McGrath, 1984) integrated many of the concepts proposed by Hackman (Hackman et al., 1967), Shaw (Shaw, 1981) and Steiner (Steiner, 1972) to propose his own typology of tasks. McGrath proposed that most group tasks can be classified into categories that reflect the following four basic processes: *generate, choose negotiate* and *execute.* Creativity tasks, such as brainstorming, and planning tasks such as agenda setting, require idea generation. Intellective task or problem solving tasks require choosing correct answers and judgment or decision making tasks

require reaching consensus on a preferred answer. Resolving conflicting views or conflicting interests require negotiation. Execute tasks are those requiring physical movement, co-ordination and athletic contests. This study adopts the McGrath's task Circumplex as the tasks performed by virtual team while collaborating towards their goal. The reason of choosing McGrath's task Circumplex over other typologies of tasks is that McGrath's Circumplex has been used in a number of computer mediated communication studies (Connolly, Jessup, & Valacich, 1990; Daly, 1993; G. DeSanctis & Gallupe, 1987). The definition of each task type is given in Table 1.

Technology dimension: Technology has been discussed in virtual team research in terms of its features such as richness, social presence, and synchronicity and so on. Many theories (information processing theory, critical social theory and so on) have been applied to study the effect of richness of technology on virtual team interaction. Among them, media richness theory, by far, has been the most used (R. Daft & Lengel, 1986; Rasters, Vissers, & dankbaar, 2002). Media richness theory (R. Daft & Lengel, 1984) categorizes media as rich or lean and has been used widely by researchers and practitioners to study the use of technology and selection of technology for decision making. According to media richness theory, higher richness of media facilitates for better communication and in addition, can lead information to change understanding in a certain time interval (R. Daft & Lengel, 1986). The core of media richness theory states that performance improves when managers use richer media for equivocal tasks and leaner media for non-equivocal tasks (R. Daft & Lengel, 1986; R. L. Daft, Lengel, & Trevino, 1987). However, most of the times proponents of this theory fail to realize that the empirical results fail to validate the claim of the theory (A. Dennis & Kinney, 1998). Although some studies have found limited support for the theory, in most of the cases, managers have made different choices than those predicted by media richness theory

(A. Dennis & Kinney, 1998; El-Shinnawy & Markus, 1992; Rice, 1992; Trevino, Lengel, & Daft, 1987). Thus, we adopt the approach suggested by Dennis and Kinney (A. Dennis & Kinney, 1998) to not to define media as rich if it has a certain number of properties. Instead, we define media characteristics using their fundamental aspects such as multiplicity of cues, immediacy of feedback (R. Daft & Lengel, 1986), social presence and parallelism (Alan Dennis & Valacich, 1999) (Definition are given in Table 1).

Organizational dimension: Organizational environment influencing virtual teams consists of two types: organizational culture and organizational structure (see table 1 for definitions). Organizational culture and structure provide the necessary power and control over the use of technology. The organizational culture is similar to what Kogut et. al. (Bruce Kogut & Zander, 1996) define as social knowledge. Appropriating this social knowledge (procedures and rules), communication and co-ordination is facilitated across individuals and groups of diverse specialized competence and cultures. Whereas, such increased communication among members of virtual teams can lead to increased social cues and hence increased shared understanding regarding organizational strategies and practices thus, leading to formation of strong organizational identification. A stronger organizational identification among virtual team members fosters cohesion and increased trust (Wiesenfeld, Raghuram, & Garud, 1999).

Piccoli et.al (Piccoli & Ives, 2000) define managerial control as a form of organizational structure, and contend that managerial control behavior can lead to higher levels of communication and co-ordination in virtual teams.

Team dimension: Team dimensions such as cultural diversity and awareness have been found out as major influential structural characteristic for virtual teams. Researchers suggest that cultural diversity lead different ways of using technology and eventually to co-ordination difficulties (Maznevski & Chudoba, 2000; Timothy Kayworth &

Leidner, 2000). They also create barriers to effective communication (Sarkar & Sahay, 2002; Timothy Kayworth & Leidner, 2000). It is difficult to achieve shared understanding and cohesion among group members with no prior history of virtual work together due to lack of support of informal interactions (Crampton, 2001; Huang & Ocker, 2006; Kraut, Gergle, & Russel, 2002).

Awareness can be defined as an understanding of activities of others, which provides context for your own activities (Dourish & Bellotti, 1992). Awareness of individual and group activities is crucial to successful collaboration (Liccardi, Davis, & White, 2007). Researchers imply that, maintaining proper level of awareness is facilitates effective collaboration (Liccardi et al., 2007).

Individual dimension: Personality, leadership, knowledge and so on can be included in the individual dimension. Researchers have shown the positive influence of personality variables (extraversion, agreeableness, emotional stability) on team performance and cohesion (O'Neill & Kline, 2008). Emotional stability is cited as predictor of team cohesion(M. R. BARRICK & M. K. MOUNT, 1991). Personality is said to lead to different interaction styles which in turn affect team performance (Balthazard, Potter, & Warren, 2004).

Social Interaction

Socio-emotional processes: These consist of processes such as shared understanding, conflict, and trust and so on. Developing *shared understanding* is important for virtual team members. Reaching a degree of shared understanding about a team's task, structure and procedures tends to be more complex in virtual teams that in co-located teams (T. Maynard & Gibson, 2004). Virtual teams have a hard time developing shared understanding due to the cultural diversity, preferred management

style etc (Rooji, Verburg, Andriesen, & Hartog, 2007). They also propose that virtual teams which use technology that do not provide visual cues will have trouble developing shared understanding and distraction of team members during virtual team meetings. Thus, use of media which provide rich visual support and social presence to the users can be used to increase the level of shared understanding among the team members.

Past research has shown that *conflict management* behavior is an important determinant of group processes and performance (Baron, 1989). Hinds and Bailey (Pamela J. Hinds & Bailey, 2003) in their study about understanding conflict in virtual teams suggest that anticipated effect of technology mediation on group conflict appears to be negative i.e. use of technology can lead to conflict in distributed teams.

Along with types of conflicts and their influence on performance, researchers have also studied the methods of conflict management. Virtual teams try to manage their internal conflict using competitive and collaborative conflict management styles (Mitzi M. Montoya-Weiss, Anne P. Massey, & Song, 2001). Among these, the collaborative conflict management style was found to be positively related to satisfaction, perceived decision quality and participation (Paul, Seetharaman, Samarah, & Mykytyn, 2004).

Trust development in virtual teams also presents significant challenges because it is difficult to access team-mates' trustworthiness without ever having meeting them (MacDonough et al., 2001). Researchers state that a new form of trust called 'swift trust' develops among team members as the life of virtual teams is temporary and hence short (Jarvenppa & Leidner, 1999)

Decision processes: Decision processes involve processes like communication and collaboration which lead to decision making through action. Communication is the core of any virtual team. Research on virtual team has focused on the need to create a team of excellent communicators, selection of right technology for most effective

communication etc (Powell et al., 2004). Communication between virtual teams is impaired due to technology which is a lean media as compared to rich face-to-face interactions (Sara Kiesler & Sproull, 1992). In addition to this, researchers have found that lack of shared understanding and mutual awareness hamper communication (Crampton, 2001). Also, ineffective leadership effects communication between virtual teams negatively. Early results suggest that, the frequency and predictability of communication and the extent to which a feedback is provided on a regular basis, improves team communication leading to higher trust and improved performance (Jarvenppa & Leidner, 1999).

Co-ordination refers to the consistency and co-ordination among virtual teams members. Co-ordination has been linked to virtual team performance. Cultural diversity, time difference and mental models have been found to have a negative impact on virtual team co-ordination (Galegher & Kraut, 1994; Powell et al., 2004).

Table 1. Variables Associated with Structural Characteristics

Variables	Definitions
Organizational Dimension	The entities in organization which form the social context in virtual teams.
Organizational Culture	- Organizational Culture can be defined as a pattern of shared basic assumptions that a group learned as it solved its problems to external adaptation and internal integration that has worked well enough to be considered valid and, therefore, to be taught to new members as the correct way you perceive, think, feel in relation to those problems
Organizational Structure	- The hierarchical structure present in organization
Training	- The efforts taken by organization to familiarize virtual team members with the issues involved in virtual environments
Management	

	- Managers in an organization committed to virtual teams
Task Dimension Generate Choose Negotiate	The tasks performed by a virtual team while moving towards its goal. - These tasks are collaborative and cooperative in the sense that the group is not required to decide on a single best response or to evaluate the quality of members' contribution - These tasks require co-ordination in a more typical sense. Value of contribution that each member makes to the group product depends on the contribution of other members - These tasks involve issues that are subject to party's values and attitudes versus facts and involve inherent conflict in viewpoints or interests.
Technology Dimension Multiplicity of Feedback Social Presence Parallelism Immediacy of Feedback	The technology characteristics used by virtual team members. - Multiplicity of cues refers to the number of ways in which information can be communicated, such as text (*spoken or written words themselves*), verbal cues (*tone or voice*), or non-verbal cues (*physical gestures*). - The extent to which a technology enables a communicator to experience communication partners as being psychologically present. - Parallelism is the number of simultaneous conversations that can exist effectively. - Immediacy of Feedback is the extent to which a medium enables users to give rapid feedback on the communications they receive
Group Dimension Cultural Diversity Awareness	The culture and awareness present in virtual group members. - The diversity of national, regional, organizational culture present in a virtual team.' - The level of knowledge individuals have regarding other members' activities in a virtual team.
Socio-Emotional Processes Trust	The feelings of trust, cohesion, relationships developed by the teams.

Shared Understanding Cohesion	- Trust can be defined as belief in the virtual team system and team members - Shared understanding can be defined as an organized understanding or mental representation of knowledge that is shared by team members - Cohesion can be defined as feeling of closeness and bond between team members.

3. Extended Adaptive Structuration Theory Framework Virtual Teams

The conceptual model for the study is given in Figure 1. From left to right, the framework consists of structural characteristics (Organizational dimension, task dimension, technology dimension, group dimension and individual dimension), social interaction (socio-emotional processes, decision processes), control structure (Mission) and outcomes (Performance and satisfaction).

In this study, we view virtual team effectiveness as a reconciliation of the dichotomy of virtual teams and group processes. The characterization of virtual teams and group processes as a dichotomy is based on the description of one of the most talked about dichotomy of sociology, i.e. structure and agency. Agency refers to the capacity of individuals to act independently and to make their own choices. Structure refers to those factors such as social class, gender, ethnicity which limit and constrain the opportunities that individuals have. Similar to structure and agency, virtual team effectiveness depends upon virtual teams (i.e. the structural characteristics in this study[1]) which consist of factors which can influence, limit and constrain the group processes.

[1] Lipnak and Stamps (Lipnack & Stamps, 2000) developed a periodic table representing virtual teams. The table includes people, goals, tasks, media and other factors represented by structural characteristics in our framework.

Giddens (Giddens, 1986) proposed theory of structuration to reconcile the dichotomies of sociology. Desanctis and Poole (Gerardine DeSanctis & Poole, 1994) adapted this theory to study the role of advanced information technology in changing the organizational structure. AST describes how technology consists of structural characteristics which are appropriated by groups to help them in making decisions. Most of the research on virtual teams has focused on technology and groups. Thus, we feel that AST is an ideal base to study virtual teams.

However, the premise of AST is that advanced information technologies are used to automate the functions in organizations leading to changing the structure of organization and increasing efficiency. The way groups appropriate the structures of advanced information technology shapes their decision process and leads to different outcomes in terms of efficiency. For example, in the seventies and eighties computer systems were used to carry out business tasks such as billing, inventory management and so on. Such technologies (computer systems or group support systems) were utilized by individuals who were co-located in an organization. Although virtual teams are a new form of organization itself, the geographical, cultural and temporal separation of its members makes it functionally different from a real organization and using just AST might not be enough. Also, in case of virtual teams, technology is used as the communication linkages among the group members and thus, technology, along with social structures influences the decision processes of the group directly and also leads to some emergent forms such as trust, conflict, shared understanding and so on. Whereas in case of AST appropriation signifies use of a certain technology by individuals in a more than one ways, appropriation in virtual teams implies selection of different technologies for different tasks. Thus, we propose a new theory called Extended Adaptive Structuration Theory, which adapts the AST for virtual teams.

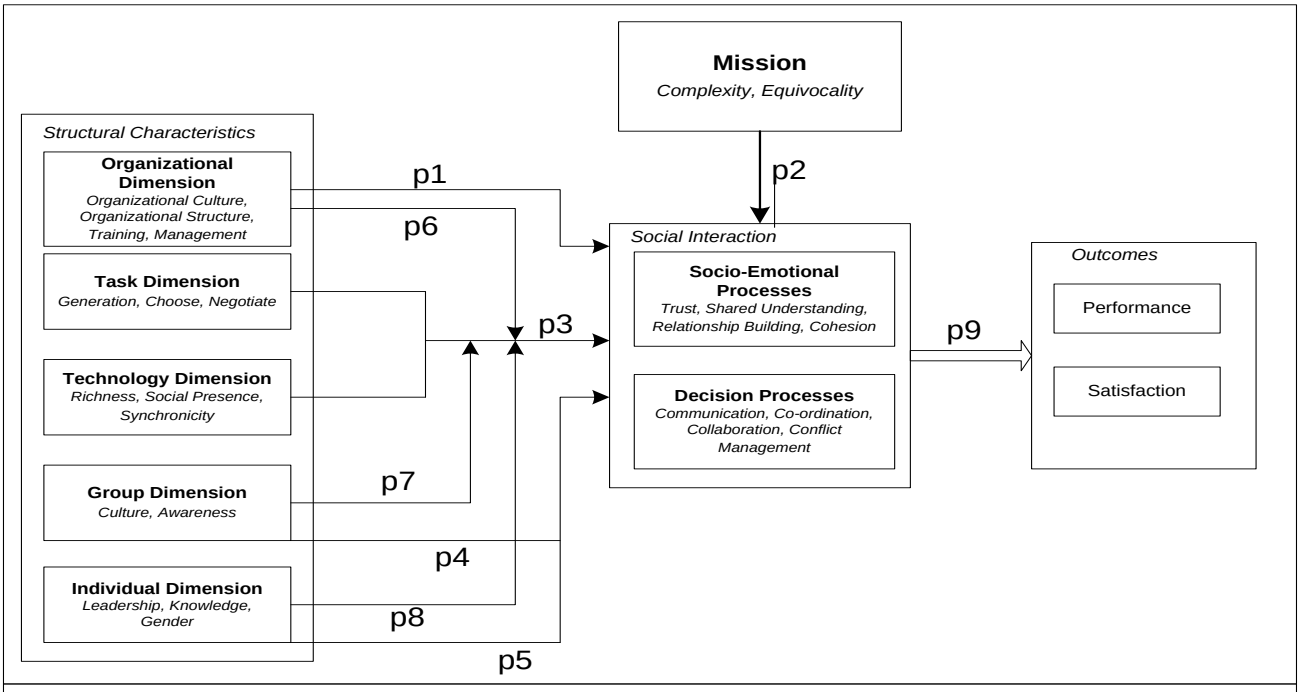

Figure 1. Extended AST framework for Determinants of Virtual Team Success

Following the Structuration and AST theories, we also concentrate on social structures provided by technology and institutions as a basis of group processes or social interaction in the framework. Organizational dimension includes organizational culture, structure, management and training and brings *power* into the virtual team interaction through providing organizational capabilities for humans to accomplish outcomes.

The technology and task dimension in our framework (Figure 1) provide interpretive schemes or *meaning* to be communicated and constituted in the social interaction. Norms, as mentioned in the structuration theory are organizational conventions or rules governing legitimate or appropriate conduct. Since, virtual teams are usually culturally dispersed; such norms can be expressed through cultural norms prevailing in groups as a whole and individuals. Thus, group and individual dimension form the norms of our framework.

One significant difference between the structuration theory, AST and EAST is that, in both structuration and AST theories, the social interaction has no specific purpose and it continues to evolve quite freely. However, all the virtual teams are deployed with some specific goals. Thus, we propose that there should be one more structure in addition to the three proposed by structuration and AST theories. We call this structure as *control* structure. The mission of virtual team is the component of control structure in our study.

4. Propositions of Extended Adaptive Structuration Theory

In this section, we extend the discussion of constructs presented in the literature review section and put forth 10 propositions. The propositions are put forth in the order that we think virtual teams move towards effectiveness of performance.

Organizational Dimension

Virtual teams are a new form of organization, in which organizational structure and form can be defined in terms of communication linkages among organizational units (Zack & McKinney, 1995). These communication linkages are enabled by technology. However, since communication is a social process, to determine the effectiveness of virtual teams, it is imperative that we understand how existing social processes (in organizations) viz. organizational culture and structure influence patterns of this new form of organizational communication (Zack & McKinney, 1995).

Since these technology enabled communication linkages are something new, the social communication among members of virtual teams is clouded by ambiguity and uncertainty. Thus, educating virtual teams regarding the difference in group work or collaboration in virtual environment, use of new technologies and so on will go a long way to achieve effective performance from these new forms of organization. Jarvenppa

et. al (Sirkka L. Jarvenpaa et al., 1998) conducted a study to determine the antecedents of trust in global virtual teams and found that taking part in team building activities is helpful for stimulating the antecedents of trust. Such kind of education or training will be provided by organizational management or organizational structures controlling the virtual teams.

Thus, we define organizational dimension as consisting of four components: *organizational culture, organizational structure*, *training and management.*

Organizational Culture: Organizational Culture can be defined as a pattern of shared basic assumptions that a group learned as it solved its problems to external adaptation and internal integration that has worked well enough to be considered valid and, therefore, to be taught to new members as the correct way you perceive, think, feel in relation to those problems (Schein, 2004). Thus, organizational culture may include set organizational norms and practices, values that focus on collaboration, respecting and working with people with different cultures, keeping criticism constructive and so on (Duarte & Snyder, 1999; Schein, 2004). Along with this, organizational culture may also include the reputation of the organization, present and past successes or failures of the organization and so on. As mentioned in the above definition, such organizational culture influences the new members who join organizations and sets the standard for virtual team members working together.

The above definition of organizational culture emphasizes the fact that it has to do with shared assumptions, priorities, meanings and values, with patterns of beliefs among people in organizations. The beliefs are related to many socio-emotional processes such as trust, cohesion, shared understanding and so on (Frost, Moore, Louis, & Lundberg, 1985).

The essential ingredient of collaborative effort is trust. High performance teams are characterized by high mutual trust among members. An organizational climate of trust enables employees to surface their ideas and feelings, use each other as resources and learn together (Costigan, Ilter, & Berman, 1998).

However, temporal and spatial dispersion, which is the defining characteristic of virtual teams, weakens the ties that bind organizations and their members. Thus, in case of virtual teams, members experience some initial level of trust, shared understanding and cohesion which is definitely weaker than in a traditional co-located environment.

Organizational Structure: Organizational structure can be defined in number of ways, such as the degree of hierarchy present in organization, the way in which processes are structured and so on. For example, an organization's product group can be structured to ensure quick responses to the customer, with a very flat hierarchy to facilitate strong relationships, quick communication and fast decisions. On the other hand, an organization's structure may be very hierarchical restrictive and control oriented. Communication in such an organization may be restricted and may lead to more time in reaching solution. Also, a strongly hierarchical organization may give virtual team members false impressions of their superiority in rank above other, even if no such priority were specified and may lead to certain assumptions regarding communication and co-ordination even before the team starts working. Such assumptions regarding communication and co-ordination patterns based on perceived ranks may lead to conflicts.

Training: Although many organizations are deploying virtual teams since quiet a long time, it is still too soon for all organizational members to have been virtually for enough time to have developed and grasped the nuances of doing team work in a virtual environment. The issues of trust, shared understanding, communication, collaboration

and so on are quiet complex and different in a virtual environment as compared to a co-located environment. Hence, providing some sort of training to the members of virtual teams regarding how to use and when to use different technologies, what to expect on the trust and conflict front while working virtually, how to communicate effectively and co-ordinate with remote members without severing the ties between them and so on can be quite useful and go a long way in making the virtual teamwork effective.

Various authors have suggested ways to prepare virtual teams to respond to the challenges mentioned above. Duarte and Synder (Duarte & Snyder, 1999) recommend that virtual teams participate in face-to-face team building sessions prior to undertaking their virtual assignments. Other suggestions include training virtual teams in drafting of mission statements, clarification of individual team roles (Kirkman et al 2002), identification of appropriate technologies to use given a team's task (Malhotra and Majchrjak, 2004) and so on. Blackburn et.al (2003) proposed a comprehensive virtual team training program consisting of training in technology usage, group processes, and cross cultural awareness. Beranek (2000) found out that teams which were trained on development of trust and relational links did develop higher levels of rational links and trust that teams which did not receive training.

Summarizing the above discussion, it can be said that, the organizational dimension influences the social interaction among virtual team members. Hence, it is proposed that

P1: *Organizational Dimension will determine and subsequently manage the initial level of socio-emotional and decision processes in virtual teams.*

> P1a: Organizational Culture will determine an initial level of socio-emotional processes among the virtual team members.

P1b: Organizational structure will determine an initial level of decision processes among virtual team members.

P1c: Virtual teams receiving training on various issues on virtual environment will positively influence socio-emotional processes and decision processes.

Mission

Katzenback and Smith (Katzenback & Smith) proclaim in their widely acknowledged essay about teams, that to be an effective team, a team must define its own goal based on the one set by the organization. Following Katzenback, we also contend, that for virtual teams to be effective, they must draft their own mission statement. Previous literature has concentrated on group task performance as an overall success. However, task of virtual teams can include number of sub-tasks. For example, if a virtual team is collaborating to develop a software program, then this task of developing software will include sub-tasks such as planning, idea generation and so on. Each of these subtasks might require different media support. Extant literature has evidence that virtual teams using multiple technologies have been more effective (Timothy Kayworth & Leidner, 2000). The mission will be drafted in the first electronic communication among the team and will act as a process structure for the virtual team and will set the tone of social interaction among virtual team members. The mission of virtual teams will consists of number of tasks and each task will be carried out using different set of technology features.

Across their many papers defining Media Richness Theory, Daft and Lengel, discussed five primary task related factors that may affect organizational processing of information: *equivocality, uncertainty, routineness, complexity* and *emotional content.* Equivocality and uncertainty were almost similar factors and uncertainty was removed from later

research (A. Dennis & Kinney, 1998). Routineness can be defined as the ability of a task to be analyzed. If information about how a task can be performed is available or known, the task is said to be analyzable. A small sub-task can be said to have the property of routineness. However, a mission such as software development can't be categorized as routine or non-routine simply because it is too complex. Thus, following Daft and Lengel, we propose that Mission of virtual teams have two properties: *Equivocality* and *Complexity.*

Simply forming and deploying teams dispersed in time, space and cultures isn't going to lead to effective outcomes for the organizations. Certain mechanisms are required to make virtual teams achieve and integrate the outcomes with that of the organizations. We contend that Mission will be one such mechanism. Equivocality can be defined as ambiguity, the existence of multiple and conflicting interpretation about an organizational situation (Weick, 1979) and in our context, of the goal of virtual teams. Complexity can be defined as the difficulty level of the task. To the extent that a task is equivocal and complex, structural design can facilitate the amount of information needed for management co-ordination and control (R. Daft & Lengel, 1986). Similarly, during the drafting of the mission statement virtual teams will determine the level of processes such as co-ordination, communication, trust and so on required for the team to achieve the goal. Thus, we propose:

P2: Mission of virtual teams will provide control structure which can be defined in terms of its complexity, interdependence and equivocality. To the extent that Mission varies in complexity, interdependence and equivocality different forms of social interaction are encouraged by the technology.

Fit between Task and Technology

It has been shown that tasks of a group account for more than half of the group interactions (Ilze Zigurs & Buckland, 1998). In virtual teams, since these tasks are carried out extensively by the means of technological links, it is important to determine the type of technology used for different types of tasks. Significant amount of research has focused on the choice of technology for carrying out different tasks (R. Daft & Lengel, 1986; A. Dennis & Kinney, 1998; Hollingshed, McGrath, & O'Connor, 1993). However, most of the research has concentrated on the relationship among three constructs: *task, technology* and *performance* i.e. they studied the effect of using a particular task with a particular technology (based on various media use theories) on performance variables such as decision time (A. Dennis & Kinney, 1998), decision quality (Kelly Burke & Chidambaram, 1999) and satisfaction and so on. Few of them discuss how the fit between task and technology influences group processes such as communication(Ngwengama & Lee, 1997; Rasters et al., 2002), perceptions of communication interface and social presence (Kelly Burke & Chidambaram, 1999). Maybe, the reason for this is that media use theories were proposed for explaining how organizations process information. These theories explained how organizations can reduce uncertainty and equivocality of tasks by using rich communication technologies. Thus, although organizational members use technologies to communicate and carry out different tasks, they are most probably co-located (inter-departmental, inter-branch) and know each other personally and hence group processes such as communication, co-ordination, trust and so on aren't much affected by using technologies to carry out tasks. However, in case of virtual teams, group members are geographically separated and aren't familiar with other members of the team. Thus, in this study, we affirm that the fit between task and technology will influence the decision processes (communication, co-

ordination, conflict management) and lead to socio-emotional processes (viz. trust, conflict, shared understanding). This influenced group interaction will then determine the performance of the virtual teams.

Generate Tasks: These tasks are collaborative or co-operative in the sense that group is not required to decide on a single best response or to evaluate the quality of members' contribution. Each member can independently contribute ideas and each original idea will increase group productivity and the level of consensus required is low. This implies members can exchange or share information which can be divergent, such that not all group members need to focus on the same information at the same time (Alan Dennis & Valacich, 1999). Aggressive members might dominate by contributing too many ideas, denying non-aggressive members a chance to put forward their suggestions and evaluating their messages. Since generate tasks do not require evaluative and emotional connotations about message, this may be considered as a hindrance (Hollingshed et al., 1993). This might generate social anxiety in the group.

A technology providing high immediacy of feedback in such a case might heighten the social anxiety in the virtual group. This may lead to reduced trust and may increase conflict among team members. A technology characterizing of parallelism might be a good fit for Generate tasks, since parallelism enables participation of all members. A technology having characteristics of parallelism can allow users to simultaneously put forth their ideas. Such a facility will lead to reducing communication-based co-ordination losses (Graetz, Barlow, Proulx, & Pape, 1997), which might be apparent in a technology with high immediacy of feedback. Thus, using a technology with high parallelism with generate tasks will lead to increased co-ordination among virtual groups.

Studies have shown that, using facilitating technologies such as EBS with simple computer teleconferencing have helped generate more number of ideas (Graetz et al.,

1997). This implies that a technology providing multiplicity of cues can lead to increased communication. Since, in Generate tasks, members do not need to agree or converge on some particular ideas of plans, perception of group member as psychologically present won't make any difference. Thus, social presence won't make any significant influence over group processes and might just increase costs.

Choose Tasks: These tasks require more co-ordination as compared to Generate tasks. These tasks are more interdependent. Intellective tasks are those with demonstrably correct answers (McGrath, 1984)**.** Problem solving can be stated as an example of intellective tasks. Although, a shared understanding or consensus is required in such tasks, literature states that reaching an agreement on a solution is pretty straightforward, since there is not much debate among group members once the answer is reached (McGrath, 1984). The need for co-ordination is not explicit since, even if a single individual comes up with a solution, it is considered to be a group solution. From our definition of parallelism it is clear that an intellective task can be well achieved using a technology having parallelism. Since, parallelism allows different viewpoints at the same time without allowing members to give evaluative or critical feedback, virtual group members can put forth their solutions and can agree on one that looks most promising. Parallel communication appears conducive to production of previously un-discussed information (Dennis, 1996). Using a parallel technology for intellective tasks will positively influence shared understanding among virtual team members.

In intellective tasks, group members have to carefully process the pieces of information that are presented by other group members. This can be achieved by the means of just factual information without resorting to the means of multiple cues. However, immediate feedback on the acceptance or non acceptance of a solution provided by members can

lead to increase in trust among virtual group members. Again, social presence might not make much of a difference in approving a solution put forth by group members.

Judgment tasks are those which do not have a correct answer and group members come up with an optimum answer based on shared understanding (McGrath, 1984). Since the group is seeking an optimum or preferred answer, attaining consensus requires communication not just of facts, but also values, beliefs and attitudes about the merits of alternative solutions. Using a technology having high multiplicity of cues will allow for the high co-ordination among team members. If group members are able to emphasize important points, display doubts or uncertainty, the amount of knowledge each members have will be known. Since the level of knowledge and integrity possessed by individual members are antecedents of trust, we can say that using a technology with multiple cues will lead to increased trust among virtual team members. Since judgment tasks do not have any correct answers, attaining group consensus is very important. Immediacy of feedback enables mid-course corrections in message transmission, so that misleading elements in the message as sent can be quickly corrected. A media with high immediacy of feedback will allow members to communicate more leading to cohesion and share more views regarding the solution. Thus, we can say immediacy of feedback will increase communication and shared understanding among team members. Also, since there are tend to be conflicting views in these tasks, technology providing social presence might help get consensus among group members.

Negotiation Tasks*:* These tasks involve issues which are subject to parties' values versus facts. Negotiate tasks involve inherent conflict in viewpoints or interests (McGrath, 1984). These tasks are the most interdependent of the three and reaching consensus among group members is highly dependent on co-ordination of group members. Using parallel media with negotiation tasks would impede communication and

co-ordination among team members. A technology with high immediacy of feedback will increase co-ordination and communication. Since, group members' values are an issue with these tasks, the presence of as many cues as possible will be necessary to reach a good decision. These tasks are said to generate highest number of conflicting viewpoints among group members. Conflicts can't be just resolved based on factual information. Thus, technology with social presence will help develop trust and hence cohesiveness among group members. It is easy to resolve conflicts with people you trust.

An example of how different media characteristics used with different tasks will influence social interaction in virtual teams is given in table 2.

Table 2. TASK-TECHNOLOGY FIT

Task Type / Technology Features	Generate Tasks	Choose Tasks		Negotiate Tasks
		Intellective Tasks	Judgment Tasks	
Multiplicity of cues	Communication (+)	-	Trust (+)	Co-ordination (+), Communication (+)
Social Presence	-	-	Shared Understanding (+)	Trust (+), Cohesiveness (+)
Parallelism	Co-ordination (+)	Shared Understanding (+)	Communication (-), Co-ordination (-)	Conflict (+), Trust (-)
Immediacy of Feedback	Conflict (+), Trust (-)	Trust (+)	Shared Understanding (+), Communication (+), Cohesion (+)	Co-ordination (+), Communication (+)

Based on the above discussion we propose:

P3: Social Interaction Processes will vary depending upon the degree of fit between task type and selected set of technology properties.

Group Dimension

Since virtual teams are a group of functionally, culturally and geographically dispersed individuals, it will be characterized by different human behavior as compared to homogenous group of people, which will have a certain influence on the social interaction.

Cultural Diversity: The field of IS boasts of a number of studies which investigate the use of IT by people of varying national culture (Samarah, Paul, & Mykytyn, 2002). These studies imply that cultural characteristics of different nations might lead to different use of IT. This emphasizes the fact that people of different culture have a different perspective of using technologies. This makes cultural diversity an important point in the study of virtual team effectiveness. Cultural diversity is not only visible across national borders but also on different levels such as regional, organizational or professional (functional) level and team level. The different cultural factors co-exist, interact with each other and lead to different social interaction among virtual teams. One of the major challenges faced by virtual teams is effective communication and co-ordination since technologies lack the smoothness of face-to-face communication and constrain rich information exchanges and flexible negotiations (Kraut, Fussell, Brennan, & J, 2002). Jarvenappa and Leidner (Jarvenppa & Leidner, 1999) predicted that cultural diversity can lead to trusting behaviors in some groups and reduced trusting behaviors in some groups. However, their results did not support their hypothesis.

Awareness: Awareness among group members can be defined as the knowledge among group members regarding the activities of others. Previous literature has demonstrated the necessity of awareness for successful and effective collaboration, and co-ordination. Weisband (Weisband)found that teams that shared information about where they were and what they were doing performed better that teams who did not.

Weisband also found that awareness of other group members' activities lead to similar behavior of group members. Such a similar work ethic can lead to increased cohesiveness as well as shared understanding among virtual teams.

Thus, we propose:

P4: The nature of social interaction will vary depending on variations in group dimension

> P4a: Cultural Diversity in virtual teams will influence the decision processes, however it will not have any influence on the socio-emotional processes in virtual teams.
>
> P4b: The level of awareness of others' activities in a virtual team will have a directly proportional influence on decision processes and socio-emotional processes.

Individual Dimension

A team demonstrates different interaction styles (social interaction in this study) while collaborating towards their goals. It has been showed that team's interaction style influences performance (Watson & Michaelsen, 1988). The interaction styles are an aggregation of behaviors exhibited by individual team members which are rooted in their individual personalities (Balthazard et al., 2004), knowledge, gender and leadership qualities.

Personality: Personality has been consistently shown to have a positive relationship with successful task performance. Most frequently used definition of personality is the Big Five model by Barry and Stewart (Barry & Stewart, 1997) and consists of five traits: extraversion, openness to experience, emotional stability, agreeableness and conscientiousness. Extraversion was found to be the "key" personality trait at individual level (Barry & Stewart, 1997) and the limited research that studies personality in the

virtual team domain also have studied only extraversion (Balthazard et al., 2004; S. Strauss, 1996). Thus, in this study, we also consider only extraversion as personality variable. Extraversion refers to the degree to which individuals are gregarious, friendly, compliant, co-operative, nurturing, caring and sympathetic in contrast to introversion which is characterized by those who are shy, unassertive and withdrawn (Balthazard et al., 2004). Extroverts are usually active participants in group interactions and often have high intra-group popularity (M. Barrick & M. Mount, 1991; Barry & Stewart, 1997). Thus, extroverts being popular within groups can influence other group members to exchange social information through communication technologies. Exchanging social communication has been suggested as an avenue to build relationships among virtual teams (Powell et al., 2004). Virtual teams that send more social communication achieve higher trust (Jarvenppa & Leidner, 1999) and better social and emotional relationships (Robey, Khoo, & Powers, 2000).

Knowledge: Many virtual teams are by design, cross functional and include a number of experts in different domains. Thus, it is very likely that the team members possess diverse technological skills. Having diverse technological skills may lead to conflict as members can't agree upon the type of technology to be used (Sarkar & Sahay, 2002). The level of knowledge possessed by virtual team members reflects the ability to do efficient and effective work. Ability of virtual team members is an antecedent of trust in virtual teams (Sirkka L. Jarvenpaa et al., 1998). Equal level of knowledge possessed by every team member leads to increased cohesiveness, trust and higher perceived decision quality in virtual teams (Tan, Wei, Huang, & Ng, 2000; Warkentin & Beranek, 1999).

P5: Social Interaction will vary as per the variations in the Individual Dimension

P5a: Personality of individual virtual team members will influence socio-emotional processes as well as decision processes.

P5b: The level of level of knowledge will be positively related to trust, relationship building and cohesion in virtual teams. The diversity of knowledge possessed by virtual team members will be negatively related to conflict and cohesion in virtual teams.

Appropriation of Task-Technology Fit

Adaptive Structuration theory and Institutionalist School argue that people appropriate technology in different ways. And it is the appropriation which influences the performance and not the fit between task and technology (Gerardine DeSanctis & Poole, 1994). This research defines appropriation as selection of single or multiple technology characteristics for carrying out one of the task types defined in McGrath's task Circumplex (McGrath, 1984). Such an appropriation will depend upon the social structure of the group i.e. Organizational Dimension, Group Dimension and Individual Dimension.

Organizational Dimension: Technological feasibility is no longer a problem for virtual teams. Any teams today communicate at least some part using technologies. Rapid innovation of collaborative techniques has been witnessed in the last decade. Thus, a plethora of technologies are available today for team to collaborate virtually. The decision to invest and incorporate technology will depend on the impressions and reviews of new technologies which management of an organization obtains from IT vendors, consultants, and other organizations and so on. Along with this, history of implementing virtual teams and using technologies can be defined by organizational

culture, which will also play an important role in deciding which technologies should be used to deploy virtual teams.

Individual Dimension: Different leadership styles, diversified technological skill will all lead to different patterns of technology use.

Group Dimension: Awareness can be defined as an understanding of activities of others, which provides context for your own activities (Dourish & Bellotti, 1992). Features of technology can be altered to affect different types of awareness in users (Liccardi et al., 2007). Thus, the need for awareness will dictate the use of technology. Also, it has been found that culture leads to different use of IT.

Thus, we propose:

P 6, 7, 8: the fit between task type and technology characteristic will be appropriated by organizational dimension, individual dimension and group dimension.

Outcomes

Since we are concentrating on virtual team effectiveness and not efficiency, we have excluded decision time as performance variable from our framework. Virtual team effectiveness can be determined by decision quality, solution acceptance and satisfaction of team members with the solution. However, as can be seen from the above discussion and propositions, precise predictions regarding how appropriations will be done and how these appropriations will influence outcomes are difficult to make. The goal of virtual teams will provide a control structure which will encourage and constrain the appropriations made by the structural features of technology task, organization, group and individual dimensions. These appropriations along with structural features of organizational, group and individual dimensions will influence the nature of social interaction. The effectiveness of virtual teams will be contingent on the degree to which

social interaction among virtual team members (as defined in our framework) was able to reduce the equivocality and complexity of the goal of virtual teams.

For example, once an organization deploys a virtual team, the team will define their own goal based on the objective decided by the organization. This goal will be usually defined during the first electronic meeting of the virtual teams. Based on the complexity of the goal, the team will decide how many sub-tasks the goal has to be divided into and based on the equivocality of goal; the team will determine the required levels of communication, co-ordination, trust and other processes of social interaction. Thus, in general, the required social interaction to achieve effectiveness will depend on the ability of virtual team to 1) faithfulness or unfaithfulness of appropriation of the technology (here faithfulness of appropriation refers to the choosing the right technology characteristic for the right tasks), 2) positive rather than negative socio-emotional and decision processes imported from the organizational dimension at the start, 3) knowledge of individuals leading to an aggregate capable of reducing the equivocality and complexity of goal.

P9: Effective outcomes of virtual teams will result, when 1) virtual teams define a goal for themselves, 2) the degree to which the equivocality and complexity of defined goal is reduced by social interaction enabled by faithful appropriation processes and social structure.

5. Case Scenario: An Example of Implementation of Virtual Teams

Since this is a theory paper, we do not perform any experiment, nor do we collect any data to evaluate the validity of the model. However, to give a detailed idea of a virtual team's way to effectiveness based on our model, we explain a hypothetical case scenario of how a group of teams dispersed geographically might work to achieve a

certain complex goal. We adopted an example of how a Hewlett Packard laptop makes its way to market (Lauden & Lauden).The idea for the product and initial design came from HPs Laptop Design Team from United States. HP headquarters in Houston approved the concept. Graphics processors were designed in Canada and manufactured in Taiwan. Taiwan and South Korea provided the liquid-crystal display screens and many of the memory chips. The laptop's hard disks came from Japan. Laptop assembly took place in China. Contractors in Taiwan did the machine's engineering design with the Chinese manufacturers. Thus, this case is a perfect scenario for implementation of virtual teams.

Among the multiple teams collaborating to get a HP laptop to market, we consider the case of only two teams. Let's consider the graphics processors design team in Canada and manufacturer of graphic processor team in Taiwan. Since the geographical dispersion among these teams is huge, most of the collaboration between these two teams will be using technology since; face-to-face meetings will cost a lot of time and money. Thus, HP might consider providing the two teams with a bit of training regarding the issues involved in virtual environment to make them familiar with the characteristics and dynamics associated with working with others in a virtual setting. Training could also involve making the team members familiar with structure of both the teams. For ex, is one team more hierarchical while the other is not? It can help the teams to cross-coordinate effort when needed to complete critical product development. Also, training with using the technologies selected for disposal at the hands of virtual teams.

Once training is done, the two teams will meet for the first times virtually to discuss their goals. Since, graphics processor development is a complex task since it comprises of many different technologies and interdependent operations. The teams will draft their own mission at this stage based on the organizational goals and thus get a clear and

shared focus. For the scenario in question, the mission statement can be drafted by answering in detail questions such as: What are we trying to develop? Is it a product design or a prototype? The teams will discuss and identify the challenges required for this collaborative activity. They will discuss which type of technologies are to be used, recommend practices of working together, assign responsibilities and so on. Such an activity will set the tone of social interaction among the team members. The trust which was imported from the organizational dimension will be build upon swiftly after this stage. While defining their mission and setting direction and discussion performance goals, the two teams will develop cohesion and shared understanding among them. Also, as we mentioned above, the teams will decide which technology to use. Such a decision will only be made after the members get a general idea of the frequency of communication; level of co-ordination is going to be required for both the teams.

The roles and responsibilities and tasks assigned while drafting the mission of the team will be carried out by individuals and groups using various technologies at their disposal and work towards achieving the mission set up by the two teams. Since the two project teams have a huge geographical dispersion between them, group and individual factors will influence the social interaction as explained by propositions of this study.

The teams will be effective to the extent that they are successful in using proper technologies with proper sub tasks and achieving the objectives stated on the mission statement, i.e. reducing the equivocality of the mission by achieving or not achieving the number of objectives set.

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