2008

Degree of Virtuality: A Theoretical Framework of Factors Influencing Technology Use by Virtual Teams

Sanjiv D. Vaidya
MIS Group Indian Institute of Management Calcutta Joka, Kolkata – 700104, India, sdvaidya@iimcal.ac.in

Priya Seetharaman
MIS Group Indian Institute of Management Calcutta Joka, Kolkata – 700104, India, priyas@iimcal.ac.in

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Sanjiv D. Vaidya
Priya Seetharaman
MIS Group
Indian Institute of Management Calcutta
Joka, Kolkata – 700104, India
Email: sdvaidya@iimcal.ac.in; priyas@iimcal.ac.in

Abstract

Virtual teams (VTs) are groups in organizations separated by organizational, spatial and/or temporal distance. Innovative information technology infrastructure coupled with the growing internationalization of commercial activity has augmented the need for VTs. But not all VTs are equally virtual. A VT's environment, characterized by the pressures the team experiences to collaborate, the inherent orientation towards collaborative work and the drive to use technology, together influence the degree of virtuality of a VT. This paper proposes two dimensions of degree of virtuality including scale and sophistication corresponding to quantity and quality of use of VT technology, thus creating a ScaSo matrix. The paper presents propositions describing the influence of various factors in the VT environment on the degree of virtuality. Such factors include information intensity, performance pressures, group culture, leadership orientation, IT orientation and organizational IT maturity. The paper concludes with implications and proposal for further research.

Keywords

Virtual teams, technology use, degree of virtuality, ScaSo matrix

INTRODUCTION

Virtual teams (VTs) are groups in organizations separated by organizational, spatial and/or temporal distance. Typically, VTs use information technology to support the business requirements of working towards and reaching common goals. Innovative information technology applications and infrastructure coupled with the growing internationalization of commercial activity has augmented the need for virtual teams (Fuller, Hardin and Davison, 2007). The need for greater inter-organizational process efficiencies have also necessitated the use of VTs created between suppliers and customers.

Today's organizations are more spatially dispersed and units or divisions are located in multiple places. Need for market expansion; economies of scale; availability of resources such as urban infrastructure, natural resources or manpower and low costs of resources such as labour are amongst the business rationale for such dispersion. VTs have become common also as a result of increasing pressures for cross functional interactions arising from greater distribution of organisational tasks. With the increasing spread of organisational departments or divisions, communication infrastructure has become a necessity. Information Technology (IT) infrastructure and organizational structural mechanisms such as VTs are therefore being more commonly used.

Unlike face-to-face teams, VTs experience certain challenges that are barriers to effective teamwork and the accomplishment of teams' goals (Powell, et. al., 2004). However, appropriate understanding of VT environments, the enabling VT technology infrastructure and its use may aid in facing and mitigating many of these challenges. Moreover, virtual teams are highly likely to vary on their level of technology use depending on various factors. In an attempt to enable such understanding, this paper aims to present a theoretical framework which captures the various factors which influence the use of technology by VTs in organizations. VT technology, in our opinion, refers to the various IT tools which support virtual teams including group support systems, extranets, intranets, bulletin boards, computer based conferencing tools, messaging systems, computer-based video conferencing systems, voice-based conference-call systems, etc.

We believe that the degree of virtuality of a team is not defined merely by the spatial, organizational or temporal distance (Shin, 2004) but also by the level of technology use by the team. A team may be collocated within the same organization but may still desire to use VT technology to support their team task. Degree of virtuality, therefore is the extent to which a team uses VT technology to support the team task measured on two dimensions corresponding to quantity and quality of technology use. The degree of virtuality of a virtual team is influenced by the team's task characteristics, the culture of the team and the inclination of the team towards different VT technology.

The following sections present a theoretical framework of factors influencing technology use by virtual teams along with a brief description of the relevant literature. The final section presents some concluding remarks and possible future research directions and the implications of the framework for practitioners and managers especially in prescriptions for managing virtual team's use of VT technology infrastructure.

THE THEORETICAL FRAMEWORK

A theoretical framework is aimed at understanding the phenomenon under study in a structured fashion. It enables thinking in multiple directions especially in creating alternative paths of action. In understanding success of virtual teams in organizations it is important to view the three broad factors which affect such success including task pressures, group behaviour and the technology support.

Pressures to Collaborate

Members of a virtual team may experience certain pressures to collaborate other than by virtue of being part of the team. Such pressure may arise from the task characteristics especially the information intensity of the task and also from sources external and internal to the team.

Information Intensity of Task

'Information Intensity of Task' refers to the level of information processing required to perform the task. The term is derived from 'information intensity' discussed in the context of an organisation, i.e. information intensity of the process and information content of the product (Porter and Millar, 1985). Certain organizational tasks may require greater information processing than others and organizations respond to such needs through various mechanisms including meetings, planning, reports and rules (Daft and Lengel, 1986). It is possible to define information intensity of a team task based on three sub-constructs including task structure, task complexity and task uncertainty, where information intensity of task can be considered high when either of them are high.

Inherent structure in team tasks result in well defined analyzability of problems and possibility of establishing causal relationships amongst the various task constructs. Virtual teams are more likely to use VT technology at a higher level of sophistication and scale when the task is inherently more unstructured. Task complexity essentially reflects the amount and nature of information to be processed in order to execute the task (Campbell, 1988; Wood, 1986). Tasks, which require processing of more amount of information or require more iterations of information processing for instance, can be considered more complex. Tasks where the information to be processed is varied are also likely to be more complex. Greater task complexity is likely to lead to higher scale and sophistication in the VT technology use by the virtual team. Task uncertainty refers to the difference between the amount of information required to perform the task and the amount of information already possessed by the members of the virtual team. If for any particular reason, members are either unable to anticipate the information required for task execution a priori or are unable to acquire the information required, then the task uncertainty can be considered high, thus leading to greater scale and sophistication in the use of VT technology by the virtual team.

> *Proposition: Virtual teams engaged in tasks of higher information intensity of task are more likely to exhibit higher levels of scale and sophistication of use of VT technology than those engaged in tasks of lower information intensity.*

External Performance Pressures

External pressures (Iacovou, et. al., 1995) are those that the organizational environment creates for the team. They can arise from factors outside the organization such as competition, suppliers, customers, etc. When such pressures are faced by the organisation in general, the virtual team concerned with the organisational responses to such pressures, are highly likely to encounter them. But teams which are indirectly associated with such situations are also likely to experience the impact of such pressures, albeit to a lesser degree.

Pressures can also arise from within the organization but outside the virtual team such as in situations when the organization perceives the task performed by the virtual team to be significant. Manifestations of the team task significance may be explicit (through resource access, rewards and punishments, etc.) or implicit (through power, prestige associated with team membership, outcome expectations, etc.). A team which is hierarchically at a higher decision making level is likely to face greater performance pressures. The type of task (primary or support activity in the value chain of the firm, Porter and Millar, 1985) the virtual team performs directly influences the significance of the task. The structural configuration of the organisation can provide indicators to the significance of a team's task. Further, when other teams or organizationally powerful individuals are dependent either for their own professional tasks or for personal reasons, on the output performance of the team's, then the organisation as a whole is likely to place a lot of importance on the team's task. Performance pressures and therefore pressures to collaborate may also arise from spatial, temporal or organizational

dispersion (Shin, 2004). In such a situation, the team is likely to turn to greater use of VT technology to aid in responding to such pressures.

> *Proposition: Virtual teams experiencing greater performance pressures are likely to exhibit higher levels of scale and sophistication of use of VT technology than those experiencing lower performance pressures.*

Internal Drive for Excellence

Internal pressures refer to pressures originating from within the team in order to achieve or match performance expectations or self-determined performance goals, as perceived by the team. Internal pressures are those felt by the team due to perceived relative importance of the task performed and the team's internal drive for excellence.

Task significance (Campion, et. al., 1993) refers to the perceptions regarding the level of importance of the task under consideration, in comparison to other tasks of the team and other tasks in the organization in general. If the team perceives that the task under consideration is less important than its other team tasks, it is likely to feel less pressurised to perform the task well. In contrast, if the team members perceive that the task under consideration is a very important task in comparison to its other tasks, the members are likely to perceive greater performance pressures, either (or both) in terms of efficiency of the task performed or the effectiveness of its outcomes. Task significance also refers to the perception of the team regarding the significance of their task in the overall organisational environment. A team may perceive its task to be a very significant task in the overall organisational schema of tasks. Such a perception may also act as a motivating factor, encouraging team members to strive for better performance.

A highly motivated team with an innate drive for excellence and keenness to produce an efficient and effective output of the team task, may also experience inherent pressures to perform. The explicit manifestations of these external and internal pressures occur as reward norms for performance as teams and as individuals in team work; and punishment norms for non-performance. Such reward norms may also exist for use of VT technology to support performance (Orlikowski, 1992). Implicit inhibitors such as peer pressure, social ostracism as a result of deficient performance, denial of subsequent team memberships, subsequent reduced task allotments etc., also work, internally within a team, and thus tend to reflect the internal and external pressures felt by the team.

> *Proposition: Virtual teams experiencing greater internal drive for excellence are likely to exhibit higher levels of scale and sophistication of use of VT technology than those that experience lower internal drive.*

Collaborative Orientation

It is quite common to find virtual teams which vary in their level of collectivistic orientation. Some teams have a tendency to be more collaborative in their approach to task execution than others. While the team sub-culture has a more dominating influence, Collaborative Orientation is influenced also by the culture of the organisation in which the team is embedded. Further, the team decision making style is also likely to impact the extent of collaborative orientation exhibited by a team.

Virtual Team Culture

The primary factor that influences the collaborativeness of the team is the team's culture. Level of cohesion and trust among the members of the team, level to which innovation and risk taking behaviour are preferred, the emphasis on attention to detail, the extent of task vs. people orientation, openness to information sharing and preference for stability are amongst the various factors which influence the individual person-team fit and thus the culture of a virtual team (Shin, 2004).

Team culture significantly affects team effectiveness (Campion, et. al., 1993). Virtual team culture can be considered passive towards collaboration when the team neither actively encourages innovation and risk taking nor does it exhibit high people orientation. The team members also display a low level of trust and cohesion. While there is no negative orientation to share information, the team members do not proactively share task related information. In other words, teams exhibiting a passive team culture towards collaboration tend to work cohesively only when there is a need but are not naturally inclined towards collaboration. On the other hand, teams exhibit negative orientation towards collaboration when team members prefer to work individually rather than collaboratively. The members hesitate to share information related to the task openly. There is a general lack of trust amongst members and an undercurrent of hostility among them. The team itself may be forcibly formed either because a cross functional or a cross-regional team is believed to be essential or because the organisation believes in using a team to perform the task. When a team is positively inclined towards collaboration, members trust each other and are open to sharing information among each other (Suchan and Hayzak, 2001). Such teams are cohesive and members are encouraged to innovate. There is a sense of

belongingness to the team and a strong inclination to perform the given task in a cooperative manner, rather than merely execute individual portions of it.

> *Proposition: Virtual teams positively inclined towards collaboration are more likely to exhibit higher levels of scale and sophistication of use of VT technology than virtual teams passively or negatively inclined towards collaboration.*

Organization Culture

Collaborative orientation is not determined solely by the team's own characteristics. It is also affected by the environment in which the team functions, especially the organisational environment. Certain organisational factors, especially the cultural environment — including the formal and informal incentives for collaboration — are likely to impact the orientation of team members towards working together on the team task. Culture of an organisation can be defined as the cognitive framework consisting of attitudes, values, behavioural norms, and expectations shared by members of an organisation (Robbins, 2002). These may include sensitivity to needs of customers, risk-taking, value placed on people vis-à-vis task, friendliness and informality of employees with one another. Some organisations tend to encourage and create environments which are suited to team work and team interactions, much more than some others which emphasize individual work. While explicit indications of such support may be available in the form of formal requirements and rewards for teamwork etc., implicit indications include perceived privileges such as membership in specific teams, degree of freedom and responsibility given to individuals.

> *Proposition: Virtual teams in organizations positively inclined towards collaboration are more likely to exhibit higher levels of scale and sophistication of use of VT technology than virtual teams in organizations passively or negatively inclined towards collaboration.*

Team Leadership Style

The role of leadership of a team can be described as the ability to influence a team towards achievement of team goals. Sources of such leadership include the formal authority or power derived from the authoritative position and the informal authority through aspects such as skill, expertise, social clout or simply gregariousness. Prior research has found the role of the leader in a virtual team to be highly significant especially since he/she has to additionally play the role of a technology facilitator (Thomas, et. al. 2007).

Characteristics of virtual team leaders include specifically their inclination and ability to ensure collaboration and cohesiveness, their ability to build trust, enable individual members to benefit from the team and vice versa (Malhotra, et. al., 2007). The team leadership orientation can thus be

a. *Positive towards collaboration*: where the team leader encourages collaborative work and supports such a working style among team members. Such leaders are normally likely to follow a collaborative, consultative or democratic decision making style, where team members participate actively in the team decision making process. This encourages the team to work in a cooperative manner towards achieving the team task. Such leaders are also likely to place considerable importance on technology adaptation by the virtual team (Thomas and Bostrom, 2008).

b. *Negative towards collaboration*: When the team leadership orientation towards collaboration is negative, the leaders discourage, explicitly or implicitly, active collaboration among team members. Such an orientation quite often defies the purpose of the very existence of the team, as the primary reason for use of organisational teams is for collaborative work. Yet, there can be two scenarios where use of teams may be in vogue even though the team leadership is negatively oriented towards collaboration among team members. One, when the existence of the team is essential to gather perceived support from a set of people in the organisation and two, when it is required by organisational policies or norms to execute the task using a team.

> *Proposition: Virtual teams with leaders who are positively inclined towards collaboration are more likely to exhibit higher levels of scale and sophistication of use of VT technology than virtual teams with leaders negatively oriented towards collaboration.*

Technology Drive

IT drive is the orientation of users, individually and collectively, towards the use of IT in the organisation (Tarafdar, 2001). A virtual team's inclination to use VT technology can be described as the tendency of the members of the team, individually and collectively, to favour the use of VT technology to accomplish the specified team task (adapted Vaidya and Seetharaman, 2008). The team members' inclination towards VT technology is likely to significantly impact the actual use by the team. In other words, a positive orientation or inclination of the team members towards VT technology is likely to translate into greater levels of actual use of the technology. Similarly, a negative orientation of the team towards VT technology is likely to be reflected in lower levels of actual use of VT technology for the team task. A virtual team's technology drive can be

operationalized using three factors including users' IT orientation, organizational IT maturity and perceived relative advantage from using the technology.

Users' IT orientation

A user's IT drive can be described as the inclination of the individual towards the use of IT. The orientation of an individual towards IT is reflected in his/her attitude towards information technology, awareness and knowledge about different IT applications and their potential uses, perceived ease of use and usefulness of different IT applications, willingness to use IT support for individual work, urge to learn various IT-based tools and techniques which can improve individual work and comfort with the use of IT, in general (Tarafdar, 2001).

Individual demographic characteristics such as age, education, IT literacy level, etc. are highly likely to impact the team member's inclination to use IT in general and VT technology in particular. It has been repeatedly argued and proven that demographic characteristics are among the foremost drivers of IT usage in organisations, especially at the individual level (Mahmood, et.al. 2001). Prior IT education or training, especially the one received during formal education, is likely to influence an individual user's orientation towards IT (Burton-Jones & Hubona, 2005). Past experience with virtual team technologies especially through repeated, directed use of them is likely to ensure greater comfort with such technologies (Lewis, et. al. 2005). Such orientation and comfort with VT technology is likely to result in greater scale and sophistication of use when called for. Hence,

> *Proposition: Virtual teams with members who have higher degree of IT orientation are more likely to exhibit higher levels of scale and sophistication of use of VT technology than those with members who have lower degree of IT orientation.*

Organizational IT maturity

'Organisational IT Maturity' (OITM) refers to the level of sophistication of use of IT, the evolutionary stage of IS in the organisation and the extent of use of IT applications for strategic decision making. In other words, OITM is a result of IT professionalism which refers to the level of 'professionalism in terms of technical competence and business understanding of IT' (Vaidya, 1990) exhibited by the organisation. While it is quite common to find organisations and individuals who have a high level of technical competence and the inclination to use IT, it is rather uncommon to find organisations/individuals who understand and appreciate the business value of IT and have the technical and managerial competence to put such knowledge into action. OITM is a factor that develops over time, as a result of the availability of IT resources in the organisation; availability of IT-related services; attitude of the organisation towards innovation adoption in general; attitude of information systems professionals in the organisation towards use of IT and orientation of the organisational leadership towards IT (Tarafdar, 2001). OITM includes the managerial ability to comprehend the possible business value that the organisation can derive from implementing and effectively managing appropriate IT applications.

> *Proposition: Virtual teams in organizations with high IT maturity are more likely to exhibit higher levels of scale and sophistication of use of VT technology than those in organizations with low IT maturity.*

Perceived Relative Advantage

Perceived relative advantage refers to the degree to which an innovation is perceived to be superior to the ideas it supersedes or replaces (Rogers, 1962). A co-located team may use alternative means of communication such as face-to-face communication, written memos, etc. if it feels that there is no significant advantage from using the VT media. But in a virtual team, the team is far more restricted to some IT support than co-located teams. Such a team may satisfice the need for communication through the mere use of an IT application such as an email service or listserv where asynchronous long-distance communication may well be achieved. The relative advantage of using advanced VT technology over alternative means of task execution, as perceived by the team members, influences its use.

Perceived Relative Advantage (PRA) results from combined effects of perceived benefits of the chosen medium, perceived costs of alternative media and the perceived adequacy of the chosen medium to perform the task set before the team. The rate of adoption of an innovation is influenced by the complexity of an innovation as perceived by members of the team (Rogers, 1962). This is especially true with a technology like IT where use of the technology is also determined by an individual's attitude towards the technology (Davis, 1986; Moore and Benbasat,1991; Venkatesh, Morris, Davis and Davis 2003) When the complexity of use of VT technology in relation to the task to be performed is perceived to be high, members of the team are unlikely to use it regularly, though they may be aware of the potential uses. Similarly, a virtual team may perceive certain costs in utilizing a particular VT technology infrastructure. Costs can be monetary expenses, time or effort required to use a particular medium. Perceptions regarding the costs of VT technology over alternative media influence the perceived relative advantage of VT technology use. The perceived adequacy of the medium chosen to perform the task is another factor which affects the perceived relative advantage. When the team uses a certain VT technology and also perceives that the medium is sufficient and adequate to perform and complete the task, it is

likely to perceive that there is a high relative advantage of the VT technology over other available media. Together, perceived benefits, perceived costs and perceived adequacy of the medium determine the relative advantage of the VT technology over other alternative media as perceived by the team members. Such advantage is likely to result in greater scale and sophistication of use of technology by virtual teams.

> *Proposition: Virtual teams with members who perceive greater relative advantage from VT technology are more likely to exhibit higher levels of scale and sophistication of use of VT technology than those with members who perceive lower relative advantage from VT technology.*

Figure 1 below represents the theoretical framework for technology use by virtual teams along with the three main constructs and the factors which influence degree of virtuality of a VT.

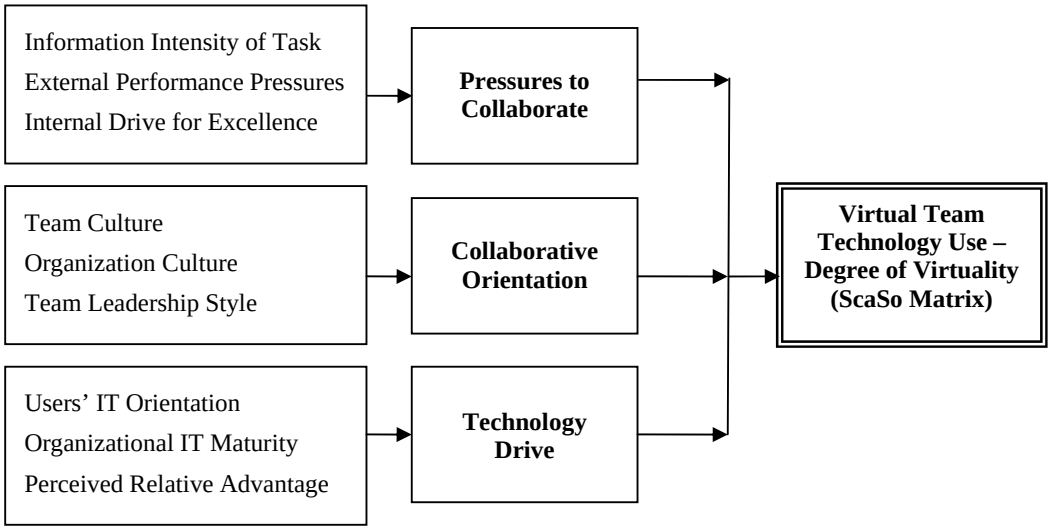

Figure 1: Technology Use by Virtual Teams: A Theoretical Framework

Technology Use by Virtual Teams – Degree of Virtuality

Degree of virtuality has often been defined on the basis of temporal, spatial, cultural, and organizational dispersion (Shin, 2004). While these factors are important in determining the need for a virtual team, they do not fully explain the concept of virtuality. They in fact describe the environment of the virtual team. Degree of virtuality, in our opinion, is also determined by the extent of IT support used by the team to complete the team task. To offer an explanation, a team which uses email (an asynchronous medium of electronic communication) can be considered less virtual than a team which uses an online group decision support system that helps it build a decision model and manage the entire group task. Similarly, a VT which conducts initial task-related discussions over VT technology and then uses face-to-face meetings is low on degree of virtuality.

The level of technology use by virtual teams can be determined by two dimensions including scale and sophistication which represent the quantity and quality of technology use. Prior literature has conceptualized similar measures of technology use by individuals, groups and organizations (see for instance, Bajwa and Lewis, 2003; Bhattacharjee, 1998; Easley, Devaraj and Crant, 2003; Eder and Igbaria, 2001; Massetti and Zmud, 1996; Vaidya and Seetharaman, 2005). Similar conceptualizations have been applied to virtual teams too (Maznevski and Chudoba, 2000).

Scale of Use

Scale of use represents the magnitude and spread of VT technology use by the team. It is hardly possible to capture the magnitude of use of intellectual technologies without considering either time or task as a basis. VT technology use is largely dependent on the task requirements and the team's creativity. It is therefore natural that the precise measure for magnitude of use will largely vary. Also, it can be measured only in the context of a specific application (or task for which the application(s) is used). Scale of use can be measured using (a) frequency of use and (b) proportion of team task performed using the VT technology. Similar measure has been proposed in the context of use of collaborative technology (Vaidya and Seetharaman, 2005). Frequency of use refers to the "regularity of utilization" of VT technology by the team for performing the team task. In other words, it attempts to capture the answer to the question — 'how often does the team use the VT to perform the task or parts of the task'. Proportion of task on the other hand, can be measured as the extent of task performed by the virtual team over various VT technologies available to the team. The choice of the extent to which VT technology is used to support the group task is dependent on the various independent constructs described in

earlier sections. A group may chose to also perform various parts of the task using various VT technologies such as email, bulletin boards, group decision support systems and voice or video conferencing. As a means of evaluating the scale of use of the group it may be necessary to consider the particular technology for which the proportion of task is highest.

Sophistication of Use

Sophistication in the context of technology use refers to 'refinement' or exhibition of higher level of knowledge. In the context of VT technology use, it refers to the use of the general VT technology infrastructure and specific VT technology applications, at various levels of refinement, as reflected in the information activities performed using the technology. A classification of group information activities in the context of collaborative technology has been provided by Vaidya and Seetharaman (2005). Similar classification of group activities using IT support has been used earlier in literature (Bajwa and Lewis, 2003; DeSanctis and Gallupe, 1987; Maznevski and Chudoba, 2000; Rana, Turoff and Hiltz, 1997; Van den Hooff, 2005; Zigurs and Buckland, 1998). Information activities include information sharing, information management, group-related information management and synchronous group decision making or group model building.

For instance a candidate selection virtual team may initially correspond over email to discuss individual candidates and their profile-fit. A substantial portion of the decision task may be performed using asynchronous technology support such as emails, file-sharing, etc. for a considerable amount of time. Once sufficient discussion is conducted, the group facilitator may invite the virtual team for a video conferencing session to make the final decision on a final chosen set of candidates. In this case a high proportion of task is performed using less sophisticated technology even though a smaller proportion of the task is performed using more sophisticated VT technology such as a video-conference application. It is thus important to measure the use of technology through both scale and sophistication of technology use.

Adapting the technology use grid proposed by Vaidya and Seetharaman (2005), we propose here a two dimension grid – the ScaSo (Scale-Sophistication) matrix (Figure 2) where the two constructs scale and sophistication are measured as mentioned above. We thus have four classes of virtual teams based on their scale and sophistication of use of VT technology.

Novices: A novice team performs certain activities, which are inherently low in complexity, using the VT technology. It is very likely that the VT uses technology quite infrequently. One reason may be the team task is divided into individual tasks and then collated, thus reducing the information intensity. Alternatively the team may be experiencing low pressures to perform and therefore does not require frequent or sophisticated use of technology support. A good example would be a team where the members may occasionally send emails to each other or post occasional notices on a bulletin board. Such teams are also likely to use alternative media for task execution such as occasional face-to-face meetings or the use of telephones.

Super Novices: A virtual team of super novices consists of frequent users of the VT technology. Such users perform less complex team activities on the technology. Where the use of VT technology is mandatory and/or a significant portion of the team task related information is communicated through the technology and where the team members are not very tech-savvy, members are likely to be frequent users but perform less complex activities using CT. Such teams are likely to consist of members who are not technology-inclined but are under pressure to use technology support either due to high information intensity, spatial dispersion or performance pressures.

Passive Experts: A team of passive experts are quite aware of the features and facilities the technology offers and are also proficient in using the same. However, lack of opportunities to actually use them prevents them from doing so regularly. At the same time, the inherent capability of the team and its competence with the technology is likely to motivate the team into using VT technology at a high sophistication level whenever they use it. Such teams are likely to be high on technology inclination but may not be experiencing high performance pressures or may be performing a task which is low on information intensity.

Active Experts: Members of a team of active experts are likely to use VT technology very regularly. A very good example of this class of teams would be a virtual software project or consulting team which very frequently uses technology support. They are likely to be utilising the technology to perform activities such as file sharing, application sharing, group data analysis, group model building and synchronous online discussions.

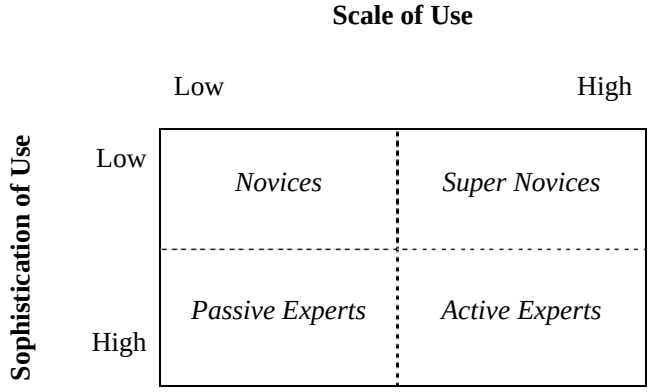

Figure 2: The ScaSo Matrix – Degree of Virtuality

Mapping

A virtual team environment can be described using the three constructs pressures to collaborate, collaborative orientation and technology drive which attempt to combine individual, task, team and organizational environment characteristics. In order to parsimoniously describe the relationship between the virtual team environment and the degree of virtuality, we consider here two states of each of the three environment constructs – 'low' and 'high'. Using this, it is possible to map the state of the environment to the position of the virtual team on the ScaSo Matrix. It is assumed here that the collaborative orientation is likely to act like a catalyst enhancing the impact of pressures to collaborate and the technology drive already present in the team. While it is possible to delineate the eight possible states arising out of low and high values of the three constructs, we believe the other four states will be fairly similar to those delineated below. Table 1 lists the four possible virtual team environments and their mapped positions on the ScaSo Matrix.

Table 1. Mapping VT environments to Position on ScaSo Matrix

Pressures to Collaborate	Collaborative Orientation	Technology Drive	Position on the ScaSo Matrix
Low	Low	Low	*Novices*
High	High	Low	*Super Novices*
Low	High	High	*Passive Experts*
High	High	High	*Active Experts*

CONCLUSIONS

The paper presented a theoretical framework to help understand technology use by virtual teams. VT environments can be described using three main constructs - pressures to collaborate arising from task and performance pressures; collaborative orientation arising from the team, organizational culture and the team leadership style; and technology drive arising from the individual users' IT orientation, organizational IT maturity and the relative advantage perceived by the team from using the VT technology. The paper proposed two dimensions of degree of virtuality in the context of technology use by virtual teams including scale and sophistication corresponding to quantity and quality of use of VT technology. The theoretical framework finally proposed a mapping of the VT environment states to the types of virtual teams based on the level of technology use. The value of the framework is two fold apart from providing a basic understanding of the relationship between VT environment and the degree of virtuality in the context of technology use. One, given a virtual team environment it is possible to predict the degree of virtuality that the team may exhibit. Such a prediction will help the team and therefore the organization to be prepared for the corresponding level of technology use. Two, knowing the factors which influence degree of virtuality, an organization can manage the factors and therefore the resulting environment through various task, cultural and technology mechanisms. Further research is warranted in this area especially through empirical validation of the framework and operationalization of various constructs and individual factors.

In order to validate the framework, we propose to conduct an empirical study of virtual teams engaged in tasks of varying degrees of performance pressures, collaborative orientation and technology drive. Since this is

amongst the first attempt to develop an integrative framework for understanding degree of virtuality in the context of technology use by virtual teams, we believe, an initial study using qualitative research methodology through cases would be most applicable. As a means of extending the study and arriving at greater generalizations, there is also a need for a large-scale survey based study. The outcomes of such a multi-method exercise will be in three directions. One, the study is expected to highlight the importance of various factors propositioned as being constructs which influence scale and sophistication of VT technology use. Two, the study will help us operationalise the various constructs using lower level variables especially in instruments devised for the large-scale quantitative survey. Such an attempt will help us understand the nature of influence of the different variables and constructs on the dependent construct along with the interactions, if any. Third, the study will also help us delineate possible management mechanisms by which technology use of virtual teams can be better managed.

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