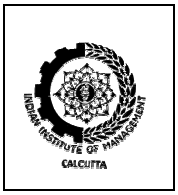

INDIAN INSTITUTE OF MANAGEMENT CALCUTTA

WORKING PAPER SERIES

WPS No. 623/ February 2008

Understanding Sophistication in Collaborative Technology Use

by

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UNDERSTANDING SOPHISTICATION IN COLLABORATIVE TECHNOLOGY USE

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ABSTRACT

Collaborative technology is an IT-based infrastructural application which enables organizations to increase operational efficiencies and effectiveness of organizational communication. It is important to identify potential challenges and barriers to collaborative technology adoption and use and therefore create means and mechanisms for anticipating, facing the challenges and removing the barriers. This paper uses exploratory cases to analyse IT-supported collaborative decision task situations to understand the factors influencing sophistication of use of collaborative technology. Preliminary qualitative analysis suggests that sophistication is a function of the users' drive to use technology, the task and group environment and the group's cultural orientation towards collaboration also influence collaborative technology use. Propositions are presented based on the analysis. Further development of an integrative framework to understand use of collaborative technology is essential for suggesting more precise and fundamental prescriptive mechanisms.

Key Words: Group Decision Support Systems, Collaborative Technology, Sophistication, Adoption and Use, Qualitative Research

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INTRODUCTION

Organizations today are increasingly facing challenges from their environment and are therefore being forced to adopt various technologies and management mechanisms which aid them in responding to such challenges. One such technology which is believed to increase productivity, and enable faster and easier work execution is collaborative technology.

Collaborative technology has become an important medium of group work in organizations mainly due to the rapid dissemination of networks and the internet (Sarker, Valacich & Sarker, 2005). As end-users of this technology, we vary in our expectations from it and our use of it. The opportunities it offers are plenty. Yet, many users we see around do not utilize IT in general and collaborative technology in particular, to its potential. The lack of sophistication in the use of collaborative technology is assumed to be due to the non-availability of support for complex organizational tasks. But a deeper look at the problem reveals more fundamental issues. In fact, given the growing diffusion of the internet, availability of suitable collaborative technology applications is a very small part of the problem. Let us take a look at the following simple everyday situations.

Using email client applications has often been a difficult proposition for many users. Take this seasoned executive. When she wants to search for a particular email she received sometime ago, she manually scans through her entire in-box trying to match the date or the sender whose mail she wanted to locate. The "find" option, that we normally take for granted in an email client, seems like a very advanced option to her.

Two geographically separated research collaborators, who were trying to work on a single document together — editing and making changes in a sequential manner, used a colour coding scheme (the key to which is decided a priori) to differentiate what is meant as a comment to the other person and the actual corrections to the document itself. Sentences to be erased were marked in red, new sentences added were in green and so on. One of the collaborators was told about the automatic track changes option that is available in many word processors, and she refused to use it, stating discomfort with such an "advanced" option.

A team of four senior executives in a medium sized consultancy firm meet every Friday morning to discuss the progress of the projects they are assigned and to exchange ideas and suggestions for future course of action. They share documents, figures, templates, even pictures and make changes to them as the meeting progresses. They are each located at four geographically distant offices of the firm.

The purpose of this paper is to present the results of an exploratory investigation of how and why individuals and therefore groups vary in their use of collaborative technology. In the context of collaborative technology, use can be defined as *employment of one or more features of a system by the members of the group to perform the group task.* We define the term collaborative technology to include the hardware, software and network infrastructure which support a variety of group tasks in the organization. It thus covers the entire spectrum of electronic mailing systems, bulletin boards, intranets and extranets, messaging systems, group support systems, decision rooms, computer conferencing tools, computer-based video-conferencing systems, etc.

While the area warrants further large-scale study and analysis, we infer from our exploratory investigation that groups differ in their levels of sophistication of use of collaborative technology due to three broad factors, viz., need for technology support, cultural orientation and the group's technology drive.

LITERATURE REVIEW

IS researchers have often argued that adoption and use of communication and collaborative technologies arise from changes in the organization itself. Three perspectives have often been used to highlight this. The first is the technological perspective which views technology as an enabler of organizational form, the second is the organizational perspective which views technology as being designed to fit organizational structures and forms and the third perspective is an "emergent perspective" which views use of technologies as "occasions" for structuring organizational situations. In these perspectives, adoption and use of technology is subsumed thus emphasizing the need to understand adoption and use in order to appreciate the role of each perspective. The following sections examine literature on the use of groups, the use of collaborative technology and factors influencing its use in organizations.

Need for Groups

An understanding of the need for use of groups by organizations is essential in an attempt to understand various collaboration challenges faced by organizations and the mechanisms that can be employed to bridge the information technology gaps to overcome these challenges.

As organizational decision making becomes increasingly complex and uncertainty in the organizational environment increases, organizations may respond by significantly increasing decision making by groups than individuals (Galbraith, 1973; Applegate, 1991). Organizations use groups when functional expertise and volume of information required to support decision making are high (Belanger & Watson-Manheim, 2006) and when the organization believes in participative decision making. Groups are also used to maximize creativity in decision process (Nonaka, 1991; Taggar 2002), to achieve organizational objectives such as distribution of work,

problem solving, increasing involvement of individuals (Nosek, 1998) and thus their commitment to the organization.

The coming of computer based networks in the 80s, and the Internet in the 90s provided groups in organizations, with technology support for their tasks. The following section examines literature on the use of collaborative technology.

Use of Collaborative Technology

Any IT-infrastructural technology or application has the potential to be used in a myriad of ways. The manner in which the user utilises the capabilities of the technology is restricted largely only by his or her imagination and the broad spectrum of facilities and features provided by the technology.

Among the early authors who appreciated the difference in level of sophistication of use were DeSanctis & Gallupe (1987). They proposed three levels at which a Group Decision Support System (GDSS) may support groups in decision making—Level 1 GDSS supports communication; Level 2 GDSS supports decision modelling and Level 3 GDSS includes machine-induced communication patterns. A similar classification has also been provided by Pinsonneault & Kraemer (1990) who differentiate GDSS from GCSS (Group Communication Support System) where GCSS primarily supports group communication, whereas GDSS focuses on group decision process. Others have also provided similar classifications (Nunamaker, Dennis, Valacich, Vogel & George, 1991; Teng & Ramamurthy, 1993; Zigurs & Buckland, 1998). Maznevski & Chudoba (2000) used the categories of information gathering, problem solving, idea construction, comprehensive decision making and generating major commitment to grade decision process while understanding various aspects of virtual teams. DeFranco-Tommarello & Deek (2004) analyzed sophistication in collaboration tool facilities and their impact on software development specifically in the context of collaborative problem solving. Weiseth, Munkvold, Tvedte & Larsen (2006) proposed a 'wheel of collaboration tools' as a typology of capabilities of collaboration tools using functions for collaboration processes, content management, process integration and interfaces to collaboration functions. More recently, Watson-Manheim & Belanger (2007) examined multiplicity of media choices based on different communication purposes for which they are used, such as coordination, knowledge sharing, information gathering, relationship development and conflict resolution.

IS literature has extensively examined the use of collaborative technology, measuring such use through various direct and indirect measures. A review of such studies examining different measures of collaborative technology use has also been provided in Vaidya & Seetharaman (2005). However, the area has been often criticized for lack of in-depth studies, lack of studies on collaborative technology diffusion patters, failure to give sufficient importance to contextual and

environmental variables and excess dependence on experimental research approaches (Qureshi and Vogel, 2001; Powell, Piccoli and Ives, 2004; Lewis, Bajwa, Pervan, King and Munkvold, 2007).

Factors affecting Use

In an attempt to understand the various causal factors influencing use of collaborative technology, models developed for technology adoption and use in general and IT use in particular, have been variedly applied in the context of collaborative technology. TAM, for instance has been applied and tested for collaborative technology such as intranets (Horton, Buck, Waterson & Clegg, 2001), emails (Burton-Jones & Hubona, 2005), courseware management tools (Dasgupta, Granger & McGarry, 2002) and negotiation support systems (Lim, 2003). Going beyond TAM, structuration theories (DeSanctis & Poole, 1994) have argued that use of technology (created by an interaction of the organizational factors and the technology) is structured by the context over time. Van den Hooff, Groot & de Jonge (2005) presented a meta-analysis of various studies and theories on adoption and use of communication technologies.

Three broad areas of focus emerge when examining literature related to use of collaborative technology. These include task characteristics (see for instance, Pinsonneault & Kraemer, 1990; Maznevski & Chudoba, 2000), technology characteristics (such as in Sarker et al., 2005) and group related aspects (Turner & Turner, 2002; Lerouge, Blanton & Kittner, 2004; Sarker et al., 2005). Group related aspects studied have also included social and cultural variables (Zack & McKenney, 1995) highlighting the importance of the social context and the paramount role of an organization's cultural environment in influencing adequate and appropriate use of groupware (Orlikowski, 1992; Lim, 2003). A more recent study examined barriers to adoption and use of collaborative technology and suggested that barriers such as organizational incentives to use, cost of using the technology, complexity of the technology itself, absence of perceived benefits and compatibility with existing meeting methods and power structures were amongst the more significant issues (Lewis, et. al., 2007). Many authors have also suggested ways of improving use of collaborative technology, such as through training, support (Orlikowski, 1992; Vandenbosch & Ginzberg, 1996), enhancing employee willingness (Yen, Wen, Lin & Chou, 1999) and cultural fit (Vandenbosch & Ginzberg, 1996).

Based on various issues raised in existing literature, we identified possible research issues and an appropriate research method to analyse and understand the factors influencing sophistication of collaborative technology use by groups.

RESEARCH METHOD

The primary aim of this study is to understand sophistication and to identify the factors that influence collaborative technology use. The choice of research methodology, therefore, should aid in this process of theory building. It has been often shown that for such studies qualitative research methodologies are more appropriate (Eisenhardt, 1989; Yin, 1994; Denzin & Lincoln, 2000). Moreover, since the emphasis is on understanding the process of use, case study as a methodology for developing and supporting the theory is more suitable (Myers, 1997).

The choice of research sites covered firms in both manufacturing and services sector keeping in mind the need to vary the basic task performed. Middle/senior management level groups, who performed at least one decision task, were chosen. Four such groups consisting of a total of 18 managers were interviewed from four firms. The purpose of this study is to examine group decision task situations and understand the factors influencing sophistication of use of collaborative technology. Detailed qualitative analysis of the in-depth interviews, it was hoped, would help achieve that research objective. We collected information about the organization, the group, the tasks performed by the group, the use of collaborative technology and IT applications, infrastructure and support in the organization. All are Indian organizations and the names of organizations used here are pseudonyms.

Table 1: Research Sites

Organization	Group / Task	Description of People Interviewed
National Finance	Product Development Group	1 Product Development Manager, 2 PDG Members, 1 IT executive
Eastern News Express	Content Team	2 Senior Reporters, 1 Reporter, 1 Senior Manager – IT, 1 VP – IT
Harp cooling Towers	Materials Planning Group	1 Stores Manager, 1 Manager – Operations, 1 Manager – IT, 1 IT Executive
Vie Insurance	Branch Administration Team	1 Senior Divisional Manager, 1 Divisional Marketing Manager, 2 Branch Managers, 1 IT Executive

Site 1 – National Finance & Investments

National Finance & Investments (NFI) is a large bank, set up in the early 90s, having a network of close to 200 branch offices and 1200 ATMs. The group chosen for study is the Product Development Group which is responsible for developing, evaluating, executing and monitoring credit and non-credit loans offered to small and medium scale enterprises. Customized products are specifically developed and evaluated for particular clients. The task essentially involves ascertaining clients' requirements, analyzing client and project related information and evaluating the risks involved. Finally a decision is taken on whether to extend credit and if so, the type of credit.

The group consists of five members, Manager – Product Development Group who oversees the group's work and is aware of all the clients whose cases are being analysed and 4 members who in groups of two or three analyse and develop various products for the clients of NFI. While clients are individually handled by various departments, cross selling of products and credits is quite common. The group is hence encouraged to collaborate and work with other departments in order to keep themselves informed of the various opportunities for credit advancement. Such collaboration, it is felt, is a necessity and accepted way of working.

Much of corporate customer data is available to the PDG through the bank's core banking solution. The core banking solution also provides considerable amount of decision support in the product development and product evaluation departments of the bank. Apart from that, PDG members also use sophisticated credit rating and risk management IT tools.

Collaborative technology is made available through an internal network connecting all the user computers. Email, local messaging software and file transfer facility are also provided. PDG members also exchange files through the electronic mail. As this often creates a problem when the file sizes are large, NetMeeting – a collaborative tool from Microsoft Technologies is used to transfer larger files. Real-time conversations using the text mode in NetMeeting are also quite common. But file transfer and NetMeeting facilities are not used with customers and others outside NFI. Such caution results from the possibility of misuse of digital form of the documents, especially if they are sent for approval or signature to the client. For internal communications and information storage, digital documents are treated as acceptable evidences.

Contract firms ensure availability and maintenance of hardware, access to software and support personnel. Adequate training on the banking solutions package and the credit rating tool is provided to the members of the PDG. PDG members take help from informal sources to learn to use the financial databases, internal records database etc. Control systems in place include passwords and login protection, implicit code of ethics on IT usage, size restrictions on file

transfers, etc. The organization relies on individual discretion on what may be considered acceptable norms for collaborative technology use.

Site 2 – Eastern News Express

Eastern News Express (ENE) is a large media house with firms operating in print, television and radio media industries. The focus of our study is a content team of ENE whose main task is to ensure availability of adequate, appropriate and verified content for ENE's flagship newspaper from various sources. The team is composed of senior reporters and a chief reporter. Each news reporter is usually allocated one or more speciality areas or a geographical location from where he reports news and stories. Quite often the reporters coordinate among themselves and choose different areas of work but in some cases, the chief or a senior reporter on receiving a lead may ask a particular reporter to cover a story. But such allocations are also based on the area of expertise or area of interest.

The senior reporters (apart from collecting stories on their own) perform a first level pruning of stories and the text material. The chief reporter along with senior reporters then decides the need for and the means of verifying the stories. The subsequent tasks of editing, pagination and pre-press are handled by the editorial staff. Our focus is on the content team whose main job is to collate and prioritise stories from various sources. It must be remembered that the newspaper, unlike other products has two unique characteristics. One, it has a very short shelf life and high degree of obsolescence and two, the product development and delivery time is also low.

At ENE, extensive investments in IT infrastructure have been made in the last decade when significant changes were made in the organization, especially in its design and structure. Suitable training and support systems were also established to encourage people to switch to IT based work practices. The various bureau offices of the newspaper are connected through a Wide Area Network. The company also has an extensively used electronic mail system based on Lotus Notes for communication within the organization and with outside people.

Two kinds of collaborative technology are thus in place in the organization. ENE uses a software called "Prestige" (from Atex) for allowing story writers to compose and categorise their stories according to the focus area. Additionally ENE reporters are also permitted to use the company email account to send their stories from afar to the editorial staff and to receive information from outside sources. "Prestige" allows multiple people to type in stories and categorise them. It also has sophisticated page making capabilities for collating stories written by various people. Reporters also sometimes use facsimile or telephones to send in their stories especially during crisis situations or from remote locations where internet connections are not available.

Site 3 – Harp Cooling Towers

Harp Cooling Towers (HCT) is in the business of manufacturing, selling and servicing industrial cooling towers, a high-value accessory for manufacturing industries such as – chemicals, power generation, oil, foundries, refrigeration, pulp and paper mills etc.

The group chosen for our study – the Materials Planning Group (MPG) - consists of the Materials Manager, Purchase Manager, Finance Manager and the Manager - Factory. The MPG's main task is to ensure availability of materials required for manufacturing. When an order is procured for manufacture, a delivery date is fixed and the marketing/sales department provides the details of the order – specifications, customer details and the delivery details - to the respective factory. The factory manager then in conjunction with the materials manager at the factory, the manufacturing engineers and the stocks assistant, decides the details of materials required including materials available in the stores and those that need to be freshly procured. While some of the inventory details are available online in the factory site inventory database, the Factory Manager prefers to recheck the availability of materials manually so as to avoid a mismatch. The process of materials planning is done on an order-to-order basis and on time basis – i.e. beginning of every month. The details of materials required to be purchased is then communicated to the purchase manager at the head office, who in consultation with the factory manager decides on the purchase details such as vendor, specifications of product, requirement date, quantity etc.

The company has been progressing quite slowly in its IT investments. While the top-management's orientation towards IT is not negative, it is not exceptionally encouraging. But the company has been consistently investing in IT resources, and now has a full-fledged IT department in place. The IT department has developed many IT applications in-house and maintains these applications, trouble-shoots users' problems and entertains their requests for improving the applications. As a result of the top-management's reactive approach to IT, a conscious strategic IT plan is not in place, but certain IT policies and plans have been framed and implemented by the middle-level managers and the IT department. The adoption and use of collaborative technology has also followed the same path.

The organization has provided internal electronic mail access to executives and managers and select administrative staff at the head office and for select managerial staff at different factory locations. While communication between factories and head office is also through snail mail, telephone and facsimile; electronic mail is very regularly used. Factory data are transferred to the head office on a frequent basis using email file attachments. A large amount of data about orders, specifications, raw materials and purchases etc. is being maintained at various sites and shared using the collaborative technology but mainly through email file attachments.

Site 4 – Vie Insurance

Vie Insurance is a large life insurance company with over 2000 branches operating under 100 divisions across 7 zones. Every division is headed by a divisional manger and he or she is helped by a marketing manager, claims manager and other departmental managers. Each branch is headed by a branch manager and is manned by administrative officers and other administrative staff.

Much of the field operations – selling and maintaining retail life insurance policies, is outsourced to agents but the actual underwriting, finalisation of policy, premium acceptance, claims processing etc. are handled by internal staff. The specific group chosen for study is a Branch Administration Team (BAT) consisting of a divisional manager, divisional marketing manager and branch managers. The group's main task is to administrate and monitor performance of individual branches by analyzing effectiveness of branches. In other words, the branch managers aggregate, analyse agent-wise premium collection, claims processed, policies expired, renewed etc. At the divisional level, the senior divisional manager aggregates similar branch level data to understand possible reasons for underperformance or superior performance of specific branches. In addition to such analysis, the team discusses and shares various related information such as new promotional schemes introduced, incentives provided for agents etc., along with problems encountered and solutions attempted in various aspects relating to branch performance monitoring. Such a collaborative effort, they believe also aids the group in improving branch-wise performance and thus divisional performance.

Vie has initiated a metropolitan area network (MAN), connecting their Zonal offices and individual MAN centres located in some main cities. Information regarding premium collection, new business development, claims processing etc. is provided by all branches to their respective divisional office on a daily basis. The MAN connected centres directly upload their data. Some other branches upload data through VSAT/ leased line connectivity and the rural and smaller urban branches send the data either through disks or through dial-up email.

Aggregated information on premium collection is available to the divisional manager on a weekly basis apart from daily information regarding premium collection, new business development, claims processing, etc. from larger branches. This enables him to be aware of the performance of the branches. Functional support staff who are equipped with IT skills are widely available to the managers aiding them in accessing and analyzing such data.

While the preferred mode of information communication amongst the BAT members is the telephone and fax, when data needs to be transferred and support staff are available, collaborative technology is used. The systems are largely text driven and absence of GUI-based systems

restricts many who are not conversant with IT from utilising the system. While transition to newer and more user friendly systems are in the pipeline, the vast size and extent of the applications reduces the possibility of making them accessible to all managerial staff.

ANALYSIS

An initial rudimentary framework was used to develop a questionnaire (interview) schedule. The interview schedule was divided into five sections each focussed on the organization, the decision making group, the task performed by the group, the use of collaborative technology to support the task and the IT environment in the organization. The data collected was first transcribed to reflect the flow of the interview itself. As opposed to standard "pure" grounded theory approach (Strauss & Corbin, 1990), this study adopted a hybrid of the "template analysis" coding procedure (King, 1998). Such a procedure was followed mainly because the literature review, data collection and analysis were conducted not sequentially but in an imbricated manner. Template coding recommends coding with a research template and is akin to thematic coding. Codes are added, deleted or shifted from one category or hierarchical level to another (Miles & Huberman, 1994; Ryan & Bernard, 2000). We created an initial set of codes based on our understanding of the literature. The transcription was then coded using various codes. Simultaneously hierarchical coding was done to establish the link between higher level constructs and lower level variables.

Each author independently coded the initial transcripts, adding and shifting codes from one macro level construct to another. This can be viewed as a qualitative factor analysis. This also helped create an overall model using multi-level variables and constructs. The codes were compared and as is often the case in theory building exercises, the authors discussed coded transcripts to arrive at a consensus. A consolidated list of codes was then made and variables corresponding to the codes created. While some of the variables were investigated earlier in the literature in a fragmented manner (such as task complexity, geographic/time dispersion, perceived relative advantage), we also found some newer constructs (response time requirements, users' IT drive, organizational IT maturity).

DISCUSSION AND THEORETICAL FRAMEWORK

Understanding Sophistication

The term sophistication refers to 'refinement' or exhibition of higher level of knowledge. In the context of collaborative technology use, it refers to the use of the general collaborative technology infrastructure and specific collaborative technology applications, at various levels of refinement, as reflected in the information activities performed using the technology.

Using both existing literature on the use of IT and collaborative technology and our analysis of the field data, we created a classification of group information activities. This presents a natural and meaningful context for defining the use of collaborative technology along the 'sophistication' dimension. The types of group information activities include:-

a. Information sharing
b. Information Management
c. Group Information Management
d. Group Decision Making

The classification of activities is based on 'roles' played by managers. Managers play three dominant roles in organizations. They are interpersonal, informational and decisional (Mintzberg, 1975). Definitions of the above listed four types of group information activities and examples of the same are specified in Table 2. While prior research on group tasks (McGrath, 1984; Zigurs & Buckland, 1998) have focused on the objectives of the task performed, this classification is based on micro level activities performed by the group. Hence we believe, this classification is more generic and therefore applicable to a larger set of group tasks encompassing the taxonomies in existing research.

Table 2: Group Information Activities – A Generic Classification

Activity	*Definition*	*Examples*	*Group observed*
Information Sharing	Refers to those group activities where group members communicate with each other and share task-related information through asynchronous technologies such as electronic mails or electronic bulletin boards	Sending electronic mails: One to One	NIE, ENE, Harp, Vie
		Sending electronic mails: One to Many	NIE, ENE, Harp, Vie
		Sending electronic mails: One to One, One to Many, with file attachments	NIE, ENE, Harp, Vie
		Sending electronic mails using a mail group	
		Pasting notices on an electronic bulletin board	
		Accessing and Reading mails or notices	NIE, ENE, Harp
Information Management	Pertains to those activities performed by an individual group member in order to organise the current and archival information generated through group interactions, in the course of the performance of the task.	Filing cabinet and work-in-progress	NIE, ENE, Harp
		Receiving data and classifying them	NIE, ENE, Harp
		Redirecting mails	NIE, ENE
		Making rules for easy storing of messages	NIE, ENE
		Searching for previous mails or notices	NIE, ENE, Harp
Group Information Management	Refers to activities that help one organise and administrate the group and information about and for the group.	Creating the online group and maintaining the group address book	NIE, ENE
		Group meeting scheduler	NIE
		Group data maintenance and group administration	NIE, ENE
		Accessing data from other computers	NIE, ENE
		Maintaining one's own data to be shared with other group members	NIE
Group Decision Making	Refers to the group communication, analysis and decision making activities that are performed online in a synchronous manner	Synchronous group discussions	NIE
		Group voting on issues, Group Document Preparation	NIE
		Group data analysis	NIE
		Group model building	

These four classes of activities are in the increasing order of complexity. A group that performs an activity on collaborative technology at a higher level of complexity can be considered a more sophisticated set of users of the technology. The complexity of these classes of activities arises from three dimensions [adapted from Wood, 1986] including Component Complexity, Coordinative Complexity and Dynamic Complexity. A similar use of the dimensions of complexity has been suggested by Nadkarni and Gupta (2007) in the context of websites.

Table 3: Dimensions of Component Complexity

Complexity Dimension / *Class of Activity*	***Info Cues***	***Distinct Acts***	***Component Complexity***
Targeted Information Sharing	Low	Low	Low
Information Management	Low	High	High
Group Information Management	High	High	High
Group Decision Making	High	High	High

Using the micro-level group decision related activities listed in Table 2, it is possible to analyze the complexity of the four activity classes. Component complexity is a 'direct function of the number of distinct acts that need to be executed in the performance of the task and the number of distinct information cues that must be processed in the performance of those acts' (Wood, 1986). Table 3 describes the component complexity of the four group information activities.

Table 4: Dimensions of Coordinative Complexity – Member Complexity

Complexity Dimension / *Class of Activity*	***No. of Members***	***Interde-pendence***	***Member Complexity***
Targeted Information Sharing	Low	Low	Low
Information Management	Low	Low	Low
Group Information Management	High	High	High
Group Decision Making	High	High	High

Coordinative complexity denotes the 'nature of relationships between…..inputs and…..products' (Wood, 1986). In other words, coordinative complexity increases as the need to harmonise different steps of the activity increases. In the context of collaborative work, coordinative complexity comprises member complexity and iterative complexity. *Member complexity* refers to the complexity arising from the number of people involved in performing the activity. Member complexity is determined by the *number of members* which refers to the number of people involved in the activity as higher number of people leads to greater amount of co-ordination

required; and the *interdependence across members* which refers to the relationship between the activities of different people as greater interdependence across different people's activities requires greater amount of coordination. Table 4 describes the member complexity of the four group information activities.

Table 5: Dimensions of Coordinative Complexity – Iterative Complexity

Complexity Dimension / ***Class of Activity***	***No. of Iterations***	***Interde-pendence***	***Iterative Complexity***
Targeted Information Sharing	Low	Low	Low
Information Management	Low	Low	Low
Group Information Management	High	Low	High
Group Decision Making	High	High	High

Iterative complexity on the other hand refers to the complexity arising out of the repetitive nature of some activities. Iterative complexity can be measured using two dimensions, the *number of iterations* and the *interdependence across iterations* in a manner similar to member complexity. Table 5 describes the iterative complexity of the four group information activities. Table 6 combines member and iterative complexity into overall coordinative complexity.

Table 6: Dimensions of Coordinative Complexity

Complexity Dimension / ***Class of Activity***	***Member Complexity***	***Iterative Complexity***	***Coordinative Complexity***
Targeted Information Sharing	Low	Low	Low
Information Management	Low	Low	Low
Group Information Management	High	High	High
Group Decision Making	High	High	High

Dynamic complexity refers to the extent of changes in information cues or in the relationships between different steps or acts in the activity. In collaborative work, synchronicity of activities increases the dynamic complexity because the more synchronous the group activities are, greater is the need to process information cues. Among the various group information activities, Group Decision Making activities exhibit 'high' dynamic complexity whereas the other three, i.e. information sharing, information management and group information management do not.

Table 7: Overall Complexity of the Group Information Activities

Complexity Dimension / *Class of Activity*	*Component Complexity*	*Coordinative Complexity*	*Dynamic Complexity*	*Overall Complexity*
Information Sharing	Low	Low	Low	***Low***
Information Management	High	Low	Low	***Low/Medium***
Group Information Management	High	High	Low	***Medium/High***
Group Decision Making	High	High	High	***High***

It must be noted that the terms "low/medium" and "medium/high" are used primarily to distinguish the complexity of the levels from each other as the four levels cannot be placed in water-tight compartments, but are rather on a continuum. We can thus treat complexity of activity performed as a means of measuring sophistication of collaborative technology use.

Factors affecting Use

A broad framework has been created to understand factors influencing sophistication in the use of collaborative technology. The three macro level factors include the need for technology support, the cultural orientation towards collaboration and the technology drive of the individual users.

Need for Technology Support

The need for technology support arises from task and group characteristics including task complexity, dispersion of information among group members, the geographic dispersion of the group and the response time requirements imposed by the task, each of which are described here in greater detail.

Task Complexity

Complexity of a task reflects the amount and nature of information to be processed in order to execute the task. With specific reference to decision tasks, complexity of a decision task is high if it exhibits outcome or solution multiplicity or there is conflicting interdependence among various paths to the solution (Campbell, 1988).

Use of groups for decision making can be a natural solution to cope with increasing complexity in organizational tasks. This therefore results in the need for collaborative technology support. Some level of task complexity was observed in all the four case sites but it is evident that PDG's task (creation of credit products) is more complex than that of the content team at Eastern News (collating and prioritising news items) as it requires greater iterations of more information processing. One of Eastern's executives said "*even though an individual reporter's task may not*

be very difficult [complex], *in the newspaper industry, one must consider the complexity of the external environment and the amount of thinking that has to go into capturing the most interesting information from that environment"*. The product development manager at NFI emphatically said "*the amount of data analysis involved in our group's task is high as the number of parameters and values we have to consider before arriving at the decision are considerably large"*. The material planning at Harp and the branch administration at Vie require less information processing and do not exhibit solution multiplicity.

Level of Information Dispersion

Organizations typically follow either social or functional specialisation in an attempt to club together activities performed by different individuals. Increase in such specialisation necessitates greater coordination and control mechanisms between the 'functions' created. Such coordination and controls are also necessary when there is an inherent level of task interdependence (Thompson, 1967). Groups are often used as coordination mechanisms (Daft & Lengel, 1986). This is more evident in large organizations when the group is spread over various departments or divisions.

In the case of Vie's BAT for instance, each branch manager had greater access to field data regarding success of promotional schemes in his or her designated area. This was reflected in the comment of a branch manager who said "*since most branches are similar in operations, I usually communicate with some other branch managers regarding promotional schemes, DO performance or other innovative activities that may help in enhancing branch performance. It would be difficult for me to get such data elsewhere"*. Similarly individual reporters and senior reporters had greater access to the finer details of each news lead and story in Eastern News' content team. MPG at Harp is a multi-functional group, naturally leading to functional information with respective individuals. The operations manager at Harp said "*Unless we coordinate and share information regarding material movements and incoming manufacturing orders, we are likely to encounter shortages and excess inventory. That would then lead to blame game. The individual group members* [would rather] *prefer to avoid such a situation."* All members of the PDG at National on the other hand had access to similar information. Information dispersion thus necessitates use of information technology for the group's activities, thus creating a need for technology support.

Response Time Requirements

Response time requirements refer to the need for faster responses arising from environmental pressures faced by the organization, in general. Alternatively, the need for faster responses can also arise from the nature of task allotted to the group. In stable environments, organizations are well aware of market situations and can predict factors of influence with a certain level of ease.

But in dynamic organizational environments, the uncertainty is likely to lead to increased need for faster responses and therefore greater coordination requirements. Use of collaborative technology may be seen as a means of meeting the demands of a dynamic situation, by rendering possible increased coordination and faster responses by groups. This was especially seen in the product development group at National who were pressured for quick responses, by clients who had alternative options. A senior reporter from ENE's content team explained – "*content team at any newspaper firm is under tremendous pressure to create the finished product as quickly as possible. Life of news is very short and competition is intense"*. On the other hand the MPG at Harp and the BAT at Vie had relatively less response time requirements.

Geographic Dispersion

Geographically dispersed units or divisions are fairly common amongst larger organizations today. With the growing geographic dispersion, communication infrastructure has become a necessity (Sarbough-Thomspon & Feldman, 1998). This is also a result of distribution of organizational tasks. When the spatial differentiation of the organization is high and as a result, internal processes of the organization are spread geographically, there is a need for members of the organization to use technology to collaborate and communicate laterally. Alternatives to the use of such communication technology would be co-location of members or intentional introduction of redundancy, both of which may be less cost-effective.

Members of the BAT at Vie are geographically dispersed though within the same large city, while members of the content team at Eastern are very often temporally and geographically separated. A reporter at Eastern said "*this is a newspaper firm. You never know when anyone is awake! There is tremendous mismatch in work times especially with reporters in the news site. We needed a technology that allows us the freedom to put in our stories when we are done with them from wherever we are*". The MPG at Harp is dispersed across locations while the members of the PDG at National are located across buildings within a single area.

The need for technology support therefore can arise from one or more of the above factors. A group experiencing pressures due to any one of these reasons is likely to be coerced into using collaborative technology for supporting the group task. Thus,

> *Proposition 1: Higher the need for technology support, higher is the level of sophistication of use of collaborative technology.*

Cultural Orientation

Group culture

It is quite common to find groups which vary in their level of collectivistic orientation. Some groups have a tendency to be more collaborative in their approach to task execution than others. A group's culture may exhibit passive, negative or positive orientation towards collaboration. Groups exhibiting a passive group culture towards collaboration tend to work cohesively only when there is an intense need to do so, but are not naturally inclined towards collaboration. When the group culture does not actively encourage collaboration, the members prefer to work individually rather than collaboratively. In such groups, members hesitate to share information related to the task openly. When the group is positively inclined towards collaboration, members trust each other, are open to sharing information, they innovate and there is a sense of belongingness. Thus there is a strong inclination to perform the given task in a cooperative manner.

The members of the branch administration team at Vie interacted comfortably with one another and shared information related to the task in an open and unhindered manner. It was very well seen that they were positive towards collaboration, especially with respect to the task. A senior manager at Vie said *"Our jurisdictions don't overlap even though our customers are spread. Moreover, we all work hard towards the overall organisational goals. Information sharing is therefore not an issue"*. At Harp, the group members came from different functions and the natural rivalry present in multi-functional groups such as that between production and finance, was seen with the materials planning group too.

Decision Making Style

Collaborative decision making style in the organization necessitates lateral relations and team work. Organizations where such lateral relations are required are thus likely to use collaboration and collaborative decision making often. In such organizations, collaborative decision making becomes a norm and an accepted and preferred practice, thus over time becoming a part of the organizational culture. Decision making style and collaborative behaviour of individuals in groups, are also conditioned by the leader's orientation especially when the leader wields a lot of influence.

The decision making style of the PDG at National can be considered collaborative as the group is cohesive in its approach to the task and each member is willing to contribute information and skills to achieve the task. The content team at Eastern is moderate in its collaborativeness. A senior reporter said *"even though we create the final product together as a team, there is an underlying sense of competition amongst the senior reporters especially when front page stories*

need to be covered. Sometimes the situation is intense, but when roles are clear we are more collaborative." At Harp, the materials planning group is less competitive and the decision making style can be classified as, at best, cooperative. The decision making style of the BAT at Vie can also be classified as cooperative as a manager put it "*we all understand that ultimately it's the agents' performance we have to monitor. To that effect we tend to be collaborative in arriving at various means to achieve success"*.

Organization Culture

Group's cultural orientation is not determined solely by the group's own characteristics. It is also affected by the organizational environment in which the group functions, through the formal and informal incentives for collaboration. An organization's culture also influences technology assimilation (Hoffman & Klepper, 2000). A senior person at ENE said "*We need to have an optimal level of designated IT use for communication, but the choice of the media is largely based on a combination of the task and the* [organization] *culture"*. Some organizations tend to encourage and create environments which are suitable for team work and group interactions, much more than some others which emphasise 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. An organization culture that promotes collaborativeness encourages use of collaborative technology (Orlikowski, 1992).

It was found that in Vie, the general organization culture was one that was passive towards collaboration. While the organization did not offer any explicit incentives for collaboration, it did not offer any disincentives either. But at Eastern, Harp and National, employees were actively encouraged to collaborate. At Eastern, there were adviser teams which helped establish better one-to-one relationship between young reporters and senior reporters. Similarly at National, incentives were provided when cross-selling of credit products were successfully executed.

The overall cultural orientation of the group towards collaboration and therefore towards use of collaborative technology is determined by the organization and group's cultural orientation toward collaboration and the decision making style of the group. This in turn influences the use of collaborative technology by the group. Hence

> *Proposition 2: The more positive the cultural orientation of the group, the higher the level of sophistication of use of collaborative technology*

Technology Drive

Users' IT Drive

A user's IT drive can be described as the inclination of the individual towards the use of IT. Individual demographic characteristics such as age, seniority, education and IT literacy level (Burton-Jones & Hubona, 2005), are highly likely to impact the group members' inclination to use IT. Individual users' IT orientation is also a result of other group members' interest in initiating colleagues into IT. This is especially true in the case of end-user computing (EUC) environments. End-users have been found to often learn faster to use the technology if 'taught' by peers and colleagues. This is more applicable in group-oriented technology environments (Mark & Poltrock, 2001), where the group's overall use of these technologies, depends on the 'network externality' or a critical mass (Markus, 1990). The group's overall level of use would be determined by the minimum uniform level of IT drive.

Most members of the PDG at National Finance, for instance, were very conversant with the collaborative technology and IT in general. At Eastern News and Harp, the group members were comfortable but relatively less conversant. A senior manager at Eastern said "*most of us think our main job is to get stories, which itself is a stressful task. We never paid much attention to learning the system. Some of us are also seasoned* [older] *reporters. With little prior training we are less inclined to learn to use IT proficiently*". The BAT members at Vie were hierarchically senior in the system and were hard pressed for time to learn new technologies. A senior manager at Vie said "*sometimes I feel this constant support from my executive assistants leaves little need for us to use such systems directly. While on the one hand it makes things easy for me, I do occasionally feel dependent on my assistants*".

Perceived Relative Advantage

Relative advantage refers to the degree to which an innovation is superior to ideas it supersedes or replaces. Groups often exhibit a tendency to choose a communication medium depending on the different interpersonal, informational or decision tasks they perform. It is also possible that the social context in which the group operates defines the choice and use of a particular medium. In essence, the relative advantage of using collaborative technology over alternative means of task execution, as perceived by the group members, influences the use of such technology in organizations (Turner & Turner, 2002; Sarker et al, 2005). Perceived relative advantage 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 group.

Members of the PDG at National Finance perceived the collaborative technology as being highly beneficial and aiding the group task execution. Similarly the content team at Eastern too felt the

collaborative technology was advantageous. A senior reporter said "*information is our life blood. The content team's task is focussed on collation of information from various sources. Use of such a system is therefore, no doubt, tremendously advantageous*". On the other hand, members of BAT at Vie and MPG at Harp were far less convinced of any significant advantage that the collaborative technology offers over other technologies and media such as telephone or facsimile. A manager at Harp said "*we do see significant advantages from maintaining data on inventory. But since we are not really a massive organization where minor inconsistencies or discrepancies create huge losses, we are yet to see any significant benefits from IT-based collaborative technology applications. We still use the telephone and facsimile to keep track of day-to-day operations"*.

Organizational IT Maturity

'Organizational IT Maturity' refers to the level of sophistication of use of IT, the evolutionary stage of IS in the organization and the extent of use of IT applications for strategic decision making. In other words, organizational IT maturity 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 organization. An organization exhibiting high IT maturity is characterised by high levels of awareness and knowledge about latest information technologies amongst employees, presence of powerful IT champions who actively encourage use of IT, existence and prevalence of innovative IT applications and solutions developed by organization members and high degree of comfort with the use of IT, in general.

Amongst the four research sites, National exhibited a high level of organizational IT maturity. Availability of IT-related services, drive to use IT and understanding of the potential strategic benefits of IT to the organization were visible in this case. On the other hand, at Vie, BAT members and IS professionals were far less knowledgeable about potential benefits from information systems for their organization and a clear understanding of possible IT support for their task was absent. At Harp, top management was hesitant to support IT investments and projects but was gradually changing. Finally, at Eastern, IT maturity of the organization was quite high especially since, Eastern was making an attempt to gain strategically from the use of IT. A senior person at Eastern said "*IT is a part and parcel of the organization, almost like an embedded fabric. Most of our organizational activities are IT-enabled."*

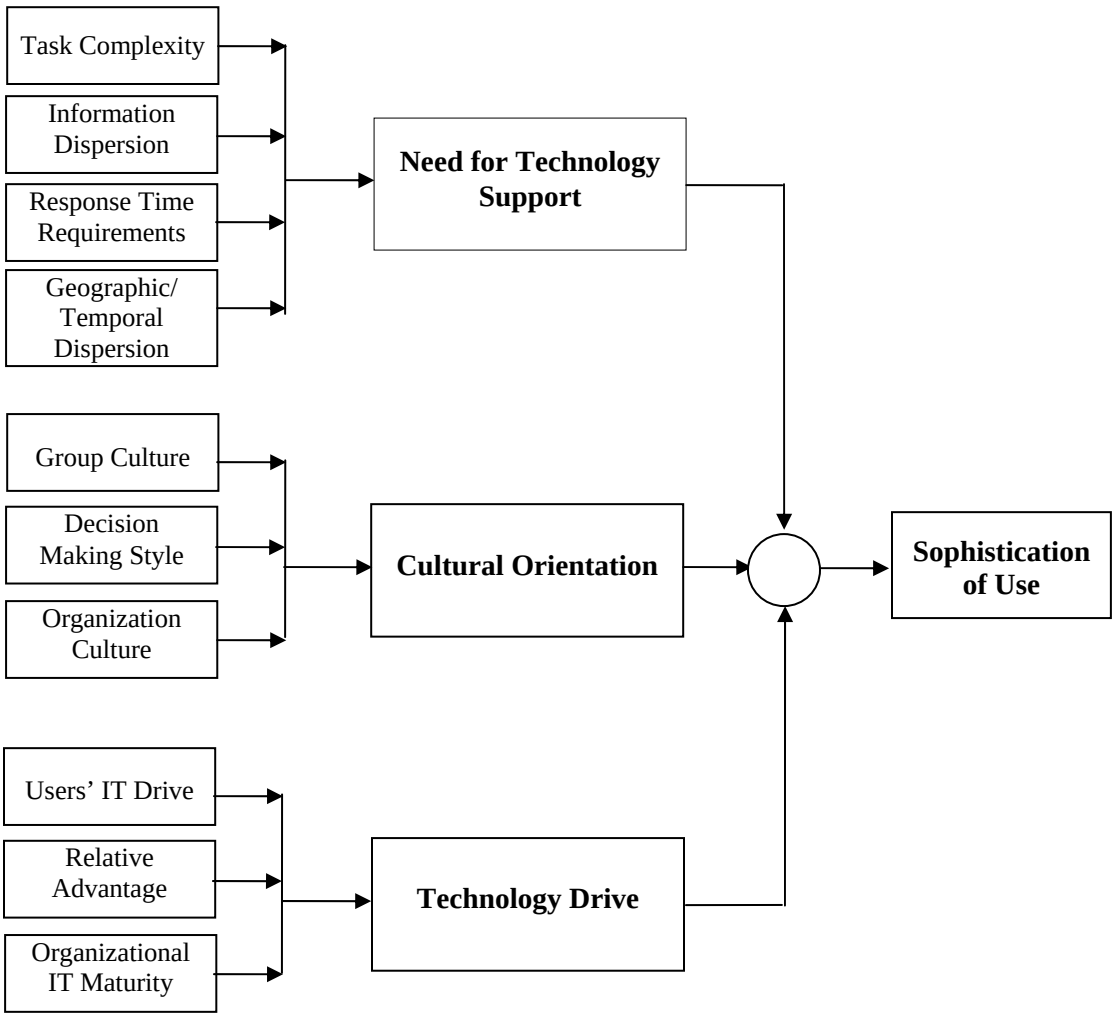

Figure 1: Factors influencing sophistication of collaborative technology use

A group's technology drive determined by the individual users' IT drive, the relative advantage of using collaborative technology as perceived by the group and the overall organizational IT maturity. Technology drive influences the group's level of sophistication in the use of collaborative technology as in

Proposition 3: Higher the technology drive, greater is the level of sophistication of use of collaborative technology.

DISCUSSION AND CONCLUSIONS

Collaborative technology has the potential to benefit organizations by increasing operational efficiencies and effectiveness of organizational communication. It is evident that a multilevel,

integrative framework of collaborative technology use is essential to understand the phenomenon. We have attempted to bridge the gap using a framework to understand the factors which influence the sophistication of use including the need for technology support, cultural orientation and technology drive and the variables underlying each of these macro level constructs. We also presented propositions suggesting the nature of overall relationship between these constructs and the level of sophistication of use.

While the area warrants further study, the preliminary conclusions can be used by managers to give adequate attention to important factors while at the same time caution him against accidentally treading on some others. For instance, one can use management mechanisms such as support mechanisms including support for creating and maintaining collaborative technology infrastructure, support through information centres, or informal mutual support mechanisms. Possible control mechanisms may include soft and hard controls to enforce uniformity in data formats, data storage, data security and etiquettes in collaborative technology use. The technology drive construct lends itself to manipulation especially through adequate awareness, training, support and a positive attitude towards IT.

A typology of generic collaborative technology-based information activities in an organization has also been created. Such a typology may stimulate managerial thought on directions in which managers can move their groups and organizations. In order to conduct qualitative research, this study employed a research strategy of case-studies, where the generalisability, especially due to size of the sample, is limited. This however is a limitation of case-study as a methodology in general. It must be remembered that the lack of integrated theories in the area forces us, as researchers, to relax certain otherwise rigid rules in methodology so as to allow for unhindered development of theory. As regards empirical methodology, case studies provide such rich data regarding organizational realities that unless such a methodology was employed, it would have been impossible to build an integrative study.

Further extensions of this study may attempt to use the scale-sophistication matrix (Vaidya & Seetharaman, 2005) and analyze factors which influence a group's position on the matrix. Such constructs may also be further developed into lower level objectively measurable variables (Vaidya & Seetharaman, 2007). Such an in-depth integrative study may also be essential to enable suggestion of prescriptive mechanisms. One may also look at understanding the role and impact of these factors on the evolution of a group from one level of sophistication to the next.

Table 8: Summary of Analysis of Cases

Organization →	**National Finance**	**Eastern News Express**	**Harp cooling Towers**	**Vie Insurance**
Group / Task →	**Product Development Group**	**Content Team**	**Materials Planning Group**	**Branch Administration Team**
NEED FOR TECH SUPPORT				
Task Complexity	High	High	High	High
Dispersion of Information	Low	High	High	High
Response Time Requirements	High	High	Moderate	Low
Geographic/Temporal Dispersion	Low	High	High	High
CULTURAL ORIENTATION				
Group Culture	Positive	Passive	Passive	Positive
Decision Making Style	Collaborative	Democratic	Cooperative	Cooperative
Organization Culture	Positive	Positive	Positive	Passive
TECHNOLOGY DRIVE				
Users' IT Drive	High	Moderate	Moderate	Low
Perceived Relative Advantage	High	High	Moderate	Low
Organizational IT Maturity	High	High	Moderate	Low
SOPHISTICATION	GDM,GIM,IM and IS	GIM,IM and IS	IM and IS	IS

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