Broadband Videoconferencing as a Knowledge Management Tool

Abstract

A Knowledge Management framework was adopted to augment research and evaluation of a broadband videoconferencing trial undertaken in 2002 at the University of Calgary. Involving distributed research teams across Canada, the *InSite Broadband Collaborative Research Project* was designed to measure the extent to which knowledge workers embedded in mediated workplace networks would adopt and then adapt small- and large-format videoconferencing in support of informal interaction aimed at knowledge creation and transfer. Textual output from informal interaction in videoconferencing and chat room sessions was recorded over a 5-month period. Data were analyzed using qualitative and content analysis methods to test for knowledge processes thought to be embedded in informal collaborative interaction. An exit survey comprising nominal and ordinal data was used to measure participant perceptions of using videoconferencing technologies to enhance knowledge-based collaboration. Indicators of knowledge processes in informal interaction were drawn from the KM and videoconferencing literatures. Analysis suggests broadband videoconferencing can be an effective enabler of communication and informal interaction dynamics supportive of knowledge creation and transfer. A concluding summary addresses barriers identified in the study and suggests approaches for future KM research in the video-mediated research domain.

Introduction

Information and knowledge processes are vital in ensuring organizations, work teams and other task-oriented collectives not just keep going but innovate and progress. Knowledge is possible when the information transferred among members of an organization or collective – in the form of statements of fact, suggestions, agreements, expressions of feeling and beliefs, plans of action, etc. – is acted upon. Acting upon information occurs in many forms, from the auto-response of the brain to information

inputs from the environment, to the highly complex and collaborative tasks of acting upon symbolic information in the designing and building of an aircraft.

One of the most common and effective ways that information is shared and acted upon is through everyday or informal interaction between people. This is reflected in the historical videoconference literature where not only is informal interaction deemed central to knowledge processes, but where a major portion of the research involved experiments designed precisely to encourage informal interaction between project participants (Fish 1990; Fish 1992; Fish 1993; Gaver 1992; Borning 1991; Landauer 1990; Bly 1993; Issacs 2002). It also aligns with perspectives of Knowledge Management and complexity theory where informal interaction is primary because:

- of its naturalness and the sheer amount of time spent in this mode
- it generates variety and is self-organizing
- its transparency as a process normally precludes conscious manipulation
- it provides the basis of rules and levels of trust required in order for higher forms of learning, planning and action to take place.

In 2001, researchers at the University of Calgary were presented with a unique opportunity to examine everyday or informal workplace interaction supported by internet-protocol based videoconferencing. Using funding from CFI and CANARIE – Canada's federally supported innovation and advanced networks research agencies – researchers designed a project management model comprising a central team based at the University of Calgary connected to four distributed research teams across Canada. "Distributed" denotes a research team whose collaborators work at a distance, typically another city. The central team converted an existing classroom into an "internet research studio," complete with ceiling-mounted projectors and enough PC-based audio and video gear to drive videoconferencing in both H.323 and AccessGrid protocols. The distributed research teams that agreed to take part in the trial were equipped with a range of desktop or laptop computers and typically high-end Polycom webcams supporting the H.323 data compression protocol. In return, they agreed to partake in the monitoring and evaluation of their use of the technology by the central team. This paper is the result of a

Knowledge Management research component I designed and deployed as a doctoral student hired to design research components for the *InSite* project.

Expectations for this KM sub-project were high: For one thing, mediated informal interaction was expected to have advanced considerably over the trials of the early 1990's, since IP-based videoconferencing technologies were affording unprecedented quantity and quality of network connectivity. However, it was also timely because of world events following 9/11/01 that appeared initially at least to heighten the need for safer and more cost-effective ways of conducting the nation's business.

It was expected from the outset, then, that the *InSite* Project would reveal interactional dynamics beyond the scope of earlier research that keyed primarily on topical behaviours of users. That is, the previous work had typically keyed on manifest indicators such as gaze control, network latency, turn length and turn taking, etc. (Fish 1993; Whittaker 1995; Sellen 1992). Indeed, most of the previous work involved primarily PC interfaces using low-bandwidth telephone networks (Fish 1992; 1993; Carletta 2000; Warkentin 1997; Sellen 1992; Webster 1998), with one of the earliest systematic trials conducted at Bell Telephone in the 1970s ("The Picturephone System," 1971). Deploying true broadband technology in research environments involving high-level (i.e. research-based) knowledge workers meant the *InSite* project could readily design processes and deploy supportive technologies to facilitate informal interaction, expect high levels of acceptance of these routines and technologies, and then measure for levels of collaboration in terms of information and knowledge flows. In addition, having ready and toll-free access to videoconferencing raised the expectation that *InSite* participants would adopt the technology quickly and use it freely to engage in typical knowledge behaviors, including socialization and trust building. It also raised the expectation of facilitating both the tacit creation and transfer of knowledge, through storytelling, model building and the like, and explicit knowledge creation and transfer, through sharing notes, planning, organizing and the like.

The KM framework was therefore designed to both encourage informal knowledge behaviours and instigate methods for measuring informal socialization, trust and knowledge creation and transfer as key constructs. To operationalize these constructs, technologies and routines were imposed upon partner projects, including a PC server to

house a chat room and virtual workspace application. Informal use of the videoconferencing technology itself also was encouraged to enhance the socialization process while capturing impressions, findings, beliefs etc. about the videoconferencing experience overall that might not otherwise be captured in formal videoconference sessions or in official reporting activities. Informal videoconference sessions held at or through the central team at the University of Calgary were audio recorded. MOO logs generated by interaction between technicians were also captured and prepared for a comparative analysis but ultimately did not contribute meaningfully to the exercise and consequently do not figure into this report.

The overall objective of the KM component of the *InSite* project was to augment the formal evaluation process by exploring mediated interaction to address the research question: does IP-based videoconferencing enhance collaboration by facilitating informal workplace interaction as indicated by knowledge activities or processes? By using knowledge or knowledge process indicators to assess the quality of informal interaction as emergent from videoconference and chat room use, the study addressed an understudied dimension of the visually-mediated collaboration process while avoiding the pitfalls of normally associated with formal, second-order perception analysis.

Research Design

Data capture

Informal interaction – Informal interaction between *InSite* participants was documented by capturing communication in technicians' MOO logs, in research assistant chatrooms, and in the videoconferencing domain itself. Although interaction in the text-based domains was interesting in its own right and supported many of the conclusions arrived at in the study, the focus of this paper in on videoconferencing specifically. :

Videoconference Transcripts – videoconference sessions conducted at the central team location at the University of Calgary were audio-recorded and transcribed by graduate students. Transcripting attempted to be as verbatim as possible, including the

backchannel 'um's and 'uh-huh's, etc. and external "noise," such as people entering and leaving the room during a session, breaking off to answer cells phones, etc.

Questionnaire– A short questionnaire was distributed at project end to all investigators, research assistants and technician to measure users' perceptions of:

- the extent to which the technology helped bring people together
- the extent to which the technology emerged as a formal vs informal medium, and
- the extent to which use of the technology enhanced knowledge-based interaction

Background research

The videoconferencing and knowledge management literatures were reviewed to acquire theory and background information, to gain an understanding of research methodologies deployed in the past and to scan for conceptual categories to be used as possible indicators of informational dynamics and knowledge processes.

Methodology

Theme-based content analysis – Due to restrictions on both time and resources available to conduct and process the results of research activities, a thematic approach to content analysis was conceived. Categories culled from the KM and videoconference literatures were used to kick-start analysis of the data, described below as being collected from both chat room sessions and audio-recorded videoconference sessions. The data was swept a second time to create categories for elements (recorded units of analysis) not falling under KM or videoconferencing themes. The data were then put into frequency tables and analyzed for pattern emergence.

Subsequent review of the literature revealed this method very closely approximated an approach described as "theme-based content analysis" (TBCA). As explained by (Neale

2001), TBCA comprises a hybrid of qualitative and quantitative approaches to research design and data analysis that emphasizes the grouping of data that emerges from self-directed complex process into meaningful categories. These categories are then refined into themes, which are used to test pre-conceived hypotheses by providing detailed information and/or (qualitative) insights into user opinions or behaviour, or as general (quantitative) indicators of potential distribution tendencies in a population (ibid.) The "self-directed" complex process studied by Neale and Nichols in their description of TBCA is a virtual reality applications research team (VRART) environment – a close fit with a videoconferencing trial that likewise emphasized exploration and interaction within a mediated environment (ibid).

TBCA also instigates a two-stage refinement method for identifying themes – involving the identification of raw theme categories (or indicators) using multiple coders and then a higher-order theme selection based upon an interpretive re-read of the data using the raw themes as a conceptual base. The *InSite* project lacked the human resources to carry out multiple coding, hence the modified approach described above whereby working categories (indicators) were derived from the existing videoconferencing and knowledge management literatures and deployed as "raw themes" or starting points in the analysis.

Once transcripts had been coded with derived indicators, both chat room and videoconferencing data sets were swept a second time to allow for an expanded set of categories to emerge from the former, and for a higher-order theme selection set to emerge from the latter. This is further described below.

Levels and units of analysis

Videoconferencing – Aside from addressing the central question of whether IP-based videoconferencing facilitates knowledge processes as embedded in informal workplace collaboration, the *InSite* project raised the question of whether or not better quality of audio, image and image size helps overcome some of the barriers identified in previous studies (Webster, 1998; Fish et al 1992, 1993). These include so-called "human factor"

issues such as audio/visual latency, lack of synchronization of audio with the visual, the impact of picture size on the sense of shared space, difficulties with turn taking, turn length, recognizing visual clues and the ability to use backchannel communication.

Backchannel devices are identical to those used in FTF encounters, such as nods of the head, hand and shoulder motion, facial expressions, as well as verbal utterances, to feedback information to a speaker to help shape and guide the exchange without interrupting its verbal flow. This was considered a problem in previous trials due to the latency of the audio transmission. To measure this in the present study, a 'collision' category was invented to describe situations when two or more speakers would initiate conversation simultaneously, usually after a natural lull in the conversation, and then have to stop and deliberately arrange for who would go next. Although measuring these factors was not a central feature of the knowledge management component, transcripts were nonetheless coded on this manifest level to compare to the previous literature and to be generally aware of the extent to which they might be implicated as factors in the study.

From a knowledge management perspective, the overriding criterion for assessing the technology is whether or not the medium facilitates or hinders informal interaction and hence information and knowledge flows. This aligns with critique of earlier research that was seen as emphasizing the measurement of outputs (decisions, agreements, meeting deadlines, etc) at the expense of measuring interaction as a *process* (Issacs 1995). Conceptually, a KM perspective on videoconferencing includes both because work teams are considered to be self-organizing – that is, the interaction under study is both emergence (process) and outcome (self-organized structure). A KM perspective, then, carries with it some built-in advantages over previous research that selects specific factors to be analyzed in isolation from or independent of the interaction itself.

Videoconference sessions broke down into two main types: sessions in which first-order research work was actually conducted, and sessions in which the technology itself was being tested or used to conduct primarily administrative meetings with partner projects. Only first-order "working" sessions were analyzed, because of limitations on time and

resources, and because they directly involved knowledge work. To start, a sample from the aggregate of the 'working" videoconference transcripts was chosen at random, imported into the *NVivo* qualitative analysis software and coded, using indicators of knowledge process as described below. Once the coded sample had been analyzed in *Nvivo*, remaining working session transcripts were scanned, codes were refined based on this further exploration of data, and the documents were prepared for statistical and qualitative analysis of overall patterns.

Reflecting the TBCA approach, transcripts were coded on two levels. On the first or topical level, thematic passages were taken as a unit of analysis. A passage was conceptualized as any length of contiguous text falling with the usually obvious bounds of the general topic under discussion. Conclusion-proposing language, such as "so, that should be interesting," "we'll see what happens," "let me know how it goes" and myriad other such devices were taken as indicating the end of a thematic section. Questions or announcements typically followed in proposing a new topic be discussed, as in "so, what do you think about x?" and "Another issue that is important here is . .." and so on.

The second level of analysis was aimed at the deeper significance of the interaction. Specific words, phrases and/or actions (as noted in the audio or by a transcriber who was also present during a session) were taken as a unit of analysis and coded as they appeared indicative of knowledge process within passages.

 Indicators

Text-based – For both MOO logs and the chat sessions, indicators were adopted from research in knowledge topologies conducted within an information systems environment (Holsapple et al 1996). While broad in nature, they appeared especially suitable for the MOO logs and chat room text-based environments:

- *Descriptive knowledge* – facts and accepted states of being, including descriptions of the environment, as well as the past, present and anticipates states in the future
- *Procedural knowledge* – "how to" information, involving steps taken in order that tasks be accomplished
- *Reasoning knowledge* – information from which inferences are or can be drawn
- *Linguistic knowledge* – information that refers to or takes communication itself as it object of inquiry
- *Assimilative knowledge* – information provided that integrates knowledge from existing sources/literatures
- *Presentational knowledge* – "knowledge governing the manner in which existing knowledge can be disclosed."

Once the data from these sources had been reviewed using these indicators, the data was reviewed a second time to create categories for elements not falling within this roster of knowledge themes. These included:

- Query (requests for information, opinions, or knowledge)
- Social (greetings, sign-offs, joking, personal exchange, etc.)
- Expander ("midchannel" entries such as "you're kidding," "no way!" etc. that encourage extended 'conversation' but don't really expect it or guide it in any particular way)
- Ontological (emoticons and other references to states of personal being)

For videoconference sessions, transcripts were coded using the chat room indicators as a base set (procedural, inferential, descriptive, etc.) and then expanded to include other types of discourse that emerged from the interaction itself. On the manifest or topical level, these included backchannel, and collision, as just described. On the deeper or latent level, several categories of exchange were conceptualized as indicative of mutual

understanding or attempts to transfer knowledge of a primarily tacit nature. Indicators of mutual understanding included explicit acknowledgements, such as "I agree," "I see what you mean" etc. that were also followed up by comments that tried to distill or integrate an idea previously made into a higher-level idea, or to make an analogy, etc. This reduced the possibility false indication when a speaker merely says "Oh, I get it" but really does not understand or only partially understands.

Indicators of knowledge transfer included metaphors, analogies, anecdotes, parables, models, etc. that were considered attempts to, as Polanyi put it, express the "inexpressible." These were derived from primarily verbal exchange, but in cases where the transcriber also attended a session, notes were often included in the text as reminders of physical actions or occurrences – such as, "X drew on a piece of paper held it up to the camera to illustrate a point," or "X indicated a layering concept by chopping at the air at higher intervals with his hand."

A 19-member free-node set ultimately was used in *NVivo* for coding transcripts. A free node set is one in which each node (code descriptor, or indicator) is logically independent of the other nodes. Thus, no attempt was made for example to nest the latent indicators (i.e. metaphor) within a passage indicator (i.e. description) because metaphors appear freely in all types of exchanges, including questions, social interaction, etc. The codes used were:

Manifest indicators

- Administrative (exchanging of email addresses, arranging next meeting, etc.)
- Assimilative (knowledge derived based on the immediate environment)
- Backchannel
- Collision
- Descriptive (statements of fact, states of being, etc.)

- Evaluative (opinion, judgments, debative)
- Inferential (making connection, drawing conclusions, etc.)
- Linguistic (takes verbalization itself as an object of discussion)
- Presentational (reference to symbolic means other than linguistic exchange)
- Procedural (how-to knowledge, step-by-step explanations, etc.
- Query (requests for information, opinions, or knowledge)
- Side conversation (local groups talking during a break)
- Social (greetings, sing-offs, joking, personal exchange, etc.)

Latent indicators

- Analogic
- Anecdotal
- Metaphoric
- Model (detailed descriptions of process components)
- Parabolic (relating to the use of parables)
- Understanding (explicit indication of understanding through the use of language of acknowledgement but also accompanied by integration of previous ideas in the speaker's own words, etc.)

Trust as a component or construct of knowledge process, production or transfer was identified as a key element but for lack of time and resources was not pursued explicitly. Of the broad constructs relevant to the research question, it presented as the most problematic, both in terms of definition and coding reliability. Trust therefore was not dealt with explicitly but instead was assumed to have happened implicitly if in fact a videoconference or series of videoconferences appeared to successfully inculcate an informal working environment, as indicated by positive socialization, mutual understanding and knowledge creation and/or transfer processes. As a result, "trust" was conceptualized as a necessary, if not a sufficient condition, that could be assumed to have been achieved in the circumstances just described.

Questionnaire

A questionnaire was distributed to each member of *InSite* upon conclusion of the project. The purpose of the questionnaire was to derive a sense of the value of the experience as perceived by project participants. The questionnaire comprised four parts, including: respondent identification; which videoconferencing format were used and the extent to which this changed from project start to project end; how the videoconference technology was used to facilitate communication and its utility as a collaborative medium; and the extent to which the medium enhanced knowledge transfer and production.

A combination of Likert scale and percentage scale questions were used to measure for rates of technology adoption and usage, perceptions of the technology as an informal and a formal communications medium, and the extent to which the experience of using the technology overall contributed to the project by enhancing knowledge transfer and creation. The questionnaire went sent and returned via email and then coded and analyzed in SPSS. Open-ended questions were not used, again for lack of time and resources to design and analyze a qualitative dimension to this instrument, although some respondents freely qualified question choices by typing in extra information.

Results

Output and pre-testing – Roughly 20 hours of one-on-one and small group-to-group videoconferencing sessions were audio recorded, generating more than 200 pages of single-spaced text. Of that total, 131 pages comprised the working sessions.

A 14-page sample from the working sessions was selected and coded, generating 121 coded passages for pre-test analysis. Manifest-level coding revealed a weighting to the descriptive, social and query types of exchange, as would be expected from participants who were new to both each other and the technology itself. Pre-testing allowed for the refinement of categories and their level of analysis. For example, passages were coded initially as discretely as possible but it quickly became clear that a given passage would

imbricate many different types of exchange. A second sweep of the sample document was made and a 19-member free node (indicator) set finalized.

Table 1. Frequency of all indicators from videoconference transcripts

Indicators, Manifest and Latent	Elements Coded
Administrative	28
Assimilative	0
Backchannel	53
Collision	8
Descriptive	52
Evaluative	18
Linguistic	0
Inferential	13
Presentational	0
Procedural	9
Query	36
Side conversation	6
Social tokens	32
Latent	
Analogic	1
Anecdotal	1
Metaphoric	13
Model	33
Parabolic	5
Understanding	29
Total	**337**

Analysis

Manifest indicators: Backchannel and Collision – High instances of backchannel and low instances of collision in communication suggest that the audio latency barriers identified as negative factors in previous trials were not significantly disruptive in the *Socialization and query* – When compared to chat room interaction, frequencies of socialization and query drop as a proportion of the manifest level "moves" in the videoconference language game, to borrow a phrase. This would appear to confirm the expectation that the videoconference environment would provide for measurably richer communication wherein backchannel and the increased instance of latent-level interaction act to mitigate "noise" or reduce uncertainty, to borrow another phrase (Weaver 1949).

The "start-up" ritual – One notable pattern to emerge was the length of time spent by participants in a socialization mode at the beginning of a session. As with most FTF encounters, discussants typically engage in a short ritual of greeting and personal fact finding (i.e. how are you? how's work going?, etc.). There's indication that this socialization ritual is extended in the videoconferencing format. Of more than a dozen working and administrative videoconference sessions recorded by the central team, a brief analysis shows the start-up ritual lasting on average for 1.5 pages of transcript, comprising about 5 minutes of greeting and fact finding, even among team members completely familiar with one another and with tasks at hand to be completed. Novelty of the equipment and a continual need to get everyone comfortable with the video-mediate space might account for this. Further research that compared such encounters with FTF encounters would be useful.

Turn taking and turn length – Because collision and backchannel did not emerge as significant factors in videoconference exchanges, turn taking did not emerge as an issue. Indeed, most working videoconference sessions held through central team lasted not significantly longer than would have a FTF meeting on the same occasion. Most working sessions lasted 45 minutes to 1 hour, suggesting normal or near normal rates of turn taking in order to get the work done. This was not quantified systematically, however, and future projects might build into their analysis a monitoring function along these lines.

Turn length likewise was not quantified systematically, although studies in this area are readily at hand that provides models for analysis (Sellen 1992; Issacs 1995; Whittaker 1993). Not surprisingly, turn length seemed dramatically longer in informal (i.e. non-lecture format) academic sessions, with one "PhD Club" session between the Universities of Calgary and Simon Fraser extending over 2 hours and comprising turn lengths of 10 minutes or more(!). This adds another dimension to the mix as previous studies accounted for turn length principally in terms of low-bandwidth, which makes it difficult to interrupt or use backchannel to hasten a speaker to conclusion or otherwise relinquish the floor (Whittaker 1993). As discussed above, another possibility is the inherent nature of the technology to allow fewer interruptions and hence more time for speakers to think about what they are saying or to hold the floor. This would appear to conflict with the high instance of backchannel in addition to the normal visual means available to participants to signal to speakers when time is up, to invite another speaker to contribute, etc. This raises the possibility that while backchannel and visual signals are present at or near FTF levels, videoconferencing instigates a "distorted space" that affects normally effective communicative devices (see report by Linda Goldenberg). Further study would be useful in investigating any such cognitive dissonances in the advanced videoconference environment.

Latent indicators –High frequencies of interaction indicative of deeper levels of meaning exchange provide evidence that IP-based videoconferencing supports levels of informal communication near or at their FTF equivalent in terms of getting work done. In one case, this was even thematized by the participants themselves when they informally discuss how informal they tend to work and how formal their collaboration should be :

> Ah, what do you envision or how do you envision this working? More formally or informally, in terms of structure?

> Ah, I had no vision of it. Um, but I'm an informal kinda person so if I had a formal vision, informal is always better but maybe we need more structure, I don't know. What do you think?

Well, I kinda like, I'm pretty informal too which is why I usually try to impose some sort of structuralist filmmaking ah discipline to keep me from floating off. Ah, so I think if we started with something like a process structure and then left it open in terms of, you know, so there's a lot of space to move around inside, that would make sense to me. I'm not sure how many, whether we should make it sort of a voluntary thing for students or should we try to integrate it into our curricula or what would be most effective? My guess would be if we had a small group for this first prototype or experiment, then we just let people participate by their own initiative. But then at the same time, if they agree to it, they have to commit to seeing it through, right?

Yeah, I'll ah hold my students at gunpoint just to make sure — It's the Maine way.

Well, we can't do that in Canada although I'm an American so that would be my tendency by training but I have a whole package of cream pies that I can use for that.

High instances of the use of models and metaphors (i.e. holding students at "gunpoint") to exchange contextually subtle or complex information aligns more or less completely with expectations that a robustly informal communicative environment would encourage these devices that are considered primary for tacit knowledge transfer. Thus, while a high proportion of the exchange is still descriptive in nature, the working sessions analyzed clearly allowed for discourse on levels approaching that of the FTF paradigm assumed in knowledge management and organizational literatures.

Coding Issues – As amply indicated above, the *InSite* project was under-resourced and lacked the time to employ other researchers to code texts. The present study, then, is limited for want of a validated coding scheme (the validity of indicators as established by several coders independently coding documents in roughly the same way) and a larger sample size over varying types of exchange. Thus, while the present study is suggestive of evidence that supports the hypothesis, indicating a basically sound research design to start with, further research would be required to verify the "findings."

Human factors – because the central team enjoyed the use of a dedicated facility with ample room for multiple projectors and screen images and size, a general sense of

"shared space" was a given in most videoconferencing sessions. Human factors analysis is relevant to a knowledge management approach to videoconferencing since the ability to engage in knowledge flows beyond the manifest level are putatively dependent upon the fluidity and serendipity of informal interaction. A focus on human factors directly related to interactional flow would be beneficial in this area.

Always on – A major element of videoconferencing experienced by central team members was the always-on feature afforded by the Access Grid (AG) format. Because the AG does not require a "dial up" in order to engage another party, myriad parties from the AG community can be sending and receiving signals on a 24-hour basis. This facilitated a number of "chance" meetings between researchers from around the "Grid" that led to direct collaboration[i]. Chance encounters are a staple in the knowledge management suite of operational strategies for organizations. This has been explicitly conceptualized since at least the pre-war period, at think tanks such as the RAND Corporation (Nasar 1998), but basically the practice itself is historically and ontologically primitive. A longitudinal research project would be useful in investigating the dynamics of chance encounters and in tracking their complicity in building social spaces in which knowledge creation and transfer are enabled.

Questionnaire

Of 15 exit surveys sent to *InSite* project participants, 14 were completed, representing a 93% return. Results of the survey indicate strong rates of adoption and use of the videoconferencing technology, with respondents reporting strongly favourable perceptions of the experience and use of the technology to enhance knowledge processes.

Uptake of the technology on a project-by-project basis over the duration of the trial was considerable. As to be expected use of the technology at project start was lower, with about 60 per cent using videoconferencing less than 20 per cent of their total contact time with colleagues:

Chart 1. Expected Usage Rates at Project Start Up

Count

Project start use
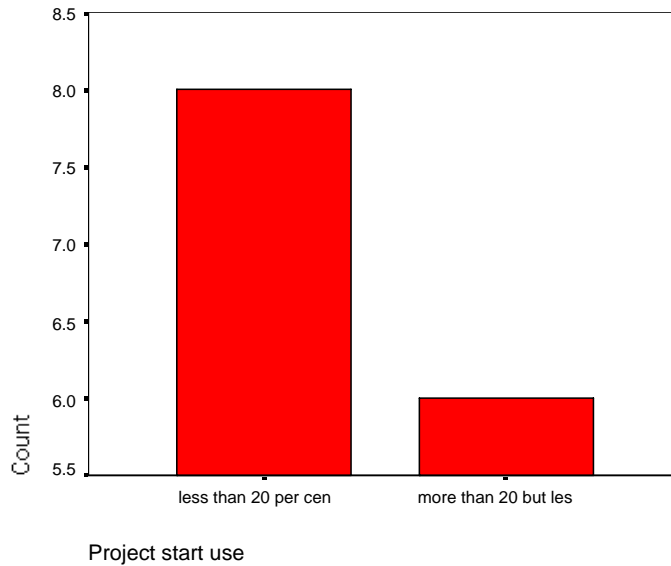
At project end, however, these rates jumped considerably, with some participants indicating this as an unexpected result. Half of respondents said they viewed the technology in general as "somewhat informal" while another 30 per cent described it as "mostly informal." This in turn jibes with the weight of respondents (almost 80 %) who considered the technology very helpful in encouraging spontaneous use to collaborate with colleagues.

Chart 2. *At project end,* what percentage of time spent communicating with distant colleagues did you use videoconference technology?
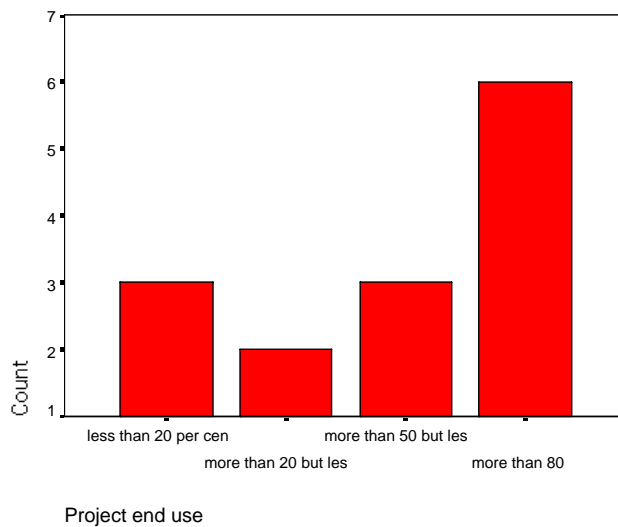

Count

Project end use

Chart 3. To what extent was your use of videoconferencing helpful in increasing the *spontaneity* of communication?

Spontaneity

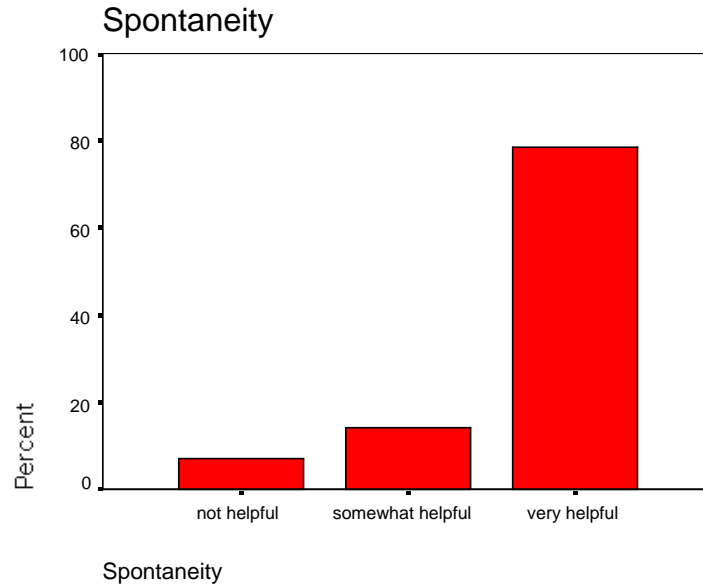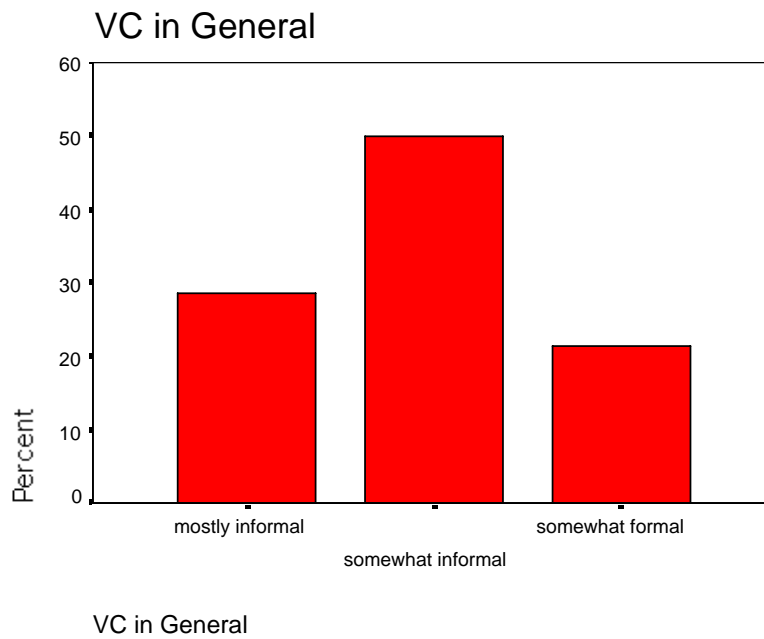Spontaneity

Chart 4. To what extent do you perceive videoconferencing *in general* to be an informal domain of interaction?

VC in General

VC in General

All participants considered the technology to be helpful in developing social relations with colleagues, with the majority (57 %) indicating it was "very helpful." All respondents thought it was helpful in increasing interaction between colleagues, with 78.6 % indicating it was very helpful (mean = 3.0 on a 1-5 Likert scale), and the vast majority thought use of the technology enhanced their knowledge in their research field (78.5 % reporting "considerable" [21.4] or "a great deal" [57.1], mean = 4.21 on a 1-5 Likert scale).

Sample size precluded making valid inferences to distributions and correlations but it was interesting to note potential connections that appeared between elements of the videoconferencing experience within the *InSite* project. For instance, while the majority of respondents perceived the technology as helpful in generating spontaneous interaction among colleagues, 57 per cent of them also felt it enhanced their knowledge of their research area "a great deal."

Chart 5. To what extent was videoconferencing helpful in *increasing interaction* between project participants?
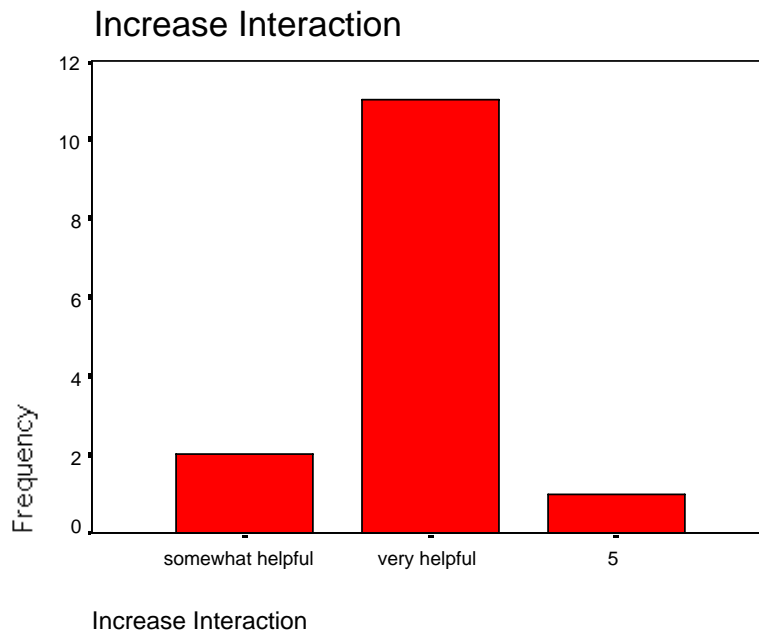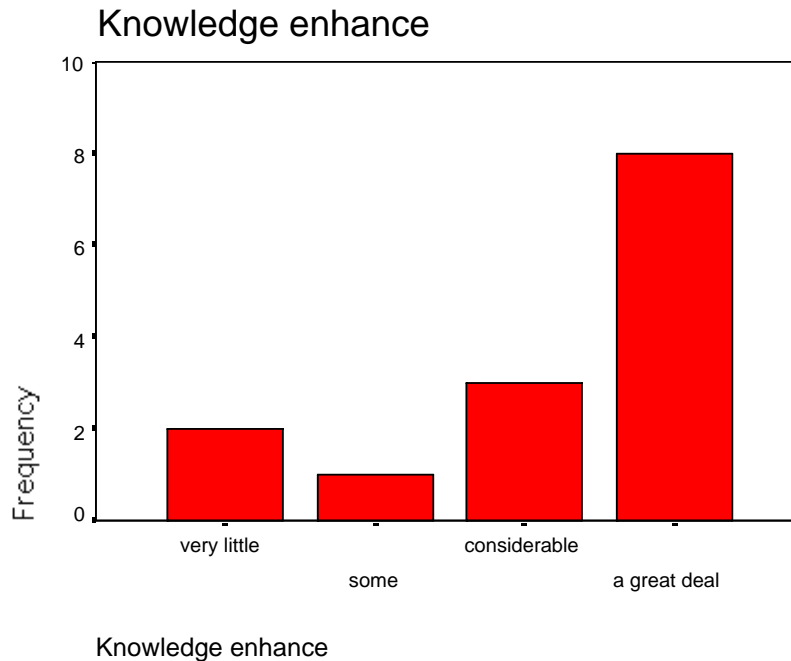

Increase Interaction

Chart 6. To what extent did use of the video conferencing equipment enhance your knowledge of your research area?

Knowledge enhance

Knowledge enhance

Questionnaire – limitations

The Knowledge Management Exit Survey was intended primarily to triangulate the "findings" described in sections above by summarizing the perceptions and outcomes of the project in discrete categories related to the research question. It was not intended to be statistically valid unto itself or to allow for inferences about distributions. However, the data captured confirms that, within the parameters of the *InSite* project, the introduction of videoconferencing instigated levels of social and organizational activities (independent variable) and processes that enhanced knowledge flow (dependent variable) in the distributed research environments under study.

With regard to knowledge processes specifically, the results of study on the basis of this data are encouraging and suggestive. Data suggesting the technology was not helpful in or did little to enhance knowledge processes were qualified by respondents as being a

function of lack of use of the technology in the first place, and not a function of the quality of the experience as such.

Surveys along these lines would do well, then, to work with a larger sample size in more varied project conditions, and further triangulate the findings through at least a series of open-ended questions, if not in-depth FTF interviews. Field observation of actual work locations to compare survey categories in FTF situations might also be crucial in validating research categories and deepening the significance of the findings by comparison.

Limitations of the study

As indicated, the study was limited by the lack of time and human resources. This had an impact on the amount and diversity of the data captured. However, the data captured via the videoconferencing working sessions provided a rich glimpse into the complexity of the interaction via the medium and the potential for its study from a knowledge management perspective. This was indicated by how the technology was perceived and used as an informal technology, and by its role in facilitating knowledge flows. Informal interaction is central to knowledge management, and the videoconferencing literature in particular, as foundational to effective workplace interaction. A further limitation of the study was its fragmented approach: partly a function of the ever-shifting schedules and personnel among partner projects. That is, while the research question of the present study is a valid and useful one, the instruments, activities and availability of time and resources allotted to its study were somewhat eclectic and mismatched. Further research in this area would do well to validate indicators in pre-testing and build its methodology around a single, focused research approach.

Further research

The study shows the value of re-visiting videoconferencing as an effective means of effecting collaboration in the distributed research domain. Further, evidence of productive informal interaction through the enhancement of knowledge processes – as

indicated by respondents and the above analysis – has opened up a research seam for further study in this area.

Some of the key factors not addressed within this study should be considered in further investigation that attempts to provide an integrated study of informal interaction and knowledge processes:

- Comparison with FTF encounters of similar quality and complexity with regard to:
  - o The socialization "front end" – the time allotted and dynamics associated with users defining their own social protocols (Ropa 1992), particularly as it relates to:
  - o The "trust threshold" – the point at which participants reveal personal agendas, theories, plans, etc. Specifically, what specific social, intellectual and communicative tokens and their level of exchange are required to cross this threshold?
- Understanding the project Honeymoon period – better indicators of the novelty factor in videoconferencing usage and when its use becomes transparent, thereby facilitating more frequent, more informal and hence more knowledge-focused interaction
- Room configuration, image size and "shared" space – study of human factors related to supporting the above by not allowing the technology to "get in the way" of the interaction
- Virtual lunchrooms – Longitudinal study of "always on" and "toll free" aspects of technology use that would study of the propensity and effectiveness of chance meetings in an environment where the technology is toll free and always on.

References

Bly, S. A., Harrison, Steve R. and Irwin, Susan (1993). "Media Spaces: Bringing People Together in a Video, Audio and Computing Environment." <u>Communications of the ACM</u> **36, 1**(January).

Borning, A. a. T., Michael (1991). "Two Approaches to Casual Interaction over Computer and Video Networks." <u>ACM</u> **0-89791-383-3/91**.

Carletta, J., Anderson, Anne H. and McEwan, Rachel (2000). "The effects of multimedia communication technology on non-collocated teams: a case study." <u>Ergonomics</u> **43, 8**.

Fish, R. S., Kraut, Robert E. and Chalfonte, Barbara L. (1990). "The VideoWindow System in Informal Communications." <u>CSCW 90 Proceedings</u>(October).

Fish, R. S., Kraut, Robert E. , Root, Robert W. and Rice, Ronald E. (1993). "Video as a Technology for Informal Communication." <u>Communications of the ACM</u> **36, 1**(January).

Fish, R. S., Kraut, Robert E. and Root, Robert W. (1992). "Evaluating Video as a Technology for Informal Communication." <u>CHI, ACM</u> **089791-513-5/92**.

Gaver, W., Moran, Thomas, MacLean, Allan, Lövstrand, Lennart, Dourish, Paul, Carter, Kathleen and Buxton, William (1992). "Realizing a Video Environment: EuroPARC's Rave System." <u>CHI, ACM</u> **0-89791-513-5/92**.

Issacs, E., Walendowski, Alan and Ranganthan, Dipiti (2002). "Hubbub: A sound-enhanced mobile instant messenger that supports awareness and opportunistic interactions." <u>CHI 2002</u>(April).

Landauer, T. K. a. K., Robert E. (1990). "CHI in the Applied Research Divisions at Bellcore." <u>CHI Proceedings</u>(April).

Nasar, S. (1998). <u>A Beautiful Mind</u>. New York, Touchstone Books (Simon and Shuster).

Neale, H., & Nichols, Sarah (2001). "Theme-based content analysis: a flexible method for virtual environment evaluation." <u>International Journal of Human-Computer Studies</u> **55**: 167-189.

Ropa, A. a. A., Bengt (1992). "A Case Study of a Multimedia Co-working Task and the Resulting INterface Design of a Collaborative Communication Tool." <u>Computer-Human Interface, ACM</u> **May 3-7**.

Sellen, A. J. (1992). "Speech Patterns in Video-Mediated Conversations." <u>ACM</u> **0-89791-513-5/92**.

Warkentin, M., Sayeed, Lutfus and Hightower, Ross (1997). "Virtual Teams versus face-to-face teams: An Exploratory Study of a Web-based Conference System." <u>Decision Sciences</u>(Fall).

Webster, J. (1998). "Desktop Videoconferencing: Experiences of Complete Users, Wary Users and Non-Users." <u>MIS Quarterly</u>(September).

Whittaker, S. (1995). "Rethinking video as a technology for interpersonal communications: theory and design implications." <u>International Journal of Human-Computer Studies</u> **42**: 510-529.

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[i] For example, central team members introduced themselves to a computer science professor at the University of Montana in Missoula and were further connected with a colleague of his at Motorola in Chicago. As Research Associates, Mark Wolfe and colleague Linda Goldenberg were also invited to visit an arts and science incubator project on Ayer's Island in Orono, Maine, following videoconferencing sessions between the University of Main and Ryerson Polytechnic in Toronto that the University of Calgary team was allowed to listen and watch in on.