Towards Optimising the Organisational and Educational Effectiveness of Videoconferencing for Vocational Education

Stephen Towers
Roy Lundin
Patrick Maguire

Abstract: Videoconferencing provides an example of a technology which has been consistently inconsistent for organisations generally. and teaching purposes specifically. Educational administrators appear to be particularly susceptible to seductive overtures ofthe technology, only to be perplexed and potentially disheartened by the reality.

This paper has four aims (1) to identify and understand some of the myths and assist educational organisations investigating videoconferencing; (2) to examine some of the similarities and differences between videoconferencing and more traditional educational practices (including face-to-face and open learning/distance education); (3) to identify and discuss potential influences for organisations during adoption and implementation. in an attempt to understand underlying process contributing to the understandings associated with the videoconferencing: and (4) to pragmatically address issues associated with the administration and management of videoconferencing systems for education and training providers.

The literature associatcd with videoconferencing together with practical experience and the findings from an intensive case study of one vocational teaching organisation adopting and implementing videoconferencing will be used to illustrate and discuss issues,

Résumé: La vrdéoconférence constitue l'exemple d'une technologie qui n'a de constant que son Inconstance, pour les organisations de façon générale et pour l'enseignement de façon particulkre. Les administrateurs de l'enseignement semblent portés à se laisser séduire par l'apparence de la technologie, pour se retrouver perplexes. votre découragés, par la réalité plus tard

Cet article a quatre buts. (1) d'identifier et comprendre quelques-uns des mythes d'une part, et venir en aide aux organisations éducationnelles qui contemplent l'utilisation de la vtdéoconférence d'autre part; (2) d'étudier les différences et les similitudes entre la vidéoconférence et les pratiques pédagogiques plus traditionnelles (y compris l'enseignement en face a face et la pédagogie ouverte ou l'éducation à distance), (3) d'identifier et discuter des Influences potentielles pour les organisations pendant l'adoption et l'implantation de la vidéoconférence et ce. dans le but de comprendre le processus fondamental qui sous-tend le savon associé à la vidéoconférence; et (4) d'étudier, de façon pragmatique, les questions liées à l'administratton et à la gestion de la vidéoconférence pour les fournisseurs d'éducation et de formation

La documcntation sur la vidéoconférence, les expériences pratiques ainsi que les conclusions d'une étude de cas Intensive impliquant une organisation d'enseignement professionnel tiendront lieu d'illustrations et d'éléments de discussion.

Introduction

Communication and information technologies are often an enigma, deceiving decision makers and designers by either failing to satisfy innovation goals, or by

influencing social settings in unanticipated ways. Videoconferencing' provides an example of one such technology that has been "consistently inconsistent" for organisations. The sparse and fragmented literature on videoconferencing provides a lengthy history of a technology which has appeared to offer substantial communication potential, but has habitually failed to meet anticipated benefits, disappointing adopting organisations (Towers and Hearn, 1995). Egido (1988) described videoconferencing as a synonym for marketing disaster. (p. 14)

Despite a history ofahnost three decades, there has been relatively little research on this technology, particularly concerning its adoption and implementation by organisations. Most research has concentrated on the comparison of videoconferencing to other teleconferencing media usually considering face-to-face as a "defacto" standard (see for example, Champness, 1973, Radford et al., 1994; Simpson, Pugh and Parchman, 1992, 1993). Understanding its adoption and implementation by organisation has mainly been undertaken by post hoc. large scale, quantitative studies or descriptive case studies and evaluation reports.

The development of strategies for organisations adopting and implementing videoconferencing have assumed a relationship between teleconferencing and Rogers' (1983) diffusion theory (for example, Johansen, 1984; Noor AL-Deen, 1988; Karnes, 1990; Jacoby, 199 l ; Earon, 1993). Although Rogers (1983) logico-linear approach is appealing for such applications, there is considerable debate over its general utility (Markus and Robey, 1988; Lewis and Seibold. 1993) for videoconferencing (Karnes, 1990; Sanderson, 1992, pp. 20 l-2 12; Earon, 1993, p. 24).

In order to address the inadequacies of prior research, this paper will elucidate some common misconceptions and influences which contribute to understanding how organisations adopt and use videoconferencing for teaching purposes

Perspectives

The authors have developed this paper from three perspectives:

I. An educational perspective

An educational perspective of videoconferencing provides a critical account of the users of videoconferencing within the educational context (Lundin and Donker, 1992; Lundin. Simpson. Hansford and Skippington, 1995). It was from this perspective that many of the myths were identified. Data were gathered using questionnaires, observations and interviews of the users.

2. An organisational perspective

An organisational perspective sought to understand and explain the processes sustaining and reinforcing the myths. The research methodology relied on a case study approach (Towers, 1997) which examined the entire context of the organisation adopting and implementing videoconferencing. Data were gathered from decision makers, designers (those responsible for designing the macro implementation strategy), local implementers (those responsible for

implementing videoconferencing locally), and users. Data were gathered using interviews, document analysis and observations. A structuration perspective(3) (Towers and Hearn, 1996) provided the theoretical framework to explicate the interactions which constitute certain human action during the adoption and implementation of videoconferencing. One major difference between the case study and the educational perspective was that the former sought to understand the processes associated with adoption and implementation of the technology within a holistic framework, whereas the latter concentrated on the users of the technology.

3. Pragmatic/technical perspective

   A pragmatic/technical perspective provides workable responses in an attempt to provide strategies to address the myths within the organisation.

Within these perspectives we identify and address 13 myths associated with videoconferencing. The following list should not be considered comprehensive, but it does represent the common inconsistencies between perception and reality found in our research and practical experience. We should also emphasise that in certain circumstances and contexts some of these myths *may actually meet expectations.* However, from our investigations these were the exception rather than the rule.

Research setting

While the following discussion draws upon research in other organisations, the main context for the paper is an organisation under the pseudonym *TrainingDept.*

TrainingDept is a large, geographically distributed state government organisation responsible for the delivery of post secondary vocational education and training courses to the community. In *1994, TrainingDept* was the major provider in the state at approximately *60* sites. *TrainingDept* 's organisational structure comprised a corporate executive called *State 0ffice* located at the state's capital and decentralised semi-autonomous *Institutes* distributed throughout the state. Most *Institutes* constituted a main campus (the location of the majority of each *Institute's* management and operation) and a number of smaller campuses which varied significantly in distance (from a few kilometres to many hundreds of kilometres) from the main campus.

Institutes usually provided education and training programs to the community through face-to-face teaching in classroom settings. *Institutes* were physically established in major population centres with limited facilities at campuses in communities with smaller populations. Distribution ofeducational disciplines was predominantly a function of population, with the greatest range of topics located at or around the state's capital city. Access to disciplines otherthan those at *Institutes* or their campuses was achieved through people moving to the place where it was offered or teachers moving to the location of demand. Unless anticipated student

demand was high, sustained or specially funded, the former situation normally dominated. One *Institute (called Open Institute)* specialised in providing correspondence or distance education materials as an alternative. Disciplines available from *Open Institute* were limited and the delivery mode primarily used printed materials and the postal system.

Exploring the myths of videoconferencing

Myth 1

Videoconferencing is a direct substitute for, and more productive than, face-to-face teaching

Assumptions of the substitutability and increased productivity of videoconferencing are the keystone upon which all the myths presented in this paper are constructed and reinforced. In structuration terms these are described as institutional properties which mutually shape and reinforce human agency. They are diffused and sustained by many sources of human action including vendors, consultants, technical staff, designers, implementers and management.

Consequently, implementation design(4), including information dissemination activities, are saturated with perceptions or interpretive schemes(5) of substitutability and increased productivity (such as printed materials, videotapes and demonstrations). Increased productivity as an interpretive scheme permeated implementation activities, manifested as tangible (for example, travel time and cost) and intangible (for example, relieving travel fatigue) advantages over other communication options, particularly travel-mediated communication.

The centrality of this myth will become evident as each of the other myths are discussed. Furthermore, the myths are not discrete and there is considerable overlap and mutual reinforcement between them.

Myth 2

Teachers have the requisite knowledge and skill base for videoconferencing and quickly adapt to it.

Finding:

This myth is developed from the assumption that videoconferencing is a direct substitute for face-to-face communication. The premise that teachers will be able to easily transfer or acquire the requisite knowledge and skills to videoconferencing significantly influences action and events during its adoption and implementation.

At *Training Dept,* teachers found videoconferencing required different knowledge, skills and practices from their previous experiences for both classroom teachers and open learning teachers. Some face-to-fade teachers reported that videoconferencing required a didactic teaching approach, and were reluctant to use traditional participative activities because they felt that they should be active for the entire time they were connected to another site. Some teachers found the placement of the camera and associated technology restricted their movement, i.e.

they were unable to move around the room or make large arm movements. It provided little relative advantage over previous practices and had high dissonance (Normann, 1971).

Furthermore, teachers were being allocated the maximum work loads in established teaching modes as a consequence of the environmental (competition) and organisational contexts (decreasing resources). Moreover, other changes occurring at TrainingDept, coming from devolution of responsibilities (meetings and resource management), resulted in additional duties for teachers. The impact of these issues in shaping the human context for videoconferencing teaching was significant across *TrainingDept.* As one implementer remarked:

> A few teachers are keen (on videoconferencing) if there is support and release (from other duties), but there is too much else to do, plus normal teaching. People have enough on their plate and don't need something new, so they avoid it. They are not negative, but don't have time for training and development.

Teachers were undertaking additional activities (such as the allocation of resources, marketing and promotion and administrative procedures) which for established teaching modes were completed as a matter of course, usually by others in the organisation.

Myth 3

Videoconferencing economically aggregates disparate students.

Finding:

This myth is based on the perception of increased productivity by being able to teach to many locations simultaneously with the one teacher. For example, at *TrainingDept* one of the aims of videoconferencing was to deliver more cost-effectively education and training programs to rural and remote locations by aggregating small groups of students in different locations. However, videoconferencing delivery proved to be only cost-effective if there were large numbers of students in each location because of the high cost of the equipment and high telecommunication charges. In addition the availability of appropriate telecommunications infrastructure in many rural and remote locations did not exist or were expensive to install.

Myth 4

Distance education institutions will be the most effective users of videoconferencing

Finding:

An underlying premise of decision makers was the compatibility of videoconferencing with distance education, and in particular the *Open Institute*

within this state system. However, organisational and human contexts associated with distance education were developed around a print-based, teacher-student asynchronous and independent delivery mode, whereas videoconferencing required teachers to interact with students in real time.

Videoconferencing was expected to be highly compatible at *Open Institute* because is operations were considered to be sympathetic with many of the goals for teaching by videoconferencing (delivery to geographically separated locations). Furthermore, the Director of *Open Institute* had allocated substantial resources for videoconferencing including a change agent (released half time from other duties) and financial resources available for any related purpose including providing human resources. However, videoconferencing was incompatible with the norms of both students and teachers.

For students, videoconferencing restricted their traditional flexibility and control over their learning. Some students had enrolled at *Open Institute* because it enabled them to undertake the course at a time, pace and place of their own choosing. Videoconferencing required them to be at a place at a certain time to be taught at a certain pace.

For teachers, videoconferencing required different skills. Previous student contact had been asynchronous by mail, or interaction mediated by telephone, with occasional face-to-face meetings. Live student contact was usually on a one-to-one basis. Learning content was provided by printed materials with the teacher acting as a mentor and tutor. Videoconferencing teaching required teachers to interact with groups of students. Furthermore, teachers believed that their present mode of instruction was more equitable to students, whereas videoconferencing was only available to students with access to facilities. Organisational structures at *Open Institute* had developed around these norms and there were no existing mechanisms for easily coordinating, aggregating or requiring students to attend videoconferencing sessions.

Myth 5

All locations within the organisation will have the same response to videoconferencing

Finding:

Lewis and Seibold's (1993, p. 347) framework proposed that variation in the forms of the innovation-in-use (across individuals or groups of users) was the result of users' structuring interactions related to the innovation. Access to different modalities of structure within certain locales influenced utilisation of videoconferencing and appropriation of sub-innovations. For example, identification of the peculiar cultural differences within an organisation (Karnes, 1990; Van Maanen and Barley, 1985) appeared important to understand the fidelity of innovation.

This situation was evident at *TrainingDept* where only four of the sixteen sites regularly used videoconferencing for teaching purposes because of the peculiarities of the local innovation context. The remaining sites made some use of videoconferencing for teaching purposes, but these were irregular events resulting from activities initiated by State Office or the Steering Committee, use by early adopters or exceptional circumstances. Using videoconferencing for most sites was incompatible with organisational and human contexts or offered no apparent relative advantage over previous practices.

The following examples are noteworthy to illustrate the different influences on the adoption of videoconferencing.

The first example, Institute 1, had two sites. Site 1 was the main campus and Site 2 was a recently established campus located over 100 kilometres from the main campus. Site 2 had organised training and education programs using local staff as well as teachers travelling (driving) from Site 1. These two sites represented what was referred to in the evaluation report (Lundin et al., 1995) as a 'natural setting' for the use of this technology. That is, videoconferencing was compatible with the norms of decision makers and teachers and provided relative advantage. The Institute Director had recently established the campus at Site 2 and was motivated by community demand to extend the number of courses. Videoconferencing offered a potential mechanism for increasing the number of courses offered to students at an affordable cost. Although learning to use videoconferencing and preparing courses were considered time consuming for teachers, so too was the time required to drive between campuses for each lesson. Teachers were more willing to provide courses via videoconferencing because travel was not required. Replacing driving with videoconferencing also lowered costs of delivering programs. In addition, the new courses were taught by casual teachers who were motivated to teach by videoconferencing because it provided them with employment.

The importance of the local culture is demonstrated when the previous example is compared with another pair of sites where videoconferencing was not used regularly. At Institute 2, three sites had videoconferencing facilities installed. Site A and Site B, several hundred kilometres apart, had established a good pattern of usage. Furthermore, Site A had also expected to use videoconferencing with another intrainstitutional site (Site C) which was about 100 kilometres away. However, Site C had been established for several years and had its own teaching staff living in, and employed from, the local area. It rarely used anyone from the main campus at Site A. Staff at Site C had the perception that the campus' future was uncertain and the emergence of videoconferencing appeared to substantiate rumours that it would be closed. At the time videoconferencing arrived, the teachers' work load was fully allocated so that any videoconferencing

teaching was an additional duty. Furthermore, prospective students living at Site C but wanting to undertake courses at Site A had a history of travelling to Site A.

The inconsistencies in the findings presented here illustrate the importance of relative advantage to the local culture. These examples suggested that acceptance of videoconferencing was facilitated where it was interpreted to be sympathetic with the culture of the local innovation context and relative advantage. Conversely videoconferencing tended to be rejected where it was considered to be antithetical and there was little relative advantage.

Myth 6

Videoconferencing will be a catalyst for change - including creating new and improved communication patterns, organisation structures. skills and knowledge

Finding:

Orlikowski and Yates (1994) indicated that the introduction of communication technologies had the propensity to influence the genre (socially recognised types of communicative actions) of organisational communication. Modifications, as a consequence of videoconferencing, at *TrainingDept* were the new and increased numbers of communication participants in administrative meetings and teaching by videoconferencing at four of the 16 videoconferencing sites.

Emulation of existing communication systems simultaneously facilitated and constrained utility. Users tended to appropriate aspects ofvideoconferencing where it was compatible and directly substitutable for existing practices (administration meetings) while rejecting other more radical aspects (for example. teaching and multipoint videoconferencing).

Supporting the literature associated with teleconferencing (Egido, 1990; Gowan and Downs, 1994; Kraemer, 1982; Nuwer, 1989; Svenning, 1982), videoconferencing was accepted and utilised where communication opportunities existed or were latent. Modalities of structure available to human agents appeared to shape the use of videoconferencing rather than modify or create new structures as suggested by some of the literature (Barley, 1986; Poole and DeSanctis, 1990; Orlikowski, 1992). That is, videoconferencing was accepted where:

communication increased between temporally and spatially separated participants, for example, established teaching between sites where videoconferencing offered significant benefits over travel;

face-to-face communication could not justify resources for travel, for example, administrative meetings;

it provided additional benefits over alternative options, for example, travel fatigue, more regular contact, visual communication, meeting community training demand, and lack of resources; and

- existing communication skills and knowledge were consistent with the use of the technology, for example, unequivocal meetings and meetings where participants were known to one another.

Videoconferencing was rejected (actively or passively) where it was antithetical to modalities of structure associated with communication. That is. videoconferencing was rejected where:

- other communication modes were considered superior and resources were available; for example, travel mediated teaching or existing teaching priorities.
- new communication protocols were required; for example, training, multipoint videoconferences, and equivocal meetings.

Myth 7

A fully automated system is a substitute jor user's skills and knowledge

Finding:

For some organisation" implementation strategies centred on the interface between the technology and the users and reinforced the need to ensure substitutability ofexisting communication skills, knowledge and practices. There was a temptation to mitigate perceived problems with the organisational and human contexts by relying on technical solutions to mirror existing structures. Uncertainty served to compound this activity and motivated the implementation design to focus on a human or technological interface between users and the technology. Orlikowski et al. (1995, p. 425) described this type of human interface as *chauffeurs* who 'relieve users of the need to interact directly with the technology'.

Technological interfaces were purposely developed by designers to restrict the scope of new skills and knowledge required by intended users for videoconferencing. The development of a technical interface reinforced the strategies selected for implementation to focus on the technology. Implementation activities centred on the selection and installation of equipment (Kyrish, 1989). Orientation to the technical context concentrated information gathering activities on technical information (equipment specifications and purchasing procedures) which tended to de-emphasise other contexts or subsume them.

At TrainingDept, the implementation team comprised two groups, (1) a system wide administration/management group and (2) a small group within each *Institute.* No teachers were represented on the administration/management group. For the majority of teachers and those within the second group, their first involvement was during training delivered shortly after the installation of equipment at the *Institute.* Although there was an attempt to design systems that had a low technological impact on the teacher, the majority of resources were expended on "off the shelf' equipment, not on modifications or people. This was partly because the majority of the funding provided was capital funding for equipment, not recurrent funding for operational support. As one decision maker said,

They are offering us $X and if we don't grab it and spend it on boxes-we lose it.

Myth 8

Organisations have the skills and knowledge to make effective decisions about adopting and implementing videoconferencing

Finding:

Decision makers generally believe they have the necessary resources and skills to adopt and implement videoconferencing within their organisation because it is perceived to be substitutive with existing communication. Furthermore, the activities and strategies decision makers and designers undertake during initiation' tend to reinforce this perception.

For example, at *TrainingDept* during the early stages of adopting videoconferencing, decision makers visited *TrainingDept2,* a similar organisation in another state. Videoconferencing was interpreted by decision makers to be an innovation that was moderately routine and offered positive relative advantage. Shortly after becoming aware of videoconferencing, it was perceived by decision makers as a potentially useful innovation that would enhance *TrainingDept 's* competitiveness by improving service provision and resource productivity. In particular, videoconferencing was considered by decision makers to (1) provide the capacity to deliver education and training programs to any point throughout *TrainingDept's* system of *Institutes,* (2) aggregate groups of students across several locations and (3) deliver training to the workplace of other organisations/industry. Decision makers considered that videoconferencing was compatible with existing infrastructure and could be implemented provided the capital for videoconferencing equipment was available. As stated by one decision maker who became responsible for implementation:

Teachers will take to this like ducks to water.

Myth 9

Staff responsible for the organisation's information and communications systems are the most appropriate to make decisions about adoption and implementation.

Finding:

As indicated by Johansen (1984) there is a tendency for organisations thinking about videoconferencing to delegate adoption and implementation activities to staffresponsible for communications information technology roles. Even with the best intentions, such staff tend to be biased towards the technology, concentrate on technical aspects and omit human, organisational and environmental issues.

The activity associated with initiation is delegated to designer(s), concentrating responsibility in a few human agents in each organisation. Perceptions of substitutability and increased productivity were readily transported from decision makers to designers. These perceptions were sympathetic, or at least not antithetical, to their existing interpretive schemes and were fundamental to human activity.

For example, at *TrainingDept* interpretive schemes encouraging the focus of activity on the technology rather than organisational or human issues were directly compatible with the designers' (who came from an information and communication technology background) existing interpretive schemes.

Designers were the de facto information gatekeepers who dominated and shaped decision making. Information sought and provided by designers influenced the decision to adopt. At *TrainingDept* biased information gathering appeared unintentional, mutually determined by available modalities of structure(8), but at another organisation information was manipulated for specific audiences.

(We) were somewhat biased towards videoconferencing, obtaining appropriate information to justify it to management.

Myth 10

The only difference between point to point videoconferencing obtaining appropriate information to justify it to management

Finding:

The same modalities which tended to facilitate appropriation of (routine) point-to-point videoconferencing operated in the rejection of more radical multipoint videoconferencing (such as the maintenance of existing communication skills and knowledge). Leonard-Barton and Sinha (1993) similarly found that matching current practices may inhibit the development of new user skills or organisational structures. During early stages of adoption, the *face-to-face* component of videoconferencing was invoked to promote it and to constitute the perception of its substitutability. During implementation. it was relatively congruent with point-to-point videoconferencing where there was continuous presence'. but it was not actualised with multipoint conferencing where only certain participants (current and previous speakers) could see one another. For example, multipoint videoconferences were considered inappropriate for many users at *TrainingDept* because of the difference in communication practice (delays in switching between sites, restricted to viewing one site, technical unreliability) and additional knowledge required to connect sites together. Interstingly, this myth was seen as a fallacy by decision makers and designers at *TrainingDept* and extra training and administrative processes were available. However, the technology was unable to meet expectations because they had not mastered point to point videoconferencing.

Myth 11

Videoconferencing will fit in with existing orgunisational structures

Finding:

The substitutability of videoconferencing contributes to decision makers' assumptions that videoconferencing could be accommodated within existing organisational infrastructure. Excluding a small proportion of resources for training and promotional activities, extra resources (finances) were principally designated

for equipment procurement. Other resources (including the staff responsible for implementation) were obtained from existing sources. This requisite acted as a caveat to circumscribe information gathering and decision making parameters which in turn constrained implementation design.

Implementation activities assumed the innovation was directly substitutable or congruent with existing organisational structures. Implementers opted for training which imparted few skills, knowledge or attitudes to users in the beliefthat existing practices would transfer to videoconferencing. For example, training was didactic and delivered in a one-off short "dose" over a few hours or days. Implementation mediation(10) was constrained by implementation design which assumed videoconferencing would be compatible with the environmental context (students and wider community), organisational context (procedures and policies), technical context (ISDN infrastructure) and human context (skills, knowledge and practices). The actual nature of videoconferencing emerged after implementation. Videoconferencing usage for teaching purposes was incompatible with the innovation context at most *Institutes.*

Teaching by videoconferencing was found to be significantly different from environmental and organisational contexts for twelve of the sixteen sites. Detailed examples are presented in Table 1.

Myth 12

Existing human resource structures are all you need

Finding:

FindingReliance on existing infrastructure constrained the selection of the local implementers on the basis of available positions considered substitutable rather than the anticipated skills, knowledge and attitudes required for videoconferencing. For example, *TrainingDept* allocated videoconferencing responsibilities to teachers or office staff with existing duties. Personnel were selected on the basis of position, personal interest or the manager's discretion. In most cases videoconferencing responsibilities were subordinate to, or were subsumed within, other existing duties of the staff. Implementers received little or no initial support and training to facilitate the implementation of videoconferencing at the local site. The type and magnitude of activity was determined by their level of resourcefulness, commitment to the technology, competing duties and self motivation.

Myth 13

Participative decision makingfacilitates videoconferencing

Finding:

According to the literature, participation enables innovation through increasing **fit** between the users and the innovation (Lewis and Seibold, 1993; Nord and Tucker, 1987); by facilitating communication of the innovation; and by gaining the support of intended users (Dean, 1987; Mintzberg, Raisinhani and Theoreti, 1976). While

Table 1: Examples of natithetical structures to videoconferencing

Environmental context (External)	Organisational context (Internal)
1. Within the regulatory framework for training, each institute was legally allowed to provide only the courses for which it was registered. Education and training programs outside of those authorized required the institute to seek formal permission. Approval required having the appropriate resources to provide the courses of organizing the programs under the auspices of the institutes which had permission. The former situation required considerable forward planning and effort by the institute for an unknown demand and return. The second situation resulted in the acknowledgement for the programs (in terms of student numbers and financial return) passing to the institute providing the teaching services. The latter situation was not seen as an advantage to the host institution in an increasingly competitive environment. Procedures or protocol to operationalise these options were not established.	1. Previous teaching activities between institutional campuses and institutes and other organizations were rarely undertaken. Most institutes and campuses had their won specific teaching areas with a corresponding local pool of teachers. Teaching outside the campus or geographical area was not normally undertaken. In order to realize teaching by videoconferencing, other accompanying innovations were required but these were either ignored or only partially implemented.
2 There was uncertainty about whether the community would understand the concept of videoconferencing and how it should be promoted.	2. Although institutes with videoconferencing had agreed to a protocol prior to implementation for crediting enrolment of students involved in inter-institutional videoconferencing, further administrative policies and procedures were required to operationalise it. While recognized, these were not realized.
	3. Selection processes for staff within institutes to undertake teaching by videoconference were ad hoc, primarily on a voluntary basis. Teaching programs were either at the discretion of teachers at the delivering location or relied on a person from the receiving site finding someone who was willing to teach particular topics. This situation was exacerbated for programs delivered between institutes where there was an absence of any mechanisms for locating a teacher from another institute to deliver a course.
	4. Development of teaching programs for videoconferencing also relied on human agents volunteering and their knowledge of how to develop such programs. The lack of program development was partially explained by an insufficient critical mass of users and skills (Markus 1990), but there was also an absence of supporting or mitigating organizational structures or strategies.
	5. Resources within an institute were a function of student enrolments from established education and training programs. Procedures for allocating resources were developed around face-to-face classroom delivery. Videoconferencing teaching at most institutes were considered under the same criteria and competed directly for resources. However, videoconferencing required additional resources (preparation time, teachers and telecommunication infrastructure), whereas the requirements for face-to-face teaching were routinized (in terms of teaching practices and infrastructure).
	6. Administrative procedures for booking videoconferencing facilities were accommodated by implementers (videoconferencing site coordinators) using the computerized booking system. Incorporating education and training programs into institutional course delivery timetables was not compatible with previous practices. Sites, staff selection, student demand and costs were unknown. As a consequence, administrators developed course timetables consistent with traditional and safe practices which also involved allocation teachers' workloads as fully as possible.
	7. The computerized administration system used to enroll students (a determinant for allocation resources to institutes) was contrary to inter-institutional teaching using videoconferencing . The system would not allow students physically located at one institute to enroll in a course at another institute and acknowledgment of enrolled students could only be awarded to one institute.
	8. Procedures for marketing and promoting courses between institutes were absent. New undertakings at either the sending site or receiving site were required for these activities to occur. The sending sites were unsure of the most effective mechanisms for such activities within another community (for example, the advertising medium) and it was antithetical to the growing competitive nature between institutes to promote someone else's courses or encourage them to enter the institutes traditional market. An implementer reported: It is a competitive market, every (institute) is jealous of contact hours, but videoconferencing needs cooperation and this could be a major impediment.
	9. The program coordinator role (implementer) emerged shortly after installation of equipment at one of the first sites to receive videoconferencing – prior to the official commencement of the pilot period. The purpose of this role was to act as the local change agent or implementer in order to facilitate videoconferencing within the institute. The steering committee requested other institutes appoint similar positions. The selection criteria for the program coordinator was not developed until the pilot project had been in operation for eleven months and the role required an additional resource commitment by the institutes which had not been previously anticipated.

this section is presented as a series of species giving their reasons for the conservation of wetlands.

The Conservation area provides the learner yet another variation on control as each graphic example allows the learner to choose between text answers to three questions: "What is it?", "What effect does it have?", and "What can we do?". These questions are referring to the various elements of human activity that affect wetland conservation. Pollution provides the learner with the least interaction as there are no responses required. The examples of sources of pollution are reinforced by pop-up text.

The Field Trip

The virtual Field Trip to the Bog has some of the most interesting characteristics of the program. Upon clicking that piece of the jig-saw you are given the option of seeing whcrc the bog is located. This geographic exercise requires the learner to find North America, Canada, Ontario and Algonquin Park, in order, before seeing an aerial view of Cloud Lake. Once their you begin your trip by seeing a three dimensional map of the area, a set of field notes (text in a graphical binder), and a small screen. On the screen the learner views a QuickTime video which allows the control and navigation. The learner can navigate to several markers within the movie, which are also shown on the map. At each marker, a set of notes and names of species which are hyperlinked to organism screens. The learner may also zoom in and out to view specific areas of the screen as well as have the view pan in any direction. This allows the learner the unique perspective of seeing where she/he has been. This is truly an example of a virtual experience.

The instructor's guide states "the Field Trip to the Bog is an excellent opportunity to synthesize knowledge by making observations and by analyzing those observations" (p.3). Making observations could be greatly enhanced if the screen display were larger and perhaps having the map as an option. Also the compression ratios on the graphics are not enough to allow for much enlargement. With the option to zoom in on objects, one would assume that the objects would not pixellate readily yet very little viewable enlargement is available.

Conclusion

The Digital Field Trip to The Wetlands is an interesting ecological package which is highlighted by a virtual field trip to a bog environment. This package utilizes a wide variety of interactive strategies to maintain attention and promote engagement with the learner. A few flaws in navigational strategy exist primarily due to the misguided assumption that student's always read the textual material supplied.

The content of this program is extensive, however some topics have been omitted or edited out. For example, the programmers chose to ignore a wide variety of wetland species when discussing adaptations and this would not go unnoticed by the experienced student and may lead to misconceptions by the novice. Many content areas have detailed textual accounts and highly interactive learning

these aspects were identified, participation also transported interpretive schemes or meaning about videoconferencing, screened out more radical parts of the

innovation and focused human activity on implementation design for routine (highly compatible) parts of the innovations (Leonard-Barton and Sinha, 1993).

User participation (during implementation design or involvement in short trials or demonstrations) appeared to be more successful in disseminating and reinforcing perceptions of the substitutability and increased productivity ofvideoconferencing rather than testing their validity. Participation confirmed the legitimacy of these interpretive schemes to enable and constrain human activity (such as decision making, information gathering and implementation design) to form selected uses of videoconferencing. Participation usually appeared insufficient to challenge perceptions of the innovation held by decision makers and designers. Accordingly, there was a continuity between human activity where interpretive schemes associated with videoconferencing were validated and transported from those who became aware of the innovation to decision makers, to designers (and stakeholders), to implementers, to users (though not necessarily in this sequence).

Participants did not have the skills, knowledge or attitudes to contradict perceptions of the technology provided by decision makers and implementers. Demonstrations or short trial periods tended to reinforce substitutability. For example, some intended users at *TrainingDept* were provided with the opportunity to trial videoconferencing between two locations over a short period which reinforced its substitutability to decision makers even though it failed for these locations once it had been implemented.

An important caveat on this finding was that the participation from the intended users in our investigations was not comprehensive or even representative. It was usually restricted to specific events or providing feedback from limited demonstrations. The selection of participants was opportunistic or assumed to be representative and they had limited and sometimes controlled exposure to videoconferencing (through verbal descriptions, demonstrations of technical capabilities or short trial periods).

Understanding perpetuation of myths

Of particular interest are the underlying processes which create and maintain these myths during adoption and implementation. The research analysis demonstrated the centrality of substitutability and increased productivity as interpretive schemes to shape initiation and implementation. This section discusses and attempts to explain how these interpretive schemes develop and are sustained as well as their ramifications for implementation.

Other research efforts have also indicated the importance of substitutability and increased productivity schemes for organisations adopting communication and information technologies (Barley, 1986; Tyre and Orlikowski, 1994). For instance, Kraut et al. (1994) found that human agents adopted new technology when the direct or indirect benefits outweighed the costs. The centrality and mutuality of perceptions of substitutability and increased productivity were most significantly demonstrated at *TrainingDept* where videoconferencing was considered substitutable for existing practices whereas only a few sites were able to derive an apparent tangible productivity dividend from implementation. Justification for decisions involved financial (cost-benefit), interpersonal and political components (Dean, 1987), though financial substantiation was most important. Without a perceived direct (financial) benefit to both organisations. in order to rationalise the resources, *substitution was* insufficient to proceed.

Even though Shulman et al. (1990) criticised decisions to adopt communication technologies on these assumptions, they remain an important motivating force. The resilience and dominance of perceptions of substitutability and increased productivity were maintained and continued to influence human activity even though designers had gathered information which disputed their validity. In a comparable example. Tyre and Orlikowski (1994, p. 108) found *thatproductivity improvement,* as a consequence of the innovation, became more important than the organisation's original objectives.

Substitutability and productivity have also featured prominently in the literature associated with videoconferencing. The identification of these interpretive schemes as important motivational forces was not new. Jacoby's (1991, pp. 113-114) synthesis of the videoconferencing literature indicated that substitutability was fundamental for researchers and practitioners in the 1970s while productivity emerged during the 1980s. Substitutability and increased productivity were often found in studies as variables explaining adoption or acceptance (see Noor Al-Deen, 1988; Pease, 1988). Even though contemporary emphasis has shifted to increased productivity, substitutability is still foundational and advocated. For example, Fussell and Benimoff (1995) recently rejected assertions that videoconferencing could not substitute for face-to-face in-person communication. They argued that substitution of videoconferencing for face-to-face in-person communication was only constrained by technical limitations.

Productivity was initially substantiated by analyses which calculated the anticipated savings gained from substituting videoconferencing for travel. Even

though there was doubt about the validity of this claim (Earon, 1993) it continued to remain an important justification of adoption provided by experts and vendors (see Nuwer, 1989; PictureTeI, 1995; Smith, 1995). Productivity has also expanded to include enhancing competitiveness through enabling more timely and effective communication (Jacoby, 1991) and by increasing communication opportunities (Egido, 1990).

Although researchers and experts associated with videoconferencing have a lengthy history of cautioning potential adopters of the efficacy of perceptions of substitutability and increased productivity (Johansen, 1984; Krauss and Fussell, 1990; Nuwer, 1989; Olgren and Parker, 1983; Short et al., 1976) these interpretive schemes persist, continue to be evoked and are widely disseminated by researchers, evaluators, vendors and the popular press. The findings confirmed that these schemes are easily accessible and quickly become assumptions for decision makers and influence how and why videoconferencing is adopted and implemented. Congruent with this finding, Mintzberg (1978, p. 942) argued that decision making and strategy formation can be *self confirming* resulting from the interaction between the environment and the organisational context.

A possible explanation for the tenacity of these schemes and their effortless assimilation is offered by Weick (1990) who suggested that new technologies create problems in sense making for managers and users because they appear to provide several possible or plausible interpretations and are therefore subject to misunderstandings. The original intentions for the innovation are developed out of human agents' knowledge and understanding of the innovation, potential use and the context. The innovation is, by its definition, novel to the organisation so the information gathered about the innovation (including the process of gathering) and the way it is understood with respect to the organisational context is arguably a key influence that underpins and determines the actions of decision makers, designers, implementers and users.

Other literature similarly indicated that human agents draw upon familiar knowledge and skills when confronted by a novel context (Krauss and Fussell, 1990; Van Maanen, 1984). For example, perceptions form because videoconferencing is assumed to be substitutable with existing face-to-face interaction (Cohen, 1984; Johansen, 1984; Stubbs and Burnham, 1990) and this assumption is reinforced by limited exposure (such as demonstrations, didactic training, biased information). Shulman et al. (1990) argued that researchers and practitioners have been preoccupied with substitution and increased productivity and considered them as innate attributes associated with communication technologies. Furthermore, they posited that designers conceived intended users as being similar to themselves and tended to concentrate on the technical infrastructure and ignore the human infrastructure. Therefore, the technology's role is confined to the 'narrowness of the frame, false conceptions of the process and false images of potential users' (Shulman et al., 1990, p. 174).

In their investigation of organisational absorptive capacity, Cohen and Levinthal (1990, p. 128) asserted that innovation performance is 'history – or path dependent'.

Consistent with their work, the findings suggested that prior knowledge may be a prerequisite to identify, understand and use new knowledge which becomes fundamental to an organisation's ability to exploit this knowledge. Consequently, organisations may not have the requisite prior experiences to critically evaluate interpretive schemes associated with the perceived nature of the innovation.

It was also found that a low level of uncertainty shaped information processing to reinforce these schemes. Harianto and Pennings (1994) considered that an organisation's absorptive capacity may be influenced by perceptions of uncertainty. Zaltman et al. (1973, p. 54) similarly suggested decision makers experience *different kinds of certainty* towards the innovation depending upon the information available concerning the consequence for implementation alternatives. The literature indicated that perceptions of the innovation potentially impacted on uncertainty (Daft et al., 1987, p. 357; Weick, 1990) which may be related to the level of risk reduction through information gathering (Galbraith, 1973; Tornatzky and Fleischer, 1990, p. 165). Consequently, where videoconferencing was understood to be routine (substitutive) and offer relative advantage (increased productivity) then uncertainty was low thereby constraining the scope of information gathering. Uncertainty decreased when the information resulting from this activity confirmed these schemes (such as the cost benefit analysis). From this line of reasoning, perceptions may result in misalignment in implementation design (Leonard-Barton, 1988). It seemed natural for those involved that further human activity should concentrate on technical issues (Kyrish, 1989) -the acquisition and installation of the hardware and software – rather than on the validation of interpretive schemes associated with the perceived nature of the innovation. Moreover, the perceived nature of the innovation was reinforced by participants during initiation (decision makers, designers and others) tending to focus on technical issues and ignoring the communication context (Svenning and Ruchinskas, .1984). That is, omitting organisational (Keen, 1990, p. 300) and user issues (Fulk et al., 1990, p. 134; Ellis, 1993). Tornatzky and Fleischer (I 990, p. 205) classified this emphasis as *technocentric*. According to Tornatzky and Fleischer (1990, p. 207), the technocentric view has a rationalist perspective of the implementation process without consideration for any social technologies. The orientation toward this perspective at the organisations studied in this research was reinforced by the selection of designers from communication or information systems sections of the organisation (Thach and Woodman, 1994).

The successful mediation of these interpretive schemes may be in part explained by the transfer of mutual knowledge between communication participants (Krauss and Fussell, 1990) used to convey meaning about videoconferencing to others. That is, the speakers must formulate their contributions with an awareness of what their addressee does and does not know' (p. 112). This was problematic, particularly if there was considerable difference between the levels of knowledge of the communication participants or both participants were novices. Communication between novices tended to simplify the message through more descriptive dialogue

(for example, information about videoconferencing relied on descriptions based on perceptions of substitutability and increased productivity).

Fulk's (Fulk et al., 1995; Fulk et al., 1990) theory of social influence is normally applied to the implementation of the technology into a social setting, but it could also be applied to initiation whereby interpretive schemes about the innovation are transported between human agents - particularly the decision makers, designers and intended users or stakeholders. There were indications that perceptions of the innovation for those involved during initiation were determined by co-worker attitudes, statements and behaviours (meetings, correspondence and disseminated information) and vicarious learning (demonstrations and didactic training). This could help explain the dissemination of the perceptions of substitutability and increased productivity in ambiguous situations and why greater exposure to the technology reduced the efficacy of these schemes (Fulk et al., 1990, p. 125). Drawing upon Collin's (1992, p. 93) contention that *emotional energy* was a fundamental modality motivating human activity, videoconferencing appeared to be an innovation that facilitated high enthusiasm and spontaneity for those involved during initiation. Even though each of the designers stated his initial objectivity in relation to videoconferencing, there was a tendency for those involved in the activity to become ardent supporters. This was manifested in the selective provision of information, high expectations and an increase in the scope of selected uses.

The findings of our research and experience supported those who argued organisational information processing should increase as technologies become less routine (Keller, 1994, p. 167) and match the design and structure of the organisation (Cohen and Levinthal, 1990; Daft and Lengel, 1984,1986; Keller, 1994; Tushman and Nadler, 1986). But these views have not previously considered that understanding of the radicalness of the innovation may be inhibited by available structural properties" and human activity. The findings indicated that it was difficult for designers to identify radical sub-innovations once an innovation was assumed to be routine and there was less uncertainty. Subsequent human activity during initiation tended to confirm this perception through information gathering.

In summary, the findings indicated that perceptions of the innovation are formed early during initiation and these tend to shape human activity during initiation while being mutually reinforced by that action. The literature indicated that interpretive schemes of substitutability and increased productivity served as dominant, but imperfect, lenses for considering innovations generally and videoconferencing specifically. Understanding unfamiliar technologies relies on prior knowledge for interpretation. However, technologies which are recondite (Weick, 1990) may constrain the frame of interpretation which may contribute to false understanding (interpretive schemes) and misinterpretations. The transportation of such interpretive schemes may be similarly transported to others participating during initiation who lack mutual knowledge. Greater uncertainty associated with these interpretive schemes appears to increase the scope of information gathering.

Pragmatic considerations

Our findings and analysis also have policy and practical implications for organisations adopting and implementing videoconferencing.

Perceptions of substitutability and increased productivity

The findings indicated that the interpretive schemes associated with the perceived nature of the innovation were acquired early during initiation. In addition these interpretive schemes were pervasive and both enabling and constraining. Therefore, one of the most important implications is the need to identify and understand interpretive schemes associated with the perceived nature of the innovation and how they can influence the innovation process in order to reduce misalignment between initiation and implementation (Leonard-Barton, 1988).

Education and training applications

Videoconferencing for education and training purposes appeared to be a radical innovation. Though it is tempting for policy makers to consider videoconferencing as a potential mechanism for reducing educational delivery costs (Ellis, 1993), it is unlikely that it will achieve such expectations in the short to medium term. Structural properties associated with the delivery of education and training are firmly grounded in face-to-face delivery (see Gooley and Towers, 1996; Lundin. 1992). Education and training programs using videoconferencing appear to require new structures of signification (skills and knowledge for teachers), control (organisational procedures and different resources) and legitimation (community acceptance). Otherwise they are likely to fail or be relegated to research projects or peripheral applications.

Videoconferencing training

In this study, training provided in an intensive session before use was quickly forgotten. Similarly, Liguori (1985) found that general training of prospective videoconferencing users was insufficient and resulted in low demand whereas one-to-one instruction with those about to use videoconferencing appeared to be more successful. Videoconferencing for applications which rely on advanced technical skills or involved equivocal communication perhaps required different training needs (Earon, 1993) -for example, formal and informal training initiatives or an apprentice style (Goodman and Griffith, 1991). Training delivered in a short concentrated block appears to have little efficacy for assisting teachers to modify their skills and practices to use videoconferencing. In particular the trainer may be faced with considerable resentment if participants are not prepared or previously informed about videoconferencing.

Successful communication using videoconferencing is considered to require new and different skills (Fussell and Benimoff, 1995; Kydd and Ferry, 1994). In this respect, there seems to be considerable merit for Hildebrand's (1995) suggestion

thattertiary institutions should include videoconferencing within their curriculum to facilitate understanding of its communication properties.

Participation during innovation

The findings and conclusions of this study have ramifications for participation and how it is managed. The types of participation evident in these case studies tended to provide limited utility for implementation and were more successful in transporting interpretive schemes about the nature of the innovation.

Participation during initiation across the four case studies ranged from nil for many locales, to demonstrations, to limited trials for certain applications. Even short trial periods by organisations proved artificial and unrepresentative of applications or the multiplicity of structures available to intended users. This was illustrated at *TrainingDept* where the retrospective justification for the decision to adopt videoconferencing for education purposes was based on its evaluation over one week between an *Institute* and a remotely located company. Yet the actual teaching use of videoconferencing at the *Institute* proved limited and did not emerge when videoconferencing was nnplemented.

Participation may require a longer period of exposure to the technology in representative situational and functional contexts with users from different locales". Lee (1989) argued that ideally, the selection of participants should include a combination of cases that are likely to produce similar and contrary results. Such an approach highlights the importance of 'minimising and maximising differences among groups to discover patterns and identify potential theoretical properties' (Johnson. 1990, p. 24).

Participation in videoconferencing appears complex because human agents had a lack of mutual knowledge with respect to the technology. It may be important to ensure participants are active rather than passive and to include those who are not the most conducive to the task or do not understand the technology rather than those who are 'accommodating, cooperative and *do* not disagree or challenge the intended system, the design models, or the process' (Beath and Orlikowski, 1994, p. 369). On the other hand, such inclusion or a longer exposure may also mitigate opportunities to appropriate more radical sub-innovation which may benefit the organisation in the longer term (as indicated by Tyre and Orlikowski, 1994). Alternatively, participation may not be as important or useful as some have thought" and is only one way of ascertaining knowledge about sympathetic and antithetic interpretive schemes. The confusion in the literature demonstrates that this is an area which warrants further research.

Reinforcing communication structures

Videoconferencing has the potential to assist with some of the contemporary imperatives of education and training, in particular the need to provide programs to participants between locations separated in time or space. However, structures were the consequence of existing and emerging opportunities related to the fundamental activities of groups/individuals rather than the presence of

videoconferencing. As recommended by Frost and Egri (1991, p. 230), 'it is not safe to assume that the best or superior inventions - innovations will survive on their own merits'.

Multipoint videoconferencing

Multipoint videoconferencing was particularly problematic for users and often did not meet expectations. Users require new skills and knowledge to communicate in multipoint videoconferences (through training). The use *of splitscreens* to view all sites simultaneously could be more consistent with existing skills and knowledge to address this problem.

Access to resources

Videoconferencing impacts upon human as well as financial resources. The findings from this research indicated the importance of sufficient organisational slack in human resources to administer and support videoconferencing rather than the tendency to incorporate responsibilities within substantive duties.

Human and technical interface

A common conclusion of videoconferencing researchers and experts is exemplified by the following quotation:

> A practitioner interested in implementing video conferencmg should be certain that the medium is both easy to use and simple to operate and as effective as face-to-face business meetings (Pease, 1988, p. 186).

The findings from this study supported the view that a simple technological and human interface facilitated acceptance of videoconferencing, but they also indicated that interpretive schemes acquired early during implementation were pervasive and foundational to subsequent use. As previously stated, there may be only a small window of opportunity for change (Tyre and Orlikowski, 1994). If the goal for innovation includes the usage of more advanced features of videoconferencing or equivocal communication, then purposeful intervention and creation of new structural properties may be required -for example, training that upgrades skills and incentives or disincentives.

Time

Initiation and implementation of videoconferencing were potentially time consuming. The time period for innovation must be sufficiently flexible to enable informed decisions and to allow appropriate implementation design and mediation.

Conclusion

The original motivation of this paper was to identify, understand and address the inconsistent findings regarding the implementation of videoconferencing. In this light its main contribution has been to peel back the skin of this superficially

straightforward technology to reveal the underlying social complexity engaged in its deployment.

An innovation such as videoconferencing constitutes structural properties which become available to human agents. These are drawn upon as modalities of structure or act as a catalyst to evoke other structural properties. The analysis of such interaction is essential for understanding and explaining how structural properties are sustained, modified or diminished in the diffusion of effective videoconferencing.

It is important to restate that the interactions contained within each myth were differentiated to aid analysis and discussion. The interaction and demarcation between human action and structural properties were in reality complex and interdependent with the social setting. As suggested by Williams and Rice (1983, p. 204):

> The new technologies are not, in an overall sense, inherently impersonal or personal. Our main challenge is to understand better their distinguishing qualities and, even more so, to develop our stylistic and persuasive strategies for their most effective use.

References

Barley, S. R. (1986). Technology as an occasion for structuring evidence from observations of CT scanners and the social order of radiology departments, *Administrative Science Quarterly, 31, 78-108.*

Barley, S. R. (1990). The alignment of technology and structure through roles and networks, *Administrative Science Quarterly, 35, 6* 1 - 103.

Beath, C. M. & Orlikowski, W. J. (1994). The contradictory structure of systems development methodologies: Deconstructing the IS-User relationship in information engineering, *Information Systems Research, 5(4) 350-377.*

Bikson, T. K., Gutek, B. A.& Mankin, D. A. (1981). *Implementation of information technology in office settings: review of relevant literature.* Rand, Santa Monica.

Champness, B. G. (1973). Attitudes toward person-person communications media, *Human Factors, 15(5), 437-447.*

Cohen, I. J. (1989). *Structuration theory: Anthony Giddens and the constitution of social life,* Macmillan, Hampshire.

Cohen, W. M. and Levinthal, D. A. (1990). Absorptive capacity: a new perspective in learning and innovation, *Administrative Science QuarterZy.35,* 128-l 52.

Collins, R. (1992). The romanticism of agency/structure versus the analysis of micro/macro, *Current Sociology, 40, 77-97.*

Contractor, N. S. & Seibold, D. R. (1993). Theoretical frameworks for the study of structuring processes in group decision support systems: adaptive structuration theory and self-organizing systems theory. *Human Communication Research, 528-563.*

Daft, R. L. & Lengel, R. H. (1984). Information richness: a new approach to managerial behaviour and organization design, in *Research in organisational behavior,* (eds.) B. Staw & L. Cummings, JAI Press, Greenwich, pp. 191-233.

Daft, R. L. & Lengel, R. H. (1986). A proposed integration among organizational information requirements, media richness, and structural design. *Management Science, 26(5),* 554-571.

Dean, J. W. (1987). *Deciding to innovate: how firms justify advanced technology.* Ballinger Publishing Company, Cambridge.

Earon, A. *S.* (1993). *Adoption of videoconferencing in education and business,* PhD thesis, UMI: 9414152, Boston College, The Graduate School of Arts and Science, Boston.

Egido, C. (1988) Videoconferencing as a technology to support group work: A review of its failure, *Association for Computing Machinery, 13, 13-24.*

Egido, C. (1990) Teleconferencing as a technology to support cooperative work: its possibilities and limitations in *intellectual teamwork: social and technological foundations of cooperative work,* (eds.) J. Galegher, R. E. Kraut and C. Egido, Lawrence Erlbaum Associated, New Jersey, pp. 35 l-370.

Ellis, M. E. (1993). Uncovering presence: what adult participants say enhances instructional videoconferencing, PhD thesis, UMI: 9411936, The Ohio State University.

Frost, P. J. & Egri, C. P. (1991). The political process of innovation, *Research in organizational behavior, 13. 229-295.*

Fulk, J., Schmitz, J. & Ryu, D. (1995). Cognitive elements in the social construction of technology. *Management Communication Quarterly, 8(3), 259-288.*

Fulk, J., Schmitz, J. & Steinfield, C. W. (1990). A social influence model of technology use, in *Organisations and communication technology,* (eds.) J. Fulk and C. Steinfield, Sage, Newbury Park.

Fussell, S. R. & Benimoff, I. (1995). Social and cognitive processes in interpersonal communication: implications for advanced telecommunications technologies, *Human Factors, 37(2), 228-250.*

Galbraith, J. *(1973). Designing complex organizations,* Addison Wesley, Massachusetts.

Giddens, A. (1979). *Central problems in social theory.- action, structure and contradiction in social analysis,* University of California Press. Berkeley.

Giddens, A. *(1984). The constitution of society,* University of California Press, Berkeley.

Goodman P. S. & Griffith. T. L. (1991). A process approach to the implementation of new technology, *Journal of Engineering and Technology Management,* 8, 261-285.

Gooley, A. & Towers, S. (1996). Turning ocean liners: managing interactive technology innovation, *Proceedings of the third international interactive multimedia symposium,* Perth, pp. 159.

Gowan, J. A. & Downs, J. M. (1994). Video conferencing human-machine interface: a field study, *Information and management, 27,341-356.*

Harianto, F. & Pennings, J. M. (1994). Technological convergence and scope of organizational innovation, *Research Policy, 23,293-304.*

Hildebrand, J. E. (1995). Videoconferencing in the business curriculum, *Journal of Business and Technical Communication 9(2), 228-240.*

Jacoby, J. P. (1991). The development and adoption of videoconferencing technology for business applications: an historical perspective, masters thesis, UMI lS49399, California State University, Fresno.

Johansen, R. (1984). *Teleconferencing and beyond: communications in the office of the future,* McGraw Hill, New York.

Johnson, J. *C.* (1990). *Selecting ethnographic informants,* Sage, California.

Karnes, H. L. (1990). Factors influencing the adoption of teleconferencing technology in the university-based teaching hospital, D.Ed. dissertation, UMI 91 17702, The Pennsylvania State University.

Keller, R. T. (1994). Technology-information processing fit and the performance of R&D project groups: a test of contingency theory, *Academy of Management Journal, 37(l),* 167- 179.

Keen, P. G. W. (1990). Telecommunications and organizational choice, in *organisations and communication technology,* (eds.) J. Fulk and C. Steinfield, Sage, Newbury Park, pp. 295-3 13.

Kraemer, K. L. (1982). Telecommunications/transportation substitution and energy, *Telecommunications Policy, 6, 39-59.*

Krauss, R. M. & Fussel. S. R. (1990). Mutual knowledge and communicative effectiveness, in *intellectual teamwork: social and technological foundations ofcooperative work,* (eds.) J. Galegher, R. E. Kraut and C. Egido, Lawrence Erl baum Associated, New Jersey, 111- 145.

Kraut, R. E., Rice, R. E., Cool, C. & Fish, R. S. (1994). Life and death of a videophone: individual, structural and social influences on the use of a new communication medium, paper presented at the International Communication Conference, Sydney, NSW, June.

Kydd, *C.* T. & Ferry, D. L. (1994). Managerial use of video conferencing, *Information and Management, 27,369-375.*

Kyrish, S. (1989). The technology and implementation of motion video conferencing, in *the teleconferencing managers guide,* (ed.) K. Hansell, Knowledge Industry Publications Inc. White Plains, New York, pp. 85-104.

Leonard-Barton, D. (1988). Implementation and mutual adaptation of technology and organisation, *Research Policy, I7, 25* l-267.

Leonard-Barton, D. & Sinha, D. K. (1993). Developer-user interaction and user satisfaction in internal technology transfer, *Academy of Management Journal,* 36(5), 1125-1139.

Lewis, L. K. & Seibold, D. R. (1993). Innovation modification during intraorganizational adoption, *Academy of Management Review, l&2), 322-354.*

Liguori, C. (1985). A videoteleconferencing *success* story, in *Teleconferencing and electronic communications: applications, technologies and human factors Volume* IV. (eds.) L. A. Parker and C. H. Olgren, University of Wisconsin Extension Centre for Interactive Programs, Madison, pp. 186-l 89.

Lee, A. S. (1989). A scientific methodology for MIS case studies, *MIS Quarterly,* March, pp. 33-50.

Lundin, R. (1992). Non-Traditional modes of delivery in higher education using state-of-the-art technologies. Report for the modes of delivery review of the Department of Employment, Education and Training (DEET) and the National Board of Employment, Education and Training (NBEET), unpub.

Lundin, R. & Donker, A. (1992). *Queensland videoconference trial.. report of the queensland government trial of compressed videoconferencing between brisbane and townsville.* Media and Information Services, Brisbane.

Lundin, P., Skippington, P.. Simpson, T. & Hansford, B. (1994). *Videolinq evaluation.. interim report August* 1994, TAFE Queensland, Brisbane.

Lundin, P., Simpson, T., Hansford, B. & Skippington, P. (1995). *Videolinq evaluation: final report,* Queensland University of Technology, Brisbane.

Markus, M. L. (1990). Toward a "critical mass" theory of interactive media, in *Organisations andcommunication technology,* (eds.) J. Fulk & C. Steinfield, Sage, Newbury Park, pp. 194-236.

Markus, M. L. & Robey, D. (1988). Information technology and organizational change: causal structure in theory and research, *Management Science, 34(5), 583-598.*

Mintzberg, H. (1978). Patterns in strategy formation, *Management Science, 24 (9) 934-94s.*

Mintzberg, H., Raisinhani, D. & Theoreti, A. (1976). The structure of "unstructured" decision processes, *Administrative Science Quarterly, 21, 246-275.*

Noor Al-Deen, H. S. (1988). Corporate teleconferencing: audio, video and computer, PhD thesis, UMI 8812373, State University of New York at Buffalo.

Nord, W. R. & Tucker, *S.* (1987). *Implementing routine andradical innovations.* Lexington Books, Lexington Massachusetts.

Normann. R. (197 1). Organisational innovativeness: product variability and reorientation, *Administrative Science Quarterly, 16,* 203-215.

Nuwer, J. (1989). Getting to the bottom line, in *The teleconferencing managers guide,* (ed.) K. Hansell, Knowledge Industry Publications Inc, Whtie Plains, New York, pp. 125-l 42.

Olgren, C. H. & Parker, L. A. (1983). *Teleconferencing technology and applications,* Artech House Inc, USA.

Orlikowski, W. J. (1992). The duality of technology: rethinking the concept of technology in organizations, *Organizational Science, 3, 398-427.*

Orlikowski, W. J. Yates, J. (1994). Genre repertoire: the structuring of communicative practices in organisations. *Administrative Science Quarterly, 39, 541-574.*

Orlikowski. W. J.. Yates. J., Okamura, K. & Fujimoto, M. (1995). Shaping electronic communication: the metastructuring of technology in the context of use. *Organization Science. 6(4), 423-444.*

Pease, P. S. (1988). Factors influencing the use of video conferencing for organizational communications, PhD thesis, University of California.

PictureTel *(1995). Applications discovery guide: corporate training,* PictureTel, Massachusetts.

Poole, M. S. & DeSanctis. G. (1990). Understanding the use of group decision support systems: the theory of adaptive structuration. in *Organisations and conznzunication technology,* eds. J. Fulk and C. Steinfield, Sage. Newbury Park. pp. 173- 193.

Radford, G. P., Morganstern, B. F., McMickle, C. W. & Lehr. J. K. (1994). The impacts of four conferencing formats on the efficiency and quality of small group decision making in a laboratory experimental setting, *Telematics and Informatics, 11(2), 97-* 109.

Rogers, E. M. (1983). *Diffusions of innovations,* 3rd edn, Free Press, New York.

Sewell, W. H. 1992, A theory of structure: duality, agency, and transformation, *American Journal of Sociology, 98(* 1), 1-29.

Short, J., Williams, E. & Christie. G. (1976). *The social psychology of telecommunications,* John Wiley and Sons, London.

Shulman, A. D., Penman, R. & Sless, D. (1990). Putting Information technology in its place: organizational communication and the human Interface. In *Applied socialpsychology and organizational settings,* (ed.) J. S. Carroll, Lawrence Erlbaum Associates, New Jersey.

Simpson, H., Pugh. L. & Parchman, S. (1992). An experimental two-way video teletraining system: design, development and evaluation, *Distance Education, I2(2). 209-231.*

Simpson, H., Pugh, L. & Parchman, S. (1993). Empirical comparison of alternative instructional TV technologies, *Distance Education, 14(* 1), 147- 165.

Smith, M. (1995). Video conferencing: the personal touch, OSP, December/January, pp. 38-39.

Stubbs, S. T. & Burnham, B. R. (1990). An instrument for evaluating effectiveness of electronic distance education systems, *The American Journal of Distance Education, 4(3), 2537.*

Svenning, L. L. (1982). Predispositions towards a telecommunication innovation: The influence of individual. contextual. and innovation factors on attitudes, intentions, and projections toward video-conferencing, PhD thesis, University of Southern California.

Svenning, L. L. & Ruchinskas, J. E. (1984). Organizational teleconferencing, in *The new media: communication, research and technology.* ed. R. E. Rice and Associates, Sage, Beverley Hills, pp. 217-248.

Towers, S. (1996). Diffusing videoconferencing in government organisations: a structurational analysis, PhD Thesis, Queensland University of Technology,

Brisbane, unpub.

Thach, L. & Woodman, R. W. (1994). Organizational change and information technology: managing on the edge of cyberspace, *Organizational dynamics, summer*, pp. 30-46.

Tornatzky, L. G. & Fleischer, M. (1990). *The Process of Technological Innovation,* Lexington Books, Massachusetts.

Towers, S. (1997). Diffusing videoconferencing in government organisations: a structurational analysis, PhD Thesis, Brisbane.

Towers, S. & Hearn, G. (1995). Videoconferencing: towards explaining plementation failure, paper presented to the Confercncc of Australian and New Zealand Communication Association, Edith Cowan University, June 5-7, Perth.

Towers, S. & Hearn, G. (1996). Conceptualising innovation in organisations: a structurationist perspective, paper presented to the Conference of Australian and New Zealand Communication Association, July 10- 12. Brisbane.

Tushman, M. & Nadler, D. (1986). Organizing for innovation, *California Management Review, 26(3), 74-92.*

Tyre, M. J. & Orlikowski, W. J. (1994). Windows of opportunity: temporal patterns of technological adaptation in organisations, *Organisational Science, 5(* 1), 98-l 18.

Van Maanen, J. (1984). Doing new things in old ways: the chains of socialization, in College *and university organization,* (ed.) J. L. Bess, New York University Press, New York.

Van Maanen, J. & Barley, S. R. (1985). Cultural organization: fragments of a theory, in *Organisational culture,* (eds.) P. J. Frost, L. F. Moore, M. R. Louis, C. C. Lunberg and J. Martin, Sage, Beverley Hills, pp. 3 l-53.

Weick, K. E. (1990). Technology as equivoque: sensemaking in new technologies, in *Technology and organizations,* (eds.) P. S. Goodman, L. S. Sproull and Associates, Jossey-Bass, San Francisco.

Williams, F. & Rice, R. E. (1983). Communication research and the new media technologies, in *Communication Yearbook* 7, (ed.) R. N. Bostrom, Sage, Beverley Hills.

Zaltman, G., Duncan, R.& Holbeck, J. (1973). *Innovations and organizations,* Wiley-interscience, NewYork.

AUTHORS

Stephen Towers is the Deputy Chief Executive of the Queensland Open Learning Network at the Queensland University of Technology.

Roy Lundin is a Senior Lecturer at the Queensland University of Technology.

Patrick is a consultant at the Queensland University of Technology.

Notes

(1) The authors wish to acknowledge the financial sponsorship and assistance for this research provided by the Queensland Government Department of Public Works and Housing (formerly the Administrative Services Department).

(2) Videoconferencing in this paper refers to Broom-based= videoconferencing systems using digital compression.

(3) Structuration requires unique conceptions of structures and systems than are usually offered by the literature. Structures are manifested as structural properties that incorporate rules and resources or Assets of transformation relations@ that human actors draw upon in their day-to-day interaction (Giddens. 1979,1984). Structuration indicates how structural properties are regularised through actors use of rules and resources. Structures and systems become reifed over time and through use have >objective= like properties. However. structural properties only exist while being reproduced and have no reality independent of the social setting within which they are used.

(4) Implementation design is defined for this research as thstratcgies and activities for introducing and disseminating the innovation to a specific context.

(5) Interpretive schemes are the basic reserves of communal knowledge routinely utilised by human agents during interaction that enable meaning to be mediated and maintained within a specific context (Orlikowski, 1992).

(6) This finding was not evident at TrainingDept but was common for other organisations (see Towers, 1997).

(7)Initiation and implementation are terms used to differentrate the activities before and after the innovation is physically present in the organisation.

(8)Modalities of structure are accessed by human agents to recursively link structural properties and human action in the reproduction of systems of interaction (Giddens, 1984). Modalities may include interpretive schemes. communication norms and traditions.

(9)Participants can see each location at all times.

(10)Mediation of the innovation is concerned with the purposeful diffusion of the innovation to the specific innovation context, primarily the users during implementation

(11) Structural properties are developed through regular patterns of interacton established through ongoing use of human agents knowledge and 'reflexive action. These structures are then drawn upon by organisational members for subsequent action which fortifies and sustains the patterns. The continuous interactions are called agency (Giddens 1979, p. 55) and the reciprocal reinforcement is called *duality of structure* (Orlikowski , 1992).

(12)Svenning and Ruchinskas (1984) call this a fair trial use.

(13) For example, contrast the conclusions of Bikson, Gutek and Mankin, 1981, p. 13 with Wagner, *1994*.