Invited paper

A Framework for Examining Desktop Video Conferencing in the Organisational Context

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This paper proposes, and applies, a framework for examining desktop video conferencing in the organisational context. The framework helps organisations both to uncover the relative benefits of, and problems in, the use of desktop video conferencing and to reconcile some of the problems that evolve from this use.

Keywords: Audio and video communications, desktop video conferencing.

1. Introduction

Desktop video conferencing is a melding together of a number of previously separate hardware and software technologies: the systems are complex, leading to a number of newly emergent issues along with traditional ones (Johansen and Bullen 1988) (Gowan and Downs 1994) (Aiken et al. 1995). There are five major factors related to a fuller and more critical understanding of desktop video conferencing within the organisational context: (1) video conferencing technology, (2) audio and video communications, (3) health and psychology, (4) management, and (5) internationalisation.

This paper examines the impact of desktop video conferencing technology on the organisation. It begins with a discussion of the five factors identified above, followed by a critical assessment of the benefits of, and problems in, the use of desktop video conferencing. It then attempts to reconcile some of the problems that have been identified.

2. Video Conferencing Technology

Because of the integration of video and networking technologies into personal computers, personal video conferencing is now a reality (Grudin 1994). The market as a whole has been experiencing rapid growth rates of between 50 and 100 percent per annum since 1989 (Szuprowicz 1994). There is now a demand for sharing documents and graphics. Desktop video conferencing systems come in three main varieties (Reinhardt 1993): store-and-forward video mail, real-time video conferencing, and document conferencing. Store-and-forward video mail allows participants to send and receive asynchronously multimedia-enhanced electronic mail. Such applications are typically built on standard multimedia messaging infrastructures so that they may be incorporated into other applications (Reinhardt 1993). Although video mail is non-interactive, it still requires considerable processing power for sending the messages and ample hard disk space for storing them. Real-time video conferencing is less demanding on the host, because the video passes through the machine without holding up the processor or system bus, and there is rarely any need to save it to disk. Document conferencing amalgamates the video conference with the participants' electronic documents. The 'master' user is the owner of the document and runs the application that produced it, while 'slave' users see a bitmap of

the document that can be marked up and annotated in real-time. The document images may be saved by any or all of the users, but the master can only be modified on permission of the 'master' user. Examples of current desktop video conferencing systems abound. One is Intel's ProShare Video 200 for Windows (Dallas 1995), which provides a number of document conferencing facilities. The local and remote users are displayed in small windows, one of which can be enlarged in size at the cost of the other. Any window can be pasted into the ProShare whiteboard for annotating with text, highlighting, or drawing with the supplied tools. A user may control one application from another, and both users can input to the same application. A notebook facility is provided that can be shared with other users that has unlimited pages, so it is useful for storing frequently required images or text.

3. Audio and Video Communications

Studies (Hahn 1992) have revealed that communication can be more than twice as effective when both audio and video are used. However, those systems that permit audio often do not ensure synchronisation (Wheelwright 1995), preferring to use available resources for video (Whittaker 1995), while some manufacturers, such as IBM, have shunned audio altogether. The video component represents a vital element of any video conference, but it relies on the audio channel for the communication of information. If the video is removed, the conference could still continue, but this would not be true if the audio channel were lost. Video consumes huge amounts of bandwidth and supplying this is costly. Furthermore, internetworking video conferencing equipment that employs varying coders (coders/decoders) has resulted in inferior image quality. Compression algorithms in desktop computers now permit digital video images, typically at around 15 frames per second (fps) which results in 'jerky' images. Some systems have as much as a four- to five-second delay between one user moving a mouse and the result appearing on the other's screen (Mill 1993). Broadcast television (in Europe) requires a minimum of 25 fps (30 fps in the US), and a bandwidth of 140 Mbps, far more than can be provided by ISDN. Networks currently have a limited bandwidth and so they do not provide a suitable platform for full-blown, full-motion video conferencing, even with compression. Typical desktop video conferencing systems require a minimum of 4 Mbps and upwards, for basic communications over LANs, though as compression techniques becomes more advanced a 2-Mbps minimum is becoming more usual. (With MANs and WANs the requirements become more stringent.) Furthermore, users experience time-delays on normal collision-detection LANs, which again results in jerky images as well as stuttering sound. Novell Netware Video, for example, leaves out 'non-essential' frames by adjusting transmission speed relative to the network load. Performance soon degrades if too many users try to use the video services simultaneously (Meredith 1994). As an alternative, because video mail is non-interactive, it does not need the large bandwidth that real-time video conferencing requires.

4. Health and Psychology

General standards have been developed that prescribe the best ergonomic viewing distance, monitor height and angle, and desk and seat height for computer users. These were developed because of the pain and discomfort brought about by badly designed workplaces or jobs that cause computer users to sit in fixed positions for long periods of time or to make awkward or rapid repetitive movements. Gestural communication involves more muscles than keyboard interaction or speech (Baudel and Beaudouin–Lafon 1993), thus this problem is more difficult to counter in video conferencing systems. Document conferences cause further impediments, since even more movement is involved. For example, one may have to use the mouse in order to highlight some data on the whiteboard, tap in some information at the keyboard and still maintain sufficient eye contact with other participants. The positioning of the camera is also of relevance here: it is typically situated at the top or on one side of the monitor - due to the impedance caused by placing it in the middle of the screen - and this causes most users to flit between looking at the camera and at the monitor in front of them. It has been found

(Harvey 1991) that humans frequently and subconsciously adjust their position in order to see better, so poor lines of sight can cause manners of movement that may lead to repetitive strain injury (RSI). When organisations use systems such as IBM's Person to Person, a new health issue arises because it does not support real-time speech except via a simultaneous telephone call (Dustdar 1995). Consequently, those typing on a keyboard while talking on a telephone that is held between the head and neck may suffer an imbalance of the vertebrae on the neck, causing torticollis (Horten 1994). Facial expressions and body language are integral components of any social interaction (Yellen et al. 1995). Video conferencing systems that provide mere faces, poor quality video and less than 25 fps, obstruct the transmission of body language. This may result in participants appearing to act 'out of character'; i.e., in a different manner than they would act in a natural meeting with full body language. "It is facial and verbal reactions to events - speed and appropriateness - that are crucially important signals for evaluating character and ability." (Gregory 1987) Humans sense unusual and unexpected events, and transmission and operation delays prevent the operator from knowing the current status of the system; this is known as delayed feedback (Shneiderman 1992). While the term is usually used in the context of user interfaces, it is also valid in the context of transmission speeds between the participants. The delays can cause illusions, e.g., some options of IBM's Person to Person permit the transmission of participant snapshots at intervals, as selected by the participants.

5. Management

There are many management issues to be considered with respect to desktop video conferencing. Managers may have to decide whether to buy new machines (based on a price-performance ratio) or make do with the machines they already have. Whatever they decide, they will then have to (re)configure the PCs and integrate them with their existing facilities. Bearing in mind these problems, the information systems manager needs to regard speed as a vital issue, in order to maintain at least 25 fps. Running video conferencing at this speed should assist in reducing the disruption to psychological processes that may take place with slower systems. There is also the need to consider whether to upgrade the existing network infrastructure, since desktop conferencing requires a considerable bandwidth (at least 4 Mbps). However, companies do not want LANs saturated with heavy video traffic. Compression techniques, however, may help to provide service over lower speed networks and this needs to be considered. Unfortunately, the vast array of differing products and technologies that exist only serve to complicate this decision. Technologies like ISDN (or, when it arrives, Broadband-ISDN) and ATM are also required to provide adequate service to users. Moreover, serious problems can be caused by other companies' infrastructures. If another company is running the system over a much slower network, then performance will degrade.

6. Internationalisation

Video conferencing is essentially designed for use by a group of users. If WAN links are utilised, then the users may be globally dispersed. A clever design for one community of users may be inappropriate for another, e.g., Arabic, Israeli, Japanese, or Chinese users will scan a screen differently from users who are native English or French. Cultures also differ in the proportion of information they are willing to share openly. Andersen Consulting found this in a project involving a large installation of Lotus Notes databases throughout the world (over 46 countries), e.g. Japanese Notes users were likely to remove their client's company name from the information they posted to the database because of a strong bias towards client confidentiality (Sykes 1996). Facial expressions and body language also differ between classes, regions, and countries. For example, the circle one makes with the thumb and forefinger is the symbol for 'A-OK' in the US, 'zero' in France, 'money' in Japan, and 'I'll kill you' in Tunisia. This is a problem in international conferencing. Although the same problem exists with natural meetings, users may be less aware of them in video conferences because of the frequency of use and the benefits of 'own territories'. That is, by being in their own office, participants may soon forget the fact that

the person they are talking to is on the other side of the world. International difficulties also spring from the 'collaborative ethic' of a culture. For example, the Scandinavians and the English are used to working in teams, whereas the Eastern Europeans are more familiar with bureaucracies and so are more individualistic in their approach. Interestingly, the Japanese are suited to the physical sharing of computers, on a ratio of around one computer to every seven workers. Finally, there is the problem of time zones. Although the idea of multi-country conferencing for some multinational companies is very attractive, it is less so for the person who has to hold a video conference in the early hours of the morning.

7. Organisational Implications of Desktop Video Conferencing

The organisational implications of desktop video conferencing fall in three levels. At the *developmental* level there are implications for the implementation and integration of video conferencing technology into the core business applications. *User* level implications relate to the end-user in terms of the human-computer interface, ease of use, and the effect on his or her general execution of duties. Finally, *operational* level implications pertain to the everyday affairs of the organisation. Each level is a progressively higher abstraction, whereby users, at the user level, utilise technologies at the developmental level as they go about tasks at the operational level.

7.1. Developmental Level Benefits

Business re-engineering Video conferencing is being used in innovative ways: in order to gain competitive advantage and to transform and re-engineer business processes. National Westminster Bank (NatWest) of the UK provide a suitable case. The Bank recently installed video conferencing kiosks in ten of its branches so that customers could speak to specialists located in Bristol from their local branch (Shillingford 1994). Barclays Bank foresees an end to its traditional branches (and other banks' branches) as they are replaced by multimedia kiosks (Angelides and Dustdar 1997). Similarly, Reebok International (Cone 1994) have used video conferencing, along with other information technologies, to streamline procedures for production, sales and marketing, research and development, administration and finance, and distribution. They have also integrated video conferencing technologies into their four-year strategic information systems plan.

Virtual organisation Some research (Panko 1988, 1992) has highlighted the importance of communication within organisations, with the amount of time spent communicating rising with rank: up to 85 percent of a top manager's day is taken up with communication. Video conferencing allows meetings to occur remotely, enabling organisations to become *virtual business entities*. Virtual organisations are seen as being crucial to commercial survival in an information society. Such organisations will cease to be based around work locations and instead operate via a base of teleworkers. Virtual organisations are temporary business entities and are typically formed in conjunction with other independent firms, so that each member may be linked to all others. Resources are pooled for the purposes of certain current market opportunities, but when these have been exploited, the virtual organisation may be disbanded. Moreover, virtual organisations may be established across continents without the need to acquire property in those countries and to set-up national headquarters, thus reducing set-up costs.

Competitive advantage The experiences of a number of organisations illustrate the way in which video conferencing may help them achieve competitive advantage. Both Ford of Europe and the pharmaceutical corporation, Ciba-Geigy (Dyffy 1992), used desktop video conferencing to reduce product development times, and Ford also used it to streamline supplier links (Riggs 1994). NatWest's deployment of multimedia kiosks is a good illustration of how organisations may differentiate their product in the market with video conferencing and thus use it as an enabler for competitive advantage. Similarly, although Unisys uses video conferencing to deliver significant travel cost savings and productivity benefits, the real benefits come from the key strategic advantages, e.g., shorter product-to-market times that the technology provides, and they now use

video conferencing for every possible application, even long-distance award presentations (Champa 1994). Those companies gaining successful competitive advantage tend to be those that use information technology to link to suppliers, distributors, or customers (Johnston and Vitale 1998).

7.2. Developmental Level Drawbacks

Reliance on immature technology Desktop video conferencing technology is still evolving and is not yet mature; it is thus not entirely reliable and needs time to stabilise. Furthermore, while there are indications that the market is experiencing rapid growth, the future adoption of the technology is unclear: this is an uncertain technology that may soon become redundant. Therefore, an adopting organisation will bear significant and risky sunk costs, e.g. the launching of the home videophone was unsuccessful: sales failed to materialise to any extent. Relying principally on video conferencing technologies as a main part of the structure may leave the organisation vulnerable. While it reaps the benefits of being virtual, when the networks are down, so is the organisation.

Alternative communication technologies Desktop video conferencing exists in parallel with conventional communication technologies, such as the telephone and electronic mail. These systems will continue to require maintenance while the video conferencing infrastructure is constructed and maintained.

Usability With video conferencing, it is the system that tends to drive the communication, not the work itself. Off-the-shelf desktop systems (such as Intel's ProShare) are perhaps the worst offenders, since they push the organisation to conform to the system rather than *vice versa*. Thus users of desktop video conferencing systems often find themselves overwhelmed. The reason for using the system, i.e., taking part in a meeting, therefore becomes second in priority. Furthermore, with document conferencing, there is a need for continuity between the applications used and the need for a whiteboard. Experience shows that when tools disrupt a user's natural work manner, systems tend to fail (Ishii and Miyake 1991).

Recognising the need to restructure If video conferencing is to play a major role within the operation and management of the organisation, it may have to be restructured: companies gaining competitive advantage from the technology are those who have transformed themselves to reduce decision time. Video conferencing is typically employed for structured, regularly scheduled meetings, but it is clear (from companies like Ford and NatWest) that spontaneous communication provides a wealth of benefits (Francik et al. 1991).

The need for training Training is necessary for desktop video conferencing systems (Moad 1994), because of their complexity; also, it is a way to introduce the system gently into the workplace and limit feelings against it. Complexity is related to the degree of difficulty users experience in understanding and using an innovation. Lack of skill and knowledge is believed to be a primary factor behind efforts to resist organisational innovation (Kwon and Zmud 1987).

Security Video conferences are frequently required to be private and secure. Unauthorised reception is possible with satellite telecommunications (Millard 1991) and a decision on the mode of communication and the security trade-offs must be made. Encryption services can be provided for LAN and WAN connections, and many algorithms exist (Stallings 1994) (Tanenbaum 1989).

7.3. User Level Benefits

Intangible costs The problem with the 'cost-benefit' perspective of video conferencing is that it often uses reduction in travel costs as the only benefit. But travel costs for an organisation should include more than just the total time managers are away from the office. Intangible costs must be considered, as well; for instance, the effect on the personal and family life of the 'travelling worker' and the wear and tear that results from travelling, such as stress and jet lag should be considered. Video conferencing appears to provide the best of both worlds. It keeps the manager close to the office (and his or her family and friends) and also in touch with his work colleagues. Furthermore, experience in the US has shown that travel decreases very little, if there is no charge back scheme, but there is improvement in the quality of decision-making

for video conferencing participants. Nevertheless, it is difficult to assess the benefits of the non-travelling decision-maker.

Always face-to-face Desktop video conferencing and video telephony provide some of the advantages of face-to-face meetings, such as the ability to maintain some form of eye contact and to indicate and express emotions visually during intercourse. While there may be difficulties in realising such advantages in practice, because the technology is somewhat immature, there are still considerable advantages to be offered over mere audio conferencing and other forms of electronic communication.

Promptness The ability to contact colleagues remotely facilitates prompt discussion. Whereas natural meetings must be foregone when colleagues are called away on other projects, and thus certain actions delayed, desktop video conferencing permits continuity of work tasks. By integrating video conferencing technology with common PC business software, digital documents can be updated by staff at different locations in real time. Furthermore, consultants can make video presentations to their clients and discuss brochures, and global real-time training to employees' desks becomes possible. However, one problem today is colour, e.g. the incorrect rendering of fabric colour in the US is impeding video conferencing use by major stores, suppliers and fabric manufacturers.

Increased meeting effectiveness Desktop video conferencing may also increase the effectiveness of traditional meetings. For example, a video conference could be used for agenda planning before the natural meeting. 'Embedded', or 'nested', video conferences can also be used effectively to permit participants who are unable to attend the physical meeting to make a remote presentation or enter into the discussion, especially when travel is impeded due to bad weather, etc. There is evidence to suggest that video conferences give good opportunities for all party participation, reduce the risk of a single individual dominating the meeting, and result in a tendency for participants to rely on facts in making decisions. Many users of studio-based video conferencing systems find that the meetings are more orderly and shorter (Long 1987).

Own territories Natural meetings take place at one party's place of work or at a neutral site. In the former case, the 'home' participant is given a slight psychological advantage and will tend to feel more comfortable. In the case of meetings at neutral sites, both parties may feel uncomfortable. Desktop video conferencing allows all parties to feel comfortable, since they may attend the meeting without leaving their own territories.

7.4. User Level Drawbacks

Informal channels Desktop video conferences tend to mushroom the organisational 'grapevine' permitting the arrangement of meetings by individuals not known at the remote sites (Hirschheim 1985); this may lead to uncertainty and refusal to attend on the part of the employees at those sites. In contrast, people tend not to reveal certain information during a formal meeting, but may do so afterwards. It is often the informal chats surrounding conferences that are more important than the actual conference itself. However, informal channels tend to be lost with desktop video conferencing.

People like travelling Studies (Kydd and Ferry 1994) have shown that managers are eager to use video conferencing to reduce short- but not long-distance travelling. Indeed, an early study (Westrum 1972) found that managers had no desire to change their travel frequency or duration.

People expect answers immediately The less information-rich the communication technology utilised, the more the communicator is removed from the person to whom he or she is communicating. When people communicate electronically they tend to expect answers immediately, because electronic communication sets new precedents.

7.5. Operational Level Benefits

Reduction in travel costs Perhaps the biggest force pushing organisations is the promise of reduced travel costs. For example, by using video conferencing between Europe and the US, Citibank Europe estimates that it has eliminated 200 hours of travel time per month. Similarly, ICL sliced its travel costs in half by using video conferencing between the UK and Japan, and BASF estimated that video conferencing saved them over $1 million a year in travel (Hindus

1992). Employers are also beginning to introduce video conferencing to reduce the travel costs associated with interviewing (Magnusen and Kroeck 1995). Individuals are more productive when the amount of time lost travelling is reduced, because they can fit more tasks into the day.

Collaborative working The use of desktop video conferencing permits collaborative work with colleagues in the environment in which much of the work is being conducted, namely the computer. Document conferencing allows the exchange of electronic documents and images that may be marked up by both parties in parallel; the original document may then be saved automatically without a need for later editing. An example of collaborative working enhanced by desktop video conferencing is concurrent or simultaneous engineering, an effort focusing on a specific product or process. NASA's Jet Propulsion Laboratories in Pasadena, California (Demarco 1994) use video conferencing to review projects, on engineering diagrams and schematics, and to conduct meetings and make presentations with other labs around the world.

Speedier arrangements With desktop video conferencing, dispersed organisations find that the decision-making process speeds up, more people can be involved in decisions than would have travelled to the natural meeting, and others can be called in at short notice. This rapid response time means that video conferences may often be arranged easily and quickly with only a fleeting pre-warning to participants.

Increased co-ordination Co-ordinating projects within a company can be greatly enhanced by employing desktop video conferencing, particularly within large organisations with a decentralised workforce who need to share common work and communicate frequently. It allows decisions to be made more rapidly than would otherwise be possible with conventional modes of communication. It also seems to result in an increased frequency of meetings. In fact, in the US, video calls are being made as routinely as telephone calls. Perhaps the greatest consequence of faster decisions is the reduction of production cycles from weeks to days (Walder 1994). Ford of Europe found that desktop video conferencing helped to reduce product development times due to speedier decisions. It also streamlined their links with suppliers and is believed to have led to greater team spirit. Apparently, as desktop video conferencing participants typically feel more involved and committed to any decisions made (Kraemer and King 1988). These results are hardly surprising, however, since desktop video conferencing tends to generate a so-called 'all-channel' group structure. In complex open-ended problems such a structure is the most likely to reach the best solution, and the level of satisfaction for individuals is fairly high (Handy 1985).

7.6. Operational Level Drawbacks

Real travel savings? Are the travel cost savings revealed above just optimistic 'guesstimates'? Would those trips have been made at all if a video conference was not utilised? One must consider whether companies have included the opportunity cost of travel of all desktop video conferences in these figures, or whether they take the time to include only those desktop conferences that have genuinely replaced a natural meeting that would have required travel. After all, one would consider it incorrect to say that every telephone call made is a saving in travel costs. Furthermore, it is not unusual for companies to find an increase in their travel expenditure as a result of a video conference revealing operational (or other) difficulties requiring in-person appearances.

Investment return on technology While it is true that the implementation of desktop video conferencing builds upon much of the organisation's existing technological resources and infrastructure, it is also true that the expense of doing so is large. This is mainly due to the high price of separate ISDN or leased-line connections (Saunders 1995). This serves as a deterrent for many firms. Moreover, such an investment is more or less specific to desktop video conferencing and so the organisation may only recoup the costs and begin to reap savings in the medium to long term.

Legal issues International conferencing brings with it a number of legal problems. Perhaps the most important is that arising from national differences in licensing rights, freedom of information, 'offensive material', intellectual property rights, copyright, and patent rights issues for creators, publishers and deliverers. These

same problems are experienced by the World Wide Web.

8. Reconciling the Implications

With the potential drawbacks of implementing desktop video conferencing in the organisation as plentiful as the benefits, there is a need for effective strategies that promote the benefits and seek to contain and limit the liabilities. Considered in this way, a number of suggestions may be made to help the organisation increase the benefits and reduce the drawbacks of video conferencing.

8.1. The Video Conferencing Technology Factor

At the *developmental* level, the reliability and appropriateness of the technology becomes of prime importance since it has implications for security and sustained competitive advantages. The technology also bears on the amount of training that must take place, since better designed systems may be more intuitive and thus require less formal training. In addition, the choice of a package that is tailorable to the organisation's and the users' needs, as well as one that has a wide support base, should not only mean a flexible system but also one that does not dominate the psychology of communication.

At the *user* level, the technological impact occurs through the intangible costs. A more useful base centred around powerful PCs tends to ensure that the non-financial benefits of desktop video conferencing are felt by the users; speed and quality makes for a more comfortable system. In addition, it should ensure that the conferencing takes advantage of the promptness offered. There is little doubt that increasing meeting effectiveness is only likely with the more expensive systems. The organisation should ensure that group members are able to communicate quickly and easily and are not hampered by slow, cumbersome or incompatible systems.

At the *operational* level, technology affects the day-to-day functioning of the organisation. Essentially the choice rests between video mail, desktop video conferencing and document conferencing, or a combination. While desktop video conferencing or document conferencing is typically preferable, video mail represents an effective compromise. If combinations are employed then there are problems of compatibility and standards which will need to be rectified, preferably at this stage. Recent attempts to make all desktop video conferencing systems intercompatible and interoperable (Clement 1996) may make this less of an issue. Thus the basic objective at this stage will be to ensure a reliable base of hardware and software that does not impose itself on the core applications of the organisation.

8.2. The Audio and Video Communications Factor

At the *developmental* level, the reliability of the infrastructure becomes of prime importance, since it has implications for security and sustained competitive advantages. Where the organisation is a component of a virtual organisation, any breakdown in the technological infrastructure also temporarily (or otherwise) destructs the virtual entity. It may be true that the more complex and expensive network infrastructures may cause the organisation to recognise their need to restructure in order to reap the rewards that this typically entails. Nevertheless, it is certainly the case that technological reliability is of prime importance for the advantages offered at the developmental level of business re-engineering, virtual organisation, and competitive advantage. The developmental level is also impacted through issues of multimedia integration, that is, the extent to which audio and video are successfully integrated into the video conferencing application.

At the *user* level, issues can be reduced to just two: (1) good quality audio and video, and (2) their ability to work together. The latter is perhaps more difficult to achieve. The lack of audio-video synchrony deteriorates the potential of benefits gained from the conference being face-to-face and from it being prompt. It also affects the advantages of organisation and the parties in being on their home territory. Poor audio and video can promote a feeling of discomfort and this can result in it being harder to reach agreement. Conversely, if the audio and video are very good, there may be an accentuation of informal channels with people expecting immediate actioning.

At the *operational* level, the basic objective is to ensure a reliable infrastructure that does not impose itself on the core applications of the organisation. The effectiveness of the technological infrastructure affects any financial comparisons that may be made with travelling, since a more reliable infrastructure will be more cost-effective. In addition, bandwidth will be of priority, since high-speed communications should enable the benefits of increased productivity, collaborative working, speedier arrangements and increased co-ordination to be brought to the fore. There is also the issue of how much of the existing infrastructure will be replaced; the pressure to do this increases inversely with the number of applications that require a specific configuration. High-bandwidth networks can, to a certain extent, take up more of the work, leaving the computers as multimedia network terminals. The choice here will depend on the type of the desktop video conferencing application employed, and on the requirements of the business. To reconcile these issues, LANs may be given priority through QoS (Quality of Service); organisations should seek to implement them through intelligent network management technologies. Furthermore, organisations should benefit from a consideration of the tasks that the video conferences are intended to support, not only now, but in the future, too.

8.3. The Health and Psychology Factor

At the *developmental* level, health is crucial for the survival of any virtual organisation. Frequent change of people using the communications technology is likely to result in deteriorating quality. At the *user* level, few of the benefits will be realised if the user feels uncomfortable or ill from desktop video conferencing use, and they will thus decide to travel more. At the *operational* level benefits may be obscured by users, with less co-ordination that do not collaborate as effectively as they might otherwise do.

8.4. The Management Factor

It is through total management that a system may fit within a top-level information systems plan. To achieve this, a preconceived telecommunications policy is required at the *developmental* level. One model that can form a basis for this is that of Grover and Goslar (1993). They describe a four-stage evolutionary model that can be used for effective telecommunications planning:

The telecommunications utility: To ensure a reliable communications service.

Exploiting localised telecommunications: To ensure resource sharing.

Integrating the chaos: To integrate telecommunications technologies through a WAN in order to facilitate co-ordination among groups and to integrate various diverse platforms for 'technological synergy'.

Being innovative: To invest in, and develop, technologies (e.g. intranet and video conferencing) to utilise the telecommunications backbone for corporate effectiveness.

Also at the development level, reliability of the network and the video conferencing system will always be of prime importance and concern. In order to integrate the technology into real-time decision making and becoming innovative, reliability must prevail under all conditions.

At the *user* level, as experience with the Cruiser desktop video conferencing system suggests (Fish et al. 1993), desktop video conferencing can often be used to prepare for work, that is, to schedule a meeting, with the actual work carried out in natural meetings. While this is useful, it is arguable that the expensive implementation costs of desktop video conferencing would justify the few benefits that this offers.

At the *operational* level, it has been argued that the greatest competitive advantage a company can possess is a vision of the future, echoed in methods (Davenport and Short 1994) that assist in the re-design of business processes. This change requires vision as well as purpose. It should reflect not only the existing opportunities based on the current socio-economic climate, but also any opportunities based on future scenarios (Hamel and Prahalad 1994). Indeed, concerns about how video conferencing fits into strategic business practices is often cited as a reason for hesitance in implementing the technology (Heckart 1994).

8.5. The Internationalisation Factor

This final factor is an important one for multinational corporations, but is more important for virtual organisations and those collaborating with international non-subsidiary firms. Then, the video conferencing takes place between colleagues that bear allegiance to different commercial entities: there is more chance that they will differ in their cultural preferences.

At the *developmental* level, there are implications, since different laws may apply in the host countries. There are no easy answers for such issues, but the situation should improve when the current debate (centred around multimedia technologies as a whole) provides policies world-wide. Until then, organisations should seek to understand the laws of the lands with which they are dealing. Moreover, the issues of usability and training indicate the need for international co-operation. While this may be difficult, particularly for firms that had had established desktop video conferencing systems before they commenced trading, the issue is an important one, and compatibility problems will need to be resolved.

It is at the *user* level that internationalisation is brought to the fore, for it is here that the advantages of meeting effectiveness, face-to-face communication, and own territories are realised. However, internationalisation becomes an issue that can only really be resolved in mutual co-operation with trading partners. Bearing in mind the drawbacks of international use, international colleagues should meet at least once in person, either before they begin the use of their organisation's desktop conferencing facilities or shortly after.

At the *operational* level, internationalisation affects all forms of collaborative work, since cultural differences may affect both the task and its processes. Consequently, it is important that an organisation knows how it differs from its cultural partner, especially since video conferencing technology tends to generate the 'all-channel' group structure. If organisations are not attentive to the differences in protocols then the results can become quite serious. For example, a person interning at a Japanese company sent an e-mail message to the company president and was promptly dismissed: he was unaware of the unwritten protocol - that e-mail in Japan has different rules to those of Europe or the US. International factors may also play a role in limiting the speed with which arrangements may otherwise be made, and the intensity of the co-ordination. The organisation will also need to adopt formal attitudes to the sales or distribution of what may be considered illegal material in the destination countries; e.g. mildly pornographic material in Arab countries, etc.

9. Concluding Discussion

Almost half of the US Fortune 500 companies are now utilising desktop video conferencing. Nevertheless, certain problems will have to be combated and the challenges met head-on. In the past, remote technologies have not posed large problems for companies; rather, they have been a catalyst for strategic advantage. However, the spiralling use of desktop video conferencing, and other groupware technologies, changes that. Remote technologies are now vastly complex and permeate ever-deeper into the organisation. This brings issues of group management and development to the fore, and poses a new challenge.

Issues involving the role of networks and communications technologies will dominate application of the technology, particularly when video conferencing runs between residential homes connected to the global information superhighway. At that time, the problems of internationalisation are likely to become very serious; it has already started as the world embraces the World Wide Web.

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